Association between depressive symptoms in the postpartum period and COVID-19: A meta-analysis

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ABSTRACT

Background: With the pandemic of COVID, the public are faced with tremendous threatens both physically and mentally. Postpartum depression (PPD) is one of the most serious complications of childbearing, bringing severe impact on a woman's mental state and mood after birth. Research has shown that maternal mental state is closely correlated with PPD, those undergo the emergency or significant life changes during the postpartum period are more likely to suffer from PPD. In this study, we conducted the meta-analysis to estimate the association between PPD and COVID-19 pandemic.
Methods: PubMed, Web of Science, PsycINFO, ScienceDirect, CNKI, China Science and Technology Journal Database, and WANFANG Database were searched for potentially relevant articles published before April 2022. Review Manager 5.2 was used to perform a meta-analysis and subgroup analysis to compute the pooled odds ratio.
Results: A total of 26 studies were included in this review. The overall pooled prevalence of PPD in the review was 24 % (95 % CI: 0.19–0.29), with China's at 22 % (95 % CI 0.16–0.28) and other countries at 25 % (95 % CI 0.18–0.32) during the COVID-19 pandemic. Moreover, compared to those who did not experience COVID-19, those who experienced it had an increased risk of PPD[OR:1.83(95 % CI 1.70–1.97)].
Conclusions: According to this analysis, there was a significantly higher prevalence and odds of PPD in those who suffered from the COVID-19 pandemic. Additionally, we also found that China had a lower prevalence of postpartum depression than other countries during the COVID-19 pandemic. Our study may provide the instruction for the care of new mother under the situation of COVID-19 prevalence.

1. Introduction

Postpartum depression (PPD), defined as an episode of major depressive disorder during postpartum period is one of the most common mental illnesses among women of reproductive age, with the high prevalence in different countries (O'Hara and McCabe, 2013). It was reported that family or personal history of depression, low income, poor social support, cultural beliefs, poor marital relationships, low self-esteem, unwanted pregnancy and recent stressful life events in a woman's life are the most common factors for PPD (Chen et al., 2022; Evagorou et al., 2016; Fallon et al., 2021; Myo et al., 2021). And history of

mood and anxiety problems, in particular, untreated depression and anxiety during pregnancy has been reported to be the strongest risk factor for PPD (Wisner et al., 2013). Oppositely, more social support, high-income, frequency of maternal care received from health professionals, emotional support from family members were identified to protectively improve PPD (Chen et al., 2022; Dadi et al., 2020; Myo et al., 2021). There are a number of negative consequences associated with PPD, such as poor sleep quality(beyond that connected with newborn care), alternation in dietary habits and mental vulnerabilities. Suicidal thoughts, as well as concerns about harming the baby, have also been reported (Norhayati et al., 2015; Wan Mohamed Radzi et al.,

2021). Without any intervention, PPD has the potential to make a profound detrimental impact on mothers, children, and families. Although the particular pathophysiology of PPD is still unclear, women who are facing emergency and life changes are much more sensitive to depression during pregnant and postpartum (Pierce et al., 2020; Thapa et al., 2020).

Coronavirus disease(COVID-19) was caused by severe acute respiratory syndrome coronavirus 2 and was declared as a pandemic by the World Health Organization (WHO) on March 11, 2020. The COVID-19 pandemic has resulted in a colossal negative impact on the public due to its profound disruption. Indeed, the COVID-19 has already been proven to cause negative mental disorders such as depression, anxiety, and traumatic stress (Esterwood and Saeed, 2020; Liu et al., 2021; Zanardo et al., 2020). Therefore, we put forward the conjecture that the prevalence of PPD may increase during the COVID-19 pandemic. However, existing studies have completely contradictory points on it. Pariente (Pariente et al., 2020) believes that postpartum depression significantly decreased after the COVID-19 outbreak [OR:0.44(95 % CI 0.26–0.75)]. Nevertheless, some studies side with our hypothesis, including Sudhinaraset (Sudhinaraset et al., 2022) [OR:3.11(95 % CI 2.53–3.82)] and Eberhard-Gran (Eberhard-Gran et al., 2022) [OR:4.16 (95 % CI 3.56–4.85)]. Furthermore, both An (An et al., 2021) and Wan (Xing et al., 2021) reported that during the first wave of COVID-19 in Wuhan, China, the prevalence of postpartum depression was higher. Outside of these two opposing conclusions, Yakupova (Yakupova et al., 2021)[OR:0.93(95 % CI 0.77–1.12)] believes that there is no connection between the increasing prevalence of PPD and COVID-19.

