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Association of postpartum depression and cesarean section: A systematic review and meta-analysis

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ABSTRACT

Objectives: Postpartum depression (PPD) is a major depressive disorder. Its symptoms begin 4 weeks after delivery. Several studies have evaluated the association of the type of delivery with PPD; however, there are controversies regarding this association. Therefore, the aim of this systematic review was to estimate the overall association between cesarean section (CS) and PPD.

Methods: The international databases of Medline, Scopus, Web of Science, Science Direct, EMBASE and Ovid were searched until May 2017. Quality assessment was done using the Newcastle-Ottawa Scale. The pooled odds ratio in case-control and relative risk in cohort studies were used as the measures of association. A random-effects model was applied for the report of the results with 95% confidence intervals.

Results: Of 989 studies, 32 articles met the eligibility criteria and were included in the review. The adjusted OR of the association between CS and PPD was 1.15 (95% CI: 1.00, 1.34) and the crude odds ratio of this association was 1.36 (1.20, 1.55). The odds ratio of the association of elective and emergency CS and PPD was 1.29 (1.12, 1.49) and 1.36 (1.20, 1.55), respectively. In addition, the pooled relative risk of the association between CS and PPD was 1.22 (0.94, 1.58) in cohort studies.

Conclusions: Based on the results of this meta-analysis, it seems CS, regardless of the type of cesarean, is a risk factor for PPD.

1. Introduction

According to the last report of the World Health Organization, depression is one of the most common diseases affecting more than 300 million people in the world.[1] In addition, depression is the most important cause of suicide-related death and results in 800,000 deaths annually.[2] (PPD) is a common disorder among women in the world. The symptoms of this disease usually begin four weeks after delivery.[3] Some of the symptoms include anxiety, feeling inefficient in the care of the newborn, inability to cope with the new situation, loss of control, obsessive thoughts, irrational fear, and disappointment.[4] In addition to negative effects on the mother-infant relationship, inappropriate nutrition, and inadequate growth of the newborn, PPD may cause learning problems for the children of affected mothers.[5] Moreover, the risk of suicide-related deaths among postpartum depressive women is more than healthy mothers.[6] On the other hand, mothers who experience PPD are more susceptible to depression in the later stages of their lives.[7] The burden of PPD in lower and middle-income countries is more than high-income countries.[8]

There are two types of CS including elective and emergent. Elective CS is a medically unnecessary CS, where the pregnant women or her doctor requests this method for delivery. Emergent CS has been defined as an unplanned CS, for example, CS accomplished before the planned date of delivery because of clinical conditions of pregnant women.[9]

Several studies have assessed the association of cesarean section (CS) and PPD. Based on the results of some studies, the type of delivery is associated with PPD.[10] Mothers who undergo vaginal delivery have a lower risk of PPD than mothers with a CS. The risk of PPD after elective CS is higher than its risk after vaginal delivery, and emergency CS.[11] Other studies have reported a higher incidence of PPD in mothers with emergency CS compared to elective cesarean and vaginal delivery.[12–14] Some studies have not shown an association between the type of delivery and PPD.[15–17]

