EPIDEMIOLOGY

Meta-Analysis of Prevalence of Erectile Dysfunction in Mainland China: Evidence Based on Epidemiological Surveys

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ABSTRACT

Introduction: The epidemiologic characteristics of erectile dysfunction (ED) in mainland China remain incompletely understood.

Aim: To evaluate the overall prevalence and determine the severity of ED in mainland China.

Methods: An extensive database search was performed of PubMed, Embase, the Chinese National Knowledge Infrastructure (CNKI) database, the WanFang database, the Chinese Biological Medical Literature (CBM) database, and the Chongqing VIP using the following terms: *erectile dysfunction, prevalence, epidemiology, epidemiological,* and *China.* Study quality was assessed using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. Data were pooled for the random-effects model. Sensitivity analyses were conducted to assess potential bias.

Main Outcome Measures: All survey studies reporting on the prevalence of ED in mainland China were included. Data extraction was performed independently by two of the authors, and conflicts were resolved by another author.

Results: Of 2,155 retrieved articles, 25 were included in this meta-analysis with a total of 48,254 participants. The pooled prevalence of ED in men was 49.69% (95% CI = 39.29−60.10). The occurrence rates of ED in age groups younger than 30, 30 to 39, 40 to 49, 50 to 59, 60 to 69, and at least 70 years were 20.86%, 25.30%, 40.48%, 60.12%, 79.10%, and 93.72%, respectively. The severity-specific prevalences of mild, moderate, and severe ED were 32.54%, 9.86%, and 13.97%, respectively. Moreover, the prevalences reported by different diagnostic methods were 14.19% for self-reports, 44.60% for the Chinese Index of Erectile Function, and 49.91% for the International Index of Erectile Function−5. The prevalence map based on a geographic information system showed an unequal geographic distribution.

Conclusion: ED is highly prevalent in mainland China, and its prevalence increases with age. More high-quality surveys on ED with larger samples throughout mainland China are needed to confirm these findings. **Wang W, Fan J, Huang J, et al. Meta-Analysis of Prevalence of Erectile Dysfunction in Mainland China: Evidence Based on Epidemiological Surveys. Sex Med 2017;5:e19−e30.**

Key Words: Erectile Dysfunction; Prevalence; China; Meta-Analysis

INTRODUCTION

As the population ages, genitourinary problems in the elderly have attracted increasing attention. Erectile dysfunction (ED), defined as the persistent inability to attain or maintain a penile erection sufficient for satisfactory sexual performance, is better understood and the most studied sexual problem worldwide, which primarily affects men older than 40 years.[1] Although it is not life-threatening, evidence has shown that it seriously impairs quality of life.[2] Many

patients feel embarrassed, ashamed, and depressed about ED; therefore, it is appropriate to say that ED has a broad impact on a man's life beyond the inability to have sex.[3] It is noteworthy that ED is a public health problem with a significant impact on male psychosocial health that cannot be ignored. Moreover, the financial burden directly or indirectly caused by ED is very significant. In previous studies, a loss of £7.0 million annually has been attributed to ED in the United Kingdom.[4] Another study showed that this cost reaches $15 billion in the United States.[5]

The prevalence of ED, first reported by Feldman et al[6] using a population-based study conducted in 1993, has been estimated at 52% in the United States. Many subsequent studies have been performed during the past two decades. However, the prevalence varies greatly across different populations and regions. According to results of the Global Online Sexuality Survey (GOSS), rates are is 45.1% in the Middle East[7] and 37.7% in the United States.[8] Previous studies have indicated that ED is prevalent in mainland China; however, existing prevalence reports vary considerably, ranging from 17.1% in five provinces (Beijing, Guangzhou, Shaanxi, Gansu, and Anhui)[9] to 92.3% in Gansu.[10] These divergent results can be explained in many ways; thus, the results of individual cross-sectional studies might lack representativeness.

Considering the huge population and the increased proportion of elderly men, the prevalence of ED might be significant. According to the sixth national census, the population reached 1.37 billion in 2010, and more than 13.26% of the population was older than 60 years (http://www.stats.gov.cn/tjsj/tjgb/rkpcgb/qgrkpcgb/201104/t20110428_30327.html). This percentage is estimated to reach 26.8% in 2050. To assess the disease burden and develop relevant policies, understanding the prevalence and epidemiologic characteristics of ED is essential. Moreover, evidence suggests that the prevalence of ED in China might continue to increase with age. Hence, the age-specific prevalence is necessary. In addition, oral drug therapy, the most frequently used treatment, shows a far better effect on mild rather than on severe ED.[11] In this respect, the severity-specific prevalence also is needed.

To date, a national epidemiologic survey of ED has never been performed in mainland China. This first meta-analysis was conducted to evaluate the overall prevalence and determine the severity of ED in mainland China. In addition, prevalence was stratified by age, severity, location, and year to identify potential risk factors for ED. This strategy can highlight directions for future research and provide an epidemiologic basis for planning and implementing public health policies as necessary.

