

# Prevalence of anxiety and depression among pregnant women during the COVID-19 pandemic: a systematic review and meta-analysis

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## Systematic Review

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## Abstract

**Background** COVID-19 has become a global pandemic. Its occurrence has substantially affected the psychological condition of pregnant women. The purpose of this study is to learn about the incidence of anxiety and depression among pregnant women during the pandemic, and to conduct a meta-analysis of the existing research.

**Methods** PubMed, Web of Science and EMBASE were searched without a lower time limit and up to August 13, 2020. The incidences of anxiety and depression among pregnant women were synthesized and discussed.

**Results** The prevalence of anxiety in 8 studies with a total sample size of 7493 individuals was 43% (95% confidence interval: 0.28-0.58), and the prevalence of depression in 7 studies with a sample size of 6116 people was 32% (95% confidence interval: 0.26-0.37). Significant heterogeneity was detected across studies of these incidence estimates. Subgroup analysis included the economic status to explore the sources of heterogeneity, and Egger's test was conducted to examine the publication bias.

**Conclusions** Since significant heterogeneity has been detected in studies of anxiety and depression, we must interpret the results with caution. As the COVID-19 pandemic will not end in a short time, corresponding psychological interventions must be implemented to address the mental health of pregnant women.

## Introduction

COVID-19 has been a public health emergency since it was discovered in Wuhan in December 2019. In March 2020, the COVID-19 epidemic was classified as a global pandemic by WHO.

As the first country with a COVID-19 outbreak, China began to be closed quickly. Patients with a confirmed and suspected diagnosis were isolated in the hospital, and the uninfected individuals were isolated at home. Because this measure was the most concise and effective, other countries and regions affected by the pandemic also began to shut down.

Most of the anxiety and fear comes from the unknown of the COVID-19 and its high infectivity. Moreover, there are no completely effective preventive or treatment measures. For pregnant women, they also worry about whether the COVID-19 will affect the fetus. Psychological problems such as anxiety and depression during pregnancy not only affect pregnant women themselves but also fetuses and newborns, causing conditions such as preterm birth, low birth weight, higher cortisol levels, and lower DA and 5-HT levels, among others (Diego et al. 2004; Tiffany Field et al. 2004; Dunkel Schetter and Tanner 2012)

A study presented that the anxiety of pregnant women was higher than that before the outbreak during the SARS pandemic in 2003, while the depression was not significantly changed (Lee et al. 2006). However, due to the lack of research on the psychology of pregnant women during SARS and other infectious diseases such as MERS and H7N9, we cannot understand the psychological effect of the outbreak of infectious diseases on pregnant women fully. Previous epidemics of infectious diseases did not last too long, but the COVID-19 epidemic has not stopped until now. This pandemic is more serious than any previous one. So, we are curious about the impact of the COVID-19 on the anxiety and depression of pregnant women.

The incidences of anxiety and depression in the perinatal period are 22.9% (Dennis, Falah-Hassani, and Shiri 2017) and 11.9% (Woody et al. 2017). In theory, the incidence of these disorders will increase during an epidemic. One study has reported that pregnant women during covid-19 are more likely to have anxiety and depression than before (OR = 1.94,  $\chi^2 = 10.05$ ) (Berthelot et al. 2020). However, another study showed that the incidence of depression during the outbreak did not change significantly compared with that before the outbreak (OR = 1, 95% CI 0.52-1.93) (Sade et al. 2020). Statistical analyses are still lacking due to the inconsistency of existing research results. The purpose of this study is to systematically review and analyze the incidence rates of anxiety and depression in pregnant women during the new COVID-19 pandemic to guide the implementation of better psychological interventions.

## Methods

### Search Strategy

We systematically searched the literature in the PubMed, Web of Science and EMBASE databases. The retrieval period did not have a lower time limit and the upper limit was August 13, 2020. The search terms Coronavirus, COVID-19, 2019-ncov, SARS-cov-2, Anxiety, Depression, and all the possible combinations of these keywords were used to identify relevant articles.

The following keywords were used for the search: (COVID-19 OR 2019 novel coronavirus disease OR COVID19 OR COVID-19 pandemic OR SARS-CoV-2 infection OR COVID-19 virus disease OR 2019 novel coronavirus infection OR 2019-nCoV infection OR coronavirus disease 2019 OR coronavirus disease-19 OR 2019-nCoV disease OR COVID-19 virus infection) AND (Pregnant Women OR Pregnant Woman OR Woman, Pregnant OR Women, Pregnant OR Pregnancy OR Pregnancies OR Gestation) AND (depression OR depressive OR Melancholia OR Melancholias OR Anxiety OR Hypervigilance OR Nervousness OR Social Anxiety OR Anxieties, Social OR Anxiety, Social OR Social Anxieties).

The literature search had no language restrictions.

### **Selection Criteria**

The inclusion criteria were 1. case reports, case series and observational studies of pregnant women with COVID-19; 2. studies that examined the prevalence of anxiety and depression; and 3. the full text was available. The exclusion criteria were 1. unrelated research articles; 2. article types such as authors' replies, reviews, and guidelines; 3. duplicate articles; 4. articles with incomplete or missing data; and 5. articles where the full text was unavailable.

