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History of miscarriage and postpartum depression: a systematic review and meta-analysis of observational studies

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ABSTRACT

Objective: To assess the association between postpartum depression (PPD) and miscarriage history and the role of moderators.
Methods: We identified observational studies of PPD rates in women with vs. without miscarriage history in Embase and Medline in July 2023 and updated in October 2024. Study quality was evaluated using the Newcastle-Ottawa Scale. The primary outcome was the odds ratio (OR, 95 % confidence intervals [95 %CI]) of PPD in women with vs. without miscarriage history. Meta-regression analyses included the effects of age, marital status, history of depression/anxiety and parity; subgroup analyses were based on PPD assessment methods and timepoint, cohorts from low-/middle-vs. high-income countries and cohorts with single vs. multiple miscarriages. We performed sensitivity analyses excluding poor-quality, cross-sectional studies and sequentially each study.
Results: Seventeen and two studies were rated as poor- and fair-quality, respectively. In 19 studies (n = 111,772), women with miscarriage history were at higher PPD risk compared to women without miscarriage (OR = 1.62, 95 % CI = 1.26 to 2.07, p < 0.001), with substantial heterogeneity (I^2 = 99.8 %). We detected some asymmetry in the funnel plot. The Egger's test was positive (p = 0.04). The OR using the trim-and-fill method was 0.98 (95 % CI = 0.70 to 1.37, p = 0.91). Higher miscarriage-related PPD ORs were estimated in low-/middle-vs. high-income countries (OR = 2.09, 95 %CI = 1.47 to 2.95, k = 10, n = 5,665, vs. 1.23, 95 %CI = 0.96 to 1.58, k = 9, n = 106,107, p = 0.02). After excluding low-quality studies the PPD OR dropped (1.15, 95 %CI = 0.50 to 2.64, k = 2, n = 2,911, p = 0.75).
Conclusions: Women with miscarriage history had higher PPD risk, although small study effects and low study quality may have led to an overestimation.

1. Introduction

Pregnancy loss due to miscarriage or stillbirth is estimated to occur in up to one-fourth of clinically-recognized pregnancies in Western countries (Strumpf et al., 2021). Miscarriage refers to the spontaneous loss of a pregnancy before 24 and 20 weeks of pregnancy in Europe and

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the US, respectively (Deutsche Gesellschaft für Gynäkologie und Geburtshilfe, 2022). Although the full etiopathology of miscarriages remains unclear, consistently reported risk factors include maternal age and maternal physical comorbidities (Sonu et al., 2024), whereas chromosomal abnormalities have also been investigated (Practice Committee of the American Society for Reproductive, 2012). Mechanisms underlying recurrent pregnancy loss, i.e. at least two failed clinical pregnancies, may be even more complicated to understand (Practice Committee of the American Society for Reproductive, 2012). Specifically, numerous immunological factors have been implicated within a diagnostic context of recurrent pregnancy loss (Vomstein et al., 2021).

The mental health burden of miscarriages has previously received considerable attention (Freedle and Oliveira, 2024; Krosch and Shakespeare-Finch, 2017); experiencing a miscarriage can lead to intense grief, loss, and sadness. Although reported prevalence rates widely vary, studies suggest that a substantial amount of women may report severe post-traumatic stress symptoms following miscarriage (Freedle and Oliveira, 2024; Krosch and Shakespeare-Finch, 2017). Additionally, increased levels of depression and anxiety have been reported during the immediate period following miscarriage (Shetty et al., 2025). Over time mental health is expected to gradually improve and reach pre-miscarriage levels one year after miscarriage (Nynas et al., 2015). Potential modifiers of the psychological sequelae of miscarriage may include a previous history of depression and lack of social resources (Cuenca, 2022). In contrast, women experiencing recurrent losses may represent an additionally vulnerable subgroup when it comes to the risk of depression (Zhang et al., 2024).

Apart from the prospective studies assessing the direct psychological sequelae of the miscarriage, an emerging amount of studies has highlighted the role of previous miscarriage regarding subsequent pregnancy and the risk of postpartum depression (PPD) after a live birth (Blackmore et al., 2011; Otani-Matsuura et al., 2022). Specifically, an elevated risk of PPD has been reported in women with previous prenatal loss (Blackmore et al., 2011). Besides, PPD refers to symptoms of major depression occurring after birth (Gastaldon et al., 2022) affecting up to one-fourth of mothers around the world (Srinivasan et al., 2020). Further, PPD has been linked to severe maternal and familiar distress (Gelaye et al., 2016), suicidal risk (Duan et al., 2019), but also impaired development and child behavior outcomes (Netsi et al., 2018).

