Original Article

The prevalence of polycystic ovarian syndrome in Chinese women: a meta-analysis

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Background: To estimate the prevalence of polycystic ovarian syndrome (PCOS) in Chinese women comprehensively and to provide references to prevent PCOS.

Methods: China National Knowledge Infrastructure, Wanfang Data, China Science and Technology Journal Database, Chinese Biology Medicine, PubMed, Embase, Web of Science, CENTRAL, CINAHL were searched to collect studies on the prevalence of PCOS from database inception from March 31, 2020. Two reviewers independently screened literature according to the inclusion and exclusion criteria of the articles, extracted data, and tested the risk of bias of the included studies. Then Stata 15.1 software performed a meta-analysis. Begg's and Egger's method were used to assess the risk of publication bias.

Results: A total of 69 studies were involved, including 154,599 participants, 12,845 patients developed PCOS. The prevalence of PCOS was 10.01% (95% CI: 8.31% to 11.89%). Subgroup analysis showed that the prevalence of PCOS in different regions was as follows: 13.35% in the west, 7.82% in the east, 14.24% in the middle, and 8.68% in the north-east. Subgroup analysis by occupation/status: the prevalence rates of workers, students, medical staff, cadres, farmers, staff, and service staff were respectively 10.37%, 16.37%, 13.97%, 6.05%, 7.05%, 8.05%, 9.05%. For individuals aged 10 to 20, between 21 and 30, 31 to 40, and above 40, the prevalence rate was 10.26%, 17.23%, 9.13%, 2.22%, respectively. The prevalence rates of PCOS 1995 to 2000 were 21.04%, from 2001 to 2005, was 5.86%, from 2006 to 2010 was 10.78%, from 2011 to 2015 was 11.44%, and during 2016 to 2020 was 5.79%. Hospital-based community-based and school-based studies were 13.41%, 5.95%, 3.01%. According to the subgroup analysis of the surveyed population, the prevalence of PCOS in the general population and infertility patients were 6.05% and 13.69%, respectively

Conclusions: The prevalence rate of PCOS is high in Chinese women, and the prevalence of PCOS varies with different regions, occupation/identity, age, time of publication, diagnostic criteria, survey time, and prevalence of the surveyed population.

Keywords: Chinese woman; polycystic ovarian syndrome (PCOS); prevalence; meta-analysis

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Introduction

Polycystic ovarian syndrome (PCOS) is the most common gynecological, endocrine system disease among women aged 18 to 44 (1). Its key characteristics are persistent anovulation, hyperandrogenism, and insulin resistance. The main manifestations are menstrual disorders and reproductive dysfunction (2-4), one of the leading causes of females in anovulatory infertility (5,6). The World Health Organization estimates PCOS has affected over 116 million women worldwide as of 2010 (7). The incidence of long-term complications, including cardio-cerebrovascular diseases, hypertension, lipid metabolism disorders, and endometrial cancer in patients with PCOS, is 2 to 6 times ordinary people (2). At present, the etiology of PCOS is still unclear. Most scholars believe it may be related to the abnormal regulation function of the hypothalamic-pituitary-ovarian axis, hyperinsulinemia and insulin resistance, abnormal adrenal endocrine function, heredity, and other aspects (8,9). For decades, because of the differences in diagnostic criteria, sampling methods, and the gradual maturity of diagnosis and treatment techniques, the prevalence rates were retrieved by domestic and foreign scholars in the epidemiological investigations on PCOS vary greatly. Previous studies have reported that the prevalence rate of PCOS among women of childbearing age in various countries is between 5% and 10% (10). In recent years, large-scale investigations of PCOS have been carried out in different regions of China (11-13). However, due to the lack of a comprehensive data collection and analysis system, there is still no data on the exact frequency, distribution pattern and trend of PCOS nationwide. This study used the research method of meta-analysis to review the latest evidence systematically from the regional population survey of PCOS to understand the prevalence of PCOS in different regions and different populations fully, thus contributing to its control and management. We present the following article in accordance with the PRISMA reporting checklist (available at http://dx.doi.org/10.21037/apm-20-1893).

Methods

Search strategy

This study will be conducted according to PRISMA guidelines. Eight databases including China National Knowledge Infrastructure, Wanfang Data, China Science and Technology Journal Database, Chinese Biology Medicine, PubMed, Embase, The Cochrane Library and Web of Science were searched to collect studies on the prevalence of PCOS in Chinese women from setting up a database to May 31, 2020. To increase the sensitivity, we use a combination of subject heading terms and free text words to retrieve documents. The subject headings include: "polycystic ovarian syndrome" and "prevalence" or "incidence" or "epidemiology" and "China" or "Chinese." The free words include: "The People's Republic of China" or "Mainland China" "Formosa" and "Stein-Leventhal Syndrome" or "Sclerocystic Ovarian Degeneration" or "Sclerocystic Ovary" and "occurrence" or "outbreaks" or "prevalence" or "endemics" or "incidence".

