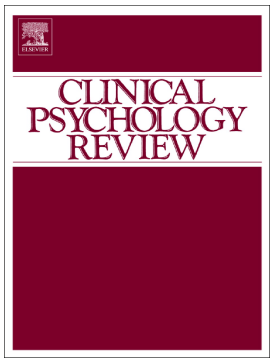

Prevalence and associated factors of antenatal depression: Systematic reviews and meta-analyses

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Prevalence and associated factors of antenatal depression: systematic reviews and meta-analyses

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Abstract

To evaluate the global prevalence of antenatal depression and clarify its potential associated factors, we conducted two systematic reviews and meta-analyses, where appropriate. PubMed, Web of Science, and Embase were used to identify studies published up to Feb 28, 2019. The pooled prevalence of any antenatal depression across 173 studies with 182 reports was 20.7% (95% CI 19.4-21.9%, $P = 0.000$, $I^2 =$ 98.4%), and the pooled prevalence of major antenatal depression across 72 studies with 79 reports was 15.0% (95% CI 13.6-16.3%, $P = 0.000$, $I^2 =$ 97.8%). The prevalence of antenatal depression was higher in low- or lower-middle-income countries, and in studies using self-report instruments or conducted after the year 2010. History of depression, lack of social support, single/separated/divorced status, unplanned pregnancy, unemployment, experience of violence, and smoking before or during pregnancy were significantly associated with antenatal depression. The results of our study indicated that a significant number of pregnant women experience depression and verified some factors that are related to this disorder. As countermeasures, it is important to develop effective risk assessment strategies as well as prevention and intervention strategies for antenatal depression based on its associated factors.

Keywords: antenatal depression, global prevalence, associated factors, interventions.

Prevalence and associated factors of antenatal depression: systematic reviews and meta-analyses

Introduction

Pregnancy is a major life event accompanied by psychological and physiological change (Ayano, Tesfaw, & Shumet, 2019), which increase pregnant women's vulnerability for the onset or recurrence of mental disorders (Kuhner, 2016). Antenatal depression is one of the most prevalent psychiatric disorders which has serious adverse impacts on both the mother and the infant's health (Alderdice, McNeill, & Lynn, 2013). Women with antenatal depression are at higher risk for substance abuse, preeclampsia, postpartum depression, edema, premature rupture of membranes, hemorrhage, and severe headaches (Bitew, Hanlon, Kebede, Honikman, & Fekadu, 2017; Horrigan, Schroeder, & Schaffer, 2008; Kurki, Hiilesmaa, Raitasalo, Mattila, & Ylikorkala, 2000; Silva, et al., 2012). For the offspring, antenatal depression can not only result in preterm birth or low birth weight, but also has a persistent adverse impact on their neurological, behavioral, and emotional development (Li, et al., 2018; Ncube, Enquobahrie, & Gavin, 2017; Van Ngo, Gammeltoft, Nguyen, Meyrowitsch, & Rasch, 2018).

Prevalence of antenatal depression across studies varied greatly, such as, 31.1% in Ethiopia, 20.7% in Turkey, and 8.5% in USA (Akcali Aslan, et al., 2014; McCall-Hosenfeld, Phiri, Schaefer, Zhu, & Kjerulff, 2016; Mossie, Sibhatu, Dargie, & Ayele, 2017). Some systematic reviews have been performed to synthesize data on prevalence of antenatal depression, but the globally representative prevalence estimates are still scarce. For example, two previous reviews estimated the epidemiology of antenatal depression in low- and middle-income countries (Fellmeth,

Fazel, & Plugge, 2017; Gelaye, Rondon, Araya, & Williams, 2016), but they excluded studies from high-income countries. The review conducted by Bennett et al. reported the prevalence of antenatal depression globally (Bennett, Einarson, Taddio, Koren, & Einarson, 2004), but it was conducted sixteen years ago, and many relevant researches have emerged in recent years. Overall, there is a need for a comprehensive and updated global estimate of antenatal depression to help us better understand depressive conditions among pregnant women.

Though lacking a globally representative prevalence of antenatal depression, there is no doubt that it is widespread and common throughout the world (Moshki & Cheravi, 2016; Mossie, et al., 2017; Tham, et al., 2016). Previous studies revealed that its high prevalence was associated with many factors, such as poor social support, unplanned pregnancy, history of depression, unemployed status, and financial problems (Lancaster, et al., 2010; Nasreen, et al., 2018). However, the results of the association between potential factors and antenatal depression in different studies are inconsistent and there are few quantitative reviews to clarify the strength of these associations (Fonseca-Machado Mde, et al., 2015; Jeong, et al., 2013; Nasreen, et al., 2018). Hence, a meta-analysis to clarify the association between potential factors and antenatal depression is required.