The pathways that could link previous experiences of miscarriage and PPD after a subsequent live birth remain elusive. Longitudinal studies have previously suggested normalization of the elevated mental health distress reported immediately after miscarriage latest one year after miscarriage (Nynas et al., 2015). However, other authors postulated a lack of evidence that mental health distress following previous pregnancy loss resolved after a live birth (Blackmore et al., 2011); nevertheless, as authors lacked data on the interval between previous loss and subsequent pregnancy, they could not assess the possibility of persisting affective symptoms following previous pregnancy loss impacting a subsequent pregnancy and the postpartum period (Blackmore et al., 2011). Of note, the number of miscarriages may be associated with symptoms of postpartum depression and anxiety, implying a higher PPD risk in women with recurrent pregnancy loss (Otani-Matsuura et al., 2022). To sum up, we may expect women with previous experience of miscarriage to have a higher risk for PPD.

Our study aimed to systematically review and meta-analyze observational studies investigating the association between previous miscarriage and PPD symptoms in women as well as potential moderators.

2. Methods

Our study was performed according to MOOSE (Meta-analyses Of Observational Studies in Epidemiology) guidelines for meta-analyses of observational studies (Stroup et al., 2000). The protocol was previously registered with PROSPERO (registration number CRD42023444207). Studies investigating PPD symptoms in women with vs. without miscarriage history were identified by searching Embase and Medline, using the following search strategy: ("Abortion, Spontaneous"[Mesh Terms] OR miscarriage [Text Word]) AND "depress*" AND (postpar* OR postnat* OR (postpartum depression [MeSH Terms])) by two researchers working independently (CGk and YES). Database search was performed in July 2023 and updated in October 2024, without language restriction since data inception. A search in PsycInfo and CINHAIL was also performed. References from identified studies were afterwards searched for further studies of interest. Authors were contacted when data was not available.

3. Eligibility criteria, information sources, search strategy

3.1. Study selection

We included cohort, case-control, and cross-sectional observational studies reporting on PPD symptoms in women with versus without miscarriage history. We did not include studies assessing depressive symptoms directly after miscarriage experience. We also excluded studies assessing psychiatric disorders other than PPD symptoms as outcome. Besides, we excluded studies without a comparator group, i.e. women without history of miscarriage. The selection of eligible studies was performed by two researchers (CGk and GS). Consensus was reached in all cases, so no third person was involved.

3.2. Types of participants

Women with miscarriage experience were included. There were no restrictions on miscarriage, e.g. the number of previous miscarriages. Studies assessing intentional abortion were not considered.

3.3. Comparator

Women without history of miscarriage.

3.4. Types of exposure

Miscarriage experience during the first or second trimester of pregnancy.

3.5. Outcomes

The primary outcome included PPD symptoms in women with miscarriage history, in comparison with women without miscarriage history.

3.6. Data extraction

Two authors (YES and CGk) independently extracted data concerning sample sizes, study design, demographic and clinical characteristics, miscarriage rates (or odds ratios when estimated by authors), and assessment methods for PPD symptoms.

3.7. Assessment of risk of bias

3.7.1. Quality of studies

The modified version of the Newcastle-Ottawa scale (NOS) for cross-sectional and cohort studies was used for quality assessment (Herzog et al., 2013); we removed the item “representativeness of the exposed cohort”, which we judged to be related to applicability, and added ascertainment of single or multiple miscarriages as described elsewhere (Schoretsanitis et al., 2020, 2022).

3.7.2. Publication bias

The potential for publication bias was assessed using visual inspection of funnel plots and performing Egger’s test as well as the

nonparametric trim-and-fill method (Egger et al., 1997).