METHODS

Literature Search

The present meta-analysis was performed according to the Meta-Analysis of Observational Studies in Epidemiology (MOOSE) guidelines.[12] In this meta-analysis, we targeted survey studies conducted in mainland China and published in Chinese or English. PubMed, Embase, the Chinese National Knowledge Infrastructure (CNKI) database, the WanFang database, the Chinese Biological Medical Literature (CBM) database, and the Chongqing VIP database were searched using the following search terms: *erectile dysfunction, prevalence, epidemiology, epidemiological,* and *China.* In addition, we added the keywords *male sexual dysfunction* and *impotence* to avoid omissions because there were several synonymous or nearly synonymous terms in Chinese. In addition, relevant articles in the reference lists were identified to ensure no related studies were overlooked. To expand the retrieval scope, the publishing period was not limited. Searching was completed on March 31, 2016. All related articles were selected by two independent investigators.

Inclusion and Exclusion Criteria

The studies included in this meta-analysis met the following criteria: (i) cross-sectional study design; (ii) a study that was conducted in mainland China (not including Taiwan, Hong Kong, and Macao); (iii) a study that was based on a community or a population; (iv) a study that reported the prevalence of ED or available data for the prevalence calculation (eg, total sample size and number of ED cases); and (v) a study published in Chinese and/or English. If several articles were based on the same surveys, the article with the most detailed data was selected after a careful review by the investigators.

Studies were excluded if they met any of the following criteria: (i) a study focused on a specific population such as military personnel or individuals with high-level intelligence; (ii) the sample method was non-random; (iii) the article was a review or reported only secondary data; (iv) the prevalence of ED was estimated only by self-reporting or the prevalence was not available; (v) the diagnosis was not based on the International Index of Erectile Function−5 (IIEF-5) or the Chinese Index of Erectile Function (CIEF; eTable 1) or the items of IIEF-5; and (vi) a duplicated study or study that used a sample already investigated in another study.

Data Extraction

In this meta-analysis, we extracted the following data from the original articles: author, year of publication, type of survey (based on a community or a population), sampling method, age range, province where the study was performed, sample size, response rate, identity of investigators, location (urban or rural), diagnostic method of ED, prevalence of ED, and the prevalence stratified by age and severity. If self-reporting was one of the diagnostic standards in the original article, then we also extracted the prevalence by self-reports to compare different methods in the diagnosis of ED.

All data were extracted by two investigators independently, and disagreement was resolved by discussion or by consultation with another investigator until a consensus was reached.

Quality Assessment

All 25 included articles were assessed using the Strengthening the Reporting of Observational Studies in Epidemiology

(STROBE) guideline.[13] The risk of bias was assessed by scoring each bias type for each study (a total of five items; low risk = 2, moderate risk = 1, high risk = 0), and the total score (maximum = 10) represented the quality score of bias risk (eTable 2). This assessment was conducted by two investigators independently; inconsistencies were settled by discussion or another investigator.

Statistical Analysis

The prevalence of ED was calculated by STATA 11.1 (Stata Corporation, College Station, TX, USA) using the data extracted from the included articles, which included overall prevalence and prevalence by age, severity of ED, location, survey year, type of investigators, diagnostic method (CIEF, IIEF-5, or self-report), and quality score of bias risk. Heterogeneity was assessed by the Q-test and the I^2 statistic, and if the P value was less than .1 or the I^2 statistic was at least 50%, then the potential heterogeneity was considered significant and a random-effects model (DerSimonian-Laird method) was selected for meta-analysis. Otherwise, a fixed-effects model (Mantel-Haenszel method) was selected. For the spatial distribution difference of ED in mainland China, ArcGIS 10 for the desktop (Stanford University, Stanford, CA, USA, 2010) was used. Furthermore, to find sources of heterogeneity, we performed a meta-regression based on the following variables separately: (i) survey year, (ii) province, (iii) age range, (iv) sample size, (v) identity of investigators, (vi) diagnostic method, and (vii) quality score of risk bias. When performing the sensitivity analysis, we removed a single study one by one at a time to detect the effect of the single study on the combined prevalence of ED in this meta-analysis. In addition, publication bias was examined by the funnel plot and the Egger test, where an asymmetric funnel plot or a P value less than 0.05 from the Egger test suggested significance.

RESULTS

Study Selection

We identified 2,155 articles (1,996 in Chinese and 159 in English) by searching PubMed (n = 130), Embase (n = 29), the CNKI (n = 703), the WanFang database (n = 492), the Chongqing VIP database (n = 666), and the CBM (n = 135). After examining these titles and abstracts, 1,924 articles were removed because they were duplicate records from among the databases or irrelevant to the prevalence of ED, and 231 potentially eligible studies were retained for further evaluation by full-text assessment. Twenty-five studies met the selection criteria and were included in this meta-analysis.[9,10,14−36] More details of the literature searching process are presented in Figure 1.