In view of these gaps in current researches regarding antenatal depression, we performed two systematic reviews with the following objectives: (1) to provide a global prevalence estimate of antenatal depression; and, (2) to compute a summary effect estimate of association between potential factors and antenatal depression. The results could provide references for identifying the level of disease burden and developing measures for managing antenatal depression.

Methods

Search strategy and selection criteria

The two systematic reviews were conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (Moher, Liberati, Tetzlaff, & Altman, 2009).

We conducted literature searches in PubMed, Embase, and Web of Science from the date of their inception up to February 28, 2019. In this study, antenatal depression included both depressive symptoms detected by validated self-reported screening instruments and clinical depressive disorders detected by structured clinical interviews. The first search focused on prevalence of antenatal depression and the second one focused on potential factors associated with it. The same search strategies were used for these two searches, and the main search strategy for PubMed is presented in Table A1. This search strategy was adapted to fit with the other two databases. In addition, we reviewed the reference list of retrieved articles to identify additional studies. We only included articles published in English.

For the prevalence search, we included studies if they: (1) researched on samples of pregnant women recruited through general obstetric or antenatal units or population surveys; (2) assessed antenatal depression using a validated diagnostic or self-report screening instrument; (3) reported the prevalence of antenatal depression or provided data that could estimate the prevalence of it. Studies were excluded if they: (1) were based solely on teenage or high-risk pregnant women; (2) did not report an assessment instrument; (3) were animal studies, reviews, letters, or commentaries. For studies with duplicate data from a single database, we selected the study with the largest sample size.

For the search of factors associated with antenatal depression, we included studies if they: (1) focused on samples of pregnant women recruited through general

obstetric or antenatal units or population surveys; (2) explored potential associated factors related to antenatal depression, such as sociodemographic, obstetric, and psychiatric variables; (3) reported effect estimates with 95% confidence intervals (CI) of the associations between factors and antenatal depression. Studies were excluded if they: (1) were based solely on teenage or high-risk pregnant women; (2) lacked any information that prevented the calculation of effect estimates and corresponding 95% CI; (3) were animal studies, reviews, letters, or commentaries.

Data extraction

For eligible studies on the prevalence of antenatal depression, we extracted the following information: name of the first author, year of publication, study location, study design, sample size, recruitment date, measure of depression, cut-off points, timing of measurement, number of cases, and prevalence of depression. For eligible studies on associated factors of antenatal depression, we extracted potential factors and their corresponding effect estimates and 95% CI. Two investigators (N. S. and X. Y.) independently performed the literature search, selected eligible studies, and extracted data; any disagreements were resolved by discussion with the third author (Y. G.).

Quality assessment

Two reviewers (N. J. and J. Z.) independently performed the quality assessment. The quality of cohort and case-control studies was evaluated using the Newcastle-Ottawa Scale (Wells, et al., 2009). The scale assesses the quality of included studies by evaluating their selection of subjects, comparability of study groups, and ascertainment of either the exposure or outcome. The score range of this scale is 0–9. We assigned scores of 0–3, 4–6, and 7–9 for low, moderate, and high quality of studies, respectively.

The quality of cross-sectional studies was evaluated by the checklist involving eleven items recommended by the Agency for Healthcare Research and Quality (Rostom, et al., 2004). The checklist assesses the quality of included studies by evaluating their source of information, ascertainment of subjects, methods for quality assurance, as well as data reporting and processing. The score range of this checklist is 0–11. We assigned scores of 0–3, 4–7, and 8–11 for low, moderate, and high quality of studies, respectively.

Analysis

Several eligible studies on prevalence reported multiple instances of antenatal depression for the same participants. For studies with multiple time-points prevalence of antenatal depression, an overall prevalence was calculated by dividing the average number of events by the average sample size and multiplying by 100%. For studies using both self-report scale and structured clinical interview, we only included data assessed by structured clinical interview to estimate a pooled prevalence of antenatal depression. For studies reporting the prevalence of minor and major antenatal depression separately, an overall prevalence of antenatal depression was calculated by dividing the total number of pregnant women with minor and major antenatal depression by the total number of pregnant women who participated in study and multiplying by 100%. Considering that major antenatal depression is harmful, its prevalence was also estimated. If studies reported the prevalence of major depression during pregnancy, we extracted corresponding data; otherwise, for studies using self-report scales, we defined major depression following recommended cut-off points of the corresponding measurements. In this study, for a case to be defined as an instance of major antenatal depression, scores of ≥13, 10, 23, 20, and 12 had to be obtained on the Edinburgh Postnatal Depression Scale (EPDS), Patient Health

Questionnaire (PHQ), Center for Epidemiologic Studies Depression Scale (CES-D), Beck Depression Inventory (BDI), and Hospital Anxiety and Depression Scale (HADS), respectively. For cohort studies, we just included the ones reported the prevalence of antenatal depression. Any study results stratified by country were considered as independent reports.