Due to the controversy in the results of the studies and lack of a

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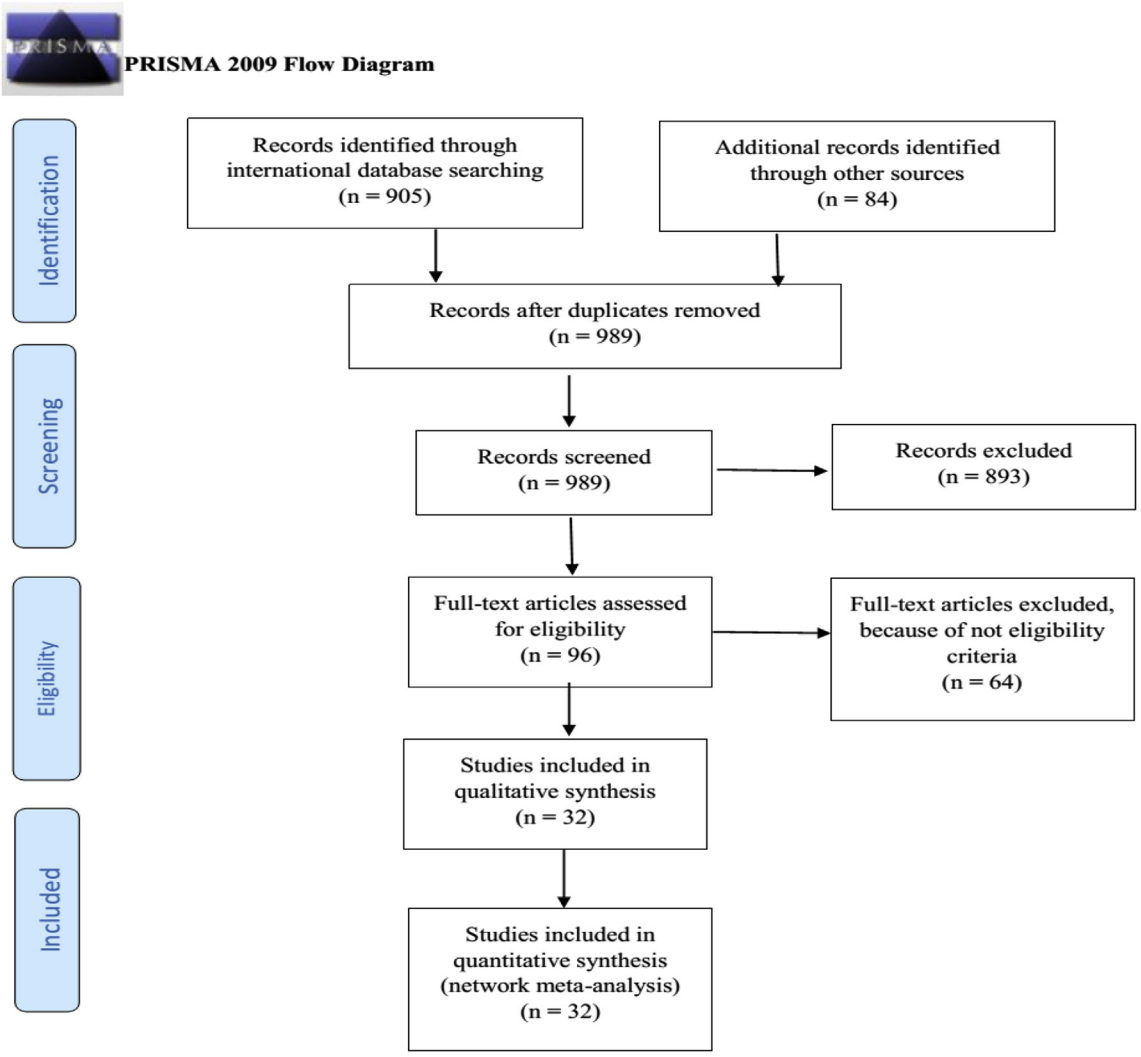

Fig. 1. A flow chart depicting the stages of retrieving articles and checking eligibility criteria for Meta-analyze.

universal consensus regarding the association between CS and PPD, this systematic review aimed to investigate the overall association of CS with PPD.

2. Methods

2.1. Search strategy

The international electronic databases were searched using a pre-designed search strategy. We combined a set of keywords including CS, PPD, cohort, and case-control studies. The databases of Medline (from January 1950 to May 2017), Scopus (from January 1973 to May 2017), Web of Science (from January 1945 to May 2017), Science Direct (from January 1823 to May 2017), EMBASE (from January 1974 to May 2017), and Ovid (from January 1860 to May 2017) were searched. In order to access more resources, the reference lists of selected articles were also scanned and the authors of selected studies were contacted.

2.2. Selection criteria for studies

All cohort and case-control studies that assessed the association of the type of delivery and PPD regardless of time, and language of publication were included in this systematic review. The primary outcome was PPD confirmed using standard tools.

2.3. Data collection and assessment of validity

Two researchers (HM and MOG) were responsible for screening the retrieved studies independently. They read the titles and abstracts of the studies in order to identify the studies that met the eligibility criteria. Then, the full texts of the selected studies were reviewed and the articles that met the inclusion criterion completely were included in the meta-analysis. Any disagreement between authors was resolved by discussion and judgment of a third author (ADI). The agreement and inter-reliability of the two authors were assessed using the Kappa statistics. The kappa value was 82%.

The following variables were extracted from the selected studies for data analysis. The name of first author, the year of publication, the sample size, average age of the mothers, number of patients of the followings: PPD (+); CS (+) depression (−); CS (+) depression (+); vaginal delivery (+) depression (+); vaginal delivery (+) depression (−). The time of PPD measurement, instruments used to diagnose depression, the adjusted odds ratio (OR) and relative risk (RR) for the association of type of delivery and PPD. Moreover, the adjusted variables for the relationship between CS and depression were extracted. The crude OR and RR of studies that did not report the adjusted OR or RR was calculated.

Table 1
Characteristics of the included studies in systematic review of the association between postpartum depression and cesarean section.