Characteristics of Included Studies and Assessment of Risk Bias

ED prevalence varied from 17.1% to 92.3% in the 25 included studies. Eighteen studies reported on the severity-specific prevalence, and 19 provided the age-specific
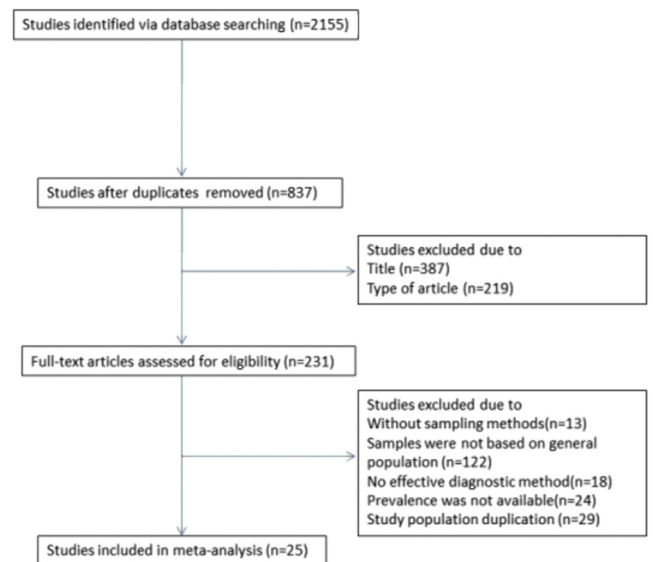

Figure 1. Flowchart of the article selection process to evaluate the prevalence of erectile dysfunction in mainland China.

prevalence. The articles were published from 2000 through 2014, and the survey dates ranged from 1993 to 2012 (five studies did not mention their survey dates). For diagnostic methods, 22 studies used the IIEF-5 or questionnaires based on the IIEF-5 to diagnose ED, two used the IIEF-5 and self-reports, and one used the CIEF and self-reports. Investigators included doctors specializing in urology or andrology (n = 5), doctors specializing in other areas (n = 6), and uniformly trained investigators whose specialty was not mentioned (n = 9) or the investigators were not described (n = 5). All studies were conducted in mainland China, covering 13 regions: Guangdong, Beijing, Chongqing, Jiangsu, Guangxi, Zhejiang, Henan, Gansu, Shandong, Shanghai, Hubei, Anhui, and Jiangxi (Table 1). Quality scores were used to assess the risk of bias in individual studies. Three studies had a quality score of 6, 10 studies had a score of 7, three studies had a score of 8, and nine studies had a score of 9; these results show that, in general, the quality of the included studies was moderate to high (eTable 3).

Synthesis of Results

Overall Prevalence of ED

As presented in Figure 2, the 25 included studies, with 20,436 patients with ED in a total sample of 48,254, were available for the evaluation of ED prevalence. The meta-analysis showed that the pooled prevalence of ED was 49.69% (95% CI = 39.29−60.10).

Prevalence by Age, Diagnostic Methods, and Severity of ED

As presented in Table 2, prevalences of ED in the six age groups of younger than 30, 30 to 39, 40 to 49, 50 to 59, 60 to 69, and at least 70 years were 20.86%, 25.30%, 40.48%, 60.12%, 79.10%, and 93.72%, respectively. A trend toward a higher prevalence

Table 1. Characteristics of included studies

Study	Survey year	Age (y)	Sample methods	U or R	Province	Investigator	Diagnostic method	RR, %	Sample size	Case size	Prevalence, %
Leng et al, 2000	1993	≥40	Multistage randomization	U	Shanghai	Uniform trained investigator	IIEF-5	98.9	1,582	1,157	73.1
Fu et al, 2001	1999	≥20	Randomized	NA	Guangxi	NA	IIEF-5	NA	5,504	1,326	24.1
Zhang et al, 2002	2001	18–70	Randomized	U	Chongqing	Medical staff	CIEF	97.6	990	442	44.6
Wang et al, 2003	NA	18–75	Cluster randomization	U	Guangdong	NA	IIEF-5	71.0	416	241	57.9
Zhang et al, 2003	2001	23–82	Systematic randomization	U	Beijing	Uniform trained investigator	IIEF-5	65.0	1,247	488	39.1
Cheng et al, 2004	2001	≥55	Cluster randomization	U + R	Hubei	NA	IIEF-5	NA	1,167	636	54.5
Wang et al, 2004	2002	≥18	Randomized	U	Jiangxi	Medical staff	IIEF-5	NA	446	214	48.0
Zhuang et al, 2004	2000	≥45	Cluster randomization	U	Guangdong	Medical staff	IIEF-5	NA	1,200	481	40.1
Jiang et al, 2005	2003	40–70	Randomized	U	Beijing	Uniform trained investigator	IIEF-5	NA	2,801	1,154	41.2
Shen et al, 2005	NA	46–65	Cluster randomization	U + R	Jiangsu	Andrology doctors	IIEF-5	NA	3,552	1,316	37.1
Yi et al, 2005	NA	21–61	Stratified randomization	R	Shandong	Andrology doctors	IIEF-5	NA	1,901	705	37.1
Cheng et al, 2007	2006	20–68	Stratified randomization	U + R	Guangdong	Uniform trained investigator	IIEF-5	NA	860	314	36.5
He et al, 2007	2000	35–74	Randomized	U + R	China	Uniform trained investigator	IIEF-5	62.0	4,763	2,815	59.1
Bo et al, 2009	2007	20–63	Randomized	R	Henan	Medical staff	IIEF-5	99.5	1,194	551	46.1
Hao et al, 2011	2007	15–60	Randomized	U	Beijing et al	NA	IIEF-5	57.9	7,372	1,259	17.1
Song et al, 2011	2008	≥50	Multistage cluster randomization	U + R	Beijing	NA	IIEF-5	99.3	1,644	1,487	90.5
Han et al, 2011	2010	≥50	Multistage cluster randomization	U + R	Gansu	Uniform trained investigator	IIEF-5	79.9	1,230	1,135	92.3
Zhang et al, 2011	NA	20–69	Stratified cluster randomization	U + R	Zhejiang	Andrology doctors	IIEF-5	98.8	340	64	18.8
Zuo et al, 2011	2008	≥18	Multistage randomization	NA	Guangdong	Uniform trained investigator	IIEF-5	77.4	759	443	58.4
He et al, 2012	2008	30–60	Stratified randomization	U	Beijing	Urologists	IIEF-5	NA	1,006	667	66.3
Liang et al, 2013	2009	40–70	Cluster age-stratified randomization	U	Shanghai	Urologists	IIEF-5	98.7	987	772	78.2
Xu et al, 2013	NA	18–60	Multistage randomization	NA	Guangdong	Uniform trained investigator	IIEF-5	97.4	3,795	943	24.8
Wu et al, 2013	2012	40–80	Stratified randomization	R	Zhejiang	Medical staff	IIEF-5	97.6	972	303	31.2
Huang et al, 2014	2008	40–80	Stratified randomization	U	Shanghai	Uniform trained investigator	IIEF-5	89.0	1,531	765	50.0
Liang et al, 2014	2011	40–80	Multistage cluster randomization	R	Zhejiang	Medical staff	IIEF-5	99.5	995	758	76.2

