**Prevalence of perinatal anxiety and its determinants in mainland China: a systematic review and meta-analysis**

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**Abstract**

**Background:** Perinatal anxiety is among the most common mental health conditions that have a huge negative impact both on mothers and their children. This study aimed to establish summary estimates of the prevalence of perinatal anxiety and its influencing factors in Mainland China.

**Methods:** A systematic search was carried out from nine major English and Chinese electronic databases to identify studies published up to August 20, 2022 with data on the prevalence of perinatal anxiety. Two reviewers conducted data extraction and quality assessment. Meta-analysis was performed using a random-effects model. Subgroup and meta-regression analyses were performed when possible.

**Results:** 271 studies representing 369,477 women were included in the study. Pooled prevalence of perinatal anxiety was 17.4% (95% CI: 16.2% to 18.7%), with prenatal anxiety 17.4% (95%CI: 16.1% to 18.8%) and postpartum anxiety 17.5% (95%CI: 13.5% to 22.4%). However, the overall estimates presented substantial heterogeneity ($I^2$ = 98.93%). Qualitative summaries demonstrated some main potential risk factors of perinatal anxiety such as women with abnormal pregnancy-labor history, poor health status, pregnancy complications, and unplanned pregnancies, and some potential protective factors such as high family income, good social support, good interpersonal relationships, and history of multiple deliveries.

**Limitation:** Very large heterogeneity among studies was observed in meta-synthesis, and all included studies used self-report scales to identify anxiety rather than diagnostic interviews.

**Conclusion:** Varying degrees of perinatal anxiety is prevalent among Chinese women. Screening and evidence-based interventions are urgent and necessary to address this public concern and promote their health and well-being.

**Keywords:** Perinatal anxiety; Prevalence; Influencing factors; China; Systematic review

## 1. Introduction

Maternal perinatal mental health has always been a major public health issue because of its adverse impact on the well-being of the mother, baby, and family (Howard et al., 2014; Stein et al., 2014). Pregnancy brings about numerous changes, including changes in physical, social, and psychological aspects, which increase women's risk of mental health problems, especially in low- and middle-income (LAMICs) countries (Fisher et al., 2012). Anxiety is among the most common mental health condition in women during the perinatal period from pregnancy to 12 months postpartum (Kendig et al., 2017). Some studies have found that anxiety is often comorbid with or even more common than depression during pregnancy and is associated with postpartum depression in many countries (Heron et al., 2004; Kessler et al., 2002; Nasreen et al., 2010). However, perinatal anxiety has received relatively limited attention.

Perinatal anxiety can have a substantial negative impact on both women and their children. Women with prenatal anxiety have been associated with a greater tendency for cesarean section (Rubertsson et al., 2014), a higher fear of childbirth (Hall et al., 2009), eating disorders (Micali et al., 2011), reduced effective coping strategies (George et al., 2013), and even an increased risk of suicide (Farias et al., 2013). Simultaneously, prenatal anxiety has been considered to be related to adverse birth outcomes, including intrauterine growth restriction (Lobel et al., 2008; Schetter, 2011), premature labor (Hasanjanzadeh and Faramarzi, 2017; Lobel et al., 2008; Staneva et al., 2015), and low birth weight (Hasanjanzadeh and Faramarzi, 2017). Anxiety during pregnancy may also adversely affect the mother-infant bond (Tietz et al., 2014). Moreover, maternal perinatal anxiety has a far-reaching impact on children. The offspring of pregnant women with perinatal anxiety had an increased risk of attention deficit/hyperactivity disorder (Glover et al., 2009; O'Connor et al., 2002a; O'Connor et al., 2002b; Rice et al., 2010), depressive symptoms, impulsivity, and adolescent cognitive impairment (Pawlby et al., 2009; Van den Bergh et al., 2005).

A recent study estimated that the prevalence of perinatal depression was 16.3% in China, which was similar to that in LAMICs but higher than that in high-income countries (Nisar et al., 2020). Many studies have demonstrated numerous influencing factors of perinatal mental health problems, including psychological, social, and biological exposures (Burger et al., 2020; Louise et al., 2014). In China, the first generation of the post-one-child policy has reached childbearing age within the past decade, most of whom are experiencing their first pregnancy and delivery (Ding, 2015a). Some studies from China showed that primiparas are more likely to suffer from perinatal anxiety and depression, which requires more effective prevention and treatment(Cui, 2013). In addition, some traditional cultural aspects, such as gender preference for male children, were found to be

associated with anxiety and depression among Chinese mothers (Kang et al., 2016; Nisar et al., 2020). These characteristics suggest the need to be aware of the role of societal trends and cultural aspects in interpreting data and planning further research.

The prevalence of self-reported anxiety symptoms in each trimester of pregnancy was estimated to be 18.2−24.6% in international studies (Dennis et al., 2017). Many studies have focused on perinatal anxiety in Chinese women but there may be substantial differences among regions in China. To the best of our knowledge, there is no systematic review of the prevalence of perinatal anxiety in mainland China. We conducted a systematic review and meta-analysis of the prevalence of perinatal anxiety and its determinants in mainland China to obtain an accurate sense of the prevalence rates and the moderators of these rates, and provide recommendations for future research and policy planning.

## 2. Methods

This systematic review and meta-analysis was based on PRISMA guidelines (Stewart et al., 2015). The registration number of the protocol of this review on PROSPERO is CRD42020170093 (Yang et al., 2020).

### 2.1. Search procedure and selection of studies

The pretest search strategy was used to conduct a bilingual system search in the following nine electronic bibliographic databases: PubMed, Embase, Web of Science, PsycINFO, CINAHL Plus, China National Knowledge Infrastructure (CNKI), Wanfang Database, VIP Database, and China Biology Medicine disc (CBMdisc). The Embase search strategy is shown in Appendix Table S1. Hand searches were also performed. Unpublished studies were not included. According to the PICOS format, the inclusion criteria of this study were as follows: Participants: studies focusing on women aged 18 years or older who were pregnant or in the postpartum period (defined as ≤12 months after childbirth); Intervention: studies reporting the prevalence of perinatal anxiety; Control: none; Outcomes: measurement and reporting of perinatal anxiety scores using a validated self-report scale or clinician-administered measure; Study design: studies with cross-sectional and cohort designs (only baseline data).

All databases were searched from inception to August 20, 2022. We searched both English and Chinese databases, and did not restrict the language to avoid potential language bias. We also did not restrict the study design and the date of publication of the studies. EndNote was used to remove duplicate articles, followed by two researchers working independently to screen the titles and abstracts of the included articles and then perform full-text screening. Finally, the bibliographies of all the included articles were searched by hand. Two

researchers discussed differences to reach a consensus, involving a third researcher when necessary.