author	Publish year	Study Type	Sample size	Age Mean	Postnatal depression number	Reported type Cesarean	OR (CI)	RR (CI)	Adjusted Variable	Questionnaire	Quality
Michael E. Silverman	2016	cohort	707701	29.3	4397	Elective Cesarean Emergency Cesarean	– –	1.37 (.96–1.97) .95 (.84–1.08)	maternal depression history, year of delivery, maternal age, cohabitation with father of the infant, hypertensive diseases, diabetic diseases, prolonged labor, mode of delivery, gestational age, birth weight for gestational age, congenital malformations, and sphincter rupture.	International Classification of Diseases (ICD)	*****
Phili M boyce	1992	cohort	179	26.7	19	Emergency Cesarean	–	2.2 (.82–5.86)	NO	Edinburgh	********
S.Meltzer Broby	2017	Cohort	392458	26.92	983	Elective Cesarean	–	1.32 (1.13–1.53)	NO	Edinburgh	****
Ri-hua Xie	2011	Cohort	385	28.26	89	Elective Cesarean	1.82 (1.04–3.17)	–	maternal age, household income, gestational age at delivery, pregnancy complications, delivery complications, birth weight, infant sex, and total postnatal social support score as the independent variables.	Edinburgh	******
Kamran pur. B	2011	Cohort	310	26.83	20	Elective Cesarean	2.53 (.93–6.88)	–	maternal age, Abortion history, Premenstrual syndrome	Edinburgh	********
Roshni R Patel	2005	Cohort	10934	–	1129	Elective Cesarean Emergency Cesarean	1.06 (.66–1.7) 1.17 (.77–1.79)	–	maternal age, gestational age at delivery, parity, neonatal head circumference, and birth weight, previous cesarean section, epidural in labour, previous miscarriage, antenatal class attendance, diabetes mellitus, fetal presentation, outcome of last pregnancy, preferred labour position, perceived loss of control in labour.	Edinburgh	******
Sari Raisanen	2013	case-control	511334	29	447	Elective Cesarean	1.32 (1.06–1.43)	–	Depression before pregnancy, Depression during pregnancy, Nulliparous, Smoking status, Socioeconomic status, Fear of childbirth	International Classification of Diseases (ICD)	*****
Zohre Sadat	2014	Cohort	321	26.53	47	Elective Cesarean	.81 (.46–1.41)	–	maternal age, Number of children, Unwanted pregnancy, Unwanted sex of baby, Level of education	Edinburgh	********
Dolatian. M	2005	Cohort	148	22.71	30	Elective Cesarean	2 (1.2–3.9)	–	BMI, employment status, exposure to secondhand smoke, child care anxiety score and self-esteem score	Edinburgh	********
abeer a alharbi	2014	Case-control	352	29.92	117	Elective Cesarean	.96 (.56–1.64)	–	Hemoglobin, Pregnancy period, Sex of child, Anemia during pregnancy, Iron pills given during pregnancy	Edinburgh	***
SS Adams	2011	Cohort	55814	30.12	2538	Elective Cesarean Emergency Cesarean	.96 (.79–1.16) 1.13 (.97–1.32)	–	maternal age, mode of delivery, obstetric complications, parity, educational level and maternal wish for cesarean delivery	SCL-8 score	********
EA Blom	2010	Cohort	4941	31	396	Elective Cesarean Emergency Cesarean	.99 (.56_1.75) 1.53 (1.02–2.31)	–	General psychopathological symptoms, family functioning, maternal ethnicity and age, education level mother, and family income	Edinburgh	********
Diana Petrosyan	2011	Case-control	4941	–	63	Elective Cesarean	.59 (.21–1.65)	–	maternal age, Premenstrual syndrome, Social support, socioeconomic status, marriage age, Spouse's age, Mother's occupation	Edinburgh	********
M. Chaaya	2002	Cohort	396	28.5	83	Elective Cesarean	.14 (.03-.56)	–	Depression during pregnancy, Chronic problems, Area, Stressful life events, Social support, Life time depression, Education, Working, Breastfeeding	Edinburgh	****
W Sword	2011	Cohort	1897	31.3	144	Elective Cesarean	1.06 (.61–1.85)	–	Mother's age, any previous depression, social support, country of birth, total household income	Edinburgh	*******

(*continued on next page*)

Table 1 (*continued*)