### **Quality Assessment**

Two reviewers independently reviewed each included article. The items on the checklist included the article title, first author's name, year of publication, country of study, sample size, assessment method, type of study, and the prevalence rates of anxiety and depression. When the reviewers' opinions were inconsistent, they sought the opinion of the third reviewer or negotiated a solution.

### **Statistical Analysis**

A random-effect model was used to estimate the pooled proportion of anxiety and depression. Statistical heterogeneity was considered present when  $p < 0.1$  or  $I^2 > 50\%$ . Publication bias was evaluated visually by constructing funnel plots and considered significant when  $p < 0.05$  according to Egger's test. STATA 14.0 software (Stata Corporation, College Station, TX, USA) was also used to conduct different analyses and all statistical tests.

## **Results**

### **Search Results**

A total of 129 articles were obtained using the search strategy. Among them, 63 articles were excluded because of duplication. After screening the titles and abstracts, 50 articles were excluded because of irrelevant contents or because they met the exclusion criteria. After screening the full-text of the remaining 16 articles, five were excluded because they did not contain the data we aimed to analyze. Finally, this study included 11 cross-sectional studies. The study selection process is illustrated in Figure 1.

### **Study Characteristics**

The summary characteristics of the included 11 studies were presented in Table 1. All of the included studies were cross-sectional studies and published in 2020. In terms of research region, 3 studies were conducted in China, 2 in Italy, 1 in USA, 1 in Belgium, 1 in Turkey, 1 in Canada, 1 in Sri Lanka and 1 in Israel. The studies were based on 45 to 1947 pregnant women, comprised a total sample size of 7493 on anxiety and 6116 on depression. 3 studies used Generalized Anxiety Disorder (GAD-7), 1 study used the Patient-Reported Outcomes Measurement Information System (PROMIS), 1 study used Hamilton Depression Rating Scale (HDRS), 1 study used Self-Rating Anxiety Scale (SAS), and 2 studies used the State-Trait Anxiety Inventory (STAI) to assess anxiety among pregnant women. 1 study used Patient Health Questionnaire (PHQ9), 1 study used HDRS, 1 study used the Edinburgh Depression Scale (EDS), and 4 studies used the Edinburgh Postnatal Depression Scale (EPDS) to assess depression.

Since the included studies were all cross-sectional studies, the Combie cross-sectional study evaluation tool was used to evaluate the included studies (Crombie 1996). An item would receive a score of '0' if the answer was 'NO', '0.5' for 'UNCLEAR', and '1' for an answer of 'YES'. The quality of the articles was assessed as follows: low quality = 0–3.5; moderate quality = 4.0–5.5; and high quality = 6.0–7.0. Based on it, 1 study was of high methodological quality and 10 studies were of moderate methodological quality.

Some studies did not clearly define anxiety and depression, but divided these conditions into three categories: mild, moderate, and severe. In the statistical analysis, we included the patients with moderate and severe anxiety and depression.

### **Overall Prevalence of Anxiety**

The prevalence of anxiety within the population reported in eight studies with 7493 subjects ranged from 3% to 82% (Figure 2). Meta-analytic pooling of these rates generated an overall prevalence of 43% (95% CI: 0.28–0.58,  $p=0.000$ ,  $I^2=99.7\%$ ), which was calculated using the random-effects model ( $p<0.05$ ), with significant between-study heterogeneity observed.

Because the medical quality and scientific research level of a region are related to its economic status, we performed a subgroup analysis (Figure 3). The summarized proportion of pregnant women with anxiety in developed countries was 49% (95% CI: 0.28-0.71), while the value in developing countries was 33% (95% CI: 0.07-0.60).

To examine publication bias in the collected articles, Egger's test was conducted to determine publication bias in terms of the prevalence of anxiety in the included articles ( $p=0.010$ ) (Figure 4). Publication bias was observed.

### **Overall Prevalence of Depression**

The prevalence of depression within the population reported in seven studies with 6116 subjects ranged from 19% to 64% (Figure 5). Meta-analytic pooling of these rates generated an overall prevalence of 32% (95% CI: 0.26-0.37,  $p=0.000$ ,  $I^2=94.6\%$ ), which was calculated using the random-effects model ( $p<0.05$ ). Significant between-study heterogeneity was observed.

A subgroup analysis was performed (Figure 6). The summarized proportion of pregnant women with depression in developed countries was 29% (95% CI: 0.20-0.39), while the proportion in developing countries was 35% (95% CI: 0.25-0.45). Egger's test of the prevalence of depression was performed ( $p=0.567$ ) (Figure 7) and revealed that publication bias did not exist.

## **Discussion**

The high heterogeneity was discovered in the present study. Therefore, we performed subgroup analysis. However, the heterogeneity of each group did not change significantly. The possible reasons must be considered with caution. The sample sizes of the included articles vary greatly. The effectiveness of different scales for screening anxiety and depression also differs. Since the present study is a meta-analysis of a single group without control groups, the heterogeneity of the meta-analysis may be significant and high. However, due to the relatively small number of studies included, we did not conduct a sensitivity analysis and meta-regression analysis to exclude some studies.

Publication bias was observed in the meta-analysis of anxiety. Due to the pandemic, the speed of review of articles will be affected. The studies may be under review or not yet published. The countries in which the included studies were conducted are mainly located in China, North America and Europe, but the new disease is a global pandemic. Relevant research or investigations may not have been conducted in other areas yet. Alternatively, the published articles may not have been included in the databases. All of these factors may lead to publication bias.

