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Research article

Prevalence of antenatal depression and postpartum depression among Chinese fathers: A systematic review and meta-analysis

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ABSTRACT

Background: Paternal antenatal depression and postpartum depression are associated with adverse health outcomes in mothers and infants; however, their prevalence among Chinese fathers remains controversial. This meta-analysis aimed to summarize the prevalence of antenatal depression and postpartum depression in Chinese fathers.

Methods: We conducted a systematic meta-analysis on the prevalence of antenatal depression and postpartum depression among Chinese fathers by searching 11 databases. Pooled estimates and 95 % confidence intervals were calculated. The choice between a random-effects model and a fixed-effects model was based on an assessment of heterogeneity among the studies as well as assumptions regarding the similarity of the studies in terms of clinical characteristics, quality, design, and conduct. Subgroup and meta-regression analyses were conducted based on the scale used to measure antenatal depression and postpartum depression, the region where the study was completed, the time of the study, the study design, the number of children, publication language, the study site, and quality assessment.

Results: This meta-analysis included 28 studies with 8795 participants. The prevalence of antenatal depression among Chinese fathers was 11 % (95 % CI: 5%–17 %, $P < 0.01$) using a random-effects model. Heterogeneity was $I^2 = 91$ %. Publication language moderated the prevalence of paternal antenatal depression (the amount of heterogeneity accounted for was 92.13 %). The prevalence of postpartum depression among Chinese fathers was 16 % (95 % CI: 13%–18 %, $P < 0.01$), using a random-effects model. The heterogeneity was $I^2 = 94$ %. The prevalence of paternal postpartum depression was moderated by the scale used to measure postpartum depression (39.17 % heterogeneity) and the region where the study was completed (33.15 % heterogeneity). Moreover, Egger's test ($t = 4.542$, $P < 0.001$) indicated publication bias in studies on postpartum depression among Chinese fathers. However, after applying the trimming correction, the pooled prevalence of postpartum depression had a P value of <0.05, indicating that despite the publication bias, the results remain reliable and unaffected in terms of effect size.

Conclusion: The prevalence of antenatal depression and postpartum depression among Chinese fathers was similar to those reported in low- and middle-income countries. Fathers should receive

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regular screening, effective prevention, and appropriate treatment. However, interpreting these results requires consideration of the limitations of the study.

1. Introduction

Perinatal depression (PND), a common perinatal mental health problem, refers to depression in women during pregnancy and within one year of delivery [1]. PND can be divided into antenatal depression (AD) and postpartum depression (PD) [2]. A growing number of studies have confirmed that AD and PD are not unique to mothers, as spouses may also experience depression during the perinatal period [3,4], a phenomenon known as paternal AD and PD. A comprehensive meta-analysis of 47 studies involving 20,728 participants revealed that the prevalence of AD in fathers was 9.76 % across all trimesters. Specifically, the prevalence rates were 13.59 % during the first trimester, 11.31 % during the second, and 10.12 % during the third trimester. For PD, the overall prevalence in the first year post-childbirth was 8.75 %. More detailed findings showed that the rates were 8.98 % in the first month, 7.82 % in the first to third month, 9.23 % in the third to sixth month, and 8.40 % in the sixth month to one year period after childbirth [5]. Studies have shown that paternal AD and PD can not only cause or even aggravate depression in pregnant women [6,7], but also increase the risk of child abuse, developmental and behavioral problems in the offspring, and mental illness [8,9]. Since China enacted the comprehensive two-child policy in 2016 and the policy of encouraging three children in 2021, the number of families with two or three children has increased, and fathers have assumed more family responsibilities and burdens. Studies have shown that experienced parents have higher rates of depression than first-time parents [10,11]. Therefore, owing to the severe consequences of paternal AD and PD, the arrival of the universal two-child policy, and the policy of encouraging three children in 2021, it is necessary to pay attention to paternal AD and PD.

Identifying the prevalence of AD and PD is the first step towards actively preventing and effectively managing paternal AD and PD. There have been studies on the prevalence of AD and PD in Chinese fathers, but the results have been inconsistent [12,13]. Moreover, these studies were limited due to small sample sizes and were conducted only in a specific province or city. Therefore, it is necessary to summarize and analyze the prevalence of AD and PD in Chinese fathers. A meta-analysis of global perinatal morbidity among fathers found that the prevalence of paternal AD throughout gestation was 9.76 % and the prevalence of PD was 8.75 % within one year after delivery [5]. However, the meta-analysis included only studies from 21 countries. Furthermore, national policies and cultural differences can affect the risk of paternal AD and PD [5]. Therefore, the generalizability of the findings of this meta-analysis is limited. Moreover, the meta-analysis included only studies that used the Edinburgh Postnatal Depression Scale (EPDS) to screen for AD and PD. Another meta-analysis confirmed that the overall case rate of paternal PD among Chinese fathers was 13.6 % (95 % confidence interval [CI]: 8.7%–21.3 %) [14]. However, this meta-analysis focused only on the postpartum period and did not include individuals with AD. Moreover, it was published in 2016 before China issued the universal two-child policy and encouraged a three-child policy. Recently, considerable research has been conducted on AD and PD in Chinese fathers. Therefore, the impact of the two- and three-child policies on AD and PD in fathers should be explored in China's current historical context.