Inclusion and exclusion criteria

The inclusion criteria are: (I) type of study: prospective or retrospective studies on the prevalence of PCOS in Chinese women published at home and abroad; (II) study population: Chinese women with a definite diagnosis of PCOS; (III) outcome indicators and the prevalence of PCOS.

The criteria for exclusion were: (I) studies with incomplete information and data that cannot be extracted; (II) studies reported or published repeatedly in the same research population, excluding those of lower quality; (III) studies not in Chinese or English; (IV) study where only the abstract is visible, and the full text cannot be obtained by contacting the author; (V) studies with low quality (the AHRQ score is below 3).

Data extraction

Two investigators (Q Wu, Z Yang) independently screened the literature, extracted data, and cross-checked. If the two researchers have inconsistent conclusions, then through discussion to resolve differences. If the differences cannot be resolved, the third party will perform judgments and arbitration. First, read the title and abstract, and after excluding irrelevant studies, read the full text further to determine whether it will be included. The content of the data extraction includes the first author, publication year, study design, research area, age, number of PCOS cases and sample size, occupation, education background, diagnostic criteria.

Statistical analysis

STATA (version 15.1; Stata Corporation) software was used to conduct statistical analysis and the point

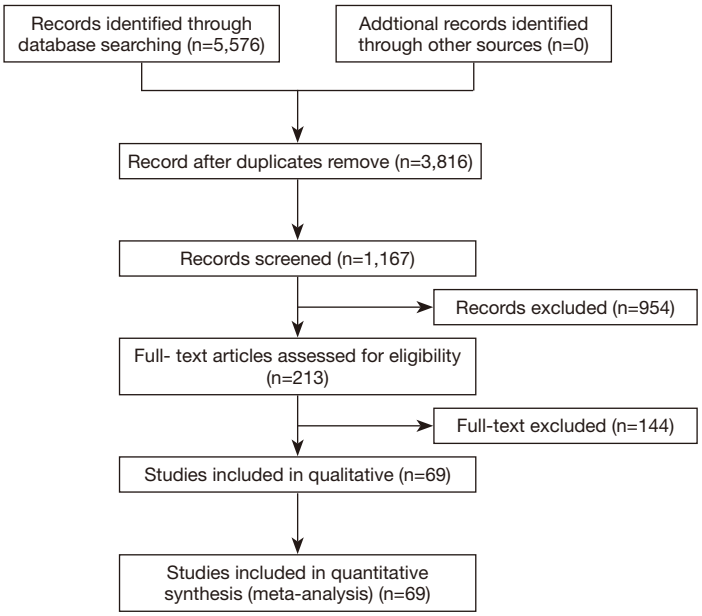

Figure 1 The flow diagram of this meta-analysis.

prevalence rates were first transformed into arcsine square-root transformed proportions (14). The heterogeneity between the included studies was determined by the Q test (P value) and I^2. If I^2<50% and P>0.1 of the Q test, it is considered the homogeneity between the studies is satisfactory, the fixed-effect model is used for meta-analysis. On the contrary (P≤0.1 or I^2≥50%), it is considered there is evident heterogeneity among studies, and the random effects model is used for combined calculation. A subgroup analysis was performed to explore the possible sources of heterogeneity among studies. Also, the subgroup analysis was conducted according to different regions, occupation/identity, age, publication time, diagnostic criteria, survey time, and survey population. Begg's test and Egger's test were used for conducting a publication bias assessment. It is considered statistically significant when P<0.05. In addition, a sensitivity analysis was performed to measure the impact of any research on aggregate estimates.

Quality assessment

The quality of the included studies was tested using the cross-sectional study quality evaluation standards recommended by the Agency for Healthcare Research and Quality (AHRQ). The AHRQ (15) standard contains 11 items, which are answered with "yes", "no," and "do not know", respectively. If the answer is "yes", the item is judged as "1", "no" or "no." "Clear" is "0" points. The score ranges from 0 to 11 points, 0 to 3 are low quality, 4 to 7 are medium quality, and 8 to 11 are of high quality. The literature quality evaluation was conducted independently by two researchers (Qiao Wu and Qin Liao), and the results were cross-checked. If the conclusions of the two researchers were inconsistent, a consensus was reached through discussion.