author	Publish year	Study Type	Sample size	Age Mean	Postnatal depression number	Reported type Cesarean	OR (CI)	RR (CI)	Adjusted Variable	Questionnaire	Quality
Kathryn A. Houston	2014	Cohort	106	31.9	10	Elective Cesarean	1.13 (.01–2.26)	–	Parity, preterm delivery age, race/ethnicity, education, income, employment status, relationship status.	PHQ-9	*******
S.M. sylvan	2016	Cohort	530	–	34	Elective Cesarean	1.1 (.5–2.4)	–	NO	Edinburgh	********
Szu-Nian Yang	2011	Case-control	10535	29.73	2107	Elective Cesarean	1.48 (1.07–2.03)	–	NO	International Classification of Diseases (ICD)	*******
Hiroko IWATA	2014	Cohort	479	37.71	103	Elective Cesarean Emergency Cesarean	.8 (.35–1.84) 2.87 (1.47–5.6)	–	NO	Edinburgh	********
ABIODUN O. ADEWUYA	2005	Case-control	876	28.37	127	Elective Cesarean Emergency Cesarean	1.47 (.31–6.99) 3.85 (1.72–7.48)	–	NO	Edinburgh	********
Jill Astbury	1994	Case-control	779	–	118	Elective Cesarean	1.88 (1.22–2.86)	–	NO	Edinburgh	****
Maria Asuncion Lara	2016	Cohort	210	29.5	36	Elective Cesarean	1.19 (.55–2.54)	–	NO	PHQ-9	******
Najafian. M	2013	Cohort	600	26.38	62	Elective Cesarean Emergency Cesarean	2.22 (.99–4.95) 4.34 (2.05–9.18)	–	NO	Edinburgh	*******
Vincenzo Zanardo	2017	Cohort	950	33.12	216	Elective Cesarean	1.52 (1.1–2.24)	–	NO	Edinburgh	********
Farhat Rehana Malik	2015	Cohort	100	29.68	41	Elective Cesarean	5.52 (2.38–12.76)	–	NO	Edinburgh	*****
Sarah J. Breese McCoy	2006	Cohort	209	–	81	Elective Cesarean	1.81 (.94–3.48)	–	NO	Edinburgh	****
Omir Weisman	2010	Cohort	1648	30.5	337	Elective Cesarean	1.25 (.97–1.61)	–	NO	Beck Depression Inventory	****
Derya Akdag Cirik	2016	Cohort	149	25	3535	Elective Cesarean Emergency Cesarean	1.11 (.38–3.3) 1.39 (.57–3.42)	–	NO	Edinburgh	****
DENZIL R. L. EDWARDS	1994	Cohort	196	26.7	35	Elective Cesarean	1.08 (.52–2.24)	–	NO	Bromley Postnatal Depression Scale	****
Paulina Hiltune	2004	Cohort	162	29	21	Elective Cesarean Emergency Cesarean	1.37 (.29–6.52) .7 (.06–7.74)	–	NO	Edinburgh	*********
Ann Josefsson	2002	Case-control	396	29.6	123	Elective Cesarean Emergency Cesarean	1.66 (.64–4.31) 1.24 (.58–2.61)	–	NO	Edinburgh	*********
Nielsen Forman	2000	Cohort	5091	–	281	Emergency Cesarean	1.1 (.7–1.9)	–	NO	Edinburgh	******

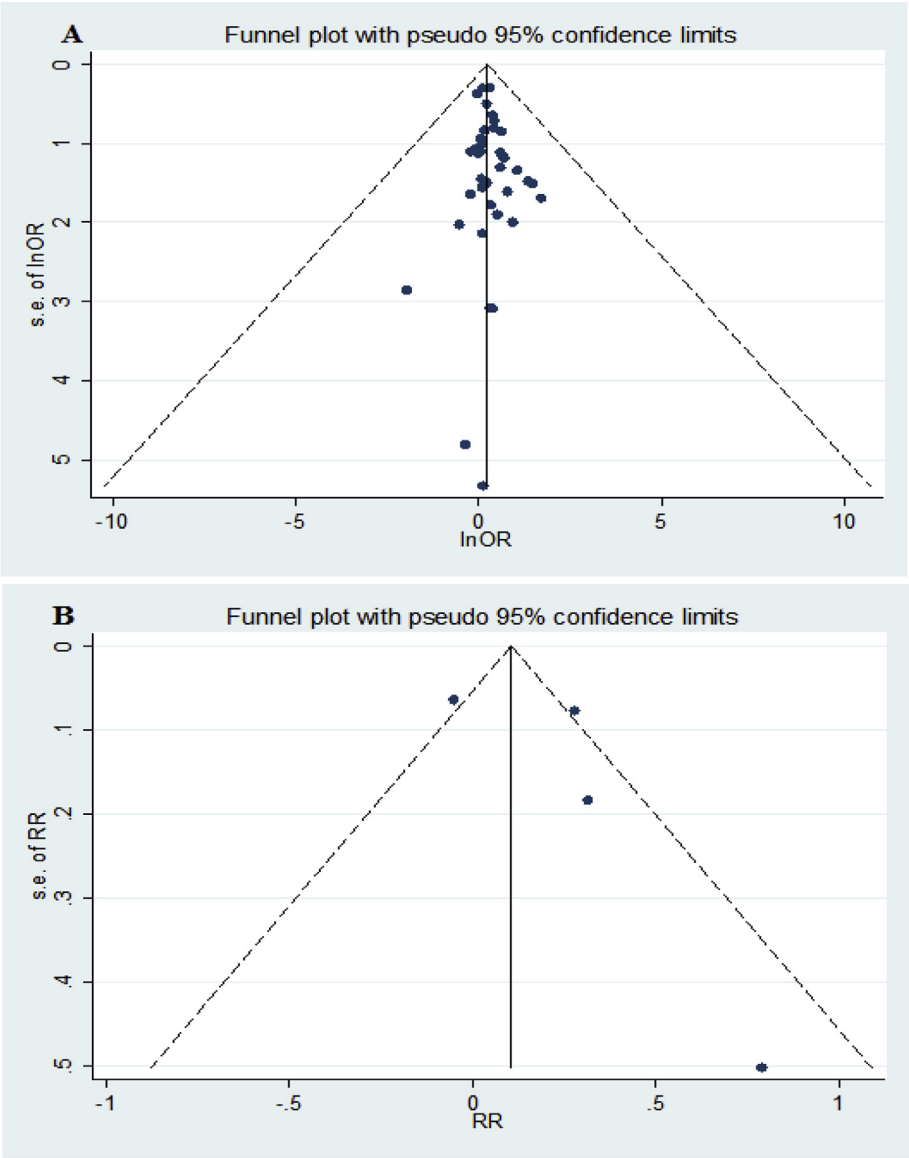

Fig. 2. Funnel Plot of included studies for the association of postpartum depression and cesarean section; A: OR and B: RR.