In the present study, in the meta- analyses focusing on prevalence of antenatal depression, the effect sizes are the prevalence of antenatal depression; and in the meta- analyses of potential factors associated with antenatal depression, the effect sizes are the odds ratio (OR) and 95% CIs of each potential factors. In the meta-analysis of prevalence of antenatal depression, due to a wide range of characteristics of the included studies, a random-effects model was used to take into consideration the between-study and within-study variance and to combine the estimates of different reports (Lau, Ioannidis, & Schmid, 1997). Statistical heterogeneity among studies was evaluated using the I^2 statistic, which indicates the proportion of total variance attributable to between-study variation. The values of 25%, 50%, and 75% represent low, moderate, and high heterogeneity, respectively (Higgins & Thompson, 2002). We conducted subgroup analyses by splitting all the participant data into subgroups to explore potential heterogeneity across studies, and the differences among subgroups were tested by meta-regression analysis. Subgroup analyses were performed according to study location, country income groups (the World Bank Classification) (The World Bank, 2019), recruitment date, pregnancy trimester, and assessment instrument. In meta-regression analysis, the outcome variable is the effect estimate and the explanatory variables are characteristics of studies that might influence the effect estimate. Publication bias was evaluated with funnel plot, the Begg's rank correlation test (Begg & Mazumdar, 1994) and the

Egger's regression test (Egger, Davey Smith, Schneider, & Minder, 1997). We performed sensitivity analyses, omitting one study at a time to assess the influence of any single study on the pooled prevalence estimates.

A variable was considered as a potential factor related to antenatal depression if at least three studies provided its OR and 95% CI. For factors having data that could be used in the quantitative meta-analysis, we calculated a pooled effect size separately for each factor using random-effects meta-analysis (Lau, Ioannidis, & Schmid, 1997). Statistical heterogeneity among studies on the associated factors of antenatal depression was also evaluated using the I^2 statistic (Higgins & Thompson, 2002). All statistical analyses were performed with STATA V.11.0 (StataCorp, College Station, Texas, USA). All statistical tests were two-sided with a 0.05 significance level.

Results

The prevalence of antenatal depression

The process of literature identification and inclusion is presented in Fig. 1. The systematic search yielded 49,849 total articles. After removing duplicates and reviewing the titles and abstracts, we identified 194 potentially relevant articles. After reading the full text of articles that may be relevant, 21 were excluded based on the inclusion criteria. Finally, 173 studies with 182 independent reports were included in the meta-analysis.

Details of the included studies are shown in Table A2. The quality assessment scores of all the studies ranged from 3–9, with an average score of 6.80. The studies were conducted in 50 countries spanning six continents, with the United States contributing the most studies (n=39), followed by Australia (n=11), Brazil (n=11), and China (n=10). A total of 166 reports were conducted in upper-middle- and high-income countries and 16 in low- and lower-middle-income countries. These

studies were published between 1984 and 2019, and their samples ranged from 21–35,374, with a total sample of 197,047. Seventeen instruments were used to identify antenatal depression, and the most frequently used was EPDS (93 reports), followed by CES-D (21 reports), BDI (12 reports), PHQ (11 reports), and the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders (11 reports). For studies using identical self-report instruments to identify depressive symptoms, there were variations in the cut-off values among different studies. For example, the cut-off score for depressive symptoms ranged from 9–13 on the EPDS. In addition, the majority reports recruited participants when they were in the third trimester.

The pooled prevalence estimate of any antenatal depression across 173 studies with 182 reports was 20.7% (95% CI 19.4-21.9%, P = 0.000, I^2 = 98.4%). The pooled prevalence of major antenatal depression across 72 studies with 79 reports was 15.0% (95% CI 13.6-16.3%, P = 0.000, I^2 = 97.8%). Of the 79 reports, 22 provided data on major antenatal depression directly, and the remaining studies have reported detailed data to calculate the prevalence of major antenatal depression according to the recommended cut-off points of the corresponding measurements.

Results of subgroup analyses are summarized in Table 1. The prevalence of antenatal depression differed significantly according to country income groups, recruitment date, and the assessment instrument used. In terms of country income groups, the prevalence of antenatal depression was higher in low-income countries (30.3%, 95% CI 23.5-37.1%) and lower-middle-income countries (30.8%, 95% CI 15.3-46.4%) than that in upper-middle-income (24.2%, 95% CI 21.2-27.2%) or high-income (18.1%, 95% CI 16.9-19.3%) countries. Additionally, the prevalence of antenatal depression was highest in studies conducted after 2010 (23.1%, 95% CI

20.9-25.3%). There were significant differences among subgroups according to the assessment method used. Prevalence of antenatal depression determined by self-report questionnaires (22.4%, 95% CI 21.0-23.8%) was higher than that by structured clinical interview (12.6%, 95% CI 10.3-14.9%). Of the different self-report instruments, the prevalence identified by EPDS was the lowest (19.8%, 95% CI 18.4-21.2%). The prevalence of antenatal depression did not significantly differ with regard to study location and pregnancy trimester.

