

Prevalence of Post-Partum Depression in India and Its Association with Risk Factors: A Systematic Review and Meta-Analysis

Bhupesh Gupta^{1*}, Kashish Grover², Shivashish Gupta³, Kirtika Gupta⁴, Ramita Goel⁵, Anshu Mittal⁶

^{1,2,3,6}Department of Community Medicine, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Haryana, India

⁴Department of ENT, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Haryana, India

⁵Department of Psychiatry, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Haryana, India

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ABSTRACT

Introduction: This study uses an exhaustive meta-analysis of descriptive epidemiological studies to determine the prevalence of major depression in post-partum females and its associated risk factors, across all ages in India.

Methodology: Using PRISMA guidelines, we searched PubMed, Scopus, Web of Science, Embase, and Google Scholar for studies from 2020–2024. The review was registered in PROSPERO (CRD42024513914). Eligible English-language observational studies reported depression prevalence in perinatal Indian women. Meta-analysis was done using R (v4.3.0), and study quality was assessed with the JBI score. Pooled prevalence and odds ratios with 95% CI were calculated. Heterogeneity was evaluated using Q and I² statistics, and publication bias was assessed with Egger's test and a funnel plot.

Results. Utilizing a random effects model, the results of 59 publications were used to estimate the prevalence of post-partum depression in India from 2020-2024 to be 19% (CI = 95: 15–23%). Meta-regression analysis found that older age post-partum females had a higher prevalence of post-partum depression as compared to young ones. Heterogeneity for prevalence was found to be 97%. The sub-group analysis found a higher prevalence of post-partum depression in Southern India (22%; 95% CI: 15–31), studies conducted in community settings (19%; 95% CI: 12–28), urban areas (19%; 95% CI: 15–24), studies using study instruments other than EPDS scale (22%; 95%CI: 11–39), and publication year 2024 (25%; 95% CI: 17-36).

Conclusion. Effective measures like psychological counselling and health education, need to be taken to control post-partum depression in India.

Keywords: Depression, Pregnancy, Prevalence, Cohort, Cross-sectional

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***Correspondence:** Bhupesh Gupta (Email: bhupeshgupta1992@gmail.com)

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INTRODUCTION

A mild to moderately severe nonpsychotic depressive episode that starts during or lasts throughout the first postnatal year is known as postpartum depression (PPD).¹ Between 300 and 750 postpartum blues cases occur for every 1,000 mothers worldwide.² Although PPD is a far more serious illness, it is typically ignored and untreated, which is detrimental to both a mother and the child. According to studies, out of 1,000 new mothers, 100–150 will suffer from PPD.² Some studies show that around the globe, the prevalence of PPD goes above 25%.^{3,4}

In India, postpartum depression (PPD) is one of the most underdiagnosed and untreