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ORIGINAL ARTICLE

Postpartum depressive mood (PDM) among Chinese women: a meta-analysis

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Abstract

Postpartum depression is a common complication of childbearing and up to 12 months postpartum. This study aimed to determine the prevalence of postpartum depressive mood (PDM) in China by performing a meta-analysis of published studies. Studies that reported the prevalence of PDM in China were identified by searching the PubMed, Embase, CNKI, and CQVIP databases. Three thousand, one hundred, and two articles were obtained, and after careful evaluation, 26 studies were finally included in the meta-analysis. The combined studies included a total of 7618 cases with 1621 cases of PDM. The studies were assessed on the basis of heterogeneity testing and the potential for publication bias. Stata software 11.0 was used to perform the meta-analysis. The random-effect model showed that the prevalence of PDM was 21% with a 95% confidence interval (CI) of 17–25%. PDM was the highest 0 to 1.5 months after delivery. PDM levels decreased to 10.4% (95% CI 9.7–11.1%, $P < 0.001$) after publication bias were corrected. Sensitivity analyses evaluated the stability of our results and showed no significant change when any single study was excluded. Subgroup analyses showed that region, instruments used, cut-off score, and time points for depression assessment were positively associated with PDM prevalence. The prevalence of PDM differed among regions, with South Central China and East China exhibiting the lowest prevalence. The prevalence was higher in regions with poor economic development, suggesting that more attention should be devoted to Southwest and North China and that the prevalence of PDM should be evaluated 0 to 1.5 months after delivery.

Keywords Postpartum · Depression · Mood · Meta-analysis · EPDS · SDS

Introduction

Postpartum depression (PPD) is a common postpartum complication (Gavin et al. 2005). According to international research data, approximately 13% of mothers experience PPD (O'Hara and Swain 1996). However, the current version of the DSM-5 (American Psychiatric Association 2013) uses the identifier "with peripartum onset," with postpartum depression occurring during pregnancy or in the 4 weeks following delivery. In fact, many studies have previously considered PPD to affect women up to 6–12 months after delivery (Gaynes et al. 2005). Postpartum depressive symptoms include, among others, (a) depressed mood, (b) weakness, (c) disappointment, (d) agitation, (e) psychological distress, and (f) sleep disorders (American Psychiatric Association 2013). In women with mood disorders, a depressive relapse often occurs in the postpartum period (Mandelli et al. 2016). Postpartum depression is a dangerous condition that prevents mothers from fully experiencing the love and happiness they expected to feel toward their newborn babies, leaving some women contemplating self-harm as the only solution (Beck 2002; Beck 1993). A review of 64 studies conducted in 17 Asian countries indicated that the prevalence of postpartum depression in Asian countries ranged from 3.5 to 63.3% (Klainin and Arthur 2009). The prevalence in China has been reported to be between 1.1 and 52.1%, this disorder is potentially quite widespread and the average estimate for the prevalence of postpartum depression is 14.7% (Qian and Yan

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2013) and is increasing yearly (Tian et al. 2014). Many factors may affect the reported data on postpartum depression, such as culture, genetics, socio-economic status, ethnicity, varying times and types of assessment, and the data reporting method (Lee et al. 2006). However, few systematic reviews have analyzed PDM in China. In this study, we conducted a meta-analysis of 26 studies in China to analyze depressive mood after delivery. From the collected published data, we determined the prevalence of PDM in China and examined regional differences in PDM prevalence.

Materials and methods

Search strategy

A pre-specified search strategy was used to identify publications reporting on PDM in the PubMed, Embase, CNKI, and CQVIP databases. To search the PubMed and Embase databases, the following keywords were used: "Pregnancy depression" OR "Postpartum depression" OR "Postnatal depression" OR "Puerperal depression." The applied constraints were "Chinese," "Humans," and "Female." Variants for all keywords were used to increase the number of studies returned by the search. The CNKI and CQVIP databases are Chinese databases, so the words were used in subject terms: ("postpartum" OR "puerpera") AND "depression" AND "prevalence." The reference lists of these identified or related articles were manually scanned to find other relevant articles.

Inclusion criteria and exclusion criteria

The inclusion criteria were as follows: (1) cohort or cross-sectional studies; (2) women diagnosed with PDM using one or more scales in postpartum; (3) the subjects of the studies were from mainland China, Hong Kong, Taiwan, or Macao; and (4) the studies have reported sample size and the prevalence of PDM. We excluded articles which were duplicate publications, review articles, abstracts, or articles that had unclear indicators or unmatched purposes. The steps involved in identifying studies meeting the inclusion criteria are summarized in Fig. 1.