Research targeted at the prevalence of PPD during the COVID-19 pandemic is unceasingly going on, although they may not hesitate to come to different conclusions. Therefore, a comprehensive understanding of the current risk factors of individuals with PPD during the COVID-19 pandemic and how this vulnerable population responds to disaster are essential for devising immediate intervention strategies to better alleviate patients' distress and better prepare for similar situations circumstances in the future. Indeed, no published meta-analyses integrate and evaluate the relationship between PPD and COVID-19 pandemic. The study aimed to investigate the published literature to estimate the influence of the COVID-19 pandemic on the prevalence of PPD and explore the risk factors of PPD. To a certain degree, this study presents an interim analysis that is currently of significance.

2. Methods

2.1. Search strategy and selection criteria

We conducted the meta-analysis following Preferred Reporting Items for Systematic Review and Meta-Analysis(PRISMA) guidelines. A systematic search was done in the following electronic bibliographic databases from the inception of the databases to April 2022: PubMed, Web of Science, PsycINFO, ScienceDirect, CNKI, China Science and Technology Journal Database, and WANFANG Database with the predefined key MeSH search terms: ("postpartum" OR "perinatal" OR "postnatal" OR "puerperium"), and ("depressive disorders" OR "depression" OR "PPD" OR "puerperal disorders"), and ("pandemic" OR "crisis" OR "epidemic" OR "COVID-19" OR "lockdown"). The review was registered in PROSPERO (CRD42022312683). There was no restriction on study types during the preliminary search.

Studies were included if they met the following selection criteria: (1) the studies reported the depressive disorder or depressive episode among women in their childbearing years; (2) the studies used validated diagnostic, self-reported questionnaires, or clinically structured interviews to assess the PPD; (3) the details and sufficient information of the samples could be extracted by authors; (4) the studies are published in authoritative organizations or magazines. Studies were excluded for the following reasons: (1) the studies are about PPD treatment efficacy and clinical trials involving PPD interventions; (2) data were not

available or adequate; (3) subjects in studies were ineligible.

The Edinburgh postnatal depression scale(EPDS)is an effective tools used to evaluate PPD and quantify depressive symptoms due to its good reliability and validity. Comprising just ten items, the EPDS is relatively quick to complete and can effectively screen the depression status of postnatal depression(Ali et al., 2016).

EndNote X9 program was used to import articles and remove duplicates. Two reviewers (Chenxinzi Lin and Qiuguo Wang) independently screened the titles and abstracts of these studies for relevance. Shortlisted full texts were screened against the eligibility criteria and appraised for quality before they were included in the review. A flowchart of the literature search was presented in Fig. 1.