Beijing et al = Beijing, Guangzhou, Shaanxi, Gansu, and Anhui; CIEF = Chinese Index of Erectile Function; IIEF-5 = International Index of Erectile Function–5; NA = not available; R = rural; RR = response rate; U = urban.
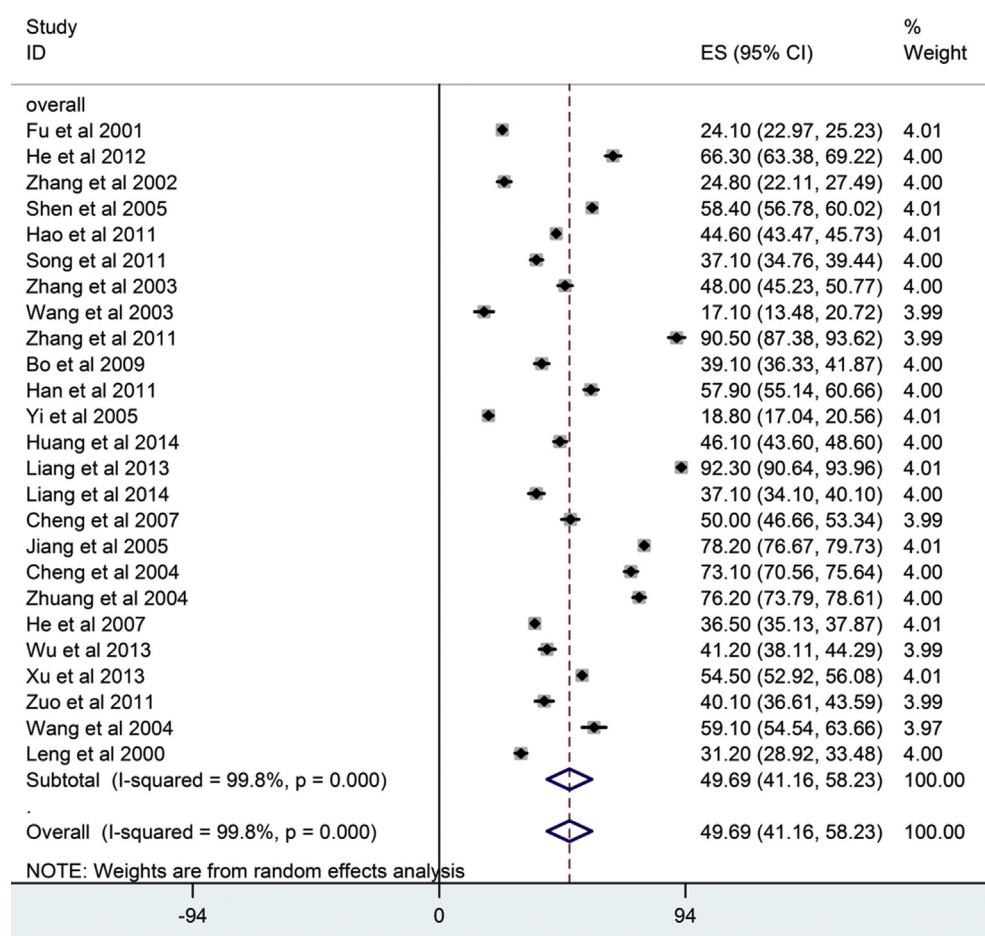
Figure 2. Forest plot for the overall estimate of the prevalence of erectile dysfunction. ES = effect size.

of ED with age could be observed; this tendency is illustrated in Figure 3. The diagnostic method was divided into three subgroups: IIEF-5, CIEF, and self-reports. Prevalences in studies using the IIEF-5, the CIEF, and self-reports were 49.91%, 44.60%, and 14.19%, respectively. Eighteen articles reported on the severity-specific prevalence. Because of the different diagnostic methods, we included only studies using the IIEF-5 for diagnosis, and the following criteria were used for classification: scores from 12 to 21 indicated mild ED, scores from 8 to 11 indicated moderate ED, and scores no higher than 7 indicated severe ED. The severity-specific prevalences of mild, moderate, and severe ED were 32.54%, 9.86%, and 13.97%, respectively (Figure 4).