Results

Study selection and participants characteristics

The literature screening process and results are shown in *Figure 1*. A total of 5,576 papers were obtained from the preliminary search, among which 265 were from PubMed database, 108 from Embase, 708 from Web of Science, CENTRAL 33, CNKI 1,071, WanFang Data 1,479, VIP 667 and CBM 1,345. After reading the title, abstract and eliminating duplicate studies, a total of 4,409 articles were excluded. Then after further reading the full text, according to the literature inclusion and exclusion criteria, 62 documents whose data could not be extracted were excluded, 15 documents whose document type was review, 29 articles with a quality score of less than 3, and 21 documents with duplicate data, 17 documents without a clear survey location, 69 articles were finally included papers

on PCOS prevalence in Chinese women (65 in Chinese and 4 in English). A total of 154,599 patients were enrolled, including 12,845 patients with PCOS. The literature includes 23 provinces (cities, autonomous regions, and particular administrative regions), including 15 Midwestern Sectional Figure *S*kating Championships, 33 in the Eastern Region, 16 in the central region, and 4 in the northeast. Among them, three were of low quality, and 57 were of medium quality, and five were of high quality. The primary characteristics of the included studies are shown in *Table 1*.

Pooled prevalence rates of PCOS

Sixty-nine articles, including 154,112 subjects and 12,845 patients, were included. The prevalence rate of PCOS reported in each study ranged from 0.45% to 35.14%. A heterogeneity test was performed on the included 69 articles, and there was significant heterogeneity among the articles (I^2=99.6%, P<0.05), so the random effects model was adopted. From the fact that there are more ratios in this study between 0–0.3 and 0.7–1, the double arcsine conversion method was used to convert the rates and then combine to calculate the prevalence. The combined conversion rate from the random effects model was 0.64 (95% CI: 0.58–0.70), and the total prevalence of PCOS in Chinese women was 10.01% (95% CI: 8.31–11.89%) (*Figure 2*).

Subgroup analysis

Subgroup analysis was conducted by region, occupation/identity, age, time of publication, diagnostic criteria, and survey population. The study area is divided into eastern, northeastern, central, and western regions, according to China's four economic zones. Occupations/identities are divided into workers, students, medical personnel, cadres, farmers, clerks, and service personnel. The age is divided into 10–20, 21–30, 31–40 years old, and over 40 years old. Research sites are divided into hospitals, communities, and schools. The year of publication is in a period of every five years. Subgroup analysis results are shown in *Table 2*.

Sensitivity analysis and publication bias

Sensitivity analysis showed there was no significant difference between the results obtained and the total combined estimate when each of the included articles was excluded one by one, showing that the results were stable. Funnel chart and Begg's method and Egger funnel figure asymmetric inspections method analysis were performed. The results show Begg's rank correlation test income =0.81, P=0.41, and Z suggests no publication bias, and P=0.01 Egger regression analysis income. Further, the funnel chart shows apparent asymmetry, suggesting a potential publication bias, language bias, the small-scale flawed method in the study designed to estimate highly. Therefore, the effect of publication bias on the results was tested by the shear compensation method. The results showed that the estimated value of the combined effect size did not change significantly, suggesting that publication bias had little impact on the results, and the meta-analysis results were relatively stable (*Figures 3*,*4*).

Discussion

PCOS is the most common endocrine disease in women of childbearing age, and its clinical manifestations are highly heterogeneous (82), which can be easily confused with endocrine diseases, including hyperprolactinemia, abnormal thyroid function, and congenital adrenal hyperplasia (83). So far, there is no cure for PCOS, but the related health risks are lifelong. Even after menopause, women with PCOS still often have higher levels of androgen and insulin resistance (3,9). In recent years, the incidence of PCOS has all increased (84), and with the improvement of diagnostic methods and the level of diagnosis and treatment, its prevalence may change accordingly. Therefore, this study intends to assess the prevalence of PCOS in Chinese adult women and analyze the time tend to determine the current prevalence of PCOS in Chinese women to decide for the prevention and treatment of PCOS to provide evidence.

Sixty-nine articles published from 1985 to 2019 were included in this study and described the prevalence of PCOS among Chinese women through the method of meta-analysis. The results show the total prevalence of PCOS in China is 10.01%, which is higher than the results obtained by Rong Li (11) and others in the epidemiological survey of female PCOS in 10 provinces (cities). However, the prevalence of PCOS in this study was lower than that in Middle Eastern women (16%) (85), which may be related to race, region, economic and cultural level, and the improvement of PCOS knowledge and diagnosis.