The prevalence of AD and PD among Chinese fathers, including studies published in Chinese and English, has yet to be systematically reviewed. This study aimed to fill this gap by summarizing and analyzing the prevalence of AD and PD among Chinese fathers to provide critical information for the effective prevention and treatment of AD and PD among Chinese fathers.

2. Materials and methods

2.1. Literature search

This systematic review and meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [15]. The protocol for this systematic review is registered in PROSPERO (CRD42022316748). Systematic literature searches were conducted in 11 electronic bibliographic databases using a pre-tested search strategy from inception to April 1, 2022. The following databases were included: PubMed, PsycINFO, APA PsycArticles, CINAHL, MEDINE via OVID, Web of Science, Cochrane, Scopus, China National Knowledge Infrastructure, VIP Database for Chinese Technical Periodicals, and Wan Fang Database for Chinese Periodicals. Two authors (X.G. and W.H.) independently searched the relevant literature. The following search strings were applied in the meta-analysis: pregnancy OR antenatal OR prenatal OR gestation OR postnatal OR postpartum OR postpartal OR perinatal OR puerperium OR puerperal OR postbirth OR mother*; depression OR depressive OR mood disorder OR affective disorder OR depressive disorders OR depression symptoms OR depress* OR mental health OR mental disorder* OR psychiatric disorders*; male OR men OR father OR Paternal OR male OR husband OR dad; and China OR Chinese. We searched each listed database by considering an adapted list of search terms, the vocabulary of the databases, and search builder specificities. Further searches were conducted on preprint servers (Biorxiv, Medrxiv, and Chinxiv), employing the above-mentioned keywords to identify potential pre-publication manuscripts that met the eligibility criteria. Moreover, searches were conducted in commonly used clinical registries, including the Chinese Clinical Trial Registry (http://www.chictr.org/cn/), International Clinical Trial Registry (http://clinicaltrials.gov/), and European Clinical Trial Registry (https://www.clinicaltrialsregister.eu/), to identify gray literature and clinical trials.

2.2. Inclusion and exclusion criteria

The inclusion criteria comprised two main components: the PICOS format (i.e., population, intervention, comparison, outcome, and study design), and additional criteria, including the publication language and age of the participants. Based on the PICOS format, the inclusion criteria were as follows. The population was Chinese men whose spouses were pregnant and had delivered within the previous 12 months. The intervention was prevalence of AD or PD among Chinese fathers or relevant data that could be used to calculate the prevalence of AD or PD among Chinese fathers. There was no comparison. The outcome was AD or PD scores that were measured using a valid self-report scale, such as the EPDS [16] and the Beck Depression Inventory (BDI) [17]. Study design included cross-sectional, cohort design (baseline data only), and case control studies. Other inclusion criteria were (1) papers published in English or Chinese, (2) the age of the fathers was older than 18 years, and (3) only articles containing complete information were included if multiple studies used the same data.

Studies were excluded if (1) they focused on specific subgroups, such as ethnic minorities, or (2) participants with other mental disorders. Two authors (X.G. and W.H.) independently assessed the study eligibility.

2.3. Study selection and data extraction

In addition to the literature retrieved from the above databases, the references listed in relevant reviews [5,14] were also examined to identify other studies. After using EndNote 20.0 software to delete duplicate documents [18], two authors (X.G. and W.H.) independently sorted through the titles and abstracts and read the full text of the rest of the literature. Any disagreements regarding literature retrieval were resolved by consensus or discussion with the senior author (Q.C.X.). The study selection process is shown in Fig. 1.

Two same two authors also independently extracted the relevant data. The data included basic bibliographic information (e.g., first author, year of publication, and language of publication) and study characteristics (e.g., year and region of the study, sample size, instruments used to measure AD or PD, and the cutoff scores for AD or PD). We considered that the cutoff score for the same scale is controversial; for example, cutoff scores that have been used for the EPDS are 10 and 13 points [19]. Different researchers may choose different cutoff scores, and different cutoff scores may result in different prevalences of AD or PD; therefore, we also extracted the cutoff score for the scale as important information. We extracted the prevalence of AD, PD, and factors influencing AD or PD in Chinese fathers and sample information (e.g., mean age and sample size). When there was disagreement regarding data extraction, the two authors reached a consensus or consulted the senior researcher (Q.C.X.). Scoring reliability between authors of 0.75 (Kappa value of the category variable) was considered acceptable. If necessary, data extraction was repeated until the required value of 0.75 was reached.