Table

Subgroup analyses of the prevalence of antenatal depression based on random-effect analysis.

	No. of reports[a]	Prevalence (%)	95% CI	I^2 (%)	*P* value for heterogeneity	*P* value between groups
Study location						0.352
African Region	8	36.2	20.6-51.7	99.3	<0.001	
Region of the Americas	61	19.6	17.5-21.8	98.2	<0.001	
South-East Asia Region	6	29.4	18.8-40.0	96.7	<0.001	
European Region	60	17.9	16.1-19.7	96.7	<0.001	
Eastern Mediterranean Region	6	40.3	26.6-54.0	97.6	<0.001	
Western Pacific Region	41	19.2	16.8-21.6	98.8	<0.001	
Country income group						<0.001
High	126	18.1	16.9-19.3	97.7	<0.001	
Upper to middle	40	24.2	21.2-27.2	98.2	<0.001	
Lower to middle	10	30.8	15.3-46.4	99.0	<0.001	
Low	6	30.3	23.5-37.1	93.4	<0.001	
Recruitment date						0.010
≤1999	17	19.3	14.7-23.8	97.8	<0.001	
2000-2009	81	18.5	16.9-20.1	97.7	<0.001	
≥2010	84	23.1	20.9-25.3	98.8	<0.001	
Trimester of pregnancy[b]						0.547
First	20	21.2	15.4-27.0	98.8	<0.001	
Second	34	15.8	13.7-17.9	97.6	<0.001	
Third	84	18.9	16.8-21.0	98.3	<0.001	
Assessment instrument						<0.001[c]
Structured clinical interview	34	12.6	10.3-14.9	93.4	<0.001	
Self-report instruments	148	22.4	21.0-23.8	98.6	<0.001	0.003[d]
EPDS	93	19.8	18.4-21.2	98.1	<0.001	
CES-D	21	24.3	21.2-27.5	96.3	<0.001	
BDI	12	26.2	20.2-32.1	95.3	<0.001	
PHQ	11	25.8	18.0-33.7	99.5	<0.001	
Other self-report instruments	11	33.0	23.7-42.3	99.0	<0.001	

CI: c

Inventory; PHQ: Patient Health Questionnaire

[a]Of the included 173 studies, one reported the prevalence of antenatal depression of two countries; one reported it of three countries; one reported it of seven countries; therefore, there are 182 independent reports.

[b]Of the included 173 studies, 10 revealed the prevalence of antenatal depression during the first trimester; 18 revealed it during the second trimester; 68 revealed it during the third trimester; 6 revealed it for the second and third trimester separately; 10 revealed it for the first, second, and third trimester, separately; and other revealed it across two or three trimesters, which cannot be categorized into a specific trimester.

[c]This *P* value indicated the difference in prevalence of antenatal depression determined by structured clinical interview and self-report questionnaires.

[d]This *P* value indicated the difference in prevalence of antenatal depression determined by different self-report instruments.

The results of sensitivity analysis showed that our findings were robust and not dependent on a single study. Our pooled estimated prevalence of antenatal depression varied between 20.33% (19.14–21.52%) and 20.79% (19.46–22.12%) after deletion of a single study. Regarding publication bias, visual inspection of the funnel plot showed some asymmetry (as depicted in Fig. 2), but the Begg's and the Egger's test did not suggest evidence of publication bias (Begg, P =0.089; Egger, P= 0.110).

Factors associated with antenatal depression

This study selection process is presented in Fig. A1. In total, 62 studies met eligibility criteria. Of these studies, 55 provided odds ratios, 3 provided prevalence ratios, 3 provided regression coefficients, and 1 provided correlation coefficients between studied factors and antenatal depression. Relevant factors from included studies were summarized into the following major categories: pregnant women's demographic characteristics, such as marital status, education, and parity; psychosocial factors, such as social support, self-esteem, experience of violence, and stressful life events; health-related factors, such as history of depression, history of abortion, chronic medical conditions, and pregnancy complications; as well as lifestyle and nutrition, such as smoking, drinking, or total fat intake.

Of the factors associated with antenatal depression, nine factors (unemployment, marital status, parity, social support, experience of violence, unplanned pregnancy, history of depression, history of smoking, and smoking during pregnancy) from 35 studies had data that could be used in the quantitative meta-analysis. The characteristics of these 35 studies are shown in Table A3. Findings from these meta-analyses (Table 2, Fig. A2.) showed that almost all the above factors (except parity) were associated significantly with antenatal depression.