The study also found significant differences among regions, occupation/identity, age, time of publication, diagnostic criteria, and prevalence rates among survey populations. In terms of regional differences in the

Table 1 The basic characteristics of the included studies

No.	First author	Publication year	Province	Study design	Age	Sample source	Sample size	Case (n)	Prevalence (%)	Quality score
1	Xu *et al.* (16)	2012	Guangdong	Cross-sectional	20–45	Hospital	215	3	1.39	4
2	Wu *et al.* (17)	2007	Guangdong	Cross-sectional	23–37	Hospital	232	24	10.34	5
3	Mao *et al.* (18)	1999	Hubei	Cross-sectional	20–40	Hospital	258	61	23.64	4
4	Pan *et al.* (19)	2017	Jiangsu	Cross-sectional	18–41	Hospital	301	75	24.91	5
5	Li *et al.* (20)	2014	Hunan	Cross-sectional	10–24	Hospital	371	29	7.82	5
6	Zhuang *et al.* (21)	2015	Jiangsu	Cross-sectional	28.96±3.55	Hospital	487	108	22.18	4
7	Zhan *et al.* (22)	2008	Guangxi	Cross-sectional	26±3.00	Hospital	640	78	12.18	5
8	Yang *et al.* (23)	2014	Hunan	Cross-sectional	20–43	Hospital	672	170	25.30	6
9	Liu *et al.* (24)	2008	Jilin	Cross-sectional	27±3.00	Hospital	1,280	288	22.50	4
10	Jiang *et al.* (25)	2007	Shandong	Cross-sectional	29.96±2.28	Hospital	1,525	230	15.08	4
11	Shi *et al.* (26)	2007	Hunan	Cross-sectional	21–47	Hospital	2,200	726	33.00	5
12	Chen *et al.* (27)	2016	Hubei	Cross-sectional	21–43	Hospital	3,147	355	11.28	4
13	Geng *et al.* (28)	2013	Henan	Cross-sectional	21–43	Hospital	3,200	1,018	31.8	6
14	Liu *et al.* (29)	2011	Anhui	Cross-sectional	18–45	Community	995	55	5.76	8
15	Fu *et al.* (30)	2018	Hubei	Cross-sectional	17–24	Hospital	2,296	136	5.92	6
16	Zhou *et al.* (31)	2006	Chongqing	Cross-sectional	22–38	Hospital	296	104	35.13	5
17	Zhou (32)	2014	Guangxi	Cross-sectional	22–40	Hospital	267	39	14.60	3
18	Sun *et al.* (13)	2016	Hebei	Cross-sectional	–	Hospital	16,343	1,467	8.98	4
19	Huang *et al.* (33)	2003	Guangdong	Cross-sectional	32.2±3.32	Hospital	447	2	0.40	5
20	Huai *et al.* (34)	2009	Xinjiang	Cross-sectional	21–65	Hospital	1,128	396	35.11	6
21	Mo *et al.* (35)	2008	Guangxi	Cross-sectional	23–43	Hospital	126	11	8.73	4
22	He *et al.* (36)	2009	Shanxi	Cross-sectional	–	Hospital	4,519	881	19.50	4
23	Xu *et al.* (37)	2005	Shanghai	Cross-sectional	22–45	Hospital	398	41	10.30	3
24	Liu *et al.* (38)	2012	Sichuan	Cross-sectional	23–41	Hospital	235	30	12.76	5
25	Su *et al.* (39)	2008	Yunnan	Cross-sectional	21–36	Hospital	210	16	7.62	3
26	Hao *et al.* (40)	2010	Chongqing	Cross-sectional	21–39	Hospital	322	22	6.83	4
27	Wang (41)	2008	Shandong	Cross-sectional	23–38	Hospital	80	4	5.00	4
28	Zhou (42)	2012	Zhejiang	Cross-sectional	22–45	Hospital	224	30	13.39	5
29	Huang *et al.* (43)	2013	Guangdong	Cross-sectional	22–35	Hospital	52	8	15.38	5
30	Zhao *et al.* (44)	2005	Zhejiang	Cross-sectional	24–36	Hospital	68	2	2.94	4
31	Zhao *et al.* (45)	2013	Guangdong	Cross-sectional	30±7.00	Community	2,988	568	19.01	6
32	Zhao (46)	2012	Jiangsu	Cross-sectional	18–42	Hospital	38	5	13.16	5
33	Song *et al.* (47)	2005	Hunan	Cross-sectional	31.14±3.86	Hospital	377	19	5.04	3
34	Qu *et al.* (48)	2017	Guangdong	Cross-sectional	24.27±3.13	Community	7,294	310	4.25	4
35	Li (49)	2008	Jiangsu	Cross-sectional	18–38	Hospital	1,080	80	7.41	4

Table 1 (*continued*)

Table 1 (*continued*)