Prevalence by Investigator, Survey Method, and Quality Score

As presented in Table 2, andrology specialists, non-andrology medical staff, and other trained staff performed the surveys. Prevalences in studies evaluated by andrology specialists, non-andrology medical staff, and other trained staff were 47.52%, 43.0%, and 47.8%, respectively. Prevalences of ED in surveys using randomized groups and other randomization methods were 49.69% and 34.61%, respectively. Prevalences of ED in studies with quality scores of 6, 7, 8, and 9 were 42.51%, 49.37%, 45.42%, and 53.68%, respectively.

ED Prevalence Stratified by Province in Mainland China

Figure 5 presents a color-coded map illustrating the prevalence of ED across mainland China (data were available for the following provinces: Beijing, Gansu, Shandong, Henan, Jiangsu, Shanghai, Hubei, Chongqing, Zhejiang, Jiangxi, Guangxi, and Guangdong). We created four levels reflecting the prevalence of ED. The prevalence of ED in the provincial regions of mainland China varied from 24.10% in Guangxi to 92.30% in Gansu. The first level represented no available data in the relevant regions and is represented as pink on the map. The prevalence of ED in the second level ranged from 0.01% to 48.00%, which appears in light red. Shanghai (67.10%), Beijing (59.28%), and Hubei (54.50%) were assigned to the third level (48.01%~67.10%), which appears in red. The highest prevalence of ED was observed in Gansu, and it was assigned to the fourth level, which is represented by darkest red on the map. However, no particular concentration of ED prevalence was indicated on the map.

Sources of Heterogeneity

A heterogeneity test was carried out on prevalence with a P value less than .001 and an I^2 statistic equal to 99.9%, which suggests the pooled prevalence was significantly heterogeneous.

Table 2. Prevalence of ED in mainland China and subgroup analysis

Variables	Surveys, n	Sample size	ED cases	Prevalence, %	95% CI	I^2, %
Overall prevalence	25	48,254	20,436	49.69	39.29–60.10	99.9
Province						
Beijing	4	6,698	3,796	59.28	31.04–87.53	99.9
Chongqing	1	990	442	44.60	41.50–47.70	NA
Guangdong	5	7,030	2,422	43.46	29.99–56.93	99.2
Guangxi	1	5,504	1,326	24.10	22.97–25.23	NA
Gansu	1	1,230	1,135	92.30	90.81–93.79	NA
Henan	1	1,194	551	46.10	43.27–48.93	NA
Hubei	1	1,167	636	54.50	51.64–57.36	NA
Jiangsu	1	3,552	1,316	37.10	35.51–38.69	NA
Jiangxi	1	446	214	48.00	43.36–52.64	NA
Shandong	1	1,901	705	37.10	34.93–39.27	NA
Shanghai	3	4,100	2,694	67.10	50.62–83.58	99.3
Zhejiang	3	2,307	1,125	42.09	6.72–77.46	99.7
Multiple cities	2	12,135	4,074	38.10	−3.06 to 79.26	100.0
Age (y)						
<30	8	5,441	1,009	20.86	13.95–27.76	85.7
30–39	8	7,112	1,468	25.30	15.28–35.31	95.6
40–49	12	5,620	1,634	40.48	28.80–52.16	96.7
50–59	16	5,215	2,786	60.12	47.45–72.80	98.9
60–69	11	3,415	2,696	79.10	72.11–86.07	97.1
≥70	10	2,164	1,958	93.72	91.23–96.22	95.1
Survey year						
1999–2002	6	14,871	6,188	43.58	29.11–58.05	99.70
2002–2005	2	3,247	1,368	44.25	37.62–50.88	86.00
2005–2008	3	9,426	2,124	33.20	13.31–53.09	99.60
2008–2011	6	7,157	5,269	72.65	58.93–86.38	99.60
2011–2014	2	1,967	1,061	53.70	9.61–97.80	99.80
Diagnostic method						
IIEF-5	24	47,264	19,994	49.91	39.20–60.62	99.9
CIEF	1	990	442	44.60	41.50–47.70	NA
Self-report	3	11,163	1,371	14.19	10.14–18.24	96.9
Investigator						
Andrology specialist	5	7,786	3,524	47.52	29.18–65.87	99.6
Non-andrology	6	6,851	3,670	43.00	15.83–70.18	99.8
Trainee	9	17,784	8,293	47.80	36.44–59.15	99.6
NA	5	16,103	4,949	48.81	18.93–78.69	100.0
Severity of ED						
Mild	18	39,728	10,715	32.54	25.75–39.34	98.5
Moderate	18	39,728	3,126	9.86	6.76–12.97	89.9
Severe	18	39,728	3,647	13.97	6.16–21.78	98.5
Survey method						
Random	25	48,254	20,436	49.69	39.29–60.10	97.9
Other random	7	12,266	3,618	34.61	21.85–47.37	98.9
Quality score						
6	3	4,447	1,849	42.51	39.04–45.98	76.8
7	10	23,546	10,040	49.37	33.33–65.42	99.9
8	3	10,148	2,967	45.42	7.95–82.90	99.9
9	9	10,113	5,580	53.68	36.44–70.92	99.8