Cross-sectional and cohort studies (only baseline data) published in peer-reviewed journals that reported the estimated prevalence of anxiety in pregnant women or women in the postpartum period were included. In addition, we included studies using effective psychological scales such as the Self-Rating Anxiety Scale (SAS) and Hamilton Anxiety Scale (HAMA). We only included studies published in English and Chinese. We also only included studies with a sample size of at least 250 people to obtain accurate prevalence estimates and to ensure that the studies had a representative study sample, a high confidence level (95 to 99%), precise prevalence estimates, and a low margin of error (Saha et al., 2008). We excluded reviews (narrative and systematic reviews, conference proceedings, case reports, qualitative studies, editorials, opinion papers, and letters), studies from Hong Kong and Macau, and studies focusing on a very specific subpopulation (e.g., people with a specific disease or disability/condition or specific occupational groups).

**2.2. Data extraction and study quality assessment**

The study information was extracted using a piloted data extraction form by the first reviewer, and the second reviewer crosschecked all extracted data for accuracy. We extracted data on the study parameters, including the first author and year of publication, study design, geographical location, sample size, sampling procedures (e.g., randomized vs. convenience sampling), response rate, perinatal time points (i.e., prenatal including the first, second or third trimester, or postnatal), instrument/measurement of anxiety and cutoff scores, type of instrument/measurement (i.e., standardized or self-developed measurements), evidence of reliability and/or validity of the measurement instrument, and reported prevalence of anxiety. Any discrepancies in data extraction were resolved through discussions between the reviewers. To determine the influencing factors of perinatal anxiety in China, we listed specific risk and protective factors for narrative synthesis.

Two reviewers independently completed the quality assessment of the included studies, using an adapted version of the Newcastle–Ottawa risk of bias tool (Stang, 2010), including the following parts: the representativeness of the sample, the adequacy of the sample size, the comparability between the respondents and nonrespondents and the satisfactory response rate, the use of common psychological measurement scales and effective cutoff scores, the quality of the descriptive statistics report, the state of informed consent, the ethical approval process and the reliability and validity of the scale used in the research. Any discrepancies in quality assessment were resolved through discussion with a third author.

**2.3. Quantitative data synthesis**

Meta-analysis was performed using Comprehensive Meta-Analysis Software (V.3, Biostat Inc. NJ, USA).

Data on the proportion of women with perinatal anxiety and the total sample size were extracted from individual studies to generate pooled estimates with exact binomial test and the associated 95% confidence intervals. These data were transformed to their logits before meta-analysis to stabilize variances (Doi and Williams, 2013). Due to the expected heterogeneity in the data, a random-effects model was employed to yield pooled prevalence estimates of perinatal anxiety (Borenstein et al., 2010). Heterogeneity across the studies was estimated using Cochran's Q statistic. The $I^2$ statistic was used to quantify the percentage of the variability in effect estimates due to heterogeneity across the studies. Sensitivity analyses were performed to identify any outliers in the meta-analysis. Egger's regression statistic and funnel plots were used to assess the presence of any publication bias (Sutton et al., 2000). In the case of significant publication bias, the trim & fill method was used to both identify and correct the asymmetry of the funnel plot to yield a corrected pooled prevalence. The following subgroup analyses were used to identify moderators of perinatal depression: measurement scales, geographical location (South vs. North), publication date (<2010 vs. ≥2010), language of publication (Chinese vs English), and whether the COVID-19 outbreak. Meta-regression analysis with random effects and the maximum likelihood method was performed by regressing logit event rates in each study with variables including average age, the gross domestic product (GDP) of province in 2020, and the study quality assessment score (Borenstein et al., 2009).

## 3. Results

### 3.1. Study selection

The search process and exclusion of studies are shown in Fig. 1. A total of 27,339 records were retrieved from nine databases. After deleting 8,472 duplicate records using Endnotes, the titles and abstracts were screened, and another 18,867 records were deleted, that is, 703 studies met the full-text screening criteria. The final data analysis included 271 studies from 29 provinces in mainland China with a sample size of 369,477 perinatal Chinese women (Fig. 2).

### 3.2. Characteristics of included studies

The characteristics of the included studies are presented in Appendix Table S2. Most of them were cross-sectional studies (n = 229, 84.5%), and there were only 42 longitudinal studies (15.5%). A total of 197 studies (72.7%) used reliable and validated scales for measurements, while 71 studies (26.2%) did not report reliability, and 74 studies (27.3%) did not report the effectiveness of the measurement scales. There were 22 studies (8.1%) with primiparas and 9 studies (3.3%) with postmenopausal women, and the other studies did not specify the

parity of the participants. The most commonly used scale for assessing perinatal anxiety was the Self-Rating Anxiety Scale (SAS) (n =157, 57.9%), followed by the Generalized Anxiety Disorder-7 (GAD-7) questionnaire (n = 31, 11.4%), Hospital Anxiety and Depression Scale (HADS) (n = 23, 8.5%), Pregnancy-related Anxiety Questionnaire (PAQ) (n = 20, 7.4%), State-Trait Anxiety Inventory (STAI) (n = 14, 5.2%), Hamilton Anxiety Scale (HAMA) (n = 11, 4.1%), Symptom Checklist-90 (SCL-90) (n = 7, 2.6%), Beck Anxiety Inventory (BAI) (n = 3, 1.1%) , SAI subscales in the STAI (n = 3, 1.1%) and Depression, Anxiety and Stress Scale-21 (DASS-21) (n=2, 0.7%).

The study samples of the 271 studies (100%) were representative. Response rates were reported in 93 studies (34.3%) and not reported in 178 studies (65.7%). A total of 229 studies (84.5%) reported descriptive statistics, and 42 studies (15.5%) did not. A total of 211 studies (77.9%) reported the informed consent process, while 60 studies (22.1%) did not. Eighty-seven studies (32.1%) reported on the ethical review process, while 184 studies (67.9%) did not. Most studies reported prenatal anxiety (n = 237, 87.5%), 25 studies (9.2%) reported postpartum anxiety, and 9 studies (3.3%) reported both. The majority of the studies used convenience sampling (n = 239, 88.2%) rather than random sampling.

**3.3. Pooled prevalence of perianal anxiety**

Using the random effects model, the pooled prevalence of perinatal anxiety was 17.4% (95% CI: 16.2% to 18.7%). There were substantial heterogeneity in studies (Q = 25265.11, $P < 0.001$), with an $I^2$ value of 98.93%. Sensitivity analysis performed by removing individual studies sequentially did not show any substantial change to the conclusion. Visualization of Begg's funnel plot and Egger's regression statistic (intercept = -4.53, S.E=1.04, $P < 0.001$) revealed significant publication bias (Appendix Fig. S1). Trim-and-fill procedures with a random effects model suggested imputation of 53 studies to the right of the mean, yielding an adjusted pooled prevalence of 22.10% (95% CI: 20.60% to 23.68%).