Among these factors, history of depression was the most significant variable in correlation with antenatal depression (pooled OR: 3.17, 95% CI: 2.25, 4.47); followed by lack of social support (pooled OR: 3.13, 95% CI: 1.76, 5.56), and experience of violence

(pooled OR: 2.72, 95% CI: 2.26, 3.27). Compared with women who were married or lived with a partner, those who were single, separated, or divorced had higher odds of being depressive (pooled OR: 2.37, 95% CI: 1.80, 3.13). Additionally, unemployed status (pooled OR: 2.41, 95% CI: 1.76, 3.29) and unplanned pregnancy (pooled OR: 1.86, 95% CI: 1.40, 2.47) were all significantly associated with antenatal depression. With regard to smoking, women who smoked during pregnancy (pooled OR: 2.04, 95% CI: 1.41, 2.95) or before pregnancy (pooled OR: 1.97, 95% CI: 1.63, 2.38) were both associated with increased odds of being depressive.

Table

Meta-analyses of factors associated with antenatal depression based on random-effect analysis.

Associated factors	No. of studies	Minimum OR	Maximum OR	Pooled OR with 95%CI	I^2 (%)	*P* value for heterogeneity
Unemployment (Yes vs. No)	5	1.26	3.90	2.41 (1.76-3.29)	56.3	0.058
Marital status (Single vs. Married)	11	1.40	14.08	2.37 (1.80-3.13)	57.7	0.009
Parity (Primiparity vs. Multiparity)	11	0.44	3.33	0.96 (0.74-1.24)	75.4	<0.001
Social support (Low vs. High)	5	1.08	7.69	3.13 (1.76-5.56)	48.0	0.104
Experience of violence (Yes vs. No)	19	1.00	12.13	2.72 (2.26-3.27)	53.6	0.001
Unplanned pregnancy (Yes vs. No)	15	0.62	8.30	1.86 (1.40-2.47)	77.5	<0.001
History of depression (Yes vs. No)	9	0.96	9.44	3.17 (2.25-4.47)	66.5	0.002
Smoking during pregnancy (Yes vs. No)	4	1.00	7.67	2.04 (1.41-2.95)	47.4	0.127
Smoking before pregnancy (Yes vs. No)	4	1.28	2.28	1.97 (1.63-2.38)	0.0	0.548

OR: odds ratio; CI: confidence interval

Discussion

The present study showed that the prevalence of any antenatal depression was 20.7%. More seriously, 15.0% of pregnant women experienced major antenatal depression. These results indicate that the mental health of pregnant women should be paid more attention. In addition, our study verified that eight common factors are associated with antenatal depression, including history of depression, lack of social support, experience of violence, single/separated/divorced status, unemployment, unplanned pregnancy, history of smoking, and smoking during pregnancy. These aforementioned associated factors should be considered when developing strategies to prevent and intervene in antenatal depression.

The overall prevalence of any antenatal depression in our study was 20.7%, which was lower than the result of 25.3% from a previous meta-analysis only including studies conducted in the low-income and middle-income countries, and 36.1% from another meta-analysis only including studies recruited migrant women from low- and middle-income countries (Fellmeth, et al., 2017; Gelaye, et al., 2016). These differences might be due to differences in socioeconomic level and study population between studies included in these meta-analyses. With respect to major antenatal depression, the high prevalence rate reminds us that it is important to perform early identification, develop intervention strategies and conduct intervention for pregnant women with minor depression that could be progress into major depression.

Our subgroup analyses suggested that the prevalence of antenatal depression was the lowest in high-income countries, and it was considerably higher in low-income and lower-middle-income countries; this reflects the difference of the prevalence of antenatal depression according to different socioeconomic levels of countries. This may be due to the fact that pregnant women in high-income countries with

high-quality medical resources may have more access to screening tests, interventions, and treatments for depression. However, it should be noted that relevant studies from low- and lower-middle-income countries are rare. Therefore, more researches are warranted in these countries to further clarify the prevalence of antenatal depression and its related factors. The overall prevalence of antenatal depression was relatively higher after 2010. Additionally, the prevalence of antenatal depression in each trimester in our study was higher than that of the same trimester in the corresponding study conducted in 2004 (Bennett, et al., 2004). This may be caused by the ongoing technological revolution in modernization (Hidaka, 2012). The modern social environment is characterized by increasing competition and social isolation, which increases psychosocial stress among people and affect their access to sufficient social support (Hidaka, 2012). Previous studies revealed that psychosocial stress and lack of social support are significantly related to antenatal depression (Dibaba, Fantahun, & Hindin, 2013; Duko, Ayano, & Bedaso, 2019; Fiala, Svancara, Klanova, & Kasparek, 2017; Melville, Gavin, Guo, Fan, & Katon, 2010). Furthermore, consistent with the review conducted in 2004 (Bennett, et al., 2004), the prevalence of antenatal depression did not differ significantly in the first, second, and third trimesters, which indicates that antenatal depression deserves close attention as early as possible and sustained attention over the entire pregnancy. Additionally, previous studies revealed that factors related to antenatal depression in the different trimesters were not the same. Some factors were related to depression throughout the entire pregnancy (e.g. low self-esteem), while others were trimester specific (Bunevicius, et al., 2009; Lee, et al., 2007). For example, unwanted pregnancy and low marital satisfiction were related to depression in the first and second trimester, respectively (Lee, et al., 2007). Therefore, exploring trimester-specific associated factors related to antenatal

depression, and conducting targeted interventions based on these factors is required.