CIEF = Chinese Index of Erectile Function; ED = erectile dysfunction; IIEF-5 = International Index of Erectile Function–5; NA = not available.
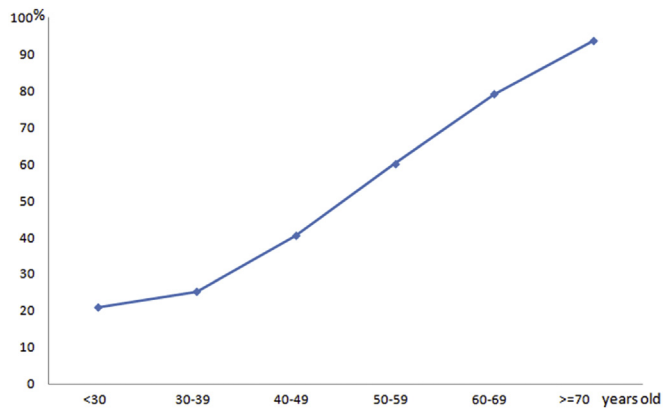
Figure 3. Prevalence of erectile dysfunction by different age groups.

The sources of heterogeneity were explored by univariate meta-regression, with the covariates of survey year, province, age range, identity of investigators, diagnostic method, and quality scores. However, none of these predictors showed a significant influence on heterogeneity among studies.

Sensitivity Analysis

"Leave one out" sensitivity analyses were used to assess the stability of this meta-analysis, and the pooled prevalence of ED increased significantly after excluding the studies of Fu et al,[17] Hao et al,[9] and Xu et al.[30] Conversely, a decrease was observed after the following single studies were excluded: Song et al,[26] Han et al,[10] Liang et al,[23] Leng et al,[22] and He et al.[19]

Publication Bias

Visual inspection indicated the funnel plot was not symmetrical and some points fell outside the funnel. However, the Begg test (t = 0.44, P = .657) and the Egger test (t = 1.52, P = .143) indicated there was no potential risk for publication bias, although the funnel plot was asymmetrical.

DISCUSSION

To the best of our knowledge, this study is the first meta-analysis of the epidemiology of ED in mainland China. The pooled overall prevalence of ED was 49.69% in this study, and the prevalence increased with age. The severity-specific prevalences of mild, moderate, and severe ED were 32.54%, 9.86%, and 13.97%, respectively. The prevalences reported by different diagnostic methods were 14.19% for self-reports, 44.60% for the CIEF, and 49.91% for the IIEF-5. However, no geographic distribution difference was found according to the currently available data.

As the often-quoted statement of the World Health Organization indicates, "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or

infirmity." ED, the most common male sexual condition, has a significant impact on male health on a global scale, and it has been regarded a major health problem for the increasingly elderly population.[1] However, the prevalence of ED obviously differs across countries. A multinational study involving 27,839 men 18 to 75 years old from eight countries (United States, United Kingdom, Germany, France, Italy, Spain, Mexico, and Brazil) showed the overall prevalence was 16%. However, the rates varied by country, from 10% in Spain to 22% in the United States.[37] According to the research of Holden et al,[38] 21% of participants were identified as having ED by telephone interview in Australia. In Asia, the prevalence of ED has been estimated at 32.4% in South Korea,[39] 32% in Japan (moderate to severe),[40] 47.8% in southern India,[41] 68% in Hong Kong (China),[42] and 27% in Taiwan (China).[43] A multinational study of 1,155 men 50 to 80 years old from Hong Kong (China), Singapore, Malaysia, Philippines, and Thailand found the prevalence of ED to be 63%.[44] The results of a meta-analysis indicated the weighted fixed-effects overall prevalence was 38.2%, and the random-effects prevalence was 42.4%. The age-specific prevalences were 15.1%, 29.6%, 40.6%, 54.3%, and 70.0% for age groups 20 to 29, 30 to 39, 40 to 49, 50 to 59, and 60 to 69 years, respectively.[45]