A total of 237 studies (n = 325,232) reported the prevalence of prenatal anxiety, with a pooled prevalence of 17.4% (95% CI: 16.1% to 18.8%, $I^2 = 98.96\%$) (Appendix Fig. S2). After adjusting for significant publication bias (Egger's regression p <0.001) (Appendix Fig. S3), the pooled prevalence for prenatal anxiety was estimated to be 22.42% (95% CI: 20.76% to 24.17%). The prevalence of postpartum anxiety was reported in 25 studies (n = 20,066), with a pooled prevalence of 17.5% (95% CI: 13.5% to 22.4%, $I^2$ =98.93%) (Fig.3). There was no evidence of publication bias (Egger's regression p = 0.32). Only nine studies reported the prevalence of anxiety among a sample of both prenatal and postpartum women, yielding a pooled prevalence of 17.1% (95% CI: 11.0% to 25.5%, $I^2 = 98.61\%$) (Fig.4).

The subgroup analysis of anxiety assessments showed that there were significant differences in the prevalence of perinatal anxiety measured by different outcome measurements (Q = 65.34, $P < 0.001$). The prevalence reported using the SAI was the highest at 34.2% (95% CI: 19.7% to 52.5%), and that using the HADS was the lowest (7.6%, 95% CI: 5.8% to 9.7%) (Fig. 5). The north-south boundary of China is the Qinling-Huaihe River area. According to this boundary, the provinces are divided into two groups: the south and the north groups. The subgroup analysis results showed that the prevalence of perinatal anxiety among women in the North (19.7%, 95% CI: 17.6% to 22.0%) was significantly higher than that in the South (15.8%, 95% CI: 14.3% to 17.3%), and the difference was statistically significant (Q = 10.13, $P < 0.01$).

To understand the impact of the one-child policy enacted in China in 1980, we conducted a subgroup analysis of studies that were published before and after 2010. The choice of this cutoff was based on the assumption that the majority of respondents in studies reporting data prior to 2010 reached childbearing age and gave birth during the enactment (1980) and relaxation (2013) of the one-child policy. Our results showed that the prevalence of perinatal anxiety was not significantly different in studies published before and after 2010 (Q = 2.73, $P = 0.09$). In addition, the prevalence of perinatal anxiety during the COVID period was significantly higher (22.3%, 95% CI: 18.5% to 26.6%) than before (16.8%, 95% CI: 15.5% to 18.1%). No differences were found based on language of publication. The details of the above results of subgroup analyses are shown in Table 1.

Meta-regression analysis showed that the provincial GDP, average age of mothers, and quality score of studies were not significantly associated with the prevalence of perinatal anxiety in mainland China (Table 2 and Appendix Fig. S4).

### 3.4. Risk and protective factors of perinatal anxiety

This study qualitatively summarized the main possible risk and protective factors of the prevalence of perinatal anxiety (Table 3). The most reported risk factors were maternal-related factors, including an abnormal pregnancy-labor history (such as abortion or giving birth to an abnormal child), poor health status, pregnancy complications, severe reactions to pregnancy, worrying about their own health or the safety of their child, a lack of related knowledge, higher pressure, multiple pregnancies, and unplanned pregnancies. Moreover, some social environment factors including poor marital relationships, dissatisfaction with living conditions, and poor family economic status, were also suggested as risk factors for the prevalence of perinatal anxiety.

In addition, studies have demonstrated some potential protective factors for the prevalence of perinatal anxiety, which include high family income, high maternal age, high educational background, good social

support, good interpersonal relationships, and history of multiple deliveries.

## 4. Discussion

### 4.1. Main findings

Perinatal anxiety is one of the priorities of public health. In recent years, it has attracted more and more attention from researchers and healthcare professionals worldwide (Dennis et al., 2017; Maria et al., 2022). To our knowledge, this is the first systematic review of perinatal anxiety for mainland Chinese women, including studies published in both English and Chinese. A total of 271 studies involving 369,477 women from 29 provinces were included. The main findings were that the prevalence of prenatal anxiety was 17.4%, and the prevalence of postpartum anxiety was 17.5%. Overall, the pooled prevalence of perinatal anxiety among Chinese women was 17.4%.

Comparing our results with previous estimates of the prevalence of self-reported anxiety symptoms, we found that our estimate of the prenatal anxiety was lower than Dennis et al.'s estimate in high-income countries (HICs) (19.4%) and LMICs (34.4%) (Dennis et al., 2017), and lower than Nielsen-Scott et al.'s estimate in LMICs (29.2%) (Nielsen-Scott et al., 2022). Moreover, our estimate of the postpartum anxiety was lower than Dennis et al. and Nielsen-Scott et al.'s estimates in LMICs (25.9% and 24.4%, respectively), but higher that Dennis et al.'s estimate in HICs (13.7%) (Dennis et al., 2017; Nielsen-Scott et al., 2022). In general, our results indicate that anxiety is a common mental health problem among Chinese perinatal women, and the prevalence of anxiety in the maternal population is significantly higher than that in the general adult population (Alonso et al., 2007; Wittchen and Jacobi, 2005).

### 4.2. Results of subgroup analyses

Subgroup analyses highlighted differences in prevalence according to several factors including measurement scales, geographical location and whether COVID-19 outbreak.

The definition of perinatal anxiety in all included studies was based on self-reported scales rather than common diagnostic interviews for various anxiety disorders such as the Mini-International Neuropsychiatric Interview or the Structured Clinical Interview for DSM. We found that the most commonly used measurement scale in this study was the SAS rather than the STAI, which was inconsistent with a previous study (Meades and Ayers, 2011). To reflect the heterogeneity of the measurement scales included in this meta-analysis, we performed a subgroup analysis to show the pooled prevalence measured by each instrument. The results also showed significant heterogeneities based on the scales except for the BAI. The variation, differences in

specificity and sensitivity, and different cut-offs applied of these self-reported scales may have contributed to high heterogeneity among studies. Furthermore, self-reported scales are likely to overestimate the true prevalence of psychiatric symptoms compared with standard interviews (Mitchell et al., 2011; Nielsen-Scott et al., 2022). Although self-reported measures have some limitations, they are of high value in the assessment of perinatal mental health in the fields of gynecology, obstetrics, and public health. Self-report tools are quick and easy to complete, are suitable for large sample studies, and are cheaper to use than diagnostic interviews. To provide a more accurate estimate of anxiety prevalence, a combination of screening scales and diagnostic clinical interviews should be used to assess anxiety in future studies.