No.	First author	Publication year	Province	Study design	Age	Sample source	Sample size	Case (n)	Prevalence (%)	Quality score
36	Wang (50)	2009	Liaoning	Cross-sectional	19–45	Community	1,600	132	8.25	8
37	Song (51)	2015	Hunan	Cross-sectional	19–45	Hospital	113	39	34.51	7
38	Ai *et al.* (52)	2013	Jiangsu	Cross-sectional	16–22	School	1,006	12	1.192	6
39	Zhang *et al.* (53)	2005	Zhejiang	Cross-sectional	18–22	School	341	50	14.662	4
40	Zhao *et al.* (54)	2012	Qinghai	Cross-sectional	22–38	Hospital	980	135	13.77	6
41	Guo *et al.* (55)	2018	Hebei	Cross-sectional	26–30	Hospital	2,000	180	9.00	3
42	Wang *et al.* (56)	2012	Hunan	Cross-sectional	21–39	Hospital	1,368	123	8.99	7
43	Li (57)	2013	Guangxi	Cross-sectional	22–38	Hospital	206	45	21.84	6
44	Jiang *et al.* (58)	2007	Shandong	Cross-sectional	–	Hospital	910	165	18.13	4
45	Zhao *et al.* (59)	2008	Guangxi	Cross-sectional	19–43	Hospital	439	86	21.86	3
46	Teng *et al.* (60)	2012	Shanghai	Cross-sectional	18–45	Hospital	514	51	9.92	6
47	Li *et al.* (61)	2012	Guangdong	Cross-sectional	19–44	Community	1,000	63	6.30	5
48	Hao *et al.* (62)	2006	Shandong	Cross-sectional	19–48	Community	1,125	81	7.20	7
49	Li *et al.* (63)	2017	Guangdong	Cross-sectional	18–42	Community	792	42	5.30	7
50	Wang *et al.* (64)	2015	Guangdong	Cross-sectional	20–45	Community	669	53	7.92	6
51	Ma *et al.* (65)	2007	Liaoning	Cross-sectional	–	Hospital	5,313	75	1.41	7
52	Wang (66)	2019	Jiangsu	Cross-sectional	20–49	Community	9,320	533	5.71	8
53	Jiang (67)	2006	Jiangsu	Cross-sectional	12–20	School	2,154	28	12.99	6
54	Chen (68)	2009	Tianjin	Cross-sectional	20–45	Community	1,337	94	7.03	7
55	Lin *et al.* (69)	2011	Guangdong	Cross-sectional	20–45	Community	791	46	5.81	7
56	Lin *et al.* (12)	2014	Xinjiang	Cross-sectional	18–45	Community	21,892	1,116	5.09	6
57	Lin *et al.* (70)	2010	Xinjiang	Cross-sectional	18–45	Community	2,867	217	7.57	7
58	Guo *et al.* (71)	2016	Shandong	Cross-sectional	–	Community	1,500	98	6.53	8
59	Wang *et al.* (72)	2016	Ningxia	Cross-sectional	12–18	Community	1,843	68	3.41	5
60	Feng *et al.* (73)	2016	Henan	Cross-sectional	17–23	School	2,182	327	14.98	4
61	Zhang *et al.* (74)	2013	Shanghai	Cross-sectional	18–45	Hospital	625	54	8.64	6
62	Song *et al.* (75)	2019	Hainan	Cross-sectional	19–24	School	10,000	53	0.53	4
63	Wang (76)	2012	Hunan	Cross-sectional	19–45	Community	1,488	130	8.74	6
64	Zhang (77)	2009	Hunan	Cross-sectional	14–20	Community	4,831	88	1.82	7
65	Wang *et al.* (78)	2016	Guangdong	Cross-sectional	25–40	Community	511	5	0.10	4
66	Jiao *et al.* (79)	2014	Liaoning	Cross-sectional	19–45	Community	1,600	132	8.25	6
67	Zhuang *et al.* (80)	2014	Sichuan	Cross-sectional	12–44	Community	1,645	184	11.19	7
68	Xiao *et al.* (81)	2008	Guangdong	Cross-sectional	20–45	Hospital	915	22	2.40	6
69	Rong *et al.* (11)	2013	Heilongjiang *et al.*	Cross-sectional	19–45	Community	15,924	894	5.61	8

"–" not reported.