2.2. Data extraction and quality assessment

Reviewers independently extracted the following data from the eligible studies: author, year of publication, country of study, participant characteristics, sample size, the postpartum depression assessment
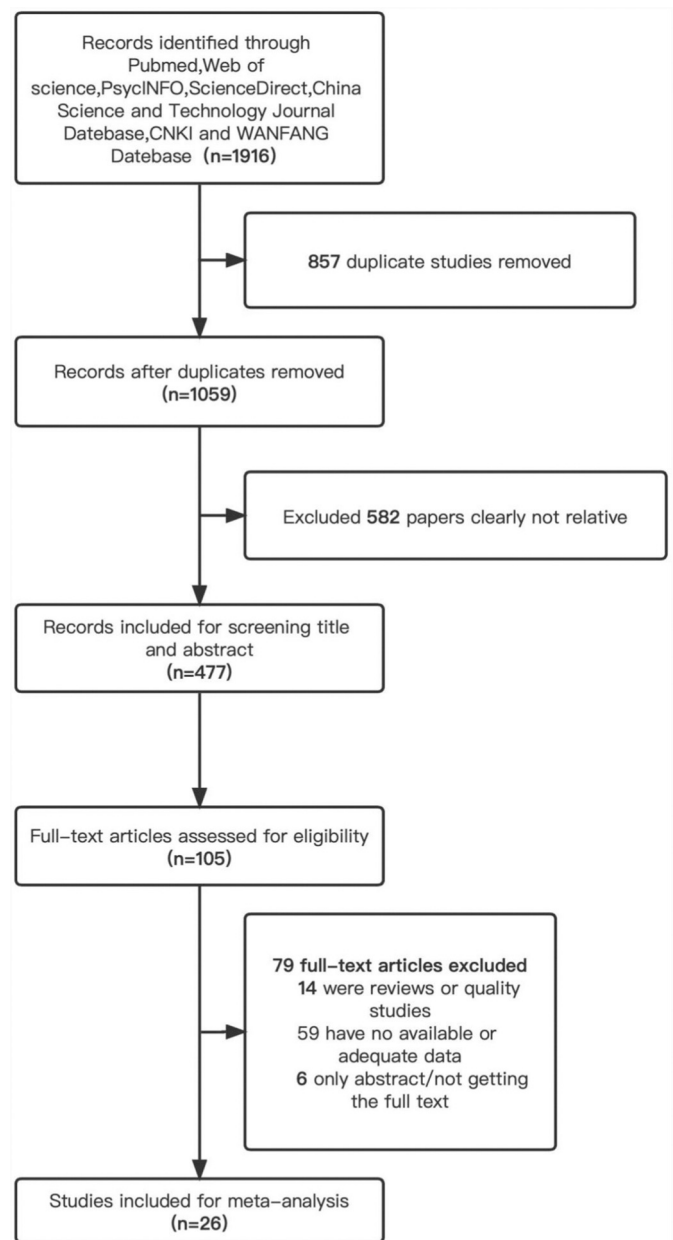

Fig. 1. Flowchart of the literature search.

criteria, cut-off points. The included studies were evaluated for the risk of bias in cross-sectional studies according to the 11 evaluation criteria recommended by **Agency for Healthcare Research and Quality** (AHRQ), with "Yes (1 point)", "No (0 point)", and "unclear (0 point)" as the answers, and the Quality score was 0. On a scale of 11 points, 0 to 3 is of low quality, 4 to 7 is of medium quality, and 8 to 11 is of high quality. The scores are listed in Table 1.

2.3. Data analysis

Depression was reported as a dichotomous variable (presence versus absence) in all studies. All analyses were performed using Review Manager 5.2. to generate a combined odds ratio (OR) and confidence interval (CI) for the risk factor. The I^2 test was used to assess the heterogeneity of the studies. High heterogeneity ($I^2 \geq 50$ %) random-effects model was used. Subgroup analysis was used to explore differences between pooled estimates and variables in different factors. We divided the data into smaller groups based on epidemic prevention policies (China and other countries) and COVID-19 impact (pre and post-covid-19) and then compared the data between the subgroups. The Cochran's Q-test and I^2 statistics were used to assess the heterogeneity across studies. Sensitivity analysis was conducted to evaluate the effect of the included study on the prevalence rate of PPD and the robustness of the results from the meta-analysis.

3. Results

3.1. Description of studies

In the retrieval strategy, 1916 related studies were obtained (535 records in PubMed, 223 records in Web of Science, 41 records in PsycINFO, 986 records in ScienceDirect, 97 records in CNKI, 18 records in China Science and Technology Journal Database, and 16 records in WANFANG Database). After removal of duplicates, titles and abstracts of remaining 477 articles were screened. A total of 26 articles were included in this meta-analysis, with a cumulative cohort of 26,689 samples, including 12,026 samples before COVID-19(all data were from COVID-19 comparative studies) and 14,663 samples after COVID-19. The included researches came from China, the United States, Russia, Japan, Norway, Brazil, India, Spain, Turkey, Kenya, and other countries around the world. The features of the 26 included studies are shown in Table 1.