The subgroup analysis based on region showed that the prevalence of perinatal anxiety among women in the North was significantly higher than that among women in the South. This difference may be related to the cultural differences between northern and southern China. Specifically, cultural practices related to the perinatal period vary from region to region and may play either a protective or detrimental role in the development of anxiety, depending on the context (Nielsen-Scott et al., 2022). Socioeconomic factors may also contribute to this difference by region in China. A study pointed out that the socioeconomic gap between different regions in China was a vital factor leading to the inequality of maternal health among different provinces in China (Guo and Huang, 2019). Besides, mental health resources are relatively scarce in northern China compared with southern China (Patel et al., 2016). To explore whether the prevalence of anxiety was associated with the economic development level, meta-regression analysis did not reveal a significant association between the provincial GDP and the prevalence of perinatal anxiety. However, a significant inverse association between the provincial GDP and depression rates was found among Chinese mothers (Nisar et al., 2020).

The subgroup analysis also showed that the prevalence of perinatal anxiety during the COVID-19 period was significantly higher than that before the COVID-19 outbreak. The COVID-19 pandemic has influenced many aspects of life, including women's pregnancy, birth and postnatal period. Emerging evidence suggest that the COVID-19 has increased the prevalence of perinatal mental health problems, such as depressive and anxiety symptoms (Chmielewska et al., 2021; Hessami et al., 2022; Iyengar et al., 2021). The higher prevalence of anxiety may be associated with maternal fear of acquiring the disease and the potential effects of the virus on their infants, limited accessibility of antenatal care resources, and lack of social support (Chen et al., 2021; Kotlar et al., 2021).

### 4.3. Influencing factors of perinatal anxiety

Most of the potential risk factors for perinatal anxiety summarized in this study were maternal or fetal

related. Pregnant women with pregnancy complications or a history of adverse pregnancy and childbirth outcomes are more likely to suffer from anxiety symptoms because they may be worried about whether they can safely survive the pregnancy and give birth smoothly and whether their physical condition will affect the baby's health. The poor physical health status of pregnant women, such as an illness during pregnancy and the need to take medicine, has been associated with increased risk of perinatal anxiety. Medication during pregnancy may lead to accidental abortion or fetal malformation. Therefore, pregnant women who need medication during pregnancy often worry excessively about fetal health, causing anxiety. More serious pregnancy reactions, such heartburn or severe vomiting, will make pregnant women worry about an insufficient or unbalanced nutritional intake, which will lead to fetal nutritional problems. Pregnant women often experience greater mental pressure due to the uncertainty of the pregnancy process and delivery outcome, such as fear of fetal health, delivery pain, and delivery safety (Kong, 2019), which easily produces anxiety.

Lack of knowledge of pregnancy, childbirth, and parenting has been found to increase risk of perinatal anxiety. If pregnant women have a low education level, lack of health awareness, or lack childbirth experience, they are unable to deal with abnormal conditions independently and use effective coping strategies, which easily leads to anxiety (Wu, 2016). Some studies investigated unplanned pregnancy as a risk factor for perinatal anxiety because these pregnant women usually do not adjust their diet, medication, or other living habits before pregnancy and will worry about the health of themselves and their fetus. At the same time, the sudden pregnancy disrupted their life, resulting in greater emotional fluctuations, thus causing anxiety.

Husbands are the most important source of social support for pregnant women. Some studies identified that marital discord was associated with a high risk of perinatal anxiety. The relationship between husbands and wives can greatly affect the mood of pregnant women during pregnancy and after delivery (Hu et al., 2014). Pregnant women who are dissatisfied with their living conditions and those with lower levels of family income have been associated with increased risk of anxiety. Crowded housing conditions or poor family finances can increase pregnant women's worries about their future lives and the financial burden of raising a new baby.

In addition, several of the included studies also focused on some possible protective factors for perinatal anxiety. A high family income level has been reported to act protectively. Studies have shown that subjective well-being, psychological well-being, social well-being, and comprehensive well-being increase with the growth of family income (Li and Chen, 2016). Pregnant women with a higher family income level will have less life and childcare burdens, fewer worries about their future lives, and therefore have less anxiety. Interestingly, high maternal age appears a potential protective factor for perinatal anxiety, although it can lead

to many adverse pregnancy outcomes (Attali and Yogev, 2021). Pregnant women of higher age have a relatively rich social experience, and high psychological and physiological tolerance, so they can manage the impact of the pregnancy well and are less likely to suffer from anxiety.

Pregnant women with good interpersonal relationships and high levels of social support are less likely to have anxiety. Social support refers to intimate relationships, community belonging, self-worth, materials, information, and the emotional support that individuals feel they have been provided by others (Li and Zhou, 2014). Therefore, good social support can effectively relieve the anxiety of women during pregnancy. The higher educational background of pregnant women has been also associated with decreased risk of anxiety. Pregnant women with high education levels usually have more health knowledge or more ways to obtain health knowledge and are more fully prepared for pregnancy, delivery, and childcare, so they have a lower psychological burden. In addition, pregnant women with childbirth experience has been associated with a lower prevalence of anxiety disorders, because these women generally have a certain understanding of pregnancy and childbirth, and therefore have a reduced risk of anxiety.

**5. Strengths and Limitations**

The main strength of this study is the search of international and Chinese databases, and the inclusion of studies published in both English and Chinese. This helps to increase transparency and reduce intellectual colonialism by making Chinese literature more widely available. Further strengths include a comprehensive literature search with no language restrictions, a robust methodology and adhering to PRISMA guidelines in conducting the systematic review.

There are some limitations in this systematic review. First, very large heterogeneity among studies was observed in the meta-synthesis, which may be caused by several factors, including different study designs, pregnant women in different trimesters, studies from various regions, and different measurement scales. Second, all included studies used self-report scales to identify anxiety, which may overestimate the true anxiety prevalence. Third, only baseline data from longitudinal studies were extracted without further analysis of the follow-up prevalence in longitudinal studies. Forth, the available studies themselves had important methodological limitations. The majority of the included studies used a convenience sampling method (88.2%), and did not provide information on ethical approval (67.9%). But it was reassuring that most of the studies reporting ethics approval were published in recent years, indicating that great progress has been made in reporting ethical considerations in observational studies. There are other limitations such as only including studies with a sample size of more than 250 individuals and only providing a narrative summary of the risk and

protective factors of perinatal anxiety.

## 6. Conclusion

In conclusion, our systematic review and meta-analysis indicate that varying degrees of perinatal anxiety are prevalent among Chinese women. Several risk and protective factors are associated with the prevalence of perinatal anxiety. China has made great strides in improving the health of its citizens in recent decades, and we believe that maternal mental health is a very important public health priority and that perinatal anxiety deserves the same attention as perinatal depression. Screening and evidence-based interventions are therefore needed to reduce the exposure of Chinese women and children to mental health problems such as perinatal anxiety and promote their health and well-being.

## Declaration of Competing Interest

None.