In general, the prevalence of antenatal depression assessed by self-reported screening instruments was considerably higher than that assessed by structured clinical interview. Therefore, when interpreting the results, we must note that majority of the studies assessed depression using self-report instruments rather than the 'gold standard' of structured clinical interviews, for diagnostic clinical interviews require health professionals and much more time. Though self-report measures potentially inflate prevalence estimates, they are convenient to perform and sensitive to depressive symptoms and thus have high clinical utility. Regarding self-report instruments, the prevalence assessed by EPDS was lower than that assessed by CES-D, BDI, and PHQ. One possible reason for this is that EPDS is a special scale for pregnant and puerperal women and CES-D, BDI, and PHQ are general scales for the general population. Another explanation is that EPDS was used more than any other scale, thus the pooled prevalence calculated from a large number of data may be more stable. If the difference of prevalence is mainly caused by the scales used, further studies are required to explore which one or which kind of scale, special or general scale, is more suitable to assess antenatal depressive symptoms.

In our study, eight factors have been confirmed to be related with antenatal depression. Of the eight factors, marital status, social support, experience of violence, history of depression, and smoking history were also reported to be related to depression among general population in previous reviews. For example, a meta-analysis of 100 relevant studies showed that social support is an important protective factor against depression (Gariepy, Honkaniemi, & Quesnel-Vallee, 2016); a few meta-analyses all indicated that experiences of violence (child trauma or intimate partner violence) were associated with depression in adults (Beydoun,

Beydoun, Kaufman, Lo, & Zonderman, 2012; Devries, et al., 2013; Mandelli, Petrelli, & Serretti, 2015); Yan et al. conducted a meta-analysis and found that compared with married elderly people, unmarried elderly people had a higher risk for depression (Yan, Huang, Huang, Wu, & Qin, 2011); and a meta-analysis of 85 relevant studies showed that both current smokers and former smokers were more likely to be depressed than non-smokers in adults (Luger, Suls, & Vander Weg, 2014). With regard to their effect sizes, history of depression was the most significant variable in correlation with antenatal depression; the second was lack of social support, and the third was experience of violence. In practice, it is recommended to assess all these confirmed factors during routine obstetric care so as to identify pregnant women at high-risk for antenatal depression. In addition, these factors should be considered when developing intervention strategies to prevent antenatal depression, such as providing psychological guidance for pregnant women who have experienced violence, encouraging families to provide more support to pregnant women, and accompany them while they participate in relevant activities during pregnancy.

This study demonstrated the global prevalence of antenatal depression, which may draw our attention to pregnant women's mental health, and can help us identify the level of antenatal depression burden. Results of subgroup analyses and meta-analyses of factors associated with antenatal depression provide references for management, optimizing prevention and intervention strategies of antenatal depression. However, there are some limitations that need to be acknowledged. First, high heterogeneity was observed. The heterogeneity across studies may result from differences in the study design, setting, samples, and outcome assessment. Second, most included studies employed self-report instruments to identify depression, which may overestimate the prevalence to a certain extent, compared to structured clinical

interviews. Third, due to the focus on general pregnant women, studies focused on high-risk pregnant women were excluded; further study is required to explore the global prevalence of antenatal depression among high-risk pregnant women. Fourth, with respect to meta-analysis of factors related to antenatal depression, we did not perform subgroup analyses. Fifth, regarding the relationship between violent experiences and antenatal depression, the majority of studies included did not specify whether the violence is childhood or current. These experiences are clinically very distinct and require different intervention strategies. Further study is warranted to clarify the association between different types of violence and antenatal depression in order to develop targeted intervention strategies. Last, only those studies published in English were included in these meta-analyses and studies in other languages were omitted.

More efforts should be put into future researches and practices. The high prevalence of antenatal depression and lack of relevant studies in low- and lower-middle-income countries highlight the need for service availability and enhanced research in these countries. Furthermore, depression is known to be under-detected and under-treated; many women do not seek help for symptoms to avoid perceived stigmas, or cannot seek help due to limited access to health resources. As most pregnant women would maintain close contact with health services during antenatal period, the possibility of enhanced antenatal depression screening programs within this setting could be explored. In addition, how we can combine associated factor identification to improve screening efficiency and accuracy as well as to enhance our clinical assessments and practice during pregnancy, also needs to be explored.

Conclusions

Our study demonstrates that the global prevalence of antenatal depression is high and a history of depression, lack of social support, single/separated/divorced status, unplanned pregnancy, unemployment, experience of violence, history of smoking, and smoking during pregnancy are significantly associated with antenatal depression. Much attention should be paid to the mental health of pregnant women, especially those from low- and lower-middle-income countries. Additionally, further studies are required to explore which scale is more suitable to assess antenatal depressive symptoms, and develop measures to efficiently prevent, screen, or treat antenatal depression by referring to its associated factors.