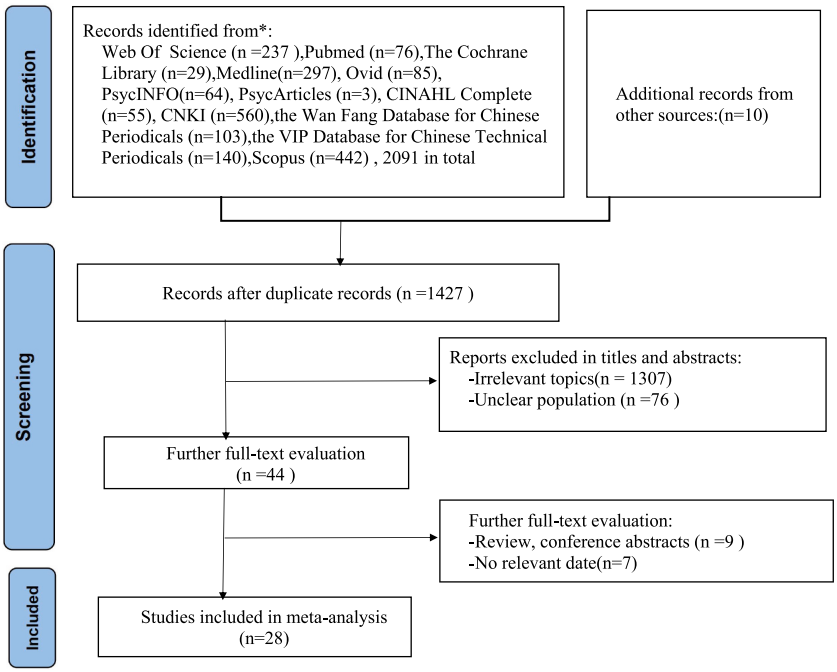

Fig. 1. Flowchart of study selection.

2.4. Quality assessment

Two authors (X. G. and W. H.) independently evaluated the cross-sectional study method checklist using the Agency of Healthcare Research and Quality (AHRQ) recommendations. The AHRQ consists of 11 items: (1) the source of information, (2) inclusion and exclusion criteria, (3) the period used for identifying patients, (4) the sampling method, (5) consecutive subjects, (6) instrument validation, (7) exclusion reasons, (8) measure of confounding assessed and/or controlled, (9) process of missing values, (10) response rates and completeness of data collection, and (11) use of follow-up or incomplete data. Each item was rated as "yes," "no," or "unclear" based on the literature. If the answer was "yes," one point was given, and no points were given if the answer was "no" or "unclear." The scores for each item were added to calculate the total score (0–11). Generally, a total score between 7 and 11 (63.6%–100 %) represents high article quality, a total score between 4 and 6 (36.4%–63.6 %) represents medium quality, and a total score between 0 and 3 (0%–36.4 %) represents low quality [20,21].

2.5. Data synthesis

The primary outcome of this study was the prevalence of AD and PD in Chinese fathers (and the 95 % CIs). The prevalences of AD and PD were calculated using the frequency and total sample size reported in the study. Forest plots were used to display the pooled effect sizes and event rates for each study. The heterogeneity of the studies was tested using 95 % CIs, chi-square (χ^2) statistics, and I^2 statistics. The heterogeneity between studies was considered high when $P < 0.05$ for the χ^2 statistic or I^2>50 %. The choice between a random and a fixed-effects model is pivotal for accurately interpreting meta-analysis results. The model selection depends on our assumptions regarding the similarity of the selected studies in terms of clinical characteristics, quality, design, and conduct [15,22]. A fixed-effects model assumes that all studies have the same effect size and that the observed variations are due to chance alone. This model is suitable when studies are homogenous and believed to share the same underlying effect. Conversely, a random-effects model is used when studies are expected to have varying effect sizes, possibly due to differences in populations, interventions, outcomes, or other characteristics. This model accounts for variations beyond the sampling error by adding a term to handle the extra variability among the studies. In our meta-analysis, the included studies showed significant diversity in publication year and geographical setting, introducing variability in clinical and methodological aspects. Additionally, high heterogeneity was evident in the preliminary tests (e.g., the I^2 statistic), necessitating a model that accommodates these differences. Consequently, we chose the random-effects model, which provided a more generalized and applicable conclusion.