## Funding

This study was supported by the Chinese Medical Association Publishing House (CMAPH-NRP2019005) and China Medical Board (21-419).

## Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit it for publication.

## Acknowledgments

The authors acknowledge the funding from the Chinese Medical Association Publishing House and China Medical Board.


## Author contributions

LY, AR and XL conceived and designed the study. LY, JS and YN searched, screened and did the data extraction. JS, AN conducted the data analysis with supervision from AW. JS and LY first drafted the paper and all the authors revised and approved it.

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**Figure legends**

**Fig. 1.** Flow chart illustrating the identification of included studies.

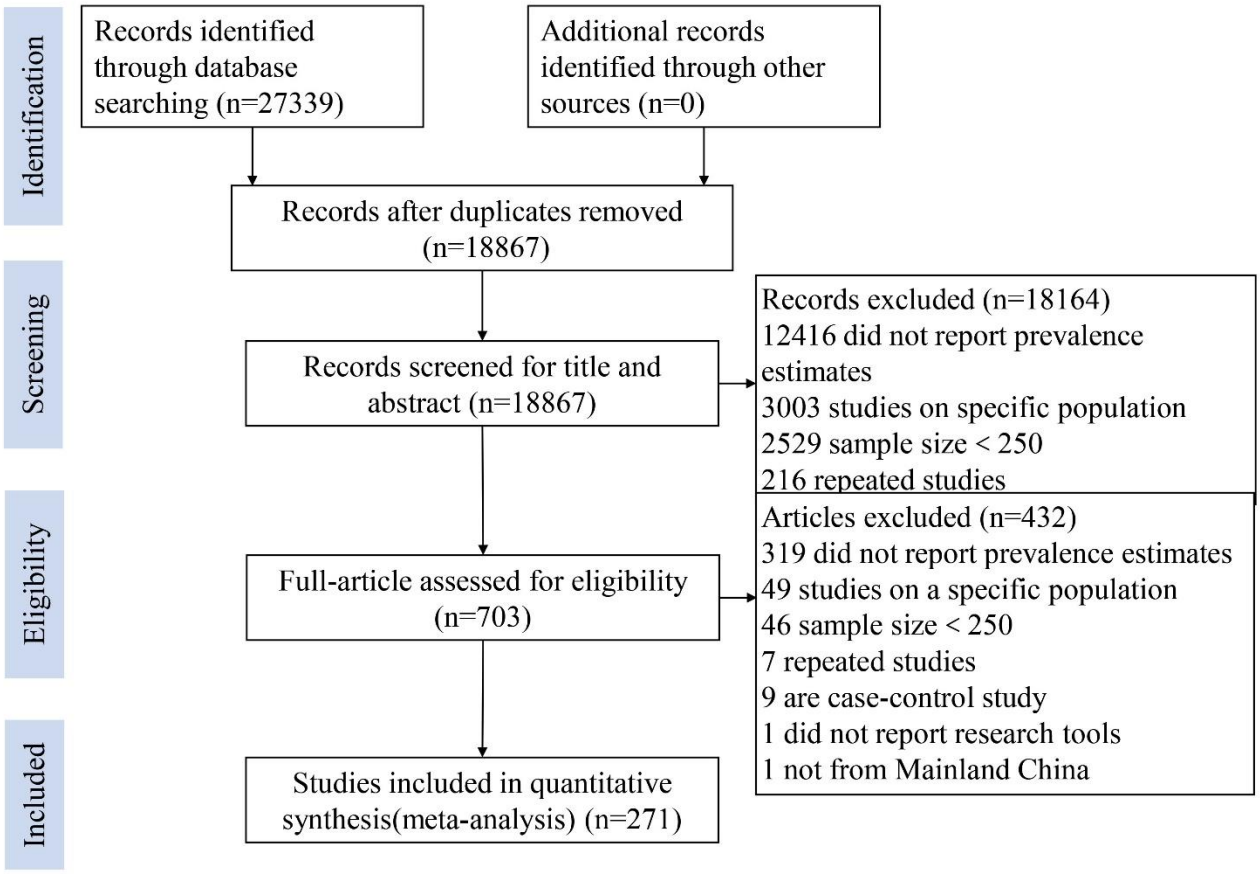

**Fig. 2.** Distribution of perinatal anxiety across the provinces of Mainland China.

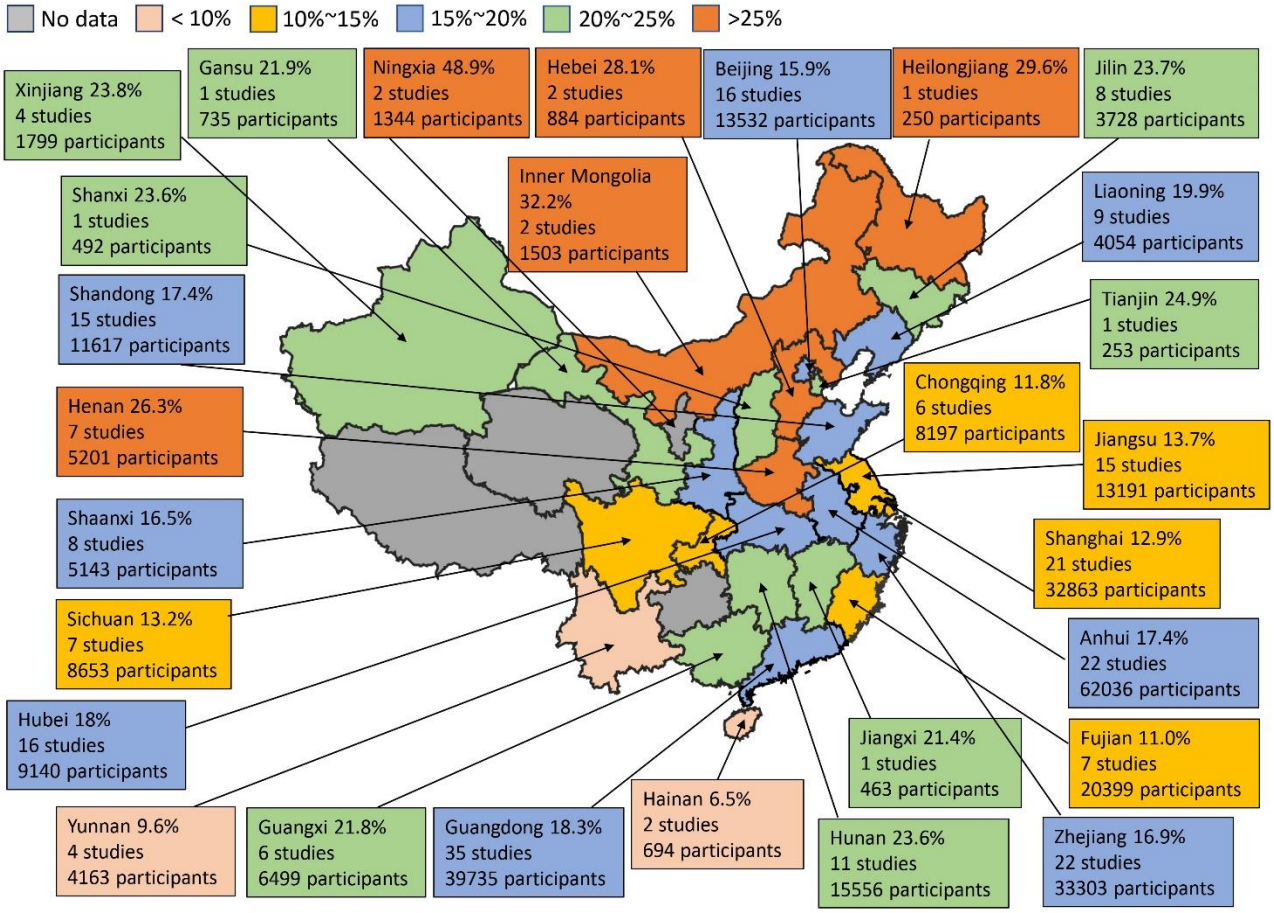

**Fig. 3.** Forest plot of the prevalence of postpartum anxiety.

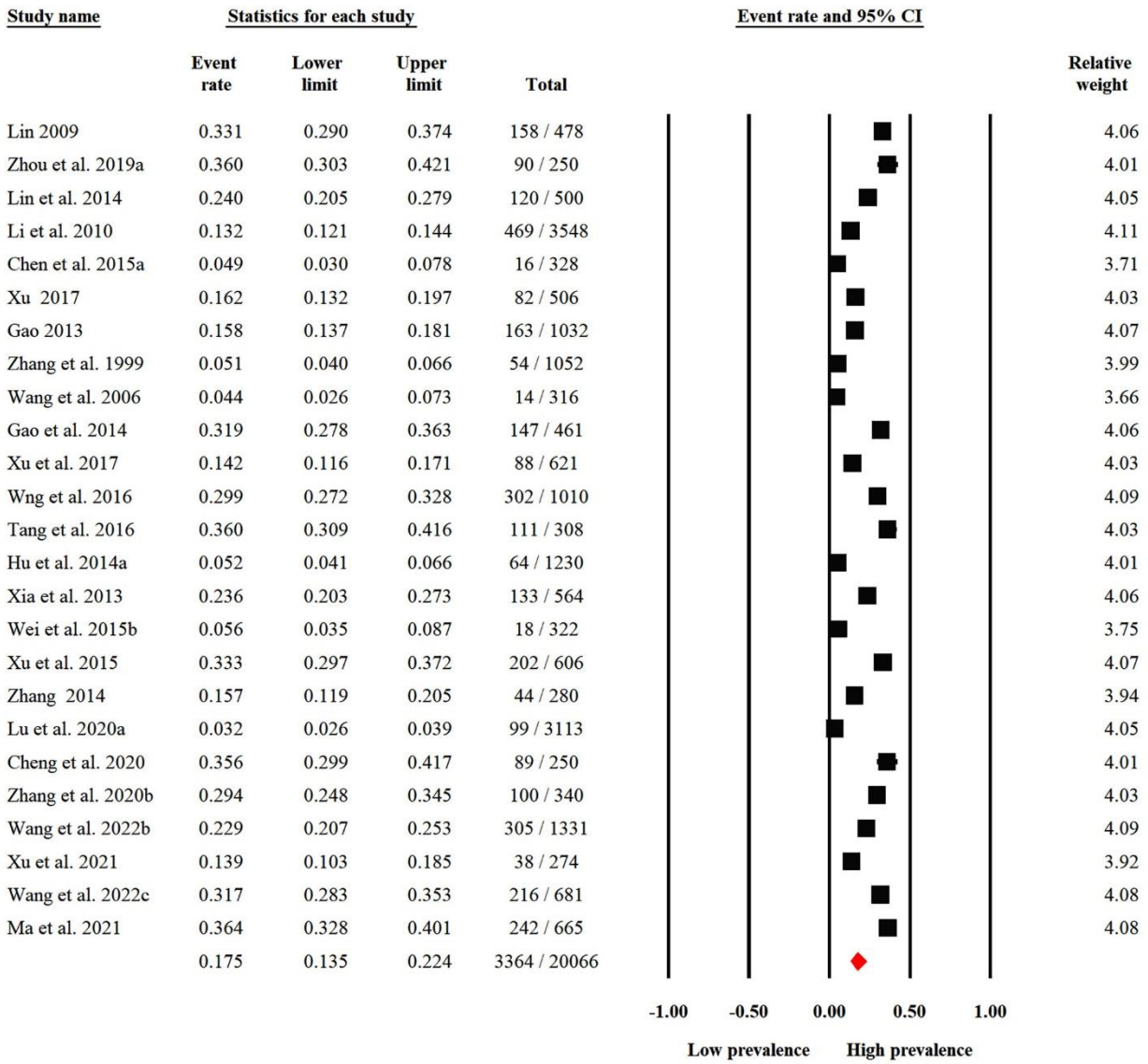