This study aims to estimate the incidence rates of anxiety and depression among pregnant women worldwide. According to the results, we can provide information about the corresponding psychological interventions to implement during pregnancy. Therefore, despite the presence of publication bias and high heterogeneity, this study still has some reference value.

The psychological problems of pregnant women are mainly due to the isolation caused by the pandemic. These women experience loneliness because of reduced social interactions and anxiety caused by trivial matters during pregnancy. During this period, the husband's company is particularly important. According to some studies, when the husband is not around, the incidences of psychological problems such as fear, depression and anxiety, in pregnant women will increase; however, if the husband also has corresponding psychological problems, the couple will interact with each other (Ahorsu et al. 2020). Therefore, in addition to the pregnant women themselves, their families also require corresponding psychological support.

Due to isolation alone at home, most of the studies included in the study were conducted using means of online questionnaires. Many people spend most of their time browsing the Internet to alleviate their anxiety and loneliness. News about COVID-19 will increase anxiety (WHO 2020). A wide variety of information about COVID-19 is available on the Internet. Most of the information is negative. Therefore, a closer focus on the information on the pandemic available on the Internet will lead to increased anxiety (Moghanibashi-Mansourieh 2020). Exaggeration and false information about the new pandemic will increase people's anxiety, while positive news about disease cures and vaccine development will reduce psychological problems. Therefore, during the pandemic, appropriate information should be selected, and communication and relaxation through interaction with the social network are recommended.

In the present study, we conducted a subgroup analysis based on the economic status of the source regions. Due to the limited number of articles, this parameter did not affect the overall heterogeneity. In addition to people from different regions, the risk of psychological problems will also be significantly different among people in the same area, because of the differences in occupation, income, education background and cognitive level. A study has shown that, compared to people with a master's degree or higher, those with a bachelor's degree group had a depression risk of 0.39 (95% CI 0.17-0.87). Compared with professionals, industrial service workers and other staff had a depression risk of 0.31 (95% CI 0.15-0.65) and 0.38 (95% CI 0.15-0.93) respectively (Wang et al. 2020). The potential explanation for this finding is that people with a higher income and cognitive level may pay closer attention to their mental health. Pregnant women have a similar focus on their mental health. Therefore, we closely monitor the psychological status of pregnant women with different incomes and cognitive levels, and provide different interventions based on their differences and specific conditions.

In addition, no difference in the levels of depression and anxiety were reported between pregnant women who were positive for COVID-19 and women without the infection in a recent study (Kotabagi et al. 2020). However, due to the small number of included samples, the research results should not be generalized and are not representative. However, because the COVID-19-positive mothers are isolated in a hospital, they will have greater access to the corresponding psychological interventions.

## Conclusion

In a few months, COVID-19 has become a global pandemic. It not only substantially affects people's physical health but also exerts a certain effect on people's psychological condition, particularly pregnant individuals with greater emotional sensitivity. An understanding of the incidence rates of anxiety and depression among pregnant women is important to guide the implementation of psychological interventions prior to the occurrence of these disorders.

## Declarations

### Authors' contributions

H.Y and Y.G conducted the literature search and selected studies. Q.X and Y.Y assessed the methodological quality of the studies and extracted data. J.Z conceived and planned the review, assessed the methodological quality of the studies, verified the data, and drafted and revised the manuscript. R.Z provided methodological advice, content expertise, and revised the manuscript. All authors contributed to writing the protocol. All authors read and approved the final manuscript.

### Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

### Ethics approval and consent to participate

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

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## Table

First author	Study date (year, month, day)	Region	Study design	Survey method	Study population	Patients (No.)		Assessment tools		Quality score
						Anxiety	Depression	Anxiety	Depression	
Ceulemans, M. (Ceulemans, Hompes, and Foulon 2020)	NA	Belgium	cross-sectional	online questionnaire	2421	327	612	GAD-7	EDS	5.5
Durankuş, F. (Durankuş and Aksu 2020)	NA	Turkey	cross-sectional	online questionnaire	260	NA	92	NA	EPDS	5.5
Lebel, C. (Lebel et al. 2020)	2020.4.5-2020.4.20	Canada	cross-sectional	Semi-structured interview	1764	813	653	PROMIS	EPDS	6
Li, X. (Li et al. 2020)	2020.4.25-2020.5.9	China	cross-sectional	online survey and face-to-face interviews	45	37	29	GAD-7	PHQ-9	5.5
Liu, X. (Liu et al. 2020)	2020.2.3-2020.2.9	China	cross-sectional	online questionnaire	1947	64	NA	SAS	NA	5.5
Mappa, I. (Mappa, Distefano, and Rizzo 2020)	2020.3.9-2020.3.12	Italy	cross-sectional	online semi-structured questionnaire	178	137	NA	STAI	NA	5.5
Patabendige, M. (Patabendige et al. 2020)	2020.4.27-2020.5.20	Sri Lanka	cross-sectional	face-to-face questionnaire	257	45	50	HADS	HADS	5.5
Preis, H. (Preis et al. 2020)	-2020.4	USA	cross-sectional	online questionnaire	788	341	NA	GAD-7	NA	5.5
Saccone, G. (Saccone et al. 2020)	2020.3.15-2020.4.1	Italy	cross-sectional	NA	100	68	NA	STAI	NA	5.5
Sade, S. (Sade et al. 2020)	2020.3.19-2020.5.26	Israel	cross-sectional	face-to-face questionnaire	84	NA	21	NA	EPDS	5.5
Wu, Y. (Wu et al. 2020)	2020.1.1-2020.2.9	China	cross-sectional	face-to-face questionnaire	1285	NA	372	NA	EPDS	5.5