3.2. Estimated pooled prevalence of PPD during the COVID-19 pandemic

The pooled prevalence of PPD was 24 % (95 % CI: 0.19–0.29), slightly higher than the prevalence of 17.22 % during the non-pandemic period, and high heterogeneity was detected across studies ($I^2 = 98$ %, p < 0.00001). Fig. 2 presents the individual effective size of the studies that reported the prevalence of PPD among postpartum women during the COVID-19 period.

3.3. Estimated pooled prevalence of PPD in China and other countries during the COVID-19 pandemic

Studies included were divided into China and other countries, given their different policies in responding to the COVID-19 pandemic. Specifically, China has resorted to strictly implementing dynamic zero-COVID policies and lockdown policies, while other countries do not. The pooled prevalence of PPD was statistically significant (p < 0.00001) when stratified by geographical regions, with China having a lower prevalence of 22 % (95 % CI 0.16–0.28) than other countries having a

Table 1
Characteristics of included studies on postpartum depression during the COVID-19 pandemic[a].

Author	Year	Country	n	N[b]	Source	Diagnostic Tool (cutoff)	Postpartum Time	AHRQ score
Abulaiti (Abulaiti et al., 2022)	2022	China	288	2218	Hospital	PHQ-9($\geq$10)	6–8 weeks	6
An (An et al., 2021)	2020	China	70	209	Society	EPDS($\geq$10)	NR	7
Boekhorst (Boekhorst et al., 2021)	2021	Netherlands	5	59	Society	EPDS($\geq$12)	8–10 weeks	6
Eberhard-Gran (Eberhard-Gran et al., 2022)	2022	Norway	1164	3642	Society	EPDS-4($\geq$6)	2 weeks-13 months	7
Galletta (Galletta et al., 2022)	2021	Brazil	69	178	Hospital	EPDS($\geq$12)	56.85 $\pm$ 34.03 days	7
Gildner (Gildner et al., 2021)	2021	America	103	971	Society	EPDS($\geq$13)	2–89 days	6
Gluska (Gluska et al., 2022)	2022	Israel	53	421	Hospital	EPDS($\geq$13)	About 10 weeks	7
Hu (Hu et al., 2022)	2022	China	6	82	Society	PHQ-9($\geq$10)	Within 6 weeks	8
Hui (Hui et al., 2021)	2020	China	133	954	Hospital	EPDS($\geq$10)	1 day	7
Layton (Layton et al., 2021)	2021	Canada	240	298	Society	EPDS($\geq$13)	Within 12 months	7
Mariño-Narvaez (Mariño-Narvaez et al., 2021)	2021	Spain	28	75	Hospital	EPDS($\geq$10)	Within 1 month	9
Matsushima (Matsushima et al., 2021)	2021	Japan	160	558	Society	EPDS($\geq$9)	5 months	6
Oskovi-Kaplan (Oskovi-Kaplan et al., 2021)	2020	Turkey	33	223	Hospital	EPDS($\geq$13)	Within 48 h	9
Ostacoli (Ostacoli et al., 2020)	2020	Italy	72	163	Hospital	EPDS($\geq$13)	Within 3 months	8
Pariente (Pariente et al., 2020)	2020	Israel	37	223	Hospital	EPDS($\geq$10)	1 day	7
Peng (Peng et al., 2021)	2021	China	24	71	Society	SDS($\geq$50)	Within 3 months	6
Sudhinaraset (Sudhinaraset et al., 2022)	2022	Kenya	411	1072	Society	EPDS($\geq$10)	2–4 weeks and 10 weeks	8
Terada (Terada et al., 2021)	2020	Japan	35	461	Hospital	EPDS($\geq$9)	1 month	8
Vatcheva (Vatcheva et al., 2021)	2021	Belgium	15	34	Hospital	EPDS($\geq$10)	3–6 months	7
VidhiChaudhary (VidhiChaudhary et al., 2021)	2021	India	48	408	Hospital	EPDS($\geq$9)	Over 48 h for vaginal and 4–7 days for cesarean delivery	7
Wan (Xing et al., 2021)	2020	China	79	176	Hospital	EPDS($\geq$13)	10–14 days	8
Wei (Ying et al., 2021)	2021	China	14	45	Hospital	PHQ-9($\geq$5)	30 days	6
Wu (Wu et al., 2022)	2022	China	22	301	Society	EPDS($\geq$10)	Within 6 months	7
Yakupova (Yakupova et al., 2021)	2021	Russia	722	1645	Society	EPDS($\geq$10)	Within 14 months	9
Zanardo (Zanardo et al., 2020)	2020	Italy	26	91	Hospital	EPDS($\geq$12)	1 day	7
Zhang (Zhang et al., 2022)	2022	Canada	12	85	Hospital	EPDS($\geq$13)	6–10 weeks	9