In previous studies, the prevalence of ED was significantly influenced by age[46]; this pattern was confirmed in this meta-analysis. The prevalence nearly doubled from no older than 30 years to 40 to 49 years (20.86% and 40.48%) and doubled again from 40 to 49 years to 60 to 69 years (40.48% and 79.10%). Moreover, the severity of ED increased with age: elderly men had a relatively high prevalence of severe ED. This is consistent with two other independent, population-based, large-scale studies of Spanish[47] and Saudi Arabian[48] men. The pathophysiologic explanation for the age trend is complicated, and the preventive value of this insight is limited. In contrast, some lifestyle factors that cause ED deserve more attention. Evidence from the third National Survey of Sexual Attitudes and Lifestyles in Britain indicated ED was associated with smoking, use of alcohol, unsafe sex (at least two partners and no condom use in the past year), and recreational drugs.[49] Moreover, dietary factors can affect the prevalence of ED. A survey conducted in Italy showed that an unhealthy diet and physical inactivity were risk factors for ED.[50] The intake of fruits, nuts, and vegetables and the ratio of monounsaturated lipids to saturated lipids also were associated with the development and progression of ED. In mainland China, the high prevalence of ED can be explained by at least three factors. First, vasculogenic disorders are believed to be the most important risk factor for ED.[51] Currently, cardiovascular disease is among the top health problems of the Chinese people, and its prevalence has increased continuously during the past 30 years,[52] which could play an essential role in the high prevalence of ED in mainland China. Second, the prevalence of tobacco use in adults in China is one of the highest in the world and is increasing.[53] Many studies have shown that men who smoke have a higher risk of ED and that there is a dose response.[54]
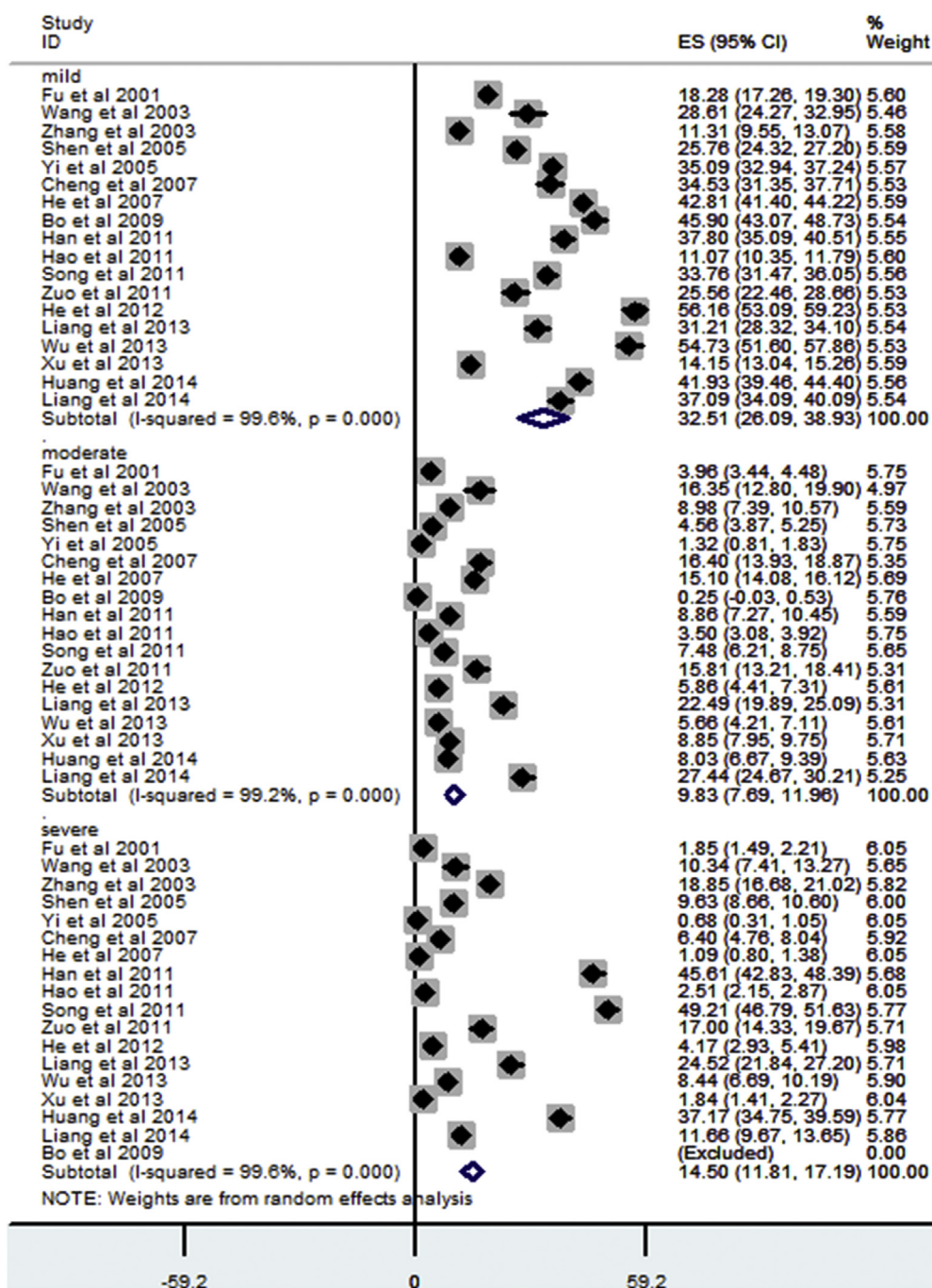
Figure 4. Severity-specific prevalence of mild, moderate, and severe erectile dysfunction. ES = effect size.

Third, physical activity, an important way to maintain one's health, has a positive effect on the prevention of ED. Some conventional Chinese behaviors such as physical inactivity are potential reasons for the high prevalence of ED.[55] To ascertain the effect of these lifestyle activities on ED, further studies of Chinese men are needed.

An interesting result was found in this meta-analysis: the prevalence of ED measured using the IIEF-5 was triple that measured using self-reports (49.91% and 14.19%). Similarly, the result of a population-based study in Taiwan (China) was 13.1%