Table 1 Characteristics of the studies included in the meta-analysis

## Figures



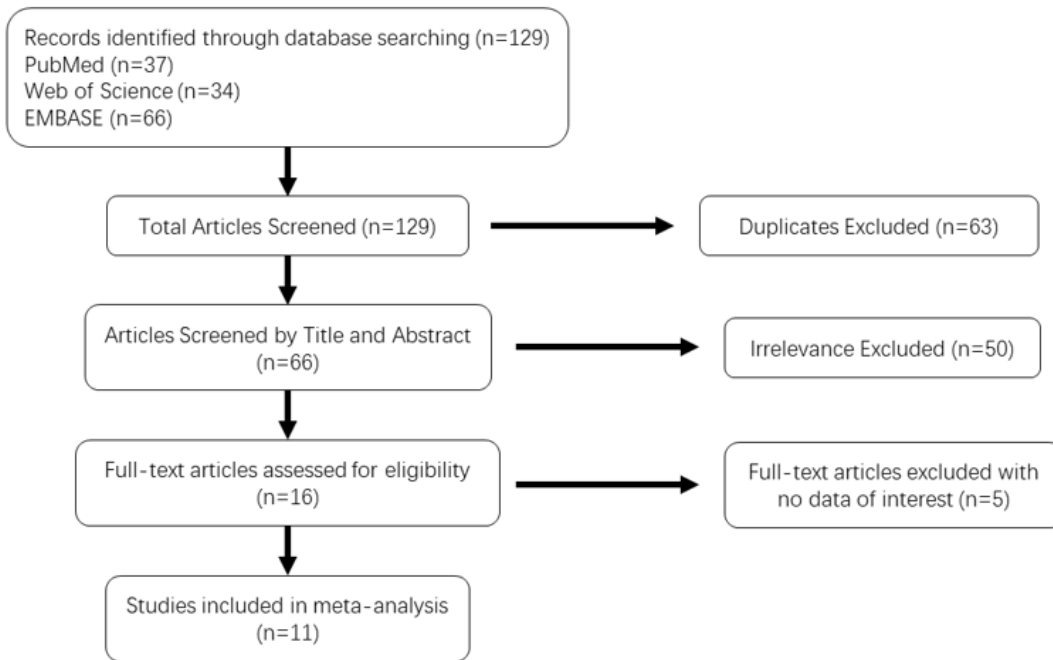


Figure 1

Flowchart of the process used to select studies for inclusion in the meta-analysis