3.8. Data synthesis

Given the potential heterogeneity related to study populations concerning demographic characteristics and miscarriage experience, we used a random-effects model as the primary outcome. We estimated the summary odds ratios (ORs) and 95 % confidence intervals (95 %CI). We used the DerSimonian-Laird estimator to estimate the heterogeneity variance parameter (τ^2) (DerSimonian and Laird, 1986). We also calculated the I-square (I^2) statistic to measure the proportion of variability potentially attributed to heterogeneity (Higgins et al., 2003). Moreover, we performed a meta-regression analysis to investigate the effects of several demographic and clinical parameters (Borenstein et al., 2009). Specifically, we assessed the effect of age, marital status (percentage single/divorced mothers), history of depression or anxiety and parity, which have been previously investigated in the context of PPD symptoms (Baattaiah et al., 2023; Doncarli et al., 2025; Pham et al., 2018).

Subgroup analyses included samples assessed with different assessment methods for PPD, the timepoint of assessment for PPD symptoms, cohorts from low-/middle- (LMICs) vs. high-income countries (non-LMICs) and cohorts with history of single vs. multiple miscarriages. The type of PPD assessment method, i.e. standardized vs. unstandardized, may affect results as assessment precision differs (Gastaldon et al., 2022). Moreover, depressive symptoms during the first postpartum week, also known as maternity blues, may be associated with adjustment problems rather than clinical depression (Gastaldon et al., 2022). Last, previous studies have suggested higher risk of PPD symptoms in women with more than one miscarriage compared to women with one miscarriage (Blackmore et al., 2011; Otani-Matsuura et al., 2022).

Sensitivity analyses were conducted, excluding low-quality and cross-sectional/case-control studies and sequentially excluding one study at a time. To perform analyses, we used the package metagen in R (Schwarzer et al., 2015).

4. Results

The electronic database search yielded 138 citations from Medline, 364 from Embase, and four when the search was updated in October 2024. An additional search in PsycInfo and CINHAIL did not report any further studies of interest. After removing 114 duplicates, 441 unique studies remained. After the exclusion of 406 records based on title and abstract screening, 35 articles were full-text screened, leading to the rejection of 9 papers due to lack of PPD rates in women with miscarriage experience, four papers due to outcomes other than PPD symptoms, one paper due to exposure other than miscarriage, one paper due to lack of control group and one paper due to data overlap. Ultimately, 19 studies fulfilled all inclusion criteria and were used for data extraction (Supplementary Fig. 1).

4.1. Study characteristics

Of the 19 studies there were 10 cohort and nine cross-sectional studies. The total number of participants was 111,772 including 24,297 women with previous miscarriage; the mean age and standard deviation was 29.1 ± 6.2 years (Table 1). Only one study matched study groups for maternal age, whereas in one study the percentages of women with history of depression were comparable (Table 1).

4.2. Risk of bias of included studies

4.2.1. Quality assessment

The Supplementary Table 1 summarizes the quality assessment of individual studies according to the NOS. Of the 19 studies, two were rated as fair and 17 as poor quality (Supplementary Table 1). Quality concerns were mainly raised due to lack of matching processes between women with or without miscarriage for previously reported confounders, as well as samples of women with multiple pregnancy losses.

4.2.2. Publication bias

When inspecting the funnel plot we detected some asymmetry (Supplementary Fig. 2). The Egger's test for publication bias was positive (p = 0.04). The OR using the trim-and-fill method was 0.98 (95 %CI = 0.70–1.37; random-effects model, p = 0.91).

Value < 0.001).

4.3. Primary outcome

Women with a history of miscarriage had higher risk of PPD symptoms compared to women without, with an OR of 1.62 (95 %CI = 1.26 to 2.07, p < 0.001, k = 19, n = 111,772, random effects model) (Fig. 1). Heterogeneity was high (I^2 = 99.8 %, τ^2 = 0.27).

4.3.1. Meta-regression analyses

We did not observe any effects for age (estimated co-efficient −0.03, 95 %CI = −0.10 to 0.04, p = 0.40), marital status (estimated co-efficient −0.006, 95 %CI = −0.03 to 0.02, p = 0.61), history of depression/anxiety (estimated co-efficient −0.02, 95 %CI = −0.07 to 0.02, p = 0.30), and parity (estimated co-efficient −0.008, 95 %CI = −0.02 to 0.002, p = 0.12).