We conducted comprehensive subgroup and meta-regression analyses to qualitatively explore the sources of heterogeneity. Our subgroup analyses were structured around multiple variables: scales used to measure antenatal and postnatal depression, geographic location of the studies, timing of the assessment (divided into the pre- and post-implementation phases of the 2016 two-child policy), study design, number of children, publication language, and study setting (community vs. hospital). Additionally, we utilized meta-regression techniques to quantitatively evaluate the impact of continuous variables, such as the sample size, the mean age of participants, and the publication year, on the observed heterogeneity. Sensitivity analysis using the leave-one-out method was performed to test the reliability of the findings. Lastly, funnel plots, Egger's test, and Duval and Tweedie's trim and fill analyses were used to assess potential publication bias. The trim and fill algorithm is based on formalizing a qualitative approach using a funnel plot. Briefly, the asymmetric outlying part of the funnel is trimmed after estimating the number of studies in the asymmetric part [23]. R Studio software was used for statistical analysis to generate forest plots, sensitivity analysis, Egger's test, and funnel plots. We performed meta-regression and Duval and Tweedie's trim and fill analyses using Stata software version 14.0. Quality assessment and data extraction were performed using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA).

3. Results

3.1. Study characteristics

A total of 2091 original studies were identified. Additionally, 10 studies were manually obtained by searching for other published meta-analyses. Finally, 28 studies published in English (n = 11) [12,24–33] or Chinese (n = 17) [34–50] with 8795 participants were included in the meta-analysis (Fig. 1). Of the 28 studies, four studies [26,31,44,49], including 1024 participants, were conducted during pregnancy, and 27 studies [12,24–48,50], including 8507 participants, were conducted during the first year after delivery. In addition, three studies [26,31,44] (n = 736) examined maternal spousal depression before and after delivery. The most commonly employed scales to assess AD and PD were the EPDS (n = 22), followed by the BDI (n = 2) [12,35], Self-Rating Depression Scale (SDS) (n = 2) [27,36], and Burns Depression Checklist (BDC) (n = 1) [46]. Only one study used the General Health Questionnaire (GHQ-12) [26]. Seventeen studies [12,26,27,29–32,34–36,38,39,41,42,44,46,49] were conducted before the two-child policy, and 11 studies [24,25,28,33,37,40,43,45,47,48,50] were conducted after the two-child policy. Most studies were cross-sectional (n = 23), with three longitudinal designs [26,31,32] and only two cohort designs [30,42]. A total of 26 studies were conducted in hospitals and two were in the community. Detailed data are presented in Tables 1 and 2.

Prenatal studies were conducted in Beijing [49] (one study, n = 288), Zhejiang [44] (one study, n = 349), and Hong Kong (two studies, n = 387) [26,31]. Postpartum studies were conducted in Beijing [34] (one study, n = 501), Shaanxi [32,41] (two studies, n = 319), Henan [46] (one study, n = 120), Anhui [35,42] (two studies, n = 1261), Jiangsu [27,33] (two studies, n = 1350), Hubei [38,45] (two studies, n = 999), Shanghai [28] (one study, n = 318), Zhejiang [43,44,47] (three studies, n = 676), Hunan [48,50] (two studies, n = 409), Fujian [12,39] (two studies, n = 506), Guangxi [37] (one study, n = 200), Guangdong [24,25,29,36,40] (five studies, n =

Table 1
Basic information of studies on the prevalence of antenatal depression among Chinese fathers.

No	First Author	Language of publication	Study year	Sample size	Age range	Mean age of fathers (Mean ± SD)	Study site	Province	Screening measure		First-time to be a father	Quality of assessment
									scale	Cut-off		
1	Koh, Y. W.	English	Not Clear	187	19–55	34.19 ± 5.21	Hospital	HongKong	EDPS	≥13	first	8 (high quality)
2	Xu, W. Q.	Chinese	2012–2013	349	23–39	26.5 ± 2.9	Hospital	Zhejiang	EDPS	≥13	first	6 (moderate quality)
3	Ngai,F.W.	English	2014	200	Not Clear	34.5 ± 4.7	Hospital	HongKong	GHQ	≥3	second	7 (moderate quality)
4	Cheng,X.	Chinese	2018–1019	288	Not Clear	First child:(33.19 ± 4.59),second Child: (37.09 ± 4.2)	Hospital	Beijing	EPDS	≥9.5	First and second	6 (moderate quality)

Notes. EDPS: The Edinburgh Postnatal Depression Scale; GHQ:The General Health Questionnaire; SD: Standard Deviation.

Table 2
Basic information of studies on the prevalence of postpartum depression among Chinese fathers.