Data extraction

The quality of the studies was assessed and scored by two investigators independently (Ting-Yu Mu and Da-Hui Zhang) using the Newcastle-Ottawa quality assessment scale (NOS) for observational studies (Robert et al. 2005). In the case of disagreement, a third investigator (Cheng-Lu Zhang) was consulted. From each study, we extracted information about the region of study, publication year, sample size, sample socio-demographics, measures used for depression assessment, cut-off scores used for each measure, time points for depression assessment, and the prevalence of PDM. Coded values were then aggregated to ensure accuracy. If original important data were unavailable in the relevant articles, we contacted the corresponding author to obtain the necessary information.

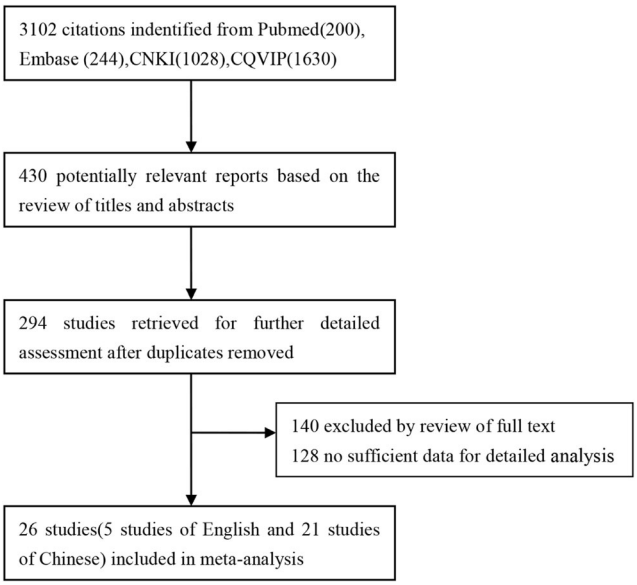

Fig. 1 Flowchart of selected articles

Statistical analysis

The following data were extracted from each study: the first author's name, year of publication, sample size of study, mean and standard deviation of age and depression scores, measurement time, and occurrence rates. The mean PDM (95% CI) was calculated as the effect size (ES), and 95% confidence intervals (95% CI) were described using a forest plot. The data distribution was assumed to be normal, with a z value of + 0.68 corresponding to the reported 25th and 75th percentiles. In this manner, the standard deviation was calculated (Nakken and Szodoray 2010). The statistical heterogeneity within studies was measured by calculating the Q statistic (Higgins and Thompson 2002). Next, we estimated the effect of heterogeneity in each study via the method $I^2 = [(Q - df)/Q] \times 100\%$ (Higgins et al. 2003). The fixed-effect model was used if there was no statistical difference in heterogeneity ($P > 0.05$) or I^2 was > 50%; otherwise, a random-effect model was used for further analyses. Publication bias was visually estimated by generating a funnel plot, and Egger's linear regression test was performed to explore the asymmetry of the funnel plot (Egger et al. 1997). To detect the sources of heterogeneity, further subgroup analyses were performed according to region (Southwest, North China, South Central China, East China), measurement time (0–1.5 months, 1.5–3 months, 3–6 months,

NA), scales (EPDS ≥ 14, EPDS ≥ 13, EPDS ≥ 10, EPDS ≥ 9.5, SDS ≥ 53, SDS ≥ 50, SDS ≥ 42, SDS ≥ 41, HAD ≥ 9, GHQ ≥ 12). To reduce selection bias as much as possible, when comparing regions according to their legislation, we selected a quite homogeneous subgroup of nine studies that use the same instrument, the EPDS, with a cut-off point of 13 (which is highly specific to screening for PDM) and the same screening period (between 0 to 1.5 months). We categorized this subgroup of nine studies according to the location of the studies' Chinese administrative division: municipalities directly under the central government (five studies), provincial capitals and sub-provincial (three studies), or prefecture-level cities (one study). All statistical analyses were conducted using Stata 11.0 software.