4.3.2. Subgroup and sensitivity analyses

The Supplementary Fig. 3 shows the results of the subgroup analyses based on the timepoint of assessment for the PPD symptoms; we did not detect significant differences for ORs of PPD symptoms in women with miscarriage history for studies assessing depression ≤1 week at postpartum compared to studies assessing PPD symptoms >1 week at postpartum (OR = 1.52, 95 %CI = 0.59 to 3.95, k = 4, n = 2,135, vs. 1.68, 95 %CI = 1.30 to 2.17, k = 14, n = 109,071, p = 0.85). However, ORs of PPD symptoms for miscarriage history were larger in studies from LMICs compared to studies assessing cohorts from non-LMICs (OR = 2.09, 95 % CI = 1.47 to 2.95, k = 10, n = 5,665, vs. 1.23, 95 %CI = 0.96 to 1.58, k = 9, n = 106,107, p = 0.02, Supplementary Fig. 4). Last, we did not report differences for ORs of PPD symptoms for miscarriage history in studies investigating women with one vs. two vs. ≥ three previous miscarriages (OR = 1.29, 95 %CI = 0.86 to 1.92, k = 3, n = 96,473, vs. 1.35, 95 %CI = 0.63 to 2.91, k = 2, n = 82,363, vs. 1.24, 95 %CI = 0.66 to 2.33, k = 2, n = 79,609, p = 0.99, Supplementary Fig. 4).

Apart from one study, all other studies applied standardized criteria for PPD; after eliminating this study, we estimated an OR of 1.65 (95 % CI = 1.27 to 2.15, k = 18, n = 111,206, p < 0.001). In a sensitivity analysis including the two studies rated as of fair quality, we estimated an OR of 1.15 (95 %CI = 0.50 to 2.64, k = 2, n = 2,911, p = 0.75) with heterogeneity being substantial (I^2 = 64.8 %, τ^2 = 0.27). When excluding cross-sectional, i.e. including only cohort studies, we estimated an OR of 1.60 (95 %CI = 1.17 to 2.21, k = 10, n = 107,506, p = 0.004) with heterogeneity remaining large (I^2 = 99.9 %, τ^2 = 0.24).

When sequentially excluding one study at a time, ORs and heterogeneity did not substantially change (Supplementary Table 2).

5. Discussion

Our systematic review and meta-analysis suggested an elevated risk of PPD symptoms in women with history of miscarriage; the risk of PPD symptoms was by approximately 62 % higher in women with miscarriage history as compared to women without miscarriage history. Compared to ORs associated with other risk factors included in a previous umbrella review (Gastaldon et al., 2022), the OR of PPD symptoms associated with miscarriage history is moderate and larger than risk factors such as gestational diabetes, unintended pregnancy and antenatal anaemia (1.60, 1.53, and 1.47 respectively). However, we

Table 1
Characteristics of included studies (in chronological order).