No	First Author	Language of publication	Study year	Sample size	Age range	Mean age of fathers (Mean ± SD)	Study site	Province	Screening measure		First-time to be a father	Quality of assessment
									scale	Cut-off		
1	Xu, W. Q.	Chinese	2012–2013	349	23–39	26.5 ± 2.9	Hospital	Zhejiang	EDPS	≥13	First	6 (moderate quality)
2	Zhou, Y.	Chinese	2016	142	Not Clear	28.4 ± 4.8	Hospital	Zhejiang	EDPS	≥10	First	6 (moderate quality)
3	Ngai,F.W.	English	2014	200	Not Clear	34.5 ± 4.7	Hospital	HongKong	GHQ	≥3	First	7 (moderate quality)
4	Chung, TKH.	English	2011	551	Not Clear	Not Clear	Hospital	HongKong	EDPS, BDI	EDPS > 9.5,BDI > 10.5	Not Clear	7 (moderate quality)
5	Li,Y.H.	Chinese	2009	254	22–45	30.05 ± 3.55	Community	Anhui	BDI	≥4	Not Clear	6 (moderate quality)
6	Zhang,X. F.	Chinese	2007	120	Not Clear	Not Clear	Hospital	Henan	BDC	≥4	First	5 (moderate quality)
7	Gao, L. L.	English	2006–2007	130	24–43	31.92 ± 3.15	Hospital	Guangdong	EDPS	≥13	First	7 (moderate quality)
8	Koh, Y. W.	English	Not Clear	187	19–55	34.19 ± 5.21	Hospital	HongKong	EDPS	≥13	First	8 (high quality)
9	Mao, Q.	English	2007–2008	376	22–39	27.09 ± 4.46	Hospital	Fujian	EDPS	≥13	First	8 (high quality)
10	Zhang, Y. P.	English	2013	166	Not Clear	29.00 ± 2.9	Hospital	Shaanxi	EDPS	≥10	First	5 (moderate quality)
11	Lai, M.H.	Chinese	2013–2014	501	20–50	30.84 ± 4.47	Hospital	Beijing	EDPS	≥9	Not Clear	5 (moderate quality)
12	Luo, G	Chinese	2015–2016	200	23–40	30.76 ± 3.67	Hospital	Guangxi	EDPS	≥10	Not Clear	6 (moderate quality)
13	Luo, L. B	Chinese	2014–2015	187	22–53	29.83 ± 3.87	Hospital	Hubei	EDPS	≥9	First	5 (moderate quality)
14	Wang, J. N.	Chinese	2014	153	21–38	28.0 ± 1.9	Hospital	Shaanxi	EDPS	≥10	First	6 (moderate quality)
15	Weng, T. T.	Chinese	2013–2014	1007	Not Clear	Not Clear	Hospital	Anhui	EDPS	≥10	Not Clear	5 (moderate quality)
16	Wu,J.M.	Chinese	2018–2019	185	22–48	29.84 ± 4.465	Hospital	Zhejiang	EPDS	≥9	First	6 (moderate quality)
17	Bao,Y.M.	Chinese	2018	220	25–48	28.5 ± 4.67	Hospital	Hunan	EPDS	≥9	Second	6 (moderate quality)
18	Mao,Q.	Chinese	2006–2007	130	24–43	31.92 ± 3.15	Hospital	Fujian	BDI	≥10	First	6 (moderate quality)
19	Yuan,X.H.	Chinese	2018–2019	812	23–51	31.25 ± 7.92	Hospital	Hubei	EPDS	≥9	First	6 (moderate quality)
20	Zhou,Y.	Chinese	2020	189	25–42	32.4	Hospital	Hunan	EPDS	≥9	Second	6 (moderate quality)
21	Jia,L.	English	2017	318	Not Clear	31.78 ± 3.72	Hospital	Shanghai	EPDS	≥10	Not Clear	7 (moderate quality)
22	Duan,Z.Z.	English	2017–2018	950	Not Clear	31.7 ± 3.93	Community	Jiangsu	EPDS	≥10	Not Clear	7 (moderate quality)
23	Li,D.N.	English	2017	189	Not Clear	36.12 ± 2.39	Hospital	Guangdong	EPDS	≥10	First	7 (moderate quality)
24	Li,Z.M.	Chinese	NR	122	Not Clear	30.33 ± 4.59	Hospital	Guangdong	SDS	≥42	First	6 (moderate quality)
25	Nie,M.	Chinese	2017	257	Not Clear	Not Clear	Hospital	Guangdong	EPDS	≥9	First	6 (moderate quality)
26	Cui.Y.	English	2017	212	Not Clear	Not Clear	Hospital	Guangdong	EPDS	≥10	First	7 (moderate quality)
27	Kong,L.P.	English	2011	400	Not Clear	30.76 ± 4.60	Hospital	JiangSu	SDS	≥53	Not Clear	7 (moderate quality)

Notes. EDPS: The Edinburgh Postnatal Depression Scale; BDI: Beck Depression Inventory; SDS: Zung Self-Rating Depression; BDC: Burns Depression Checklist; GHQ: The General Health Questionnaire; SD: Standard Deviation.

910), and Hong Kong [26,30,31] (three studies, n = 938). Detailed data are presented in Supplementary Figs. 1 and 2.

3.2. Methodological quality assessment

The mean AHRQ score was 6.25 and ranged from 5 to 8, indicating medium quality. Specifically, three studies on AD were rated as moderate quality [26,44,49], and one study on AD was rated as high quality [31]. Twenty-five studies on PD [24–28,30–48,50] were rated as moderate quality and two studies on PD were rated as high quality [12,29] (Tables 1 and 2).