**Fig. 4.** Forest plot of the prevalence of anxiety both prenatal and postpartum.

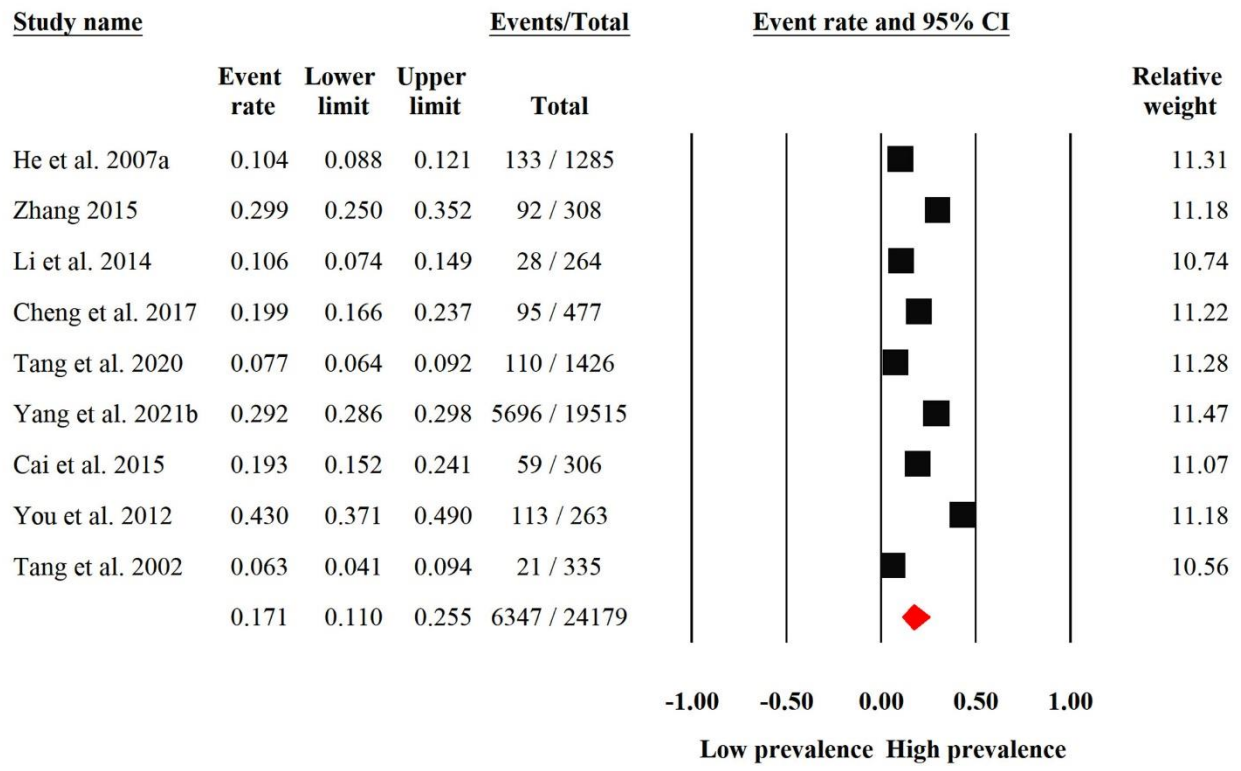

**Fig. 5.** Forest plot of the prevalence of perinatal anxiety based on measurements.

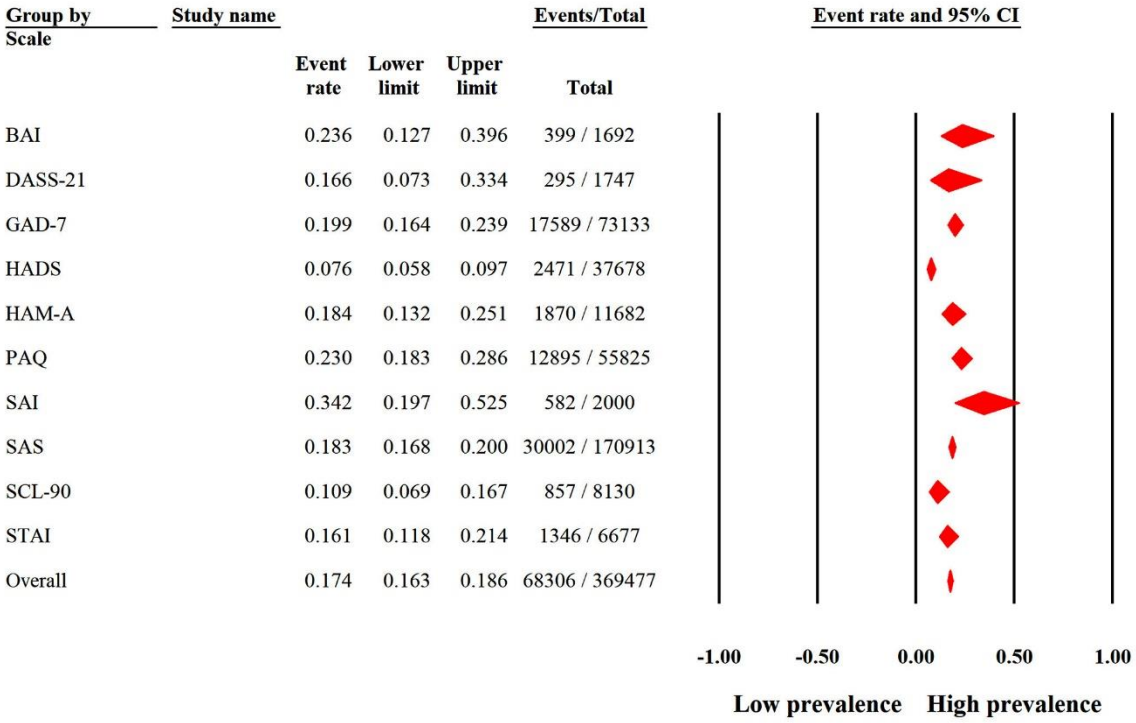

**Table 1** Subgroup analysis based on measurements, regions, before and after year 2010, language of publication and whether COVID-19 outbreak.

| Group | Study No. | Prevalence (%) | 95%CI (%) | | $I^2$ (%) | Q | *P* |
|---|---|---|---|---|---|---|---|
| | | | Lower | Higher | | | |
| **Assessment tool** | | | | | | 65.33 | **<0.001** |
| Beck Anxiety Inventory | 3 | 23.6 | 12.7 | 39.6 | 0.00 | | |
| Depression, Anxiety and Stress Scale-21 | 2 | 16.6 | 7.3 | 33.4 | 55.61 | | |
| Generalized Anxiety Disorder-7 | 31 | 19.9 | 16.4 | 23.9 | 99.16 | | |
| Hospital Anxiety and Depression Scale | 23 | 7.6 | 5.8 | 9.7 | 96.95 | | |
| Hamilton Anxiety Scale | 11 | 18.4 | 13.2 | 25.1 | 98.48 | | |