2.4. Risk of bias assessment

We assessed the risk of the bias of the studies using the Newcastle-Ottawa Scale (NOS).[18] The following items were for cohort studies: 1) The representativeness of the exposed cohort; 2) Selection of the non-exposed cohort; 3) Ascertainment of exposure; 4) Demonstration that outcome of interest was not present at start of study; 5) Comparability of cohorts on the basis of the design or analysis, 6) Assessment of outcome, 7) Was follow-up long enough for outcomes to occur, and 8) Adequacy of the follow up of cohort studies. In addition, the following items were used for case-control studies: 1) Is the case definition adequate, 2) Representativeness of the cases, 3) Selection of Controls, 4) Definition of Controls, 5) Comparability of cases and controls on the basis of the design or analysis, 6) Ascertainment of exposure, 7) the same method of ascertainment for cases and controls, 8) Non-Response rate.

3. Data analysis

3.1. Heterogeneity and publication bias

Chi-square test was applied at a significance level of 10% to assess heterogeneity in the results of the studies. Tau[2] was used to investigate heterogeneity between the results of studies. Finally, heterogeneity was quantitatively reported using I2 statistics.[19] Publication bias was assessed using the funnel plot visually and Egger test.[20,21]

3.2. Measure of association

A meta-analysis was performed to obtain the pooled measure of association. The pooled odds ratio (OR) and relative risk (RR) were calculated separately with 95% confidence intervals (CI). A random effects model was applied to report the pooled results. The Stata 11 (Stata Corp, College Station, TX, USA) was used for data analysis.