3.3. Prevalence of AD among Chinese fathers

The overall prevalence of AD among Chinese fathers was 11 % (95 % CI: 5%–17 %; $I^2 = 91$ %) (Fig. 2). According to the prenatal subgroup analysis and meta-regression analysis results, publication language accounted for 92.13 % of the heterogeneity ($P < 0.01$). Subgroup analysis indicated that the prevalence of perinatal AD in Chinese publications (16 %, 95 % CI: 10%–22 %) was higher than that in English publications (5 %, 95 % CI: 3%–8%) (Supplementary Table 1 and Supplementary Figs. 3–9). Meta-regression analysis results showed that the publication language explained the study heterogeneity more than other variables (study scales, study region, study time before or after the two-child policy in 2016, study design, number of children, and quality assessment) (Supplementary Figs. 10–15).

3.4. Prevalence of PD among Chinese fathers

The overall prevalence of PD among Chinese fathers was 16 % (95 % CI: 13%–18 %, $I^2 = 94$ %) (Fig. 3). According to the results of the subgroup analysis and meta-regression analysis, the scale used to measure PD and the region where the study was conducted accounted for 39.17 % and 33.15 % of the heterogeneity, respectively ($P < 0.01$). The subgroup analysis indicated that the prevalence of PD among Chinese fathers was the highest in Henan Province (46 %, 95 % CI: 37%–55 %) and lowest in Hong Kong (6 %, 95 % CI: 4%–9%). The results of the subgroup analysis of the number of children showed that the PD rate measured by the BDC was the highest (46 %, 95 % CI: 37%–55 %), and the PD rate measured by the GHQ-12 was the lowest (10 %, 95 % CI: 6%–15 %) (Supplementary Table 2 and Supplementary Figs. 16–23). The meta-regression analysis showed that the scale used to measure PD and the region where the study was conducted explained the heterogeneity of the studies (Supplementary Figs. 24–30).

3.5. Publication bias and sensitivity analysis

In this review, only four studies on the prevalence of AD in Chinese fathers were included, and none met the requirements for publication bias. Therefore, we only estimated publication bias for PD among Chinese fathers.

Considering the relatively high heterogeneity ($I^2 = 94$ %), publication bias was visually assessed using funnel plots and Egger's test quantitatively. According to the funnel plot, the literature was extremely scattered, showing apparent asymmetry (Supplementary Figs. 31–32). According to Egger's test results ($t = 4.542$, $P < 0.001$), the included studies were biased by publication (Supplementary Table 3). Likewise, the Duval and Tweedie trim and fill analysis showed a significant publication bias (Supplementary Figs. 33–34). Notably, after correction using the trimming method, the P value of the pooled effect of PD prevalence in Chinese fathers was <0.05, indicating that publication bias did not affect the effect size (Supplementary Table 4). We performed a sensitivity analysis to test the reliability of the meta-analysis, which showed that removing any one study would not lead to a marginally significant difference between the two groups ($P < 0.0001$; Supplementary Figs. 35–36). The overall prevalence of AD and PD among Chinese fathers was 11 % and 16 %, respectively, which was considered relatively reliable.

4. Discussion

Global attention has recently been paid to AD and PD as public health priorities. The present study provides the first comprehensive evidence of the prevalence of AD and PD among Chinese fathers. This meta-analysis found that, among Chinese fathers, the prevalence of AD and PD was 11 % and 16 %, respectively.

According to the relevant literature, the prevalence of AD and PD among fathers varies worldwide. In an Australian study, 12 % of

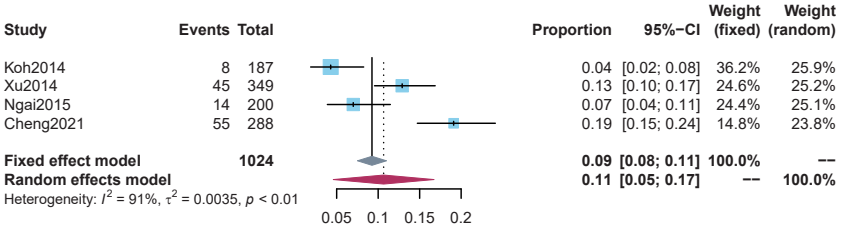

Fig. 2. Forest plot of the studies on the prevalence of antenatal depression among Chinese fathers.