Results

Study characteristics

Based on the inclusion and exclusion criteria, 2808 articles were excluded. Of the other 294 potential articles, 26 articles were ultimately included in the meta-analysis after examining the title, study type, abstract, and full text of articles published between January 1, 1996 and February 4, 2016. Together, the 26 studies selected provided information about 7618 women who had just given birth, including 1621 with PDM. A total of 2902 subjects had a high school degree or less, and 4176 had a college degree or additional education. Of these studies, ten studies reported the type of childbirth. According to the reported data, 1719 subjects had cesarean births, and 927 had vaginal delivery. A total of 2857 study subjects had given birth for the first time (unipara) and 244 subjects had given birth at least twice. The region of study included 12 provinces, 1 municipality, and Hong Kong. The studies included 2 from Southwest China, 2 from North China, 10 from South Central China, and 12 from East China. The time points for depression assessment were divided into four parts: 0–1.5 months after delivery, 1.5–3 months after delivery, 3–6 months after delivery, and unknown evaluation time points. The measurement of PDM in these studies included the EPDS, SDS, GHQ-12, and HAD and used different cut-off scores. The major characteristics of the selected studies are summarized in Table 1.

Meta-analysis results

Heterogeneity test results

Heterogeneity was evaluated with the heterogeneity statistic Q and quantified using I^2. The results showed marked heterogeneity among the studies ($I^2 = 95.8\%$, $P < 0.001$) (Fig. 2).

Overall effects and subgroup analysis

The overall random-effect estimate of PDM was 21% (95% CI, 17–25%). The heterogeneity in the published rates of PDM was statistically significant and large in magnitude (Fig. 2). Subgroup analyses showed that region, instruments used, cut-off score, and time points for depression assessment were positively associated with PDM prevalence (Table 2). When we analyzed only studies using SDS screening, we observed that by increasing the cut-off point, we decreased the heterogeneity of the assessment: SDS ≥ 41 ($Q = 17.02$, $I^2 = 88.3\%$, $P < 0.001$) and SDS ≥ 53 ($Q = 2.76$, $I^2 = 63.8\%$, $P = 0.096$). Meanwhile, different regions have a variety of options for PDM assessment tools, but they still mostly use the EPDS for screening.

The studies in North and Southwest China reported relatively higher levels of PDM, and those in South Central and East China exhibited the lowest rates (Southwest 23.9% [95% CI, 10.2–37.6%]; North China 27.2% [95% CI, 3.5–50.9%]; South Central China 18.6% [95% CI, 15.3–22%]; and East China 20.7% [95% CI, 14–27.3%]). Heterogeneity testing showed that South Central China ($Q = 44.00$, $I^2 = 79.5\%$, $P < 0.001$) had a PDM rate lower than the overall average ($Q = 594.81$, $I^2 = 95.8\%$, $P < 0.001$) and lower than the rate in studies in other areas (Southwest [$Q = 27.46$, $I^2 = 96.4\%$, $P < 0.001$]; North China [$Q = 26.31$, $I^2 = 96.2\%$, $P < 0.001$]; and East China [$Q = 385.22$, $I^2 = 97.1\%$, $P < 0.001$]).

Postpartum depressive mood prevalence was the highest (21%, 95% CI, 15.9–26.1%) in studies that measured it 0–1.5 months after delivery. When measured at 1.5–3 months (18.2%, 95% CI, 7.9–28.5%), the prevalence was lower, and when measured at 3–6 months (11.5%, 95% CI, 7.1–15.9%), it was the lowest. The prevalence in subjects measured at an unknown evaluation time point was 24.4% (95% CI, 20.8–28.0%). The heterogeneity measured at 0–1.5 months ($Q = 457.20$, $I^2 = 96.3\%$, $P < 0.001$) and 1.5–3 months ($Q = 57.56$, $I^2 = 94.8\%$, $P < 0.001$) remained high (Table 2).

When we compared the estimated prevalence of PDM in a quite homogeneous group of studies (using the same screening methodology) according to the type of Chinese administrative division of the region, we observed that the prevalence of PDM was highest in the prefecture-level city (25.4%, 95% CI, 20.3–30.4%), lower in the provincial capitals and sub-provincial areas (19.5%, 95% CI, 13.6–25.4%), and lowest in the group of municipalities directly under the central government (12.9%, 95% CI, 5.9–19.9%) (Table 3).