	Study design	Sample size	Miscarriage history	n	n PPD	Matched/ comparable for		Age (SD), years	Marital status (Single or divorced), n (%)	History affective Disorders, n (%)	Primiparous, n (%)	Assessment		Single Miscarriage, n (%)	Quality
						Age	Depression					PPD			
												Time-point (days)	Scales		
Hughes 1999 (England)	Cohort	120	Yes No	60 60	6 3	✓	X	29.6 (20.0–46.0)	0 (0.0)	4 (6.6) 6 (10.0)	120 (100.0)	42	EPDS	NP	Fair
Cryan 2001 (Ireland)	Cohort	377	Yes No	101 276	37 64	X	X	28.3 (5.5)	109 (28.9)	62 (16.4)	137 (36.3)	>42	EPDS	NP	Poor
Cantilino 2010 (Brazil)	Cross-sectional	399	Yes No	93 306	12 17	X	X	27 (6.0)	58 (14.5)	37 (9.3)	225 (56.4)	≥14	SCID-I	NP	Poor
Blackmore et al., 2011 (England)	Cohort	11,279[a]	Yes No	2473 8806	316 819	X	X	NP[b]	NP[b]	NP	NP	60	EPDS	1871 (75.7)	Poor
Giannandrea 2013 (USA)	Cross-sectional	142[c]	Yes No	44[c] 98	18[c] 26	X	X	NP[d]	NP[d]	NP	NP	>84	SCID-I	NP	Poor
Chojenta et al., 2014 (Australia)	Cohort	584	Yes No	178[e] 406	NP NP	X	X	NP	17 (2.9)	57 (9.8)	156 (26.7)	≤365	Self-report	NP	Poor
Kinsey 2015 (Pennsylvania)	Cohort	2791	Yes No	448 2343	22 134	X	✓	27.3 (4.3)	109 (24.3) 671 (28.6)	114 (25.4) 525 (22.4)	2791 (100)	30	EPDS	NP	Fair
Lara 2016 (Mexico)	Cohort	210	Yes No	NP NP	NP NP	X	X	29.5 (6.3)	41 (19.5)	45 (21.4)	95 (45.2)	42	SCID-I PHQ-9[f]	NP	Poor
Shi 2018 (China)	Cohort	213	Yes No	59 154	21 14	X	X	NP	0 (0.0)	30 (14.1)	176 (82.6)	3–7	EPDS	NP	Poor
March 2018 (Australia)	Cross-sectional	566	Yes No	124 442	37 119	X	X	NP	144 (25.4)	NP	211 (37.3)	NP	CES-D	NP	Poor
Azad 2019 (Bangladesh)	Cross-sectional	376	Yes No	85[g] 291	43 105	X	X	23.0 (5.1)	11 (2.9)	NP	183 (48.7)	≤365	EPDS	NP	Poor
Mahale 2021 (India)	Cross-sectional	561	Yes No	38 523	10 33	X	X	NP	NP	11 (2.0)	5 (0.9)	42	EPDS	NP	Poor
Vivilaki 2021 (Greece)	Cross-sectional	90[h]	Yes No	19 71	6 33	X	X	NP	1 (1.1)	NP	45 (50.0)	≤7	EPDS	NP	Poor
Lin 2022 (Taiwan)	Cross-sectional	1197	Yes No	NP NP	NP NP	X	X	33.5 (4.8)	NP	NP	NP	≤2	EPDS	NP	Poor
Otani-Matsuura et al., 2022 (Japan)	Cohort	90,158[i]	Yes No	20,531 69,627	2253 8216	X	X	NP	NP	NP	NP	180	EPDS	16,027 (78.1)	Poor
Moya 2023 (Malawi)	Cross-sectional	635[j]	Yes No	44 591	2 19	X	X	22.8 (6.4)	110 (17.3)	NP	311 (49.0)	≤3	EPDS	NP	Poor
Hsu 2024 (Taiwan)	Cohort	1,608[k]	Yes No	NP NP	NP NP	X	X	33.2 (4.0)	65 (4.0)	NP	1051 (65.4)	≤365	EPDS	NP	Poor
Nasralla 2024 (Sudan)	Cross-sectional	300	Yes No	NP NP	NP NP	X	X	29.7 (9.7)	NP	21 (7.0)	NP	≤42	EPDS	NP	Poor
Rajendran 2024 (India)	Cohort	166	Yes No	NP NP	NP NP	X	X	NP	0 (0.0)	46 (27.7)	77 (46.4)	≤42	HAMD-17	NP	Poor
Total	Cohort: 10 Cross-sectional: 9	111,772	Yes No	24,297 83,994	2783 9602	No/NP: 17 At least one: 2		29.1 (6.2)	1336 (16.4)	958 (16.7)	5538 (64.3)	>7 days: 4 ≤7 days: 14	EPDS: 13 SCID-I: 3 CES-D: 1 HAMD-17: 1 Self-report: 1	17,898 (77.8)	Poor: 17 Fair: 2

CESD: Center for Epidemiologic Studies Depression Scale; EPDS: Edinburgh Postnatal Depression Scales; HAMD-17: Hamilton Depression Rating Scale; ICD: International Classification of Diseases; NP: not provided; PHQ-9: Patient Health Questionnaire; PPD: postpartum depression; SCID-I: Structured Clinical Interview for DSM Disorders; SD: standard deviation; UK: United Kingdom; USA: United States of America.

[a] The total sample at 2 months postpartum.

[b] Data for the sample at two months portpartum not available. For the original sample of the study (n = 13.133) mean age = 27.78 (4.91) years old, living without partner; n = 3.033 (23.8).

[c] We only included women with a previous miscarriage. The original study sample was 192 women also including women with abortion experience.

[d] Data available for the original study sample (n = 192) mean age = 24.7 (5.5) years old, living without partner; n = 118 (61.4).

[e] Together with women with miscarriage (n = 162) authors included 16 women with previous pregnancy termination for medical reasons, twelve women with previous stillbirth and eight women with ectopic pregnancy.

[f] We used the odds ratio of previous miscarriage-associated postpartum major depression as assessed with SCID (2.46, 95 %CI = 1.65–3.25), whereas the estimated odds ratio using PHQ-9 was 2.50 (95 %CI = 1.77–3.13).