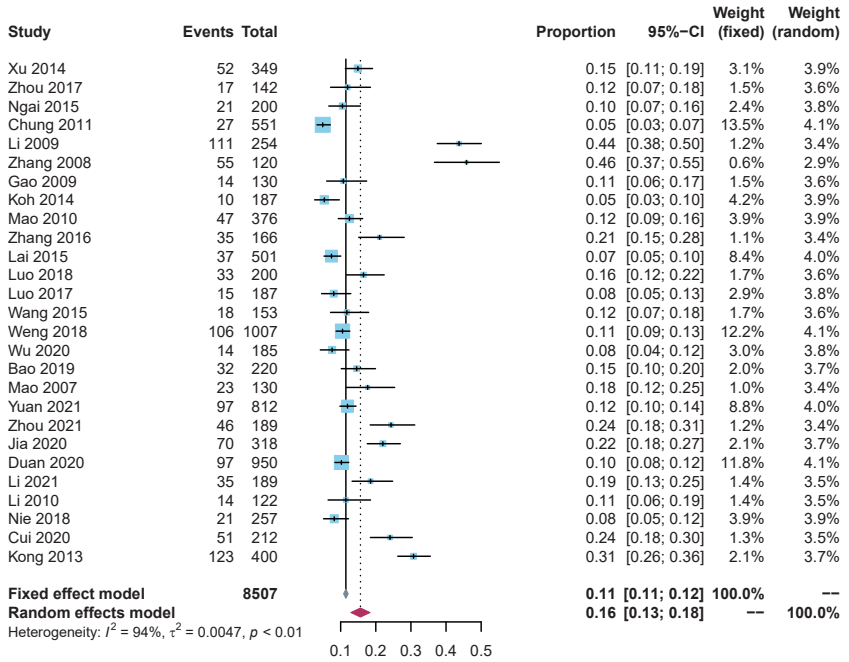

Fig. 3. Forest plot of the studies on the prevalence of postpartum depression among Chinese fathers.

fathers were significantly distressed during mid-pregnancy [51]. The prevalence of paternal PD was 9.7 % among Japanese fathers [52]. A meta-analysis of 43 studies showed that approximately 10 % of men globally had experienced AD [53]. Another meta-analysis that included 74 studies with 41,480 participants found a meta-estimate of paternal depression of 8.4 % [54]. Our meta-analysis revealed that the prevalence of AD among fathers in China was higher than that among fathers in high-income countries. A cohort study of 769 fathers in Spain showed that the prevalence of paternal PD was 3.4%–4.0 % [55]. A Swedish study found a prevalence of paternal PD of 8.7 % [56], and a prevalence of 7.8 % was reported in Germany [57]. Our meta-analysis found that the prevalence of PD among fathers in China was between that of high-income countries (3.4%–15 %) and low-and middle-income countries (19%–25 %) [58]. A meta-analysis reported that the prevalence of PD among fathers in mainland China from 2007 to 2015 was 13.6 % (95 % CI: 8.7%–21.3 %) [14]. The wide range of AD and PD prevalence rates reported in the literature may be attributable to cultural or social differences.

Given the high heterogeneity in this study, a subgroup analysis was performed on the included studies. The results of the subgroup analysis showed that the scales used to measure PD led to heterogeneity. This indicated that the prevalence of PD among Chinese fathers was highest when the BDC scale was used (46 %, 95%CI: 37–55 %) and lowest when the GHQ-12 was used (10 %, 95 % CI: 6%–15 %). Therefore, it is essential to select a broadly applicable and standardized instrument to investigate paternal depression. Except for the EPDS, the number of studies that used other scales and the corresponding sample sizes were small. Therefore, the results should be interpreted with caution, and the advantages and disadvantages of the different scales require further exploration.

The regions in which the studies were conducted were another factor that led to heterogeneity. Our results showed that the prevalence of PD among Chinese fathers was highest in Henan (46 %), followed by Shanghai (22 %), Shanxi (16 %), and Hunan (19 %), and the prevalence of PD among Chinese fathers was lowest in Hong Kong (6 %). In general, there was a higher prevalence of PD among Chinese fathers living in inland regions with large populations and relatively poor economic development. Simultaneously, the prevalence was lower in the coastal areas with economic development. This difference may be related to the different economic regions [59]. Some meta-analyses have revealed that economic factors, such as income or unemployment, affect PD in fathers [60–62]. Limited financial resources in the presence of new family responsibilities may increase distress and anxiety among new fathers, placing them at increased risk of depression [63]. Some studies demonstrated that economic factors contributed to AD or PD in Chinese fathers [34,36,44]. Moreover, the prevalence of PD among fathers varied across regions, which may be related to the level of local medical care. The mother-child healthcare system in economically developed areas is relatively complete, and mothers and their partners in such areas have better access to support, which makes AD and PD less likely to occur [26,64]. Regions with high economic development also have a significant number of healthcare facilities and professionals. Studies have indicated that mental health services need to be improved in less-developed regions of China [65,66]. Therefore, special attention should be paid to paternal mental health in those areas of China with less developed economies and healthcare systems.