Sensitivity analyses and publication bias

We performed sensitivity analyses to evaluate the stability of our results using random-effect methods. The results showed no significant change when any one study was excluded. Egger's linear regression test was applied to assess the asymmetry of the funnel plot and evaluate the significance of

Table 1 Major characteristics of studies of the prevalence of PDM

Author, year (region)	Time of assessment as reported in article	Time classification for PPD analysis	Measure (cut-off)	Sample size	Identified cases (%)	Nos.
Hong-li Sun et al. 2015 (Southwest)	3 to 42 days postpartum	0–1.5 months	EPDS (≥ 10)	528	96 (17.00)	7
Liu Zhang et al. 2015 (East China)	1-month postpartum	0–1.5 months	EPDS (≥ 10)	162	79 (48.77)	9
Ping He et al. 2014 (East China)	2-week postpartum	0–1.5 months	EPDS (≥ 13)	419	13 (3.10)	9
Hong-Wei Zhang et al. 2014 (South Central China)	6-week postpartum	0–1.5 months	EPDS (≥ 13)	586	87 (14.85)	9
Xian-nv Wang and Wu 2014 (East China)	2-week postpartum	0–1.5 months	EPDS (> 13)	288	73 (25.35)	8
Xiu-jing Guo et al. 2013 (Southwest)	6-week postpartum	0–1.5 months	EPDS (≥ 9.5)	481	149 (30.98)	7
Yan Zhao et al. 2011 (East China)	1-week postpartum	0–1.5 months	EPDS (≥ 13)	201	45 (22.39)	8
	4-week postpartum	0–1.5 months	EPDS (≥ 13)	201	15 (7.46)	
	12-week postpartum	1.5–3 months	EPDS (≥ 13)	201	20 (9.95)	
Jin Yu, 2010 (East China)	14.56-day postpartum	0–1.5 months	EPDS (≥ 13)	673	73 (10.9)	9
Zheng-mei Li et al. 2010 (South Central China)	1-week postpartum	0–1.5 months	SDS (≥ 42)	122	19 (15.57)	6
Xin Wang et al. 2009 (South Central China)	NA	/	SDS (≥ 41)	627z	167 (25.8)	7
Hong-Xia Yang et al. 2009 (North China)	3-day postpartum	0–1.5 months	SDS (≥ 50)	119	18 (15.13)	7
Hua Zhong and Wei 2009 (East China)	1-week postpartum	0–1.5 months	HAD (≥ 9)	100	23 (23.00)	8
Bao-Long Zhao et al. 2008 (East China)	1-week postpartum	0–1.5 months	EPDS (≥ 13)	49	4 (8.16)	9
	4-week postpartum	0–1.5 months	EPDS (≥ 13)	49	2 (4.08)	
	12-week postpartum	1.5–3 months	EPDS (≥ 13)	49	4 (8.16)	
Jin-zhen Jin 2008 (North China)	1-week postpartum	0–1.5 months	EPDS (≥ 14)	209	79 (39.30)	8
Yin He 2008 (South Central China)	42-day postpartum	0–1.5 months	EPDS (≥ 13)	430	101 (23.50)	7
Xin-yong Liang et al. 2007 (East China)	NA	/	SDS (> 53)	505	134 (26.50)	6
Li-juan Nv et al. 2006 (South Central China)	NA	/	SDS (≥ 41)	260	52 (20.00)	7
Lan-fen Liu et al. 2002 (East China)	60-day postpartum	1.5–3 months	EPDS (≥ 13)	200	16 (8.00)	7
Shao-jin Hu et al. 2001 (South Central China)	3- to 5-day postpartum	0–1.5 months	SDS (≥ 53)	76	14 (18.42)	6
Jian-yin Qiu et al. 2001 (East China)	3-day postpartum	0–1.5 months	EPDS (≥ 10)	299	69 (23.08)	9
	42-day postpartum	0–1.5 months	EPDS (≥ 10)	299	4 (1.30)	
Jin He et al. 2000 (East China)	40- to 60-day postpartum	1.5–3 months	SDS (≥ 41)	210	78 (37.14)	9
Ling-ling Gao et al. 2009 (South Central China)	6- to 8-week postpartum	1.5–3 months	EPDS (≥ 13)	130	18 (13.80)	8
Qing Mao et al. 2011 (East China)	6- to 8-week postpartum	1.5–3 months	EPDS (≥ 13)	376	56 (14.90)	9
Yan Qun Liu et al. 2014 (South Central China)	6-week postpartum	0–1.5 months	EPDS (≥ 13)	198	44 (20.70)	8
Fei-Wan Ngai and Chan 2012 (South Central China)	6-week postpartum	0–1.5 months	EPDS (≥ 13)	170	36 (21.20)	9
	6-month postpartum	3–6 months	EPDS (≥ 13)	170	20 (11.80)	
Fei-Wan Ngai and Ngu 2015 (South Central China)	6-month postpartum	3–6 months	GHQ (≥ 5)	200	23 (11.50)	9