[g] Together with women with miscarriage (n = 44) there were 13 stillbirths.

[h] The original study sample was 92 women, but data were available for 90 women.

[i] The original study sample was 99202 women. We included assessments at 6 months postpartum.

[j] The original study sample was 636 women, but data were available for 635 women.

[k] The original study sample was 1813 women, but we excluded data for 205 women with termination of pregnancy.

identified major quality issues mainly related to lack of matching for potential confounders, such as age and history of depression. When including only studies of fair quality, the OR dropped to 1.15 and was no longer significant. Further, we identified possible small study effects as the funnel plot asymmetry and the Egger's test pointed out, probably due to heterogeneity between studies and methodological flaws in the studies, as highlighted by the NOS evaluation. Besides, the corrected OR using the trim-and-fill method was approximately 1.00 and was not significant. Therefore, the OR of the PPD symptoms in women with miscarriage history in our main analysis may been overestimated. Furthermore, our findings suffered from substantial heterogeneity, which can be due to the diverging designs as well as multiple confounders (Schoretsanitis and Deligiannidis, 2020); for example, there were no studies matching study groups for history of depression/anxiety or depression during pregnancy. The risk of new-onset of PPD symptoms may differ from the risk of a postpartum depressive episode in women with depressive disorders, as research for other pregnancy/obstetrical complications has previously highlighted (Schoretsanitis et al., 2024). In other words, unless studies stratify for history of depression, it is not possible to unravel the impact of the history of depression and the impact of pregnancy/obstetrical complications, such as history of miscarriage, regarding the risk of PPD symptoms. Moreover, we reported differences for ORs of miscarriage history-related PPD symptoms in cohorts from LMICs vs. non-LMICs. Previous epidemiological evidence has suggested wide disparities regarding pregnancy termination in cohorts from LMICs and non-LMIC (Bearak et al., 2020); these disparities are frequently related to the legal framework around abortion (Allotey et al., 2021). Frequently, abortions and miscarriages are reported in a pooled fashion, and it is hard to disentangle rates for each one and associated impact (Regassa et al., 2022). Therefore, reported rates of miscarriages may have been inflated additionally accounting for the psychosocial burden related to the higher ORs of miscarriage history-related PPD in cohorts from LMICs vs. non-LMICs in our analysis.

None of the included parameters included in our meta-regression analysis had significant effects on the miscarriage history-related risk of PPD symptoms. Besides, we did not report differences regarding the miscarriage history-related PPD symptoms between women with one, two or more than three previous losses. However, we might have expected a dose-dependent pattern, i.e. higher numbers of miscarriages being related to higher ORs of miscarriage history-related PPD symptoms.

Factors such as the timepoint of PPD assessment and the study design did not impact our results. Specifically, we did not report significant differences for ORs of miscarriage history-related PPD symptoms in cohorts where PPD symptoms were assessed $\leq$1 week at postpartum compared to cohorts assessed >1 week at postpartum. Last, the OR of miscarriage history-related PPD symptoms when exclusively including cohort studies was extremely close to the OR estimated in the main analysis (1.60 vs. 1.62 respectively).

5.1. Strengths and limitations

Our meta-analysis included the largest sample of women with or without history of miscarriage and PPD symptoms, with more than 110,000 women. A higher risk of PPD was observed in women with history of miscarriage in alignment with a recent meta-analysis, where authors estimated an OR 2.09 of depression related to miscarriage in seven studies (Bodunde et al., 2025), although authors assessed long-term outcomes without focusing specifically on the postpartum period. Estimates from cohorts from LMICs yielded higher ORs of miscarriage history-related PPD symptoms compared to studies assessing cohorts from non-LMICs. When excluding studies of poor quality, i.e. those that had not accounted for potential confounders, the OR dropped to 1.15 and was no longer statistically significant.