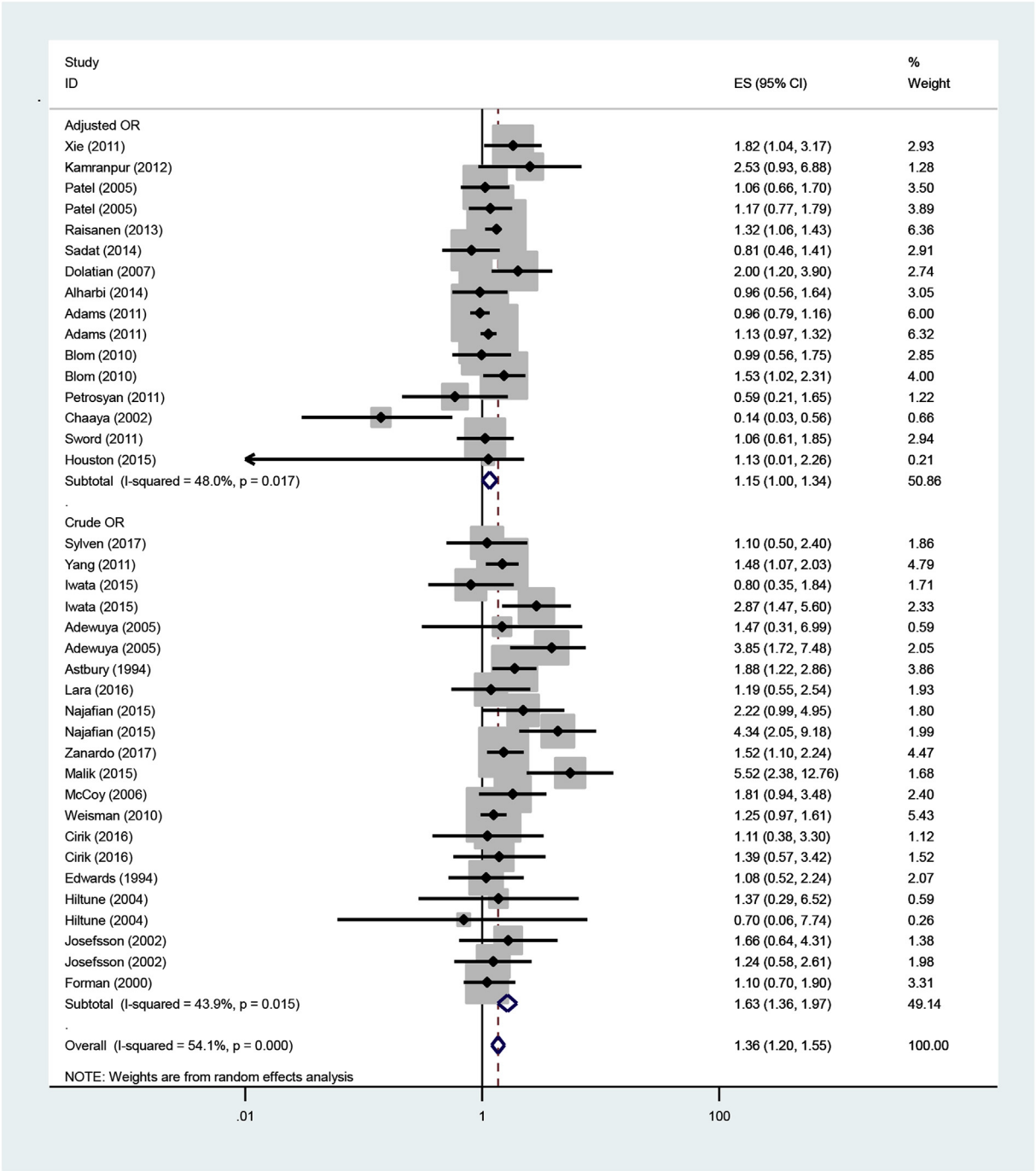

Fig. 3. Forest plot for the association of postpartum depression and cesarean section based on the crude and adjusted OR.

4. Results

4.1. Description of included studies

In this systematic review, we retrieved 989 cohort and case-control studies, including 905 studies from electronic databases and 84 studies from the list of sources. Of 989 studies, 280 were duplicates, 613 irrelevances to the aim of the study, 55 did not meet the inclusion criteria, and nine lacked the information required to estimate the indicators. Finally, 32 studies (25 cohort studies and 7 case-control studies) remained for meta-analysis [Fig. 1].[8,10–15,17,22–45] The included studies involved 1710494 participants. The characteristics of the selected studies are presented in Table 1.

4.2. Heterogeneity test

There was heterogeneity among the results of included studies. The I^2 was 57.1% for studies that reported an odds ratio (OR) and 78.7% for studies that reported a relative risk (RR). In order to reduce heterogeneity and achieve greater convergence, we performed subgroup analysis based on the type of study, type of CS (elective CS/emergency CS), type of reported indicator (adjusted/crude), method of outcome recognition (self-report/questionnaire), tools used to diagnose depression, and the quality of studies.