| Pregnancy-related Anxiety Questionnaire | 20 | 23.0 | 18.3 | 28.6 | 96.36 | | |
| Self-Rating Anxiety Scale | 157 | 18.3 | 16.8 | 20.0 | 98.54 | | |
| SAI subscales in the STAI | 3 | 34.2 | 19.7 | 52.5 | 98.88 | | |
| Symptom Checklist-90 | 7 | 10.9 | 6.9 | 16.7 | 95.31 | | |
| State-Trait Anxiety Inventory | 14 | 16.1 | 11.8 | 21.4 | 94.88 | | |
| **Regions** | | | | | | 10.13 | **0.006** |
| South | 153 | 15.8 | 14.3 | 17.3 | 98.92 | | |
| North | 99 | 19.7 | 17.6 | 22.0 | 98.63 | | |
| Multiple | 19 | 19.8 | 15.3 | 25.3 | 99.00 | | |
| **Before and after year 2010** | | | | | | 2.727 | 0.099 |
| After 2010 | 51 | 15.3 | 12.9 | 18.1 | 98.86 | | |
| Before 2010 | 220 | 17.9 | 16.6 | 19.3 | 98.95 | | |
| **Language of publication** | | | | | | 0.566 | 0.452 |
| Chinese | 222 | 17.6 | 16.3 | 19.1 | 98.90 | | |
| English | 49 | 16.4 | 13.8 | 19.4 | 99.04 | | |
| **Whether COVID-19 outbreak** | | | | | | 7.680 | **0.006** |
| Before COVID-19 | 236 | 16.8 | 15.5 | 18.1 | 98.87 | | |
| After COVID-19 | 35 | 22.3 | 18.5 | 26.6 | 98.88 | | |