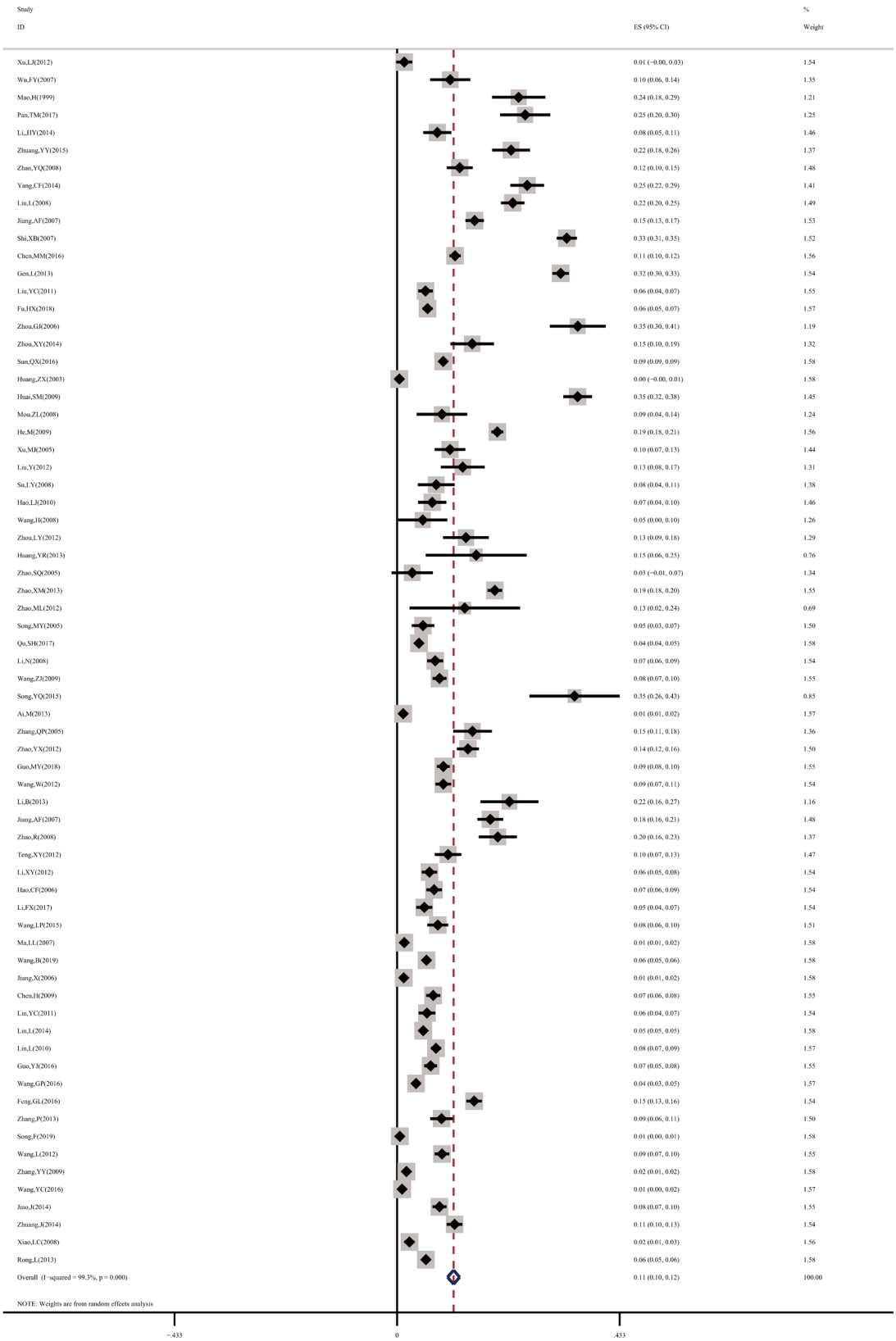

Figure 2 Forest plots of the total prevalence of polycystic ovary syndrome in Chinese women.

Table 2 Subgroup analysis of the prevalence of polycystic ovary syndrome in Chinese women