[a] AHRQ = Agency for Healthcare Research and Quality. PHQ = The Patient Health Questionnaire. EPDS = Edinburgh Postnatal Depression Scale. SDS = Self-rating Depression Scale.

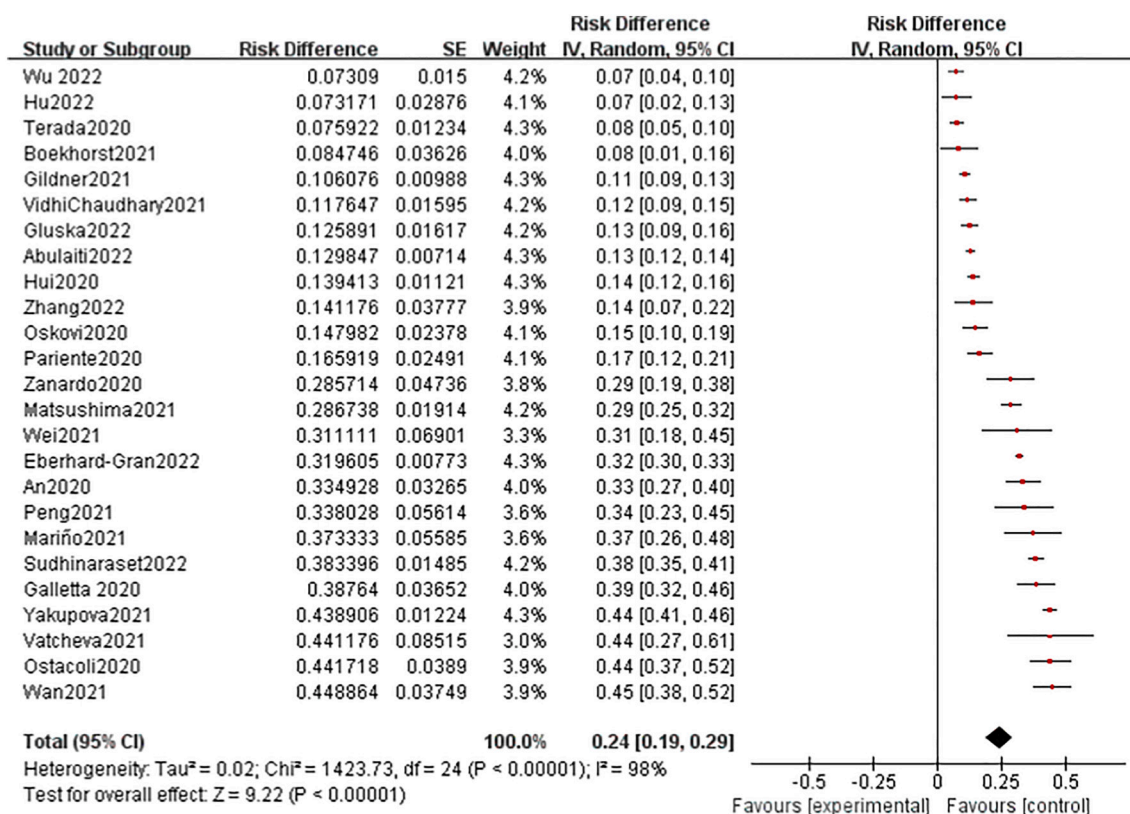[b] N stands for participants.