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Highlights

- Provides updated global estimates of prevalence of any or major antenatal depression.
- Clarifies the strength of association between many factors and antenatal depression.
- Helps to develop effective risk assessment strategies as well as prevention and intervention strategies for antenatal depression based on its associated factors.
- More relevant studies should be conducted in low- and lower-middle-income countries.
- Further studies are needed to explore which scale is more suitable to assess antenatal depression.

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Contributors: XY, NS, XX, and YG conceived the study. LQ, CY, XS, and JC commented on the research question and design. XY and NS reviewed and selected the literature, and extracted data. NJ and JZ performed the quality assessment. XY, NS and YG did the meta-analyses. XY and NS wrote the article, which was read and approved by all authors.

Conflict of Interest: None

Fig.1. Flow chart of identifying studies on prevalence of antenatal depression.

Fig.2 in the document is "Fig.2. Funnel plot for studies on prevalence of antenatal depression.

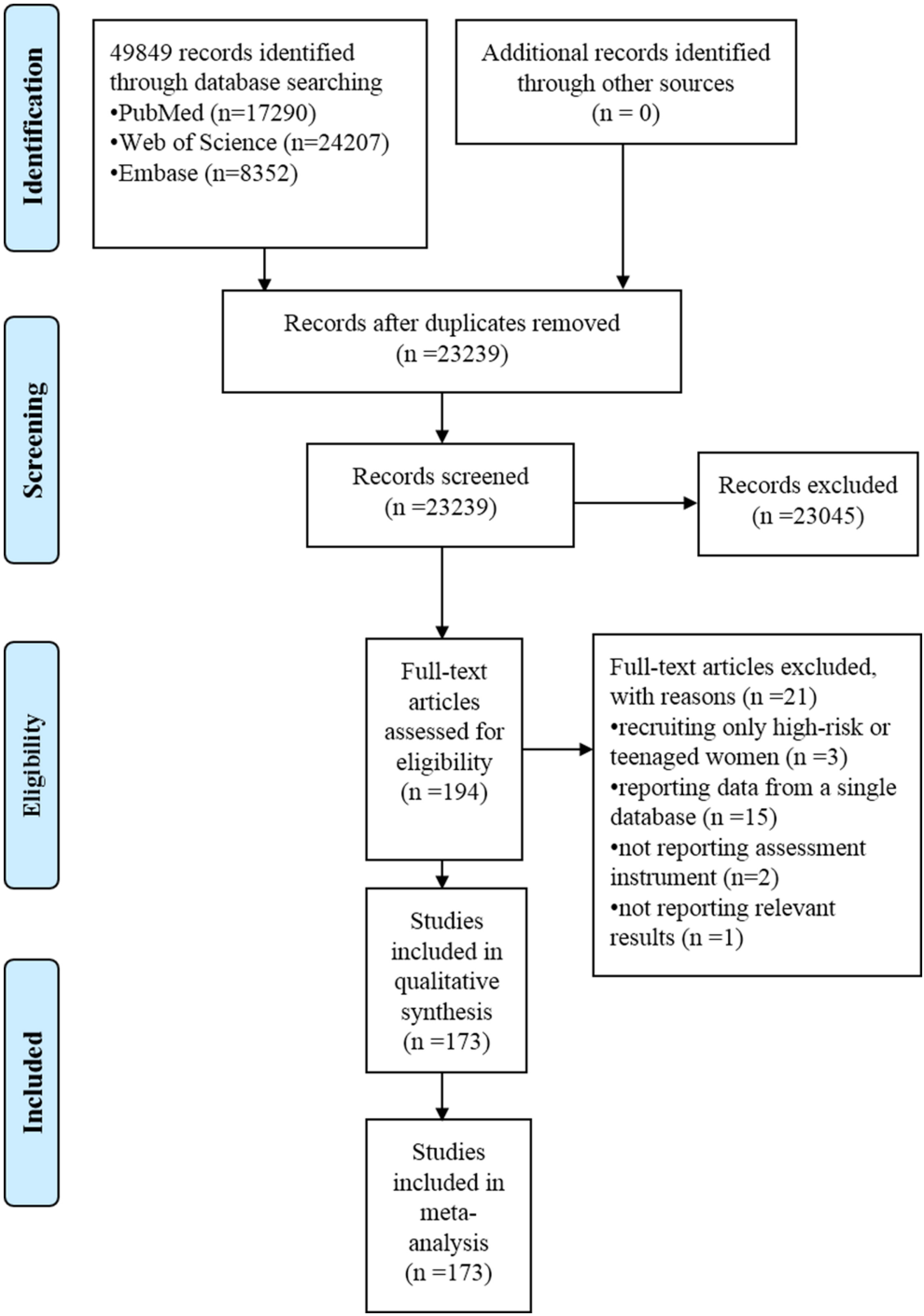
Identification
Screening
Eligibility
Included
49849 records identified through database searching
•PubMed (n=17290)
•Web of Science (n=24207)
•Embase (n=8352)
Additional records identified through other sources (n = 0)
Records after duplicates removed (n =23239)
Records screened (n =23239)
Records excluded (n =23045)
Full-text articles assessed for eligibility (n =194)
Full-text articles excluded, with reasons (n =21)
•recruiting only high-risk or teenaged women (n =3)
•reporting data from a single database (n =15)
•not reporting assessment instrument (n=2)
•not reporting relevant results (n =1)
Studies included in qualitative synthesis (n =173)
Studies included in meta-analysis (n =173)