Category	No. of studies	Heterogeneity test results		Prevalence (95% CI), %	Publication bias (P valve)	
		I^2 (%)	P valve		Begg	Egger
Area						
Western	15	98.4	0.00	13.35 (9.19–18.10)	0.89	0.53
Eastern	33	99.1	0.00	7.82 (5.84–10.05)	0.71	0.39
Central	16	99.5	0.00	14.24 (8.87–20.63)	0.23	0.77
Northeast	4	100.0	0.00	8.68 (1.92–19.67)	1.36	0.06
Occupation/identity						
Worker	5	98.8	0.05	10.37 (6.71–14.77)	1.22	0.06
Student	6	99.0	0.00	16.37 (2.55–38.75)	0.24	0.56
Medical staff	4	74.3	0.00	13.97 (8.79–20.11)	1.70	0.01
Cadre	5	98.7	0.01	6.05 (4.93–7.29)	0.73	0.59
Farmer	4	71.4	0.00	7.05 (3.75–9.51)	1.02	0.36
Clerk	3	53.0	0.00	8.05 (7.50–13.28)	0.00	0.65
Service	2	7.5	0.00	9.05 (6.41–14.38)	0.00	–
Age						
10–20	7	98.4	0.00	10.26 (5.24–16.74)	0.60	0.08
21–30	9	98.2	0.00	17.23 (8.43–28.35)	0.94	0.07
31–40	8	93.5	0.00	9.13 (4.65–14.87)	0.87	0.00
>40	3	76.6	0.03	2.22 (0.82–4.26)	1.04	0.19
Publication time						
1995–2000	2	0.0	0.00	21.04 (17.91–24.39)	0.00	–
2001–2005	5	96.1	0.01	5.86 (1.51–12.84)	1.04	0.14
2006–2010	23	99.8	0.00	10.78 (6.79–15.56)	0.79	0.06
2011–2015	27	98.7	0.00	11.44 (8.71–14.4)	0.96	0.05
2016–2020	12	99.6	0.00	5.79 (3.46–8.65)	0.75	0.80
Diagnostic criteria						
ESHRE/ASMR-2003	32	99.7	0.00	8.01 (6.14–10.14)	0.78	0.30
NIH-1990	2	87.3	0.00	5.67 (3.13–8.96)	0.00	–
AES-2006	3	95.6	0.00	5.06 (2.09–9.25)	1.04	0.34
Source of population						
Hospital	43	99.2	0.00	13.41 (10.62–16.48)	0.21	0.14
Community	22	99.7	0.00	5.95 (5.04–6.91)	0.42	0.36
School	4	99.5	0.00	3.01 (0.06–10.14)	0.34	0.48

NIH-1990 (Diagnostic criteria developed by the United States Health Organization/United States Organization for Child Health and Human Development (NIH/NICHD) in 1990): (I) oligoovulation, (II) signs of androgen excess (clinical or biochemical), (III) exclusion of other disorders that can cause menstrual irregularity and hyperandrogenism. ESHRE/ASMR-2003 [Diagnostic criteria developed by the European Society of Human Reproduction and Embryology (ESHRE) and the American Society for Reproductive Medicine (ASRM) in 2003]: (I) oligoovulation and/or anovulation, (II) excess androgen activity, (III) polycystic ovaries (by gynecologic ultrasound) AES-2006 (Diagnostic criteria developed by the American Androgen Excess Society in 2006): (I) excess androgen activity, (II) oligoovulation/anovulation and/or polycystic ovaries, (III) exclusion of other entities that would cause excess androgen activity.

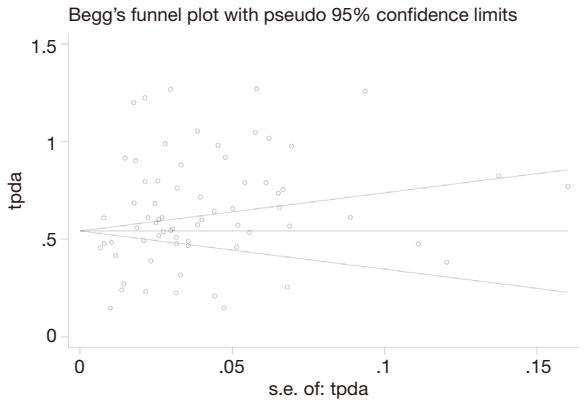

Figure 3 The funnel plot diagram of Beggar rank correlation analysis

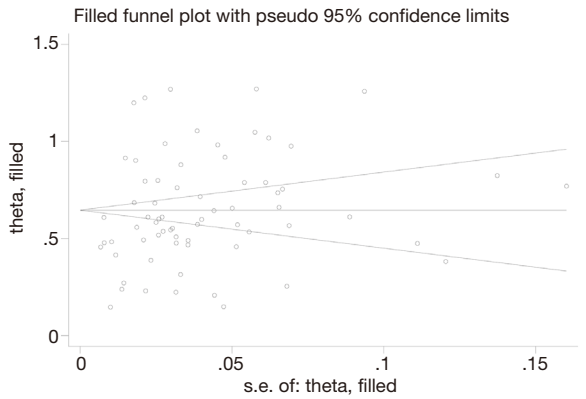

Figure 4 The funnel diagram of the shear compensation method.

prevalence rate of female PCOS, the prevalence rate of female PCOS in eastern regions is significantly lower than that in central and western regions, which might be because of the following reasons: (I) compared with the eastern region, the economic status of the central and western regions is slightly lagging. The socioeconomic status of women is low. Relevant studies have shown that low socioeconomic status is related to increased exposure to environmental BPA (86), and this synthetic compound may be related to PCOS (87). Relevant animal studies have shown (88) that there is an association between the development of PCOS symptoms and exposure to BPA during the newborn period. Simultaneously, women in the central and western regions are insufficient preventive and health care conditions because of the lagging economic status (89), which delays the treatment of PCOS. (II) It is related to the living environment between regions. Women in the central and western regions are more likely to be in backward agricultural areas than women in the eastern regions and are more likely to be exposed to environmental toxins, including pesticides and smog. Studies have shown that environmental toxins have a significant impact on human health. Pollutants, including smoke, lead, pesticides, and mercury, may damage women's reproductive health and may trigger or aggravate PCOS and its related symptoms (90).