Fig. 2. Forest plot assessing the prevalence of postpartum depression during the COVID-19 pandemic.

higher prevalence of 25 % (95 % CI 0.18–0.32). The results can be seen below(Fig. 3).

3.4. Estimated pooled OR for PPD at different periods (during vs. before COVID-19)

Thirteen studies from the 26 studies, covering both pre-COVID-19 and post-COVID-19, provided data for a subgroup meta-analysis. Analyses conducted by different periods indicated significantly higher odds of PPD in the group who suffered from COVID-19 than those who did not [OR:1.83(95 % CI 1.70–1.97)]. In the subgroup of different periods, two studies showed a negative correlation between the pandemic and postpartum depression, ten studies showed a positive correlation, and one study showed no significant impact on postpartum depression. The results are presented in a forest plot below (Fig. 4).

4. Discussion

The mental health has always been a considerable issue especially in the vulnerable group. Recently, a paper published in The Lancet called for the provision of high-quality data on the mental health of the population and vulnerable groups across the world, to assess the impact of the COVID-19 pandemic (Pierce et al., 2020). Indeed, our analysis firstly revealed the prevalence of PPD during the COVID-19 pandemic.

This timely rapid meta-analysis indicated a significant increase in postpartum depression prevalence during the COVID-19 pandemic compared to previous years, 17.22 % during the non-pandemic period. In the early stage of the COVID-19, this may be primarily due to the fear of the Covid-19 virus, hospital restrictions, and lack of effective prevention and control measures. With the development of the pandemic, the impact of the pandemic on the global economy gradually emerged, many families have lost their means of support, high domestic unemployment rate and low personal income which would increase depression rate to families, indirectly contributing to postpartum depression.

As part of a relatively rapid response to the outbreak of COVID-19 in China, strict quarantine measures and lockdown policy were put in place by the government in an effort to slow down the transmission of COVID-19 (Jinru et al., 2020). These policies lead to separation from family and friends, reduce access to face-to-face physical and mental health care, and limit the ability to participate in meaningful activities. Therefore, symptoms associated with postpartum anxiety and depression may be exacerbated due to the pandemic. However, studies indicated that policy of blocking and quarantining is not a necessary factor for the increased probability of postpartum depression. Yuju Wu's survey under the quarantine and lockdown policy in rural areas of western China found that home quarantine of puerperal, playing a positive role in maternal mental health (15.83 % pre-COVID-19 versus 7.30 % post-COVID-19) (Wu et al., 2022). This result is completely opposite to the risk factors of postpartum depression reported in other studies (Doyle and Klein, 2020; Lebel et al., 2020). Similarly, it is consistent with our analysis that we found the prevalence of postpartum depression in China is lower than in other countries. This may contribute to the positive attitude of the state to deal with the epidemic. China's dynamic zero-COVID policies and high vaccination rates have ensured extremely low morbidity, mortality, and hospitalization rates and smoothed social and economic operation (Wang et al., 2020), the spread of the COVID-19 pandemic has been well controlled, people's fear of the epidemic has been slowly calmed, and the risk factor of postpartum depression during the COVID-19 pandemic has also been weakened. On the other hand, China has always tried its best to ensure the health of its people, medical institutions remained open to women with high-risk pregnancies, maintained normal obstetric examinations, and even received more medical support during the COVID-19 pandemic. Reliable medical support also gave all pregnant women strong mental support to some extent.