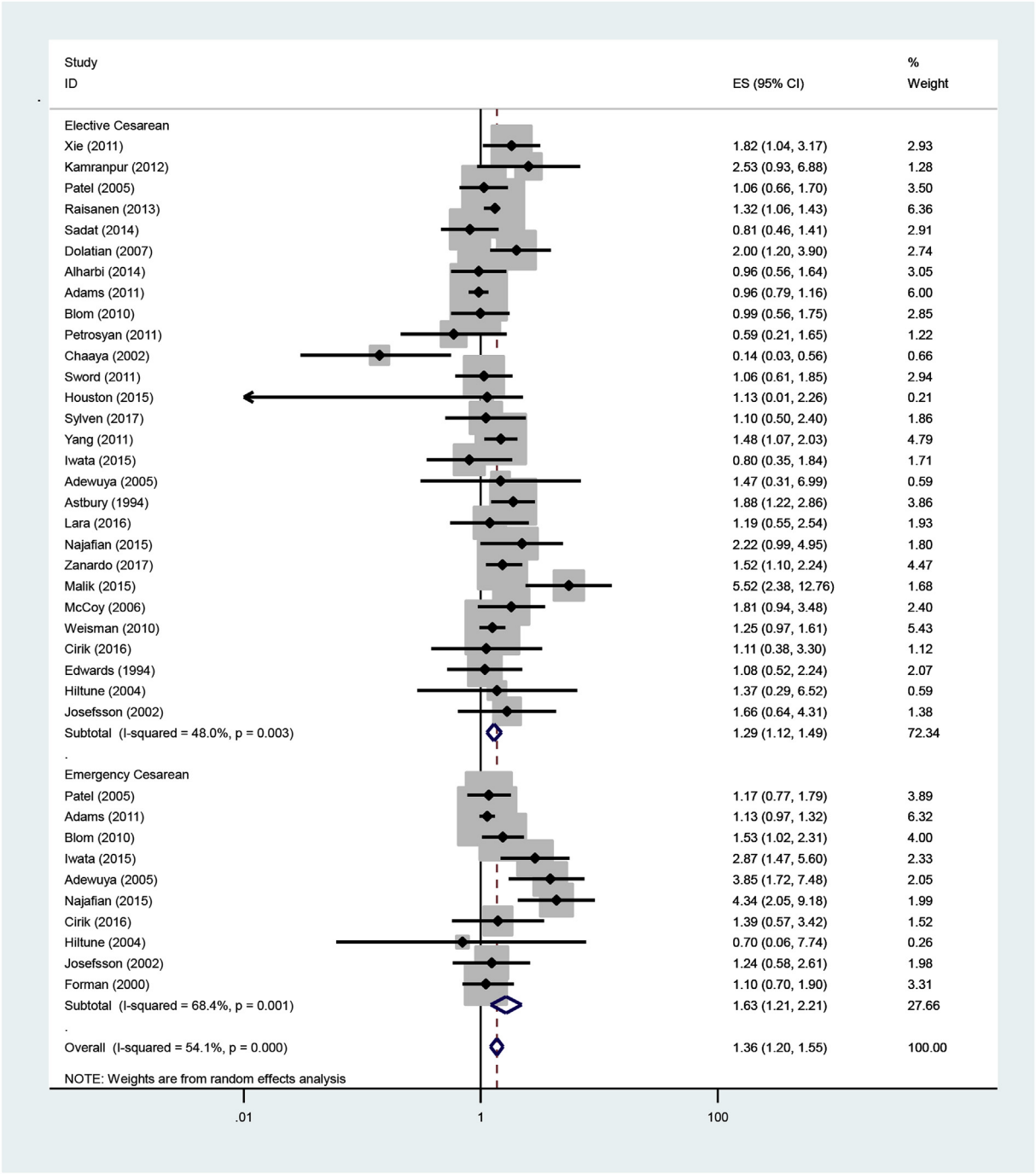

Fig. 4. Forest plot of the pooled odds ratio for the association of postpartum depression and cesarean section based on the type of cesarean.

Table 2
Subgroup analysis for the relationship between postpartum depression and cesarean section, based on the type of the used questionnaire and quality of the included studies.

Variable	OR	95% CI	I2 (%)	p-value*
Used questionnaire				
Edinburgh Postnatal Depression Scale	1.46	1.21, 1.76	54.7	< 0.001
Other questionnaires	1.19	1.07, 1.32	22.8	< 0.24
Quality of studies				
High	1.40	1.21, 1.61	56.1	< 0.001
Low	1.23	.90, 1.67	51.5	< 0.16

*p-value for heterogeneity test.

4.3. Publication bias

The results of statistical tests for both OR (Begg: p = 0.642, Egger: p = 0.182) and RR (Begg: p = 0.497, Egger: p = 0.408) indicated a lack of publication bias. In addition, in the funnel plot, the results of studies scattered nearly symmetrically on both sides of the null lines [Fig. 2].

4.4. Measures of association

The adjusted pooled OR was 1.15 (95% CI: 1.00, 1.34) and the crude pooled OR ratio was 1.36 (95% CI: 1.20, 1.55), for CS [Fig. 3]. The overall odds ratio based on the type of CS was 1.29 (95% CI: 1.12,