In terms of the difference in the prevalence of PCOS between different occupations/identities: PCOS has the highest prevalence among students. The reasons may be because of: (I) students have prolonged mental work hours and high intensity, and their bodies are under long-term stress. Catecholamine increased secretion causes the body's endocrine function disorder, sympathetic nerve excitability, and hypothalamus-pituitary-adrenal cortex hormone secretion increases, thereby reducing immune function. These factors may accelerate the occurrence of PCOS (91). (II) Students often have lousy living habits, including reversed work and rest and irregular eating and less exercise and exercise, and these are all predisposing factors for PCOS (92). As a group of people with higher socioeconomic status, cadres have better medical and health conditions and pay more attention to their health conditions, have a relatively healthier lifestyle, and reduce the chance of PCOS.

The results of a subgroup analysis with age in this study showed that the prevalence rate was 10.26% for 10 to 20 years old, 17.23% for women aged 21 to 30, and 9.13% for women aged 31 to 40, >40 years old. The prevalence of PCOS in women was 2.22%. This result shows that the prevalence of PCOS decreased significantly with age from 21 to 30 years old, suggesting that age may be related to PCOS. The reason might be because of the prosperous childbearing period for women of childbearing age between 20 and 29 years old, female reproductive endocrine function reaches its peak state, the ovarian endocrine function is vigorous, and women's ovarian endocrine function enters a state of gradual decline around 40 years old (93). The prevalence of PCOS, which is closely related to endocrine function, also decreases with the gradual weakening of ovarian endocrine function.

In terms of publication time, from 2001 to 2015, the prevalence of female PCOS has shown an upward trend. The reason may be that with the development of economy and medical and health conditions, increased patients with PCOS-related symptoms tend to go to the hospital

for treatment. Also, with the improvement of diagnosis and treatment methods, and the gradual improvement of PCOS diagnostic criteria, the diagnosis rate of PCOS has increased. The prevalence of PCOS has declined since 2016. The decline might be related to the changes in the age structure of the population in the country. The number of women of childbearing age in this study's country has shown a decreasing trend year by year. According to the 2018 Government Work Report, there were 4 million fewer women of childbearing age-aged 15 to 49 in 2017 than in 2016, with nearly 6 million fewer women of childbearing age-aged 20 to 29 during their fertile years.

Comparing the prevalence of women using the diagnostic criteria of the National Institutes of Health in 1990, the Rotterdam criteria in 2003 and the PCOS diagnostic criteria developed by the American Androgen Association in 2006, the prevalence of PCOS diagnosed using the Rotterdam criteria in 2003 is significant It is higher than the other two is like the results of researchers including Anahita Jalilian (10). However, some studies believe the Rotterdam criteria may include some women with mild phenotypes into the diagnosis, increasing the incidence of PCOS (94). In terms of the prevalence of PCOS in different survey sites, the survey conducted in the hospital has a higher prevalence rate, while the survey conducted in the school has a lower prevalence rate. The reason might be because of the differences in the subjects of the survey. Most surveys conducted in the hospital were women who had symptoms related to PCOS and went to the hospital for treatment. The cases were concentrated. The low prevalence of the survey conducted in schools may be related to insufficient self-health care, awareness of students, insufficient relevant knowledge of PCOS, and insufficient school medical and health conditions. When students have PCOS-related symptoms, including irregular menstruation and acne, they are often overlooked and miss the diagnosis and treatment of the disease.

This study also has certain limitations. Firstly, it is limited by the characteristics of single rate meta-analysis, and the heterogeneity between the literature is considerable. Secondly, significant heterogeneity exists among different studies. Although inclusion and exclusion criteria are strictly limited and subgroup analysis is conducted, the results cannot fully explain the source of heterogeneity, and unknown sources of heterogeneity may cause certain bias. Finally, only 69 studies covering 23 provinces in China were included in this study. The results were not enough to reflect the prevalence and characteristics of PCOS in all Chinese women.

Conclusions

To sum up, PCOS has a high prevalence rate in Chinese women, a significant public health problem in China. Therefore, medical and health departments should pay more attention to this situation. According to the research results, the disease has a high prevalence rate in the central region, students, and women aged 21 to 30. Therefore, more targeted screening measures should be adopted for people with the characteristics of this population, and tertiary prevention of PCOS should be actively carried out, to make an early diagnosis and early treatment, and reduce relevant medical and health resources.

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Footnote

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