when using self-reports and 26.0% when using the IIEF-5.[56] These results can be explained by insufficient knowledge of ED and the particular social psychology of Chinese men. In traditional Chinese culture, health-seeking behavior was observed as reflecting a loss of status and control, which can damage the identity of a man.[57] Moreover, having a successful sex life was not as desirable as having a good job, being observed as a man of honor, or being in control of one's own life, according to the viewpoint of Chinese men. Moreover, the sexual culture in China, long influenced by Confucianism and Taoism, has been
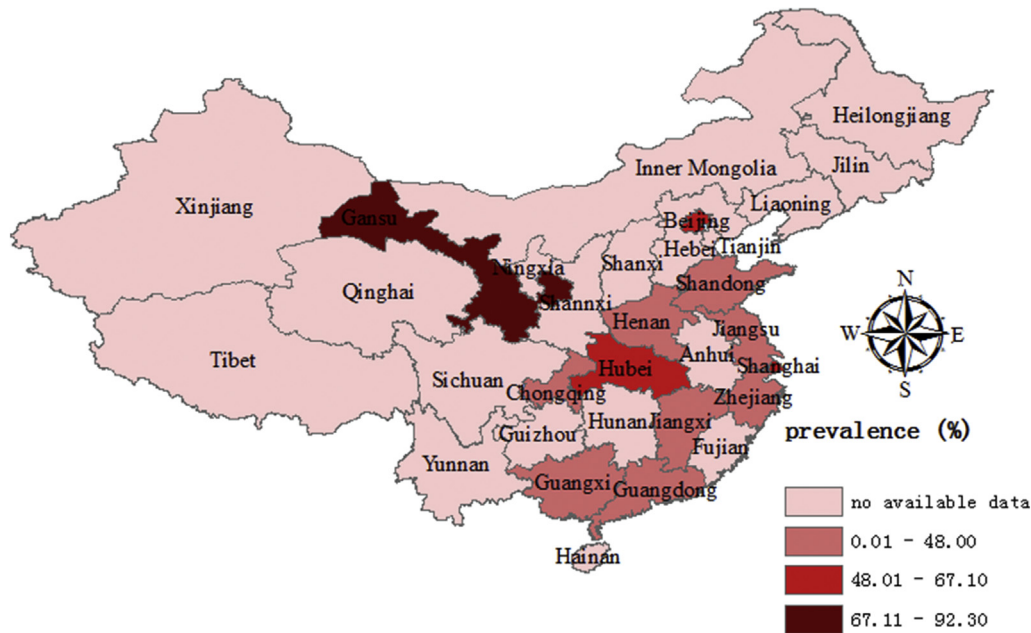
Figure 5. Provincial distribution of the prevalence of erectile dysfunction on a map of mainland China (map was created using the ArcGIS 10 system).

serious; joy has had no place in the sexual realm. In addition, traditional Chinese medicine stipulates that sex is more harmful than beneficial to men's health. Therefore, Chinese men maintain silence about their sexual problems because they fear a loss of control and damage to their culture role more than they fear an unsatisfactory sexual life.[57]

Compared with the prevalence of moderate and severe ED (9.86% and 13.97%), the prevalence of mild ED (32.54%) was much higher. Similar results were found by Martins and Abdo[58] who reported that the prevalence of ED in 1,947 Brazilian men was 35.0% (mild = 73.7%, moderate to complete = 26.3%). This result indicates that the mild type constitutes the overwhelming majority of ED cases. The therapeutic results for treatment of mild ED has been found to be more effective than for moderate or severe ED.[59] A meta-analysis confirmed this conclusion: mild ED had a relatively large impact on the young population, and it constituted approximately 70% of cases among young patients.[60] Moreover, evidence has shown that ED could be a predictor for or a marker of cardiovascular diseases.[61] However, the consultation rate was relatively low, and the awareness of patients and even clinicians was insufficient. Mild ED is often considered a psychological disorder and not a true medical problem. To overcome this problem, health education and prevention of risk factors are as important as disease screening and early diagnosis.

The time trend suggested an overall, if non-monotonic, increase in ED prevalence, which needs further confirmation. Possible reasons for this trend are varied. First, the population is aging rapidly in China, and the prevalence of ED is increasing concomitantly. Second, with the increasing competition in modern society, life stress, a known risk factor for ED, is becoming

more and more widespread. Third, in the past two decades, diagnostic technology has rapidly evolved, and the diagnosis of mild ED and psychogenic ED has become more convenient and reliable through the use of the IIEF-5. The geographic distribution of ED in this study was difficult to interpret because of the lack of studies in most provinces of mainland China. The prevalence of ED varied significantly across regions. This result, if it is not erroneous, could be explained by the variation in economic development, age structure, eating habits, life stress, people's awareness of ED, and screening rates. To clarify the distribution of ED, future studies conducted in the areas lacking data are needed.

There were several limitations to this study. First, heterogeneity should be considered in this meta-analysis, although we failed to find the source of any heterogeneity based on the present data. It has been reported that heterogeneity cannot be avoided in a meta-analysis, particularly in one based on epidemiologic surveys. Second, the age ranges in the included studies were heterogeneous, ranging from 18 to 82 years in this meta-analysis, and this variability could influence the overall prevalence estimate. Third, insufficient reported data on ED can play an essential role in the results. The included studies were conducted in only 13 regions of mainland China, which could be a relatively small number from which to estimate the overall prevalence. Fourth, diagnostic methods have changed over time, and several diagnostic methods with slightly different cutoffs were used in the included studies, which might have an effect on the results.

CONCLUSION

In summary, the present systematic review explored the epidemiologic characteristics of ED in men in mainland China.

The results showed that the overall prevalence of ED was high and increased significantly with age. This study provides only a narrow snapshot of the epidemiologic status of ED in China using current studies that draw on population-based surveys. More well-designed epidemiologic studies on ED with larger samples throughout mainland China are needed to confirm these findings.

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SUPPLEMENTARY DATA

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