Besides, in contrast to the "self-reliant families" and small family structure in European countries (Qinghong, 2001), traditional Chinese families emphasize the importance of companionship. Home quarantine enabled family members to accompany with the mother, which may
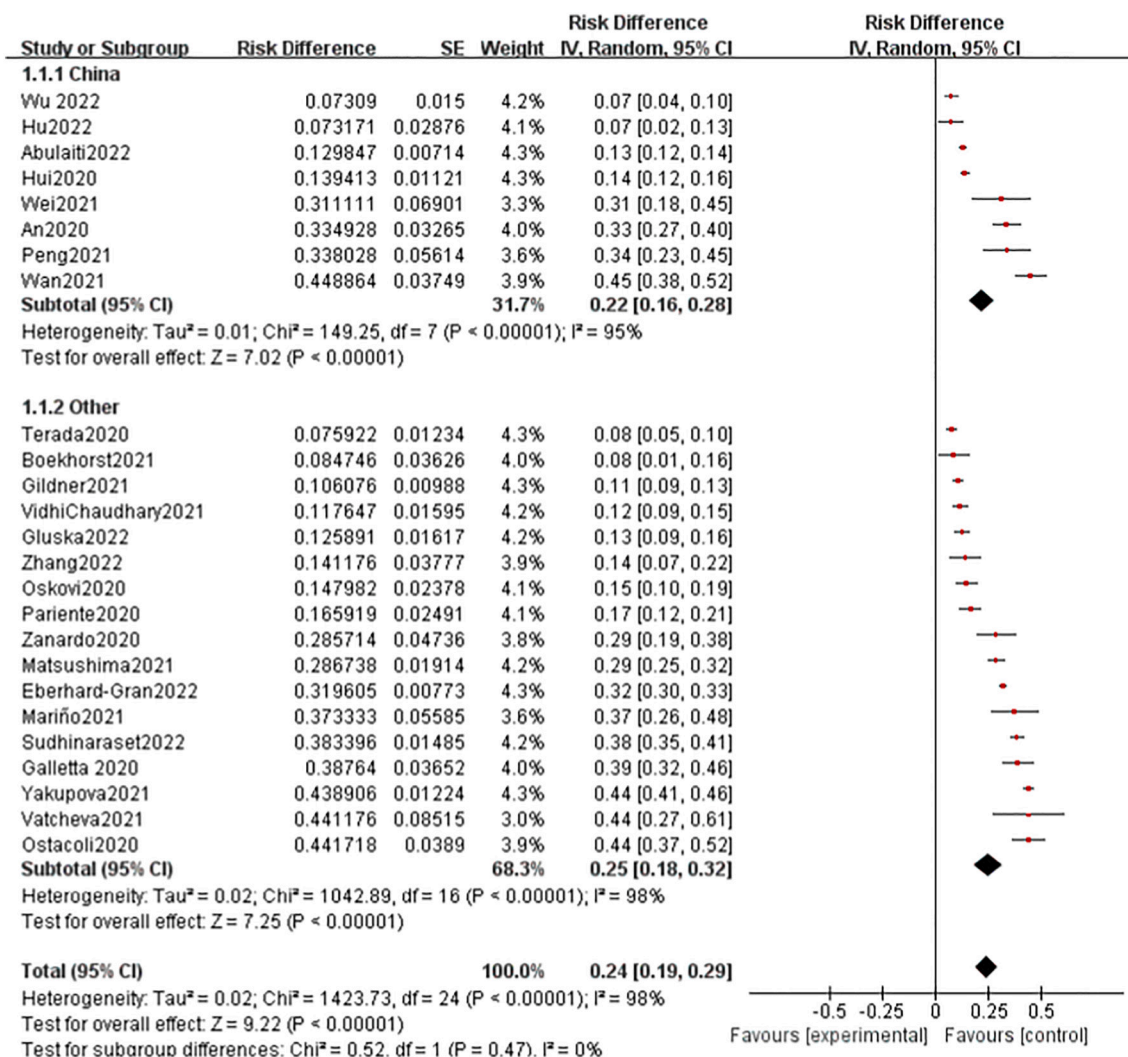
Fig. 3. Forest plot assessing the prevalence of postpartum depression in China and other countries during the COVID-19 pandemic.
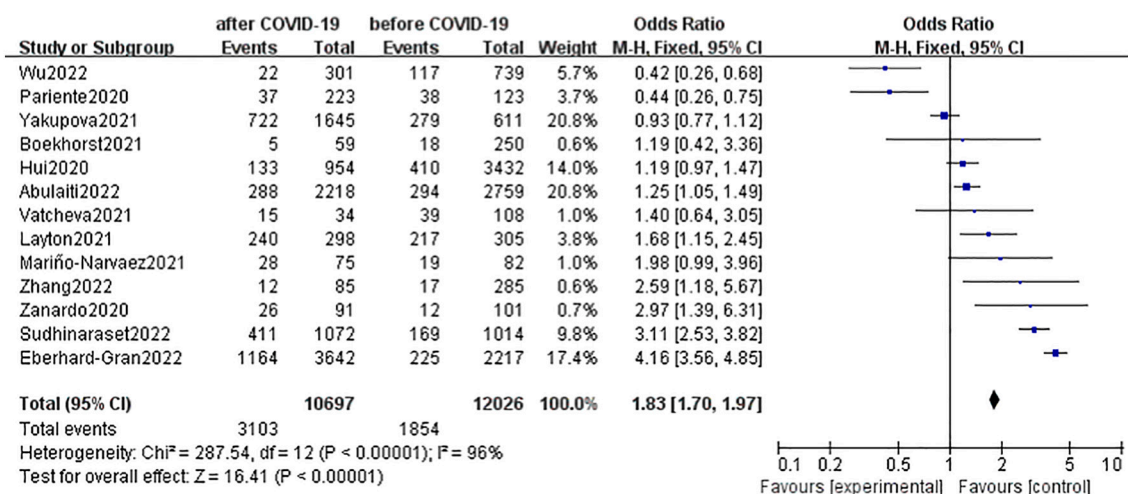