publication bias (Palma and Delgado-Rodriguez 2005), along with the results of the funnel plot suggesting the existence of publication bias. The detection results indicated the existence of publication bias based on Egger's test ($P = 0.002$) (Fig. 3). We next applied Duval's trim and fill method to re-evaluate the asymmetry of the funnel plot and publication bias after 12 imputed filled values were filled (Fig. 4). PDM prevalence decreased to 10.4% (95% CI, 9.7–11.1%, $P < 0.001$) after the correction for publication bias.

Discussion

We considered regional effects and evaluated studies from Southwest China, North China, South Central China, and East China. The prevalence of PDM is similar to economic development trends. Economic development in South Central and East China has been better than that in Southwest and North China, and the prevalence of PDM was also higher in Southwest and North China. However, another study on postpartum depression in China indicated that the prevalence of PPD in the south (including Southwest China, South Central China, East China) is higher than that in the north (including North China, Northeast China, Northwest China) (Luo and He 2007), in contrast to our study results. Meanwhile, economic development in the south is faster than north, Luo and He indicated that economic development has effects on prevalence of PPD. Therefore, further research is needed to understand the diversity in the prevalence of PDM among geographic regions in China.

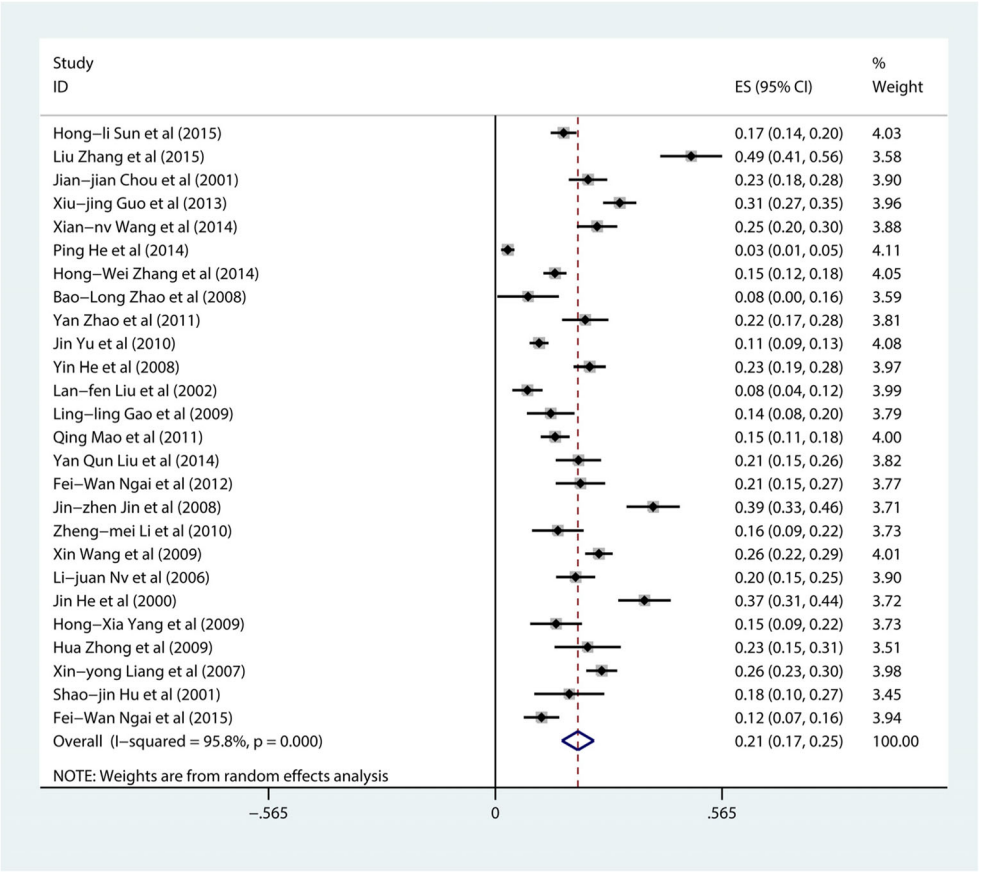

Fig. 2 Meta-analysis of 26 studies reporting on PDM in China

Meanwhile, the EPDS is an important tool for screening postpartum depression. Some studies have shown that both the GHQ-12 and EPDS are valid instruments to detect postnatal depression, but analysis by ROC curves showed that the EPDS performs slightly better than the GHQ-12 (Navarro et al. 2007). This result may indicate that the EPDS is more suitable as a self-rating tool identifying perinatal depression. However, Zhong et al. (2014) suggested that the PHQ-9 and EPDS are reliable and valid scales for antepartum depression assessment and that simultaneous administration of both scales may improve screening for antenatal depression.