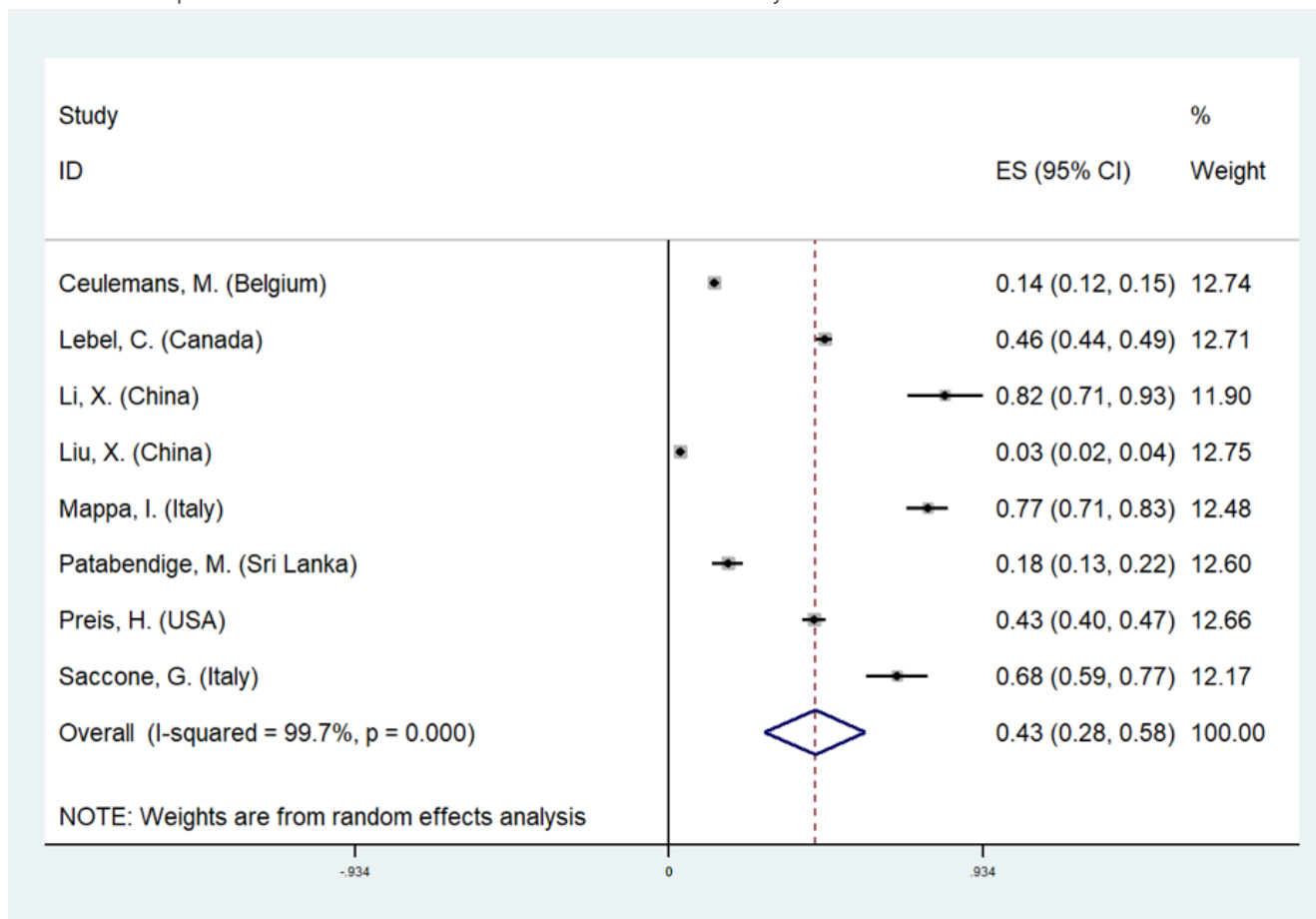


Figure 2

Summary of the proportion of pregnant women with anxiety

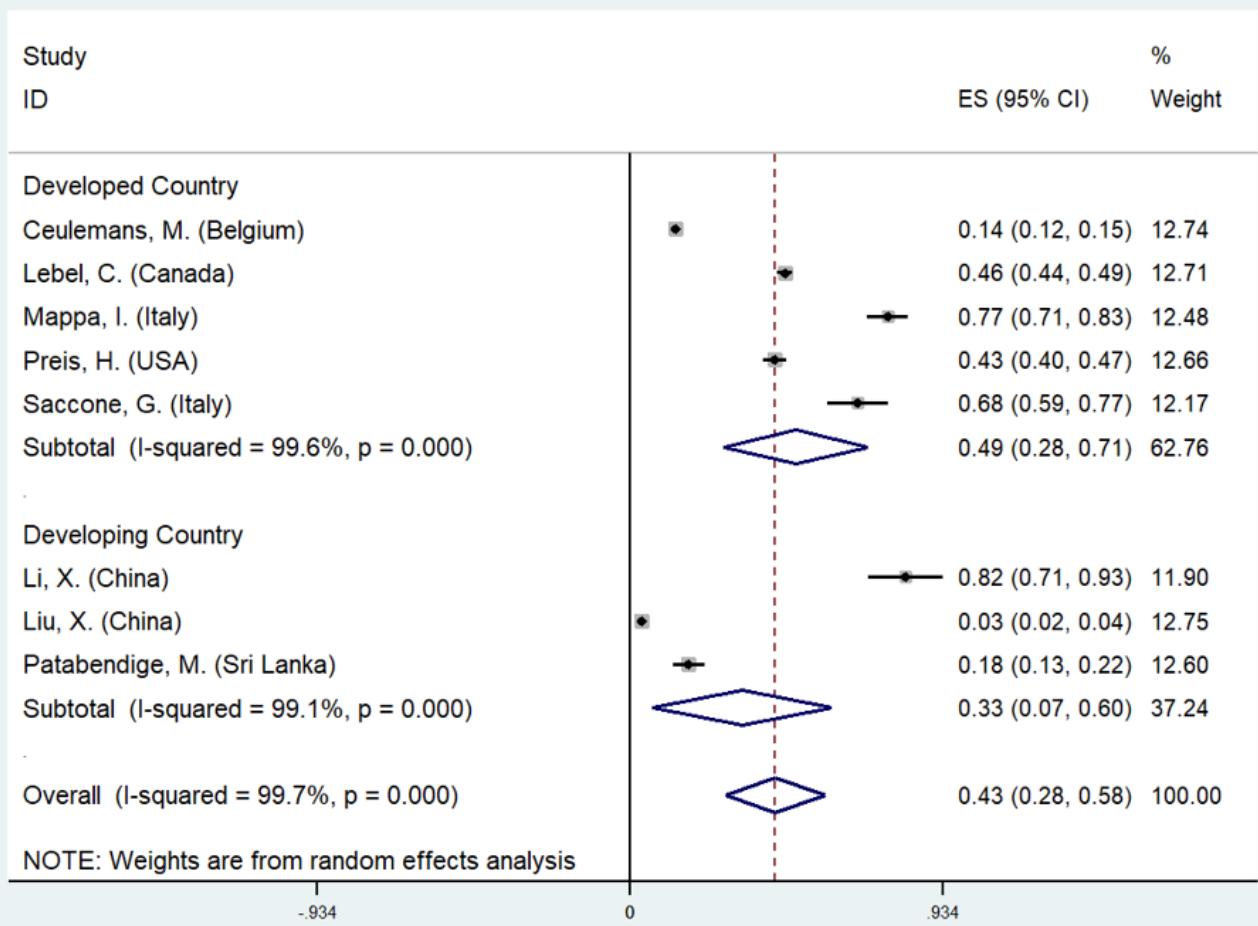


Figure 3

Subgroup meta-analysis of the summarized proportion of pregnant women with anxiety