Figure 1

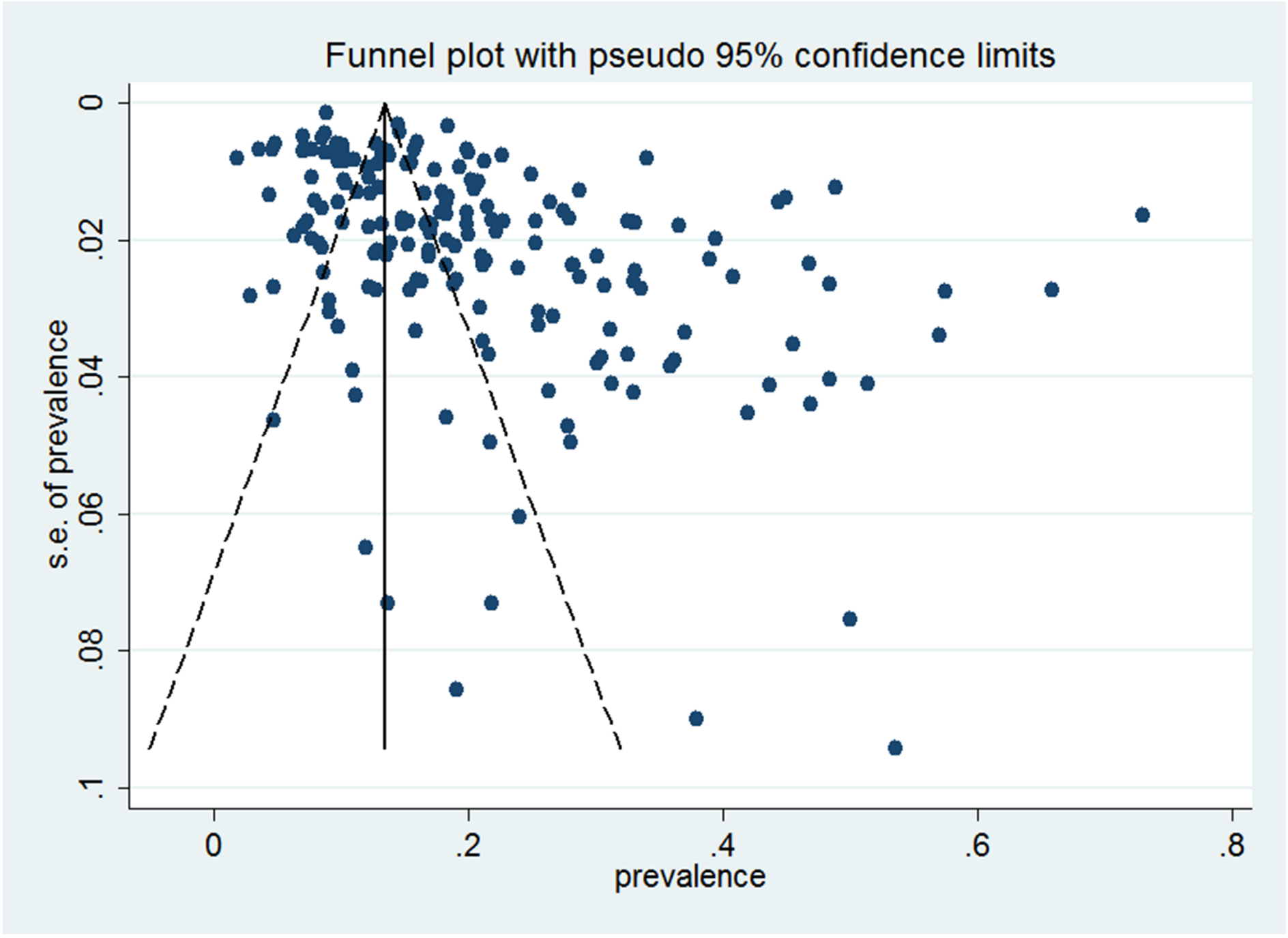
Funnel plot with pseudo 95% confidence limits
s.e. of prevalence
0
.02
.04
.06
.08
.1
0
.2
.4
.6
.8
prevalence

Figure 2