In the 26 studies analyzed, diverse methods and tools were used for screening postpartum depression. In particular, the cut-off scores for the EPDS were different (Table 1). With the use of the EPDS, Cox and Sagovsky (1987) suggested that women who scored above a threshold of 12/13 were most likely to be suffering from a depressive illness of varying severity, and a threshold of 9/10 might be appropriate if the EPDS was considered for clinical use; such screening (or detection or identification) by self-questionnaire, even with the EPDS, should be followed by a psychiatric diagnosis to ensure diagnostic accuracy before treatment. Zhong et al. (2014) found that for screening postnatal psychiatric morbidity, the optimal EPDS cut-off score was 9/10, which is higher than the 7/8 optimal score reported by Matthey et al. (2001). Tao et al. (1994) suggested that the EPDS is more suitable for screening PPD than the SDS. When we consider the subgroup in our analysis that used SDS screening, we observed that increasing the cut-off point from 41 to 53 resulted in decreased heterogeneity of the results. Moreover, the Chinese EPDS had satisfactory psychometric properties, and a cut-off score of 9/10 is recommended for screening PPD (Lee et al. 1998; Ma et al. 2017). Therefore, the EPDS is recommended to assess PPD. However, the appropriate cut-off should be selected according to the research or clinical purpose, and the different cut-off scores for the EPDS have different clinical significance. We also need to consider that the EPDS assesses not only depression symptoms (items 1, 2, 7, 8, 9, and 10) but also anxiety symptoms (items 3, 4, and 5) (Adouard et al. 2005). More recently, Bina and Harrington (2017) suggested scores of 0–18 on the depression subscale and 0–9 on the anxiety subscale, with higher scores reflecting greater symptom severity, and recommended that the EPDS depression and anxiety subscales be considered separately. Further research must examine how to reasonably use the EPDS depression and anxiety sub-scales in China.

We considered that different cut-off scores could affect the heterogeneity, so we used subgroup analysis to evaluate the effects of these factors. We noticed that the studies using the two cut-off scores (SDS ≥ 41 and SDS ≥ 53) focused on

Table 2 Subgroup analysis of PDM according to region, instrument and cut-off point and time of measurement

Stratification group	*N*	Sample size	ES[1] (95% CI)	Heterogeneity test		
				Q	*p*	I^2 (%)
Total	26	7618	0.19 (0.16–0.23)	587.25	< 0.001	95.7
Regions						
Southwest	2	1009	0.239 (0.102–0.376)	27.46	< 0.001	96.4
North China	2	328	0.272 (0.035–0.509)	26.31	< 0.001	96.2
South Central China	10	2799	0.186 (0.153–0.220)	44.00	< 0.001	79.5
East China	12	3482	0.207 (0.140–0.273)	385.22	< 0.001	97.1
Measure (cut-off)						
EPDS[2] ≥ 10	3	989	0.292 (0.142–0.442)	56.01	< 0.001	96.4
EPDS ≥ 13	12	3720	0.155 (0.109–0.200)	207.92	< 0.001	94.7
SDS[3] ≥ 41	3	1097	0.273 (0.192–0.354)	17.02	< 0.001	88.3
SDS ≥ 53	2	581	0.234 (0.158–0.311)	2.76	0.096	63.8
EPDS ≥ 9.5	1	481	0.31 (0.268–0.351)	/	/	/
EPDS ≥ 14	1	209	0.393 (0.327–0.451)	/	/	/
SDS ≥ 42	1	122	0.156 (0.091–0.220)	/	/	/
SDS ≥ 50	1	119	0.151 (0.087–0.216)	/	/	/
HAD[4] ≥ 9	1	100	0.230 (0.148–0.312)	/	/	/
GHQ-12[5] ≥ 5	1	200	0.115 (0.071–0.159)	/	/	/
Measurement time						
0–1.5 months	18	5110	0.210 (0.159–0.261)	457.20	< 0.001	96.3
1.5–3 months	4	916	0.182 (0.079–0.285)	57.56	< 0.001	94.8
3–6 months	1	200	0.115 (0.071–0.159)	/	/	/
NA	3	1392	0.244 (0.208–0.280)	4.82	0.090	58.5