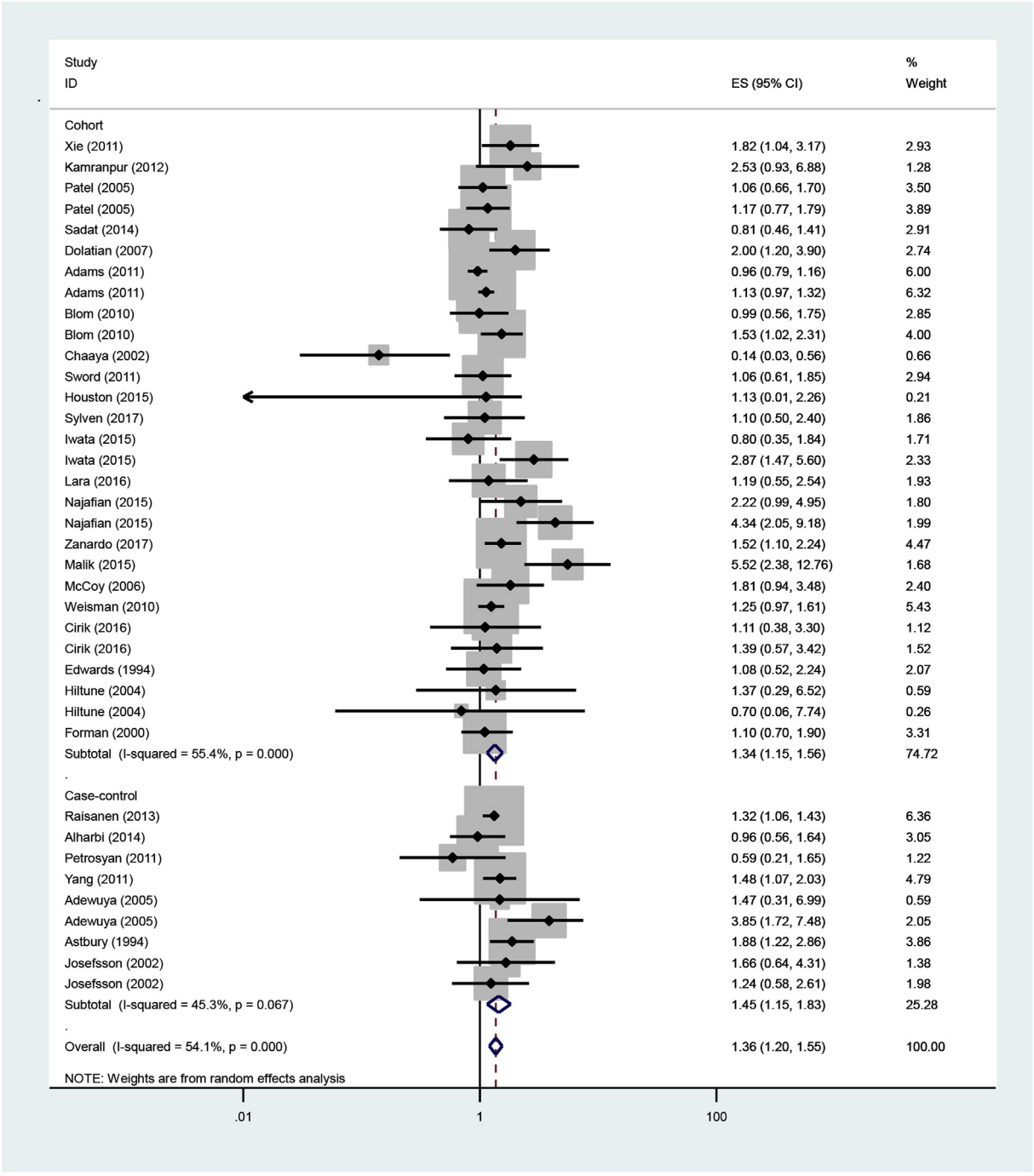

Fig. 5. Forest plot of the pooled odds ratio for the association of postpartum depression and cesarean section based on the type of study design.

1.49) and 1.36 (95% CI: 1.20, 1.55) for the elective CS and emergency CS respectively [Fig. 4]. Moreover, the pooled relative risk (RR) was 1.22 (95% CI: 0.94, 1.58) for CS.

In addition, we performed a subgroup analysis based on the type of tools applied to diagnose depression and the quality of the included studies. The pooled odds ratio for studies using Edinburgh Postnatal Depression Scale and other tools was 1.46 (95% CI: 1.21, 1.76; I^2 = 54.7%) and 1.19 (95% CI: 1.07, 1.32; I^2 = 22.8%), respectively (Table 2). The pooled odds ratio based on the type of study was 1.34 (95.1% CI: 1.15, 1.56) and 1.45 (95% CI: 1.15, 1.83) for cohort and case-control studies respectively [Fig. 5].

5. Discussion

We found an association between CS and PPD. This association was observed in the meta-analysis of both case-control and cohort studies. CS is associated with some biological changes in the mother's body, including a decrease in the level of prolactin and an increase in the level of interleukin-6.[46] These changes sever risk factors for PPD.[47] In addition, the CS is a risk factor for hemorrhage that increases the probability of PPD.[48] Moreover, CS increases the risk of infant mortality[49]; therefore, this factor might increase the risk of PPD and explain our results.

Failure in breastfeeding[50] and postpartum bleeding[51] are two reasons for maternal complications after delivery, which may also affect PPD after. In this regard, our results are in line with the findings of

other studies.[22]

Moreover, the results of our analysis showed that mothers who had an emergency CS had a higher risk of PPD than those who had an elective CS. Among factors affecting the choice of CS are social support, high household income, mother's education, father's education, and occupation.[52] On the other hand, low socioeconomic status is a risk factor for PPD.[53] Therefore, it is likely that mothers who have an emergency CS have a lower socioeconomic status than those who undergo selective surgery and are more prone to PPD. This relationship was also confirmed in a study conducted in the Netherlands in which the odds ratio of PPD was higher mothers with CS (OR = 1.53).[13] However, a study in Taiwan reported the opposite; in this study, the odds ratio of depression was higher in mothers that received elective CS (OR = 1.48) than mothers who underwent emergency CS.[11]

Our results indicated CS is a risk factor for PPD; however, other justification might be as follow: women with a tendency of depression may be generally anxious about delivery. Nowadays high request of CS is a major problem. However, the high rate of CS is not limited to the CS on request; women with some background tendencies may more frequently choose CS. Thus, not the CS itself but the temper/physiological background that leads to CS may also be associated with depression on some pregnant women.

The strengths of this study were the appropriate number of studies included in the final analysis, especially cohort studies, reporting adjusted and crude indicators separately, presenting the relationship between the type of CS and PPD separately, and analyzing studies based on their quality.

There are some limitations for this systematic review and meta-analysis. Firstly, 25% of the included studies had low quality; this issue may increase the risk of information bias. Secondary, the use of different tools for the diagnosis of PPD in the included studies so the pooled measure of association may increase the risk of information bias. However, we categorized studies based on the used tool for diagnosis of depression, 32 studies have been used Edinburgh Postnatal Depression Scale and 10 studies have been used the Patient Health Questionnaire (PHQ-9), the Beck Depression Inventory (BDI), and the Bromley Postnatal Depression Scale (BPDS). In the latter group because of the low number of studies, we could not conduct subgroup analysis. The third limitation was related to the type of reported measure of association, 18 studies reported the crude measure of association, so the confounding variables in these studies may affect the association of CS and PPD.

6. Conclusion

Based on the results of this meta-analysis, it seems CS is a risk factor for PPD. Therefore, it is recommended that decision-makers in the health system pay more attention to the CS and design long-term plans to reduce the rate of unnecessary CSs.

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Conflicts of interest

All authors declare no conflict of interest.

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