Apart from the economic pressures mentioned above, housing satisfaction, family relationships, and social support were found to be essential factors affecting the prevalence of AD and PD among Chinese fathers [60,62,67]. The housing conditions of a Chinese family reflect the economic ability of the father. If the father is unable to provide a comfortable living environment for his family, his self-esteem and emotions may be negatively affected [68]. Additionally, couples in China commonly live with their parents. With the

arrival of children, the space for family activities is reduced, and the crowded living environment will emotionally affect the household [69,70]. Furthermore, a systematic review and meta-analysis showed negative emotions experienced by perinatal women increased the depression rate of their partners to a certain extent [71]. In China, influenced by traditional culture, husbands' parents mainly care for postpartum women and infants. Due to the concept and method of feeding children, conflicts between mothers- and daughters-in-law tend to occur. The infant's father often mediates such disputes [72–74]. However, some fathers are unwilling to take responsibility for caring for their children because they lack parenting knowledge and skills. Owing to the father's absence, the mother has a heavier burden of raising children, which can lead to conflict between couples. This marital disharmony makes fathers prone to depression and other emotional disorders [70,75,76]. Studies have shown that Chinese fathers with less social support are more likely to experience PD, as men are often believed to be the family breadwinners in traditional Chinese culture. Influenced by the independent character of men, fathers are usually not good at expressing their feelings and lack ideas and behaviors to seek and obtain emotional support [60,77]. In most regions of China, a leave of absence from work is only available to women. Studies have shown that more than 70 % of fathers in China do not take a postnatal break [78–80]. Therefore, improving housing satisfaction, the marital relationship, social support, access to healthcare, and social support may reduce the prevalence of paternal AD and PD in China.

Notably, the prevalence rates of PD among Chinese fathers with a second child was 19 % (95 % CI: 10%–29 %), which is higher than the prevalence rates of 14 % (95 % CI: 11%–17 %) for PD among Chinese fathers with a first child. The traditional Chinese concept that fathers have primary responsibility for the family economy may be contributing to these rates. Children increase the families' economic pressure and responsibilities, causing fathers to bear greater physical and psychological burdens [81–83]. The father must not only care about the education of the first child but also be responsible for assisting the mother in caring for the second child, which adds more pressure on him and may lead to the occurrence of PD. Therefore, it is essential to prevent fathers from developing PD. Significantly, China has now fully implemented a two-child policy and encouraged the birth of a third child, which means that there will be more fathers with a second (or even a third) child.

Publication bias is a serious problem in systematic reviews and meta-analyses because it can undermine the integrity of the published research [84,85]. In our study, there was publication bias in the studies on the prevalence of PD among Chinese fathers, but this publication bias did not affect the effect size. To minimize bias as much as possible, measures such as the inclusion of unpublished studies and the utilization of trial registries should be taken.

This systematic review has some limitations. First, convenience sampling was used in most studies included in this review. Specifically, random sampling is recommended over convenience sampling for a more accurate prevalence calculation. Second, the AD and PD assessments were self-administered, rather than structured interviews or clinician diagnoses. In addition to depression, individuals may be diagnosed with other psychiatric disorders such as bipolar disorder. A third limitation is the considerable heterogeneity among the studies. Several factors, including different regions, measurements, and publication languages, may explain this finding. Nevertheless, the quality of the studies was not an essential predictor of heterogeneity in the results. Lastly, few studies were conducted during the prenatal period. Further high-quality studies on the prevalence of AD in Chinese fathers are required.

5. Conclusion

In summary, our systematic review and meta-analysis showed that the prevalence of AD and PD among fathers in China is comparable to that in low- and middle-income countries, yet lower than that in high-income countries. There has been a notable increase in the incidence of AD and PD among Chinese fathers over the years, particularly among those with two or more children. However, interpretation of these results requires consideration of several limitations. The studies in our meta-analysis varied in sample size and design, ranging from small, non-randomized studies to larger cohorts, potentially introducing variability and bias into prevalence estimates. Additionally, cultural differences may influence the reporting of depressive symptoms, possibly leading to underreporting. Despite these challenges, our findings highlight the need for heightened awareness and proactive screening for paternal depression in China. Medical and health departments should integrate mental health screenings into routine prenatal checks for fathers to ensure a focus on paternal mental health.

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Data availability statement

Data will be made available on request. The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation. Please contact Dr Xiao Gui if you want to get the data from this study.

CRediT authorship contribution statement

Gui Xiao: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Hu Wang:** Writing – original draft, Methodology. **Jiaji Hu:** Writing – review & editing. **Ziran Zhao:** Writing – review & editing, Methodology. **Qiyu Li:** Software. **Chunxiang Qin:** Visualization, Validation, Supervision, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e35089.

Abbreviations

PND	Perinatal depression
AD	Antenatal depression
PD	Postpartum depression
EPDS	Edinburgh Postnatal Depression Scale
CI	Confidence interval
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
BDI	Beck Depression Inventory
AHRQ	Healthcare Research and Quality
SDS	Self-Rating Depression Scale
BDC	Burns Depression Checklist
GHQ-12	General Health Questionnaire

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