ES effect size; represents the prevalence of postpartum depressive mood

EPDS Edinburgh Postnatal Depression Scale

SDS Self-Rating Depression Scale

HAD Hospital Anxiety and Depression Scale

GHQ-12 General Health Questionnaire-12 items

Inclusion criteria of studies: Using the same measurement time (0 to 1.5 months), instrument and cut-off (EPDS ≥ 13)

subjects in South Central China and East China. From the regional analysis, we can see that the prevalence of PDM in South Central China is close to that in East China. This finding may explain the apparent decline in heterogeneity but may also result from the differences in the measurement tools and the cut-off scores used in the different studies. We wish to remind the reader that those scales do not all yield diagnosis and may lead to false positive or false negative results according to the cut-off point used. Therefore, a psychiatric diagnosis is needed for confirmation.

Table 3 Prevalence of postpartum depressive mood according to type of region in a selected sample

Stratification group	*N*	Sample size	ES (95% CI)	Heterogeneity test		
				Q	*p*	I^2 (%)
Regions						
Municipalities directly under the central government	5	1512	0.129 (0.059–0.199)	79.63	< 0.001	95.0
Provincial capitals and sub-provincial	3	1214	0.195 (0.136–0.254)	12.67	0.002	84.2
Prefecture-level cities	1	288	0.254 (0.203–0.304)	/	/	/

Inclusion criteria of studies: Using the same measurement time (0 to 1.5 months), instrument and cut-off (EPDS ≥ 13)

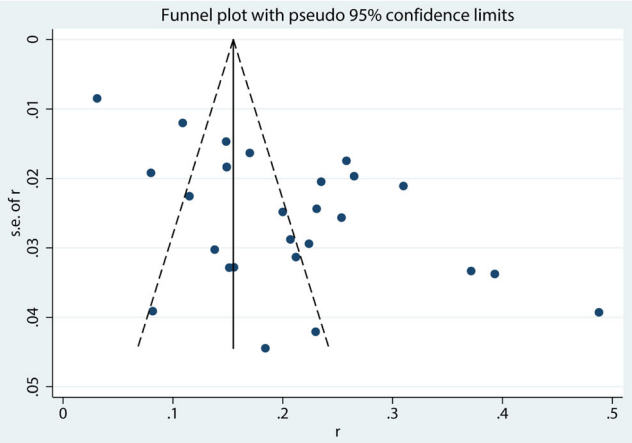

Fig. 3 Funnel plot (with pseudo 95% confidence intervals) with the standard error of the PDM difference plotted against the mean difference of PDM of each study

Next, we analyzed the data to investigate whether the different measurement times had an effect. The prevalence of PDM was higher in 0–1.5 months after delivery, consistent with previous studies and indicated that postpartum depression symptoms were usually appearing during 4–6 weeks after delivery (Alligood 2013). Although the heterogeneity of each individual time period was lower than the overall level, the heterogeneity results for the measurements at 0–1.5 months and 1.5–3 months are still higher. The regional differences in PDM levels may cause this heterogeneity.

Villegas et al. (2011) showed that the prevalence of PPD was somewhat higher among women in developing countries than among women in developed countries, and the prevalence may be higher among rural women than among either urban women or postpartum women in the general population. Studies in North China and Southwest China reported relatively higher levels of PDM, and those in South Central China and East China exhibited the lowest rates. Moreover, economic development in South Central and East China has been better than that in Southwest and North China. To further understand the prevalence of PDM in different regions, we performed further analysis. Specifically, PDM prevalence may be related to the level of regional economic development. We thus compared the prevalence of PDM in different cities in our study; the higher the economic level, the lower the prevalence of PDM was. In China, the more economically developed areas have higher living standards and better mental health care (Wang et al. 2016), which may partially explain the differing prevalence of PDM. Further study is warranted to analyze the relationship between economic level and PDM prevalence and to study the difference between this prevalence in rural and urban areas in China.