There are several limitations that need to be considered when interpreting our results. First, a number of potential moderators of the

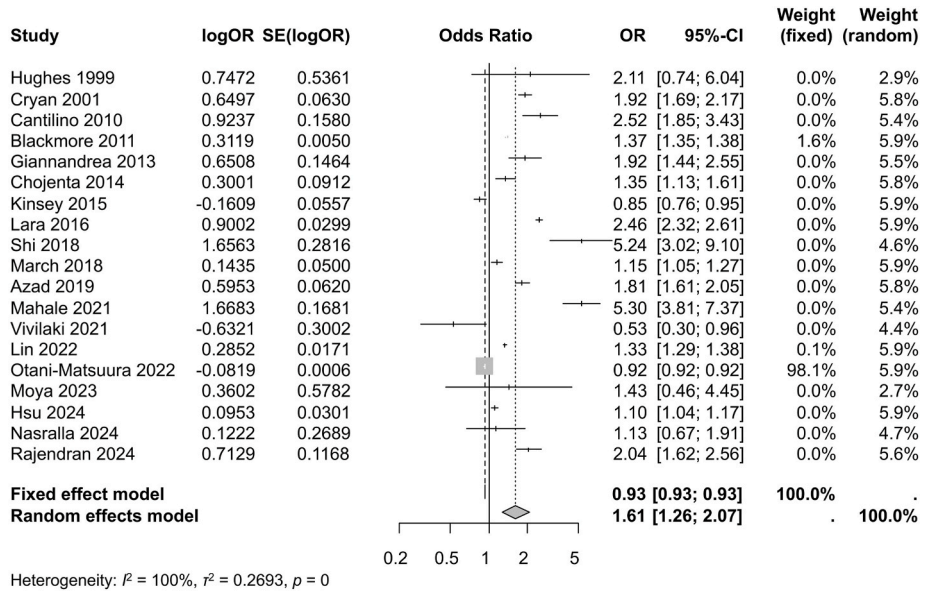

Fig. 1. Odds Ratio (OR) of postpartum depression (PPD) in women with vs. without history of miscarriage.

miscarriage history-related risk of PPD symptoms was not available and therefore could not be included in our meta-analysis; for example, data on the timepoint (or trimester) for miscarriage was not available. Besides, the understanding of history of mental health problems as a risk factor requires more granular data on history of depression vs. other types of psychiatric disorders including anxiety disorders; however, only two studies provided data on history of anxiety and this analysis was not feasible. On the other hand, we cannot exclude the possibility that the small number of studies providing data on the four moderators we selected may have led to low statistical power. Future research will need to expand on moderators of the risk of PPD symptoms associated with miscarriage history. Second, the included studies were observational; thus, they do not allow hypotheses on causality (Altman and Krzywinski, 2015). Third, matching among women with and without history of miscarriage for well-known confounders (such as maternal age and history of depression/anxiety) was barely performed (de Graaf et al., 2011). Fourth, the potential publication bias might have led to an overestimation of the miscarriage history-related PPD. Fifth, various pregnancy termination forms, e.g. miscarriage, stillbirth or ectopic pregnancies, were combined in several studies (Blackmore et al., 2011; Chojenta et al., 2014; Otani-Matsuura et al., 2022), whereas we may suspect that some studies may have reported miscarriages and abortions together. Last, the large heterogeneity reported in our meta-analysis may raise serious concerns, although, our subgroup and sensitivity analyses partially accounted for the heterogeneity. A major contributor to this heterogeneity derives from definition of PPD (or PPD symptoms) across included studies. Studies employed different assessment scales, among others validated clinical scales, screening tools, but also self-reporting, which may identify different patterns of clinical manifestations. The challenge of dealing with the heterogeneity of assessment methods is further aggravated by the timing of PPD assessment, although our subgroup analysis did not report significant effects. However, using a screening tool within 3–7 days postpartum is not validated for diagnosis, and symptom dynamics or intervention-time interactions may introduce bias.

CRediT authorship contribution statement

Christos Gkoltsos: Writing – original draft, Visualization, Validation, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Chiara Gastaldon:** Writing – review & editing, Validation, Supervision, Data curation. **Alkistis Skalkidou:** Writing – review & editing, Supervision, Conceptualization. **Yamina Ehrt-Schäfer:** Writing – review & editing, Formal analysis, Conceptualization. **Nicole Ochsenbein-Koelble:** Writing – review & editing, Supervision. **Corrado Barbui:** Writing – review & editing, Supervision, Conceptualization. **Erich Seifritz:** Writing – review & editing, Supervision, Conceptualization. **Georgios Schoretsanitis:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Ethics approval

Not applicable Patient consent statement: Not applicable Permission to reproduce material from other sources: Not applicable.

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Declaration of competing interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2025.12.034.

Data availability

No primary data was included in this study.

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