**Table 2** Meta regression analysis based on provincial GDP, average age of mothers, and quality score of studies.

| Covariate | Coef. | S.E. | 95%CI | | t | *P* |
|---|---|---|---|---|---|---|
| | | | Lower | Lower | | |
| Provincial GDP | 0.000 | 0.000 | 0.000 | 0.000 | -0.60 | 0.55 |
| Average age of mothers | 0.041 | 0.040 | -0.037 | 0.120 | 1.04 | 0.30 |
| Quality score of studies | -0.025 | 0.036 | -0.096 | 0.046 | -0.69 | 0.49 |

**Table 3** Risk and protective factors of perinatal anxiety in mainland China.

| | Number of studies | Total sample size (range) |
|---|---|---|
| **Risk factors** | | |
| Abnormal pregnancy-labor history | 19 studies (Cui, 2013; Ding, 2015b; He et al., 2007; Huang et al., 2016; Jiang et al., 2013; Li et al., 2013; Li, 2020; Li et al., 2016c; Li. et al., 2012; Liu et al., 2020b; Wang, 2011; Wang et al., 2017; Wang, 2020; Wei et al., 2015; Xia et al., 2020; Xia et al., 2019; Zeng et al., 2017; Zeng et al., 2020; Zhang, 2008) | 49,141 (292-16,621) |
| Poor health status | 11 studies (Li et al., 2016d; Qian et al., 2019; Wang et al., 2017; Wei et al., 2015; Xu and Liu, 2015; Zhang, 2008; Zhang et al., 2011)，(Jin, 2020; Shangguan et al., 2021; Yang et al., 2022; Zhang et al., 2021) | 29,781 (304-20,308) |
| Pregnancy complications | 12 studies (Huang et al., 2016; Kang et al., 2016; Li, 2015; Li et al., 2016d; Wu et al., 2018; Zha et al., 2017; Zhang, 2008)，(Guo et al., 2020; Liu and Wu, 2022; Wang et al., 2021; Wu et al., 2021; Zou et al., 2022) | 42,038 (297-15,428) |
| Severe reactions to pregnancy | 9 studies (Chen, 2016; Ding, 2015b; Gao et al., 2014; He et al., 2014; Hu, 2011; Jiang et al., 2013; Wei et al., 2017; Zhang et al., 2011)，(Cui et al., 2021) | 30,807 (304-20,308) |
| Being worried | 9 studies (Chen, 2016; Jiang et al., 2013; Liang et al., 2007; Qian et al., 2019; Wang, 2011; Wei et al., 2017; Yu and Zhu, 2010; Zeng et al., 2017)，(Chen et al., 2022) | 14,715 (505-4,116) |
| Lack relevant knowledge | 8 studies (Hu et al., 2014; Li et al., 2016a; Li et al., 2016c; Li. et al., 2012; Ma et al., 2020; Wu, 2016; Yan et al., 2011)，(Ge et al., 2021) | 4,524 (292-1,230) |
| Presence of pressure | 10 studies (Kong, 2019; Mao et al., 2014; Tang et al., 2019; Wang et al., 2015; Wei et al., 2017; Xu and Liu, 2015; Zhang et al., 2011)，(Jin, 2020; Ouyang et al., 2022; Shangguan et al., 2021) | 38,941 (520-20,308) |
| Multiple pregnancies | 8 studies (He et al., 2007; Hu et al., 2017; Jia et al., 2016; Liang et al., 2007; Lu et al., 2020b; Zheng, 2015)，(Ding et al., 2021; Lu et al., 2020a) | 17,166 (300-3,826) |

| | | |
|---|---|---|
| Unplanned pregnancies | 11 studies (Chen, 2016; Ding, 2015b; Hu et al., 2017; Jia et al., 2016; Kong, 2019; Yang et al., 2015; Zeng et al., 2017; Zhang et al., 2011)，(Jin, 2020; Liu et al., 2020b; Qian et al., 2021) | 44,651 (773-20,308) |
| Poor marital relationship | 9 studies (Hu et al., 2014; Mei and Wang, 2015; Yan et al., 2011; Yang et al., 2015; Yu and Zhu, 2010; Zeng et al., 2017)，(Sun et al., 2021; Wang et al., 2020b; Yang et al., 2021) | 10,832 (292-4,116) |
| Dissatisfied with living conditions | 7 studies (He et al., 2014; Hu et al., 2017; Hu, 2011; Qian et al., 2019; Yang et al., 2015; Zha et al., 2017; Zhang et al., 2011) | 29,703 (419-20,308) |
| Poor family economic status | 10 studies (Jiang et al., 2013; Liu et al., 2018; Wang et al., 2017; Wu, 2016; Zhang et al., 2011; Zhou et al., 2019)，(Ge et al., 2021; Liu et al., 2020b; Shen et al., 2021; Wang et al., 2020b) | 27,931 (266-20,308) |
| **Protective factors** | | |
| High family income | 9 studies (Cui, 2006; Jia et al., 2016; Kong, 2019; Wu et al., 2018; Yan et al., 2011; Yu and Zhu, 2010; Zhan, 2019)，(Feng et al., 2021; Liu et al., 2020a) | 8,882 (287-3,826) |
| High maternal age | 9 studies (Jia et al., 2016; Jiang et al., 2013; Li et al., 2016a; Li et al., 2016b; Li, 2017; Zhang et al., 2011)，(Liu and Wu, 2022; Wang et al., 2021; Wang, 2020) | 49,940 (573-20,308) |
| Good interpersonal relationships | 4 studies (Kang et al., 2016; Li et al., 2013; Liang et al., 2007; Xu and Liu, 2015) | 2,061 (300-780) |
| High education background | 10 studies (Kang et al., 2016; Shao et al., 2009; Tang, 2016; Wang et al., 2019; Wei et al., 2017; Wu et al., 2018; Yan et al., 2011)，(Li et al., 2021; Liu and Wu, 2022; Wang et al., 2022) | 4,059 (292-856) |
| Good social support | 8 studies (Gao et al., 2014; He et al., 2007; Hu, 2011; Kong, 2019; Mei and Wang, 2015)，(Wang et al., 2020a; Wang et al., 2021; Zheng et al., 2021) | 21,814 (310-15,428) |
| History of multiple deliveries | 4 studies (Gao et al., 2014; He et al., 2007; Kong, 2019; Xia et al., 2019) | 9,478 (461-6,923) |