Moreover, not only mothers but also fathers may be at risk of postnatal depression and mental health difficulties. Postnatal depression affects a significant proportion of new fathers, the overall random-effect estimate of paternal postpartum depression was 8.4%, and the higher rates of depression were observed during the 3- to 6-month postpartum period (13.0%). (Cameron et al. 2016). In a group of Chinese fathers from East China (Anhui Province), this prevalence of PDM was reported to be 43.7% (Li et al. 2009). In agreement with Matthey et al. (2001) on the English version of the EPDS, Lai et al. (2010) confirmed that the Chinese EPDS is a valid instrument for detecting postnatal depression in men. However, because children's cognitive development may be more susceptible to prenatal exposure to maternal emotional stress (Lin et al. 2017), we should pay more attention to how perinatal depression in both parents influences infant development.

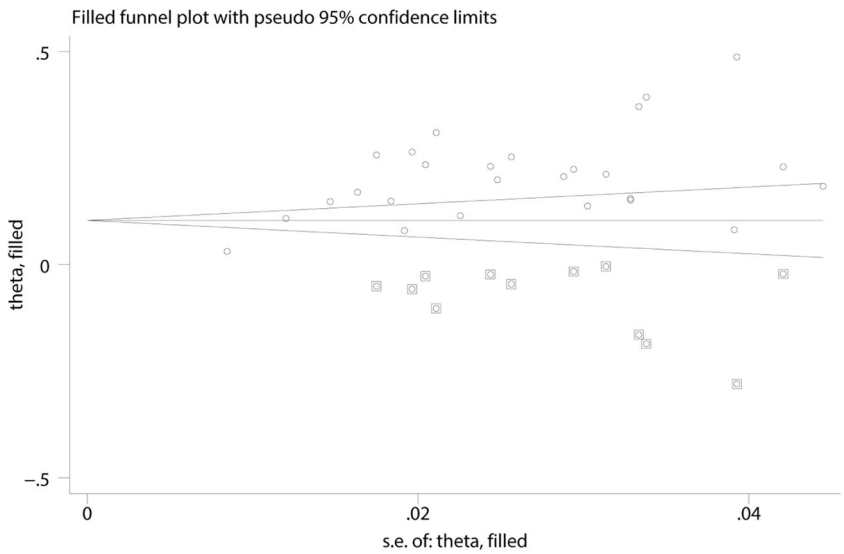

Fig. 4 Funnel plot (with pseudo 95% confidence intervals) with the standard error of the PDM difference plotted against the mean difference of PDM of each study by the trim and fill method

Limitations and Strengths

Several limitations of the current study have been described in this paper. First, the funnel plot showed some asymmetry, suggesting the possibility of publication bias. Although we conducted an adequate search of all possible search terms, it is possible that some eligible articles may have been missed, as indicated by the existence of publication bias among eligible articles. Second, this study analyzed only the depressed mood of postpartum women and not maternal PPD as defined by the DSM classification; the results cannot be extrapolated to non-postpartum women. Third, this meta-analysis is a retrospective type of research and does not prove causation, making this approach limited by any methodological deficiencies of the pooled studies.

Despite these limitations, this study also has some advantages. First, we used subgroup analysis to control for heterogeneity in our study. Second, we applied the trim and fill method to adjust for publication bias when it was identified, although trimming some studies introduces a great deal of uncertainty to the study findings. Third, this meta-analysis gathered a sample large enough to allow interesting comparisons between regions and screening methods that reveal opportunities for new hypotheses, especially on the impact of regional characteristics on screening results in China. This is the first meta-analysis in China investigating depressed mood after childbirth, and the results suggest new targets for future research in this field and provide guidelines for PPD screening.

Conclusion

In summary, the prevalence of PDM may be influenced by region, measurement time, self-rating scale, and boundary value. Between the studies analyzed in this research, there was a great difference in the prevalence of PDM depending on the self-rating scale used and the boundary value. Perinatal mental health professionals should be concerned about both parents because perinatal depression is a common problem that should be addressed as early as possible. Assessments of depression using self-questionnaires may help perinatal professionals but should be used with knowledge of their limits and the need for optional mental health referrals available. Therefore, for clinical use, such screening (or detection or identification) by self-questionnaire, even with the EPDS, should be followed by a psychiatric diagnosis to ensure diagnostic accuracy before treatment. The prevalence of PDM was the highest 0 to 1.5 months after delivery, and it was higher in regions with poor economic development. More attention should be devoted to women giving birth in towns, rural areas, and other underdeveloped areas in Southwest and North China.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

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