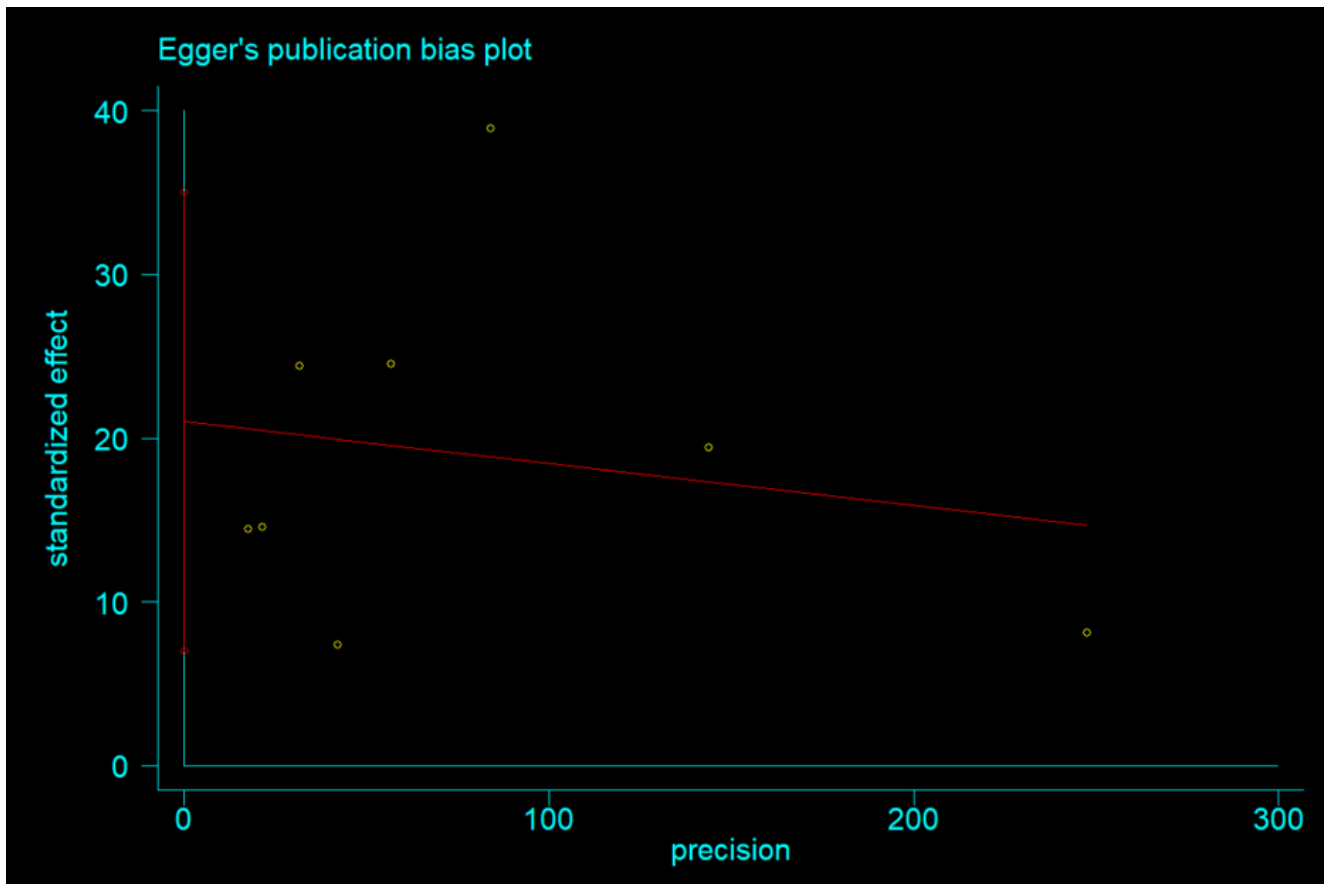


Figure 4

Egger's test for the prevalence of anxiety

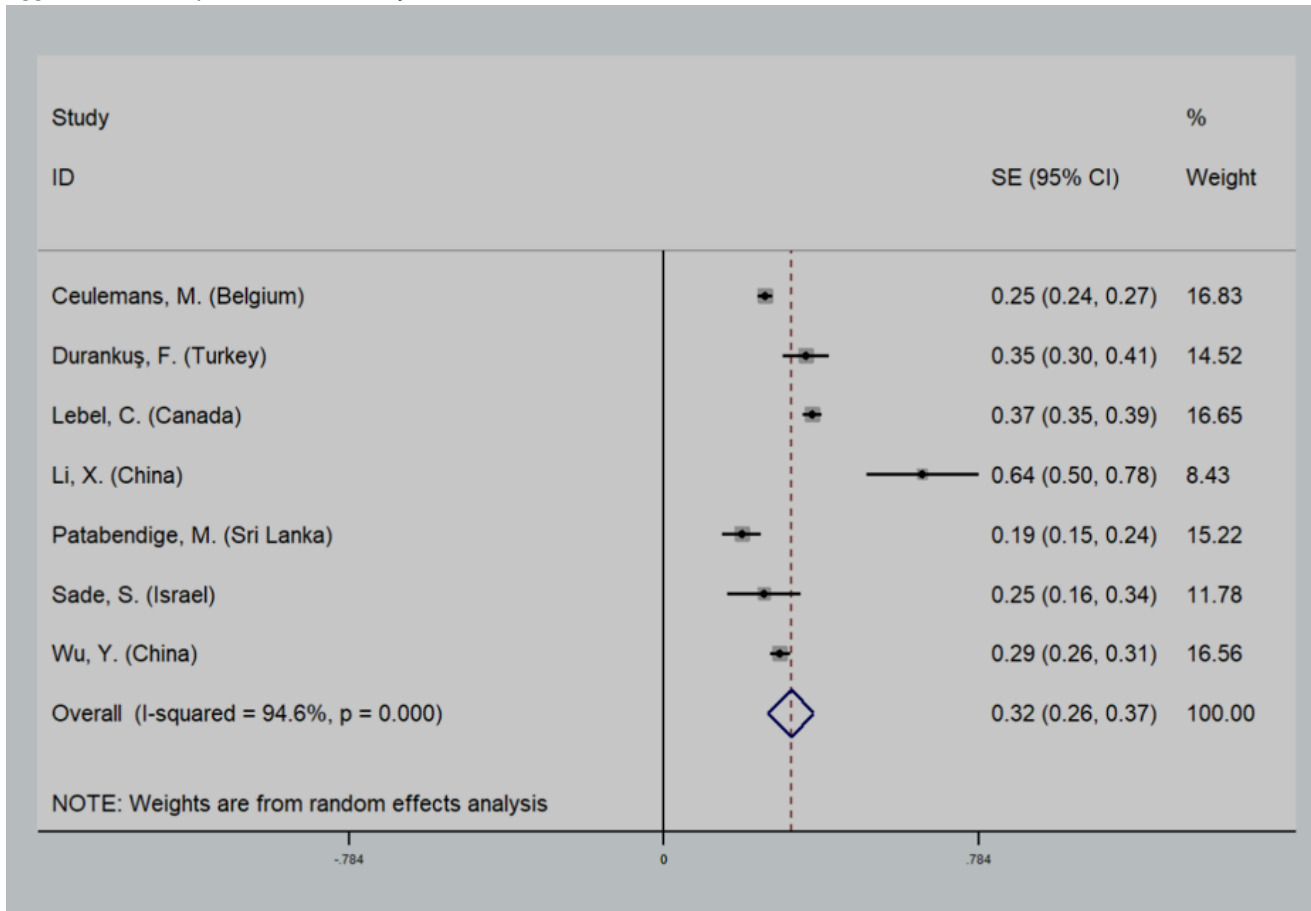


Figure 5