Fig. 4. Forest plot of pooled OR for postpartum depression at different periods (during COVID-19 vs before COVID-19).

alleviate the production and fear of the COVID-19 pandemic, reducing the prevalence of PPD. In fact, companionship due to the home quarantine during the COVID-19 pandemic had a similar impact on the prevalence of PPD in other countries too (Gildner et al., 2021; Terada et al., 2021).

Overall, although the COVID-19 pandemic directly impacts PPD prevalence, region, social support, social welfare system, the medical system, and economic development significantly influence the level of

postpartum depression. It is worth noting that distress related to the absence of partner or family members was mentioned widely (Galletta et al., 2022; Matsushima et al., 2021; Ostacoli et al., 2020; Terada et al., 2021). It is essential to have good social family support and newborn care during the period of isolation and closure to alleviate the impact on mothers. In addition, strict quarantine-lockdown policies and dynamic zero-COVID policies are put in place in China. These policies are based on the situation, keeping adapted to new changes and remaining transparent, which will better take into account the needs of epidemic prevention and social and economic development, may also put people at ease and increase people's life-satisfaction. All of above mentioned relieve people's mental health and reduce the incidence of mental disorders, especially the prevalence of PPD. However, the limitations in this review included the following aspects. First, most studies used the EPDS scale while some used the PHQ-9 scale, so the difference in PPD prevalence between the two scales was unable to assess. Also, we did not summarize all the risk factors and protective factors mentioned in the included studies, which need further research. Finally, our review did not distinguish postpartum women confirmed or suspected of COVID-19 from those without, so the findings may not represent the whole impact the COVID-19 had on postpartum depression.

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CRediT authorship contribution statement

Bin Chen and Chenxinzi Lin designed the study, carried out the statistical analysis and wrote the paper. Qiuguo Wang, Minmin Wang and Shiying Guo were responsible for literature review and inclusion data extraction and assisted with writing the original draft. Youjing Yang and Qianmin Li were assisted with writing the original draft and revised the manuscript. Shasha Tao was responsible for conceptualization, visualization, writing– review & editing, supervision and project administration.

Conflict of Interest

There is no conflict of interest and manuscript has been approved for publication by all of the authors listed.

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