Summarized proportion of pregnant women with depression

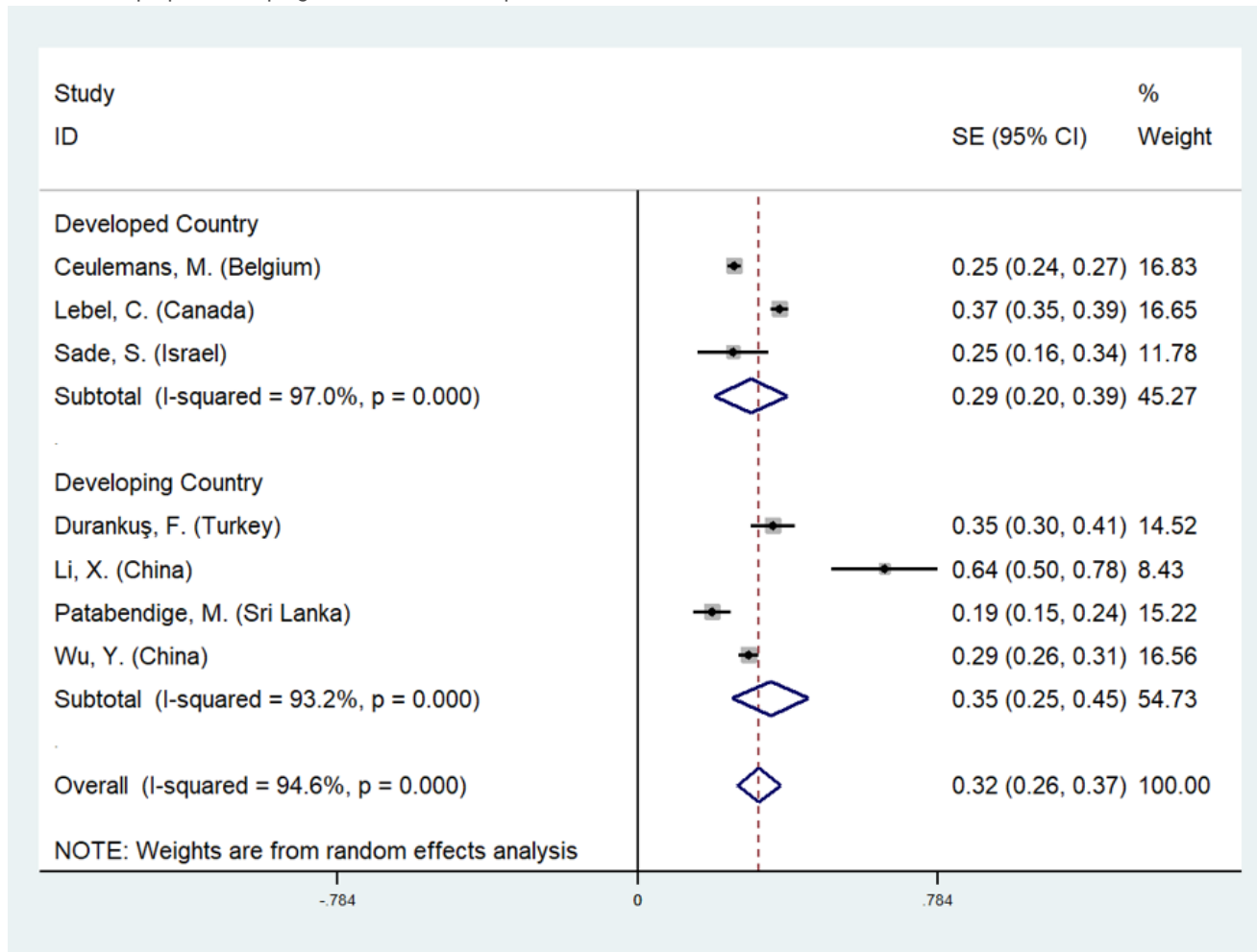


Figure 6

Subgroup meta-analysis of the summarized proportion of pregnant women with depression

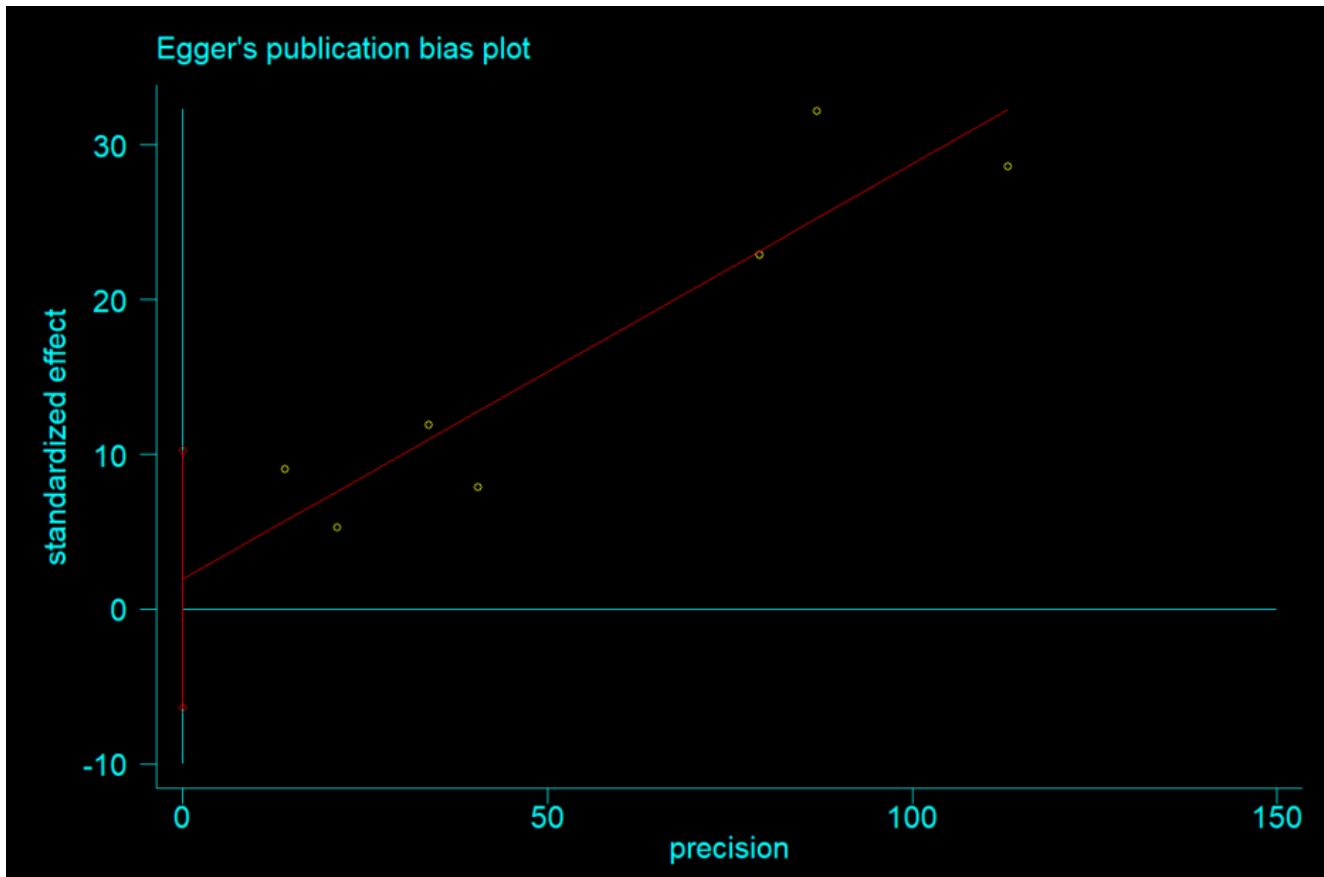


Figure 7

Egger's test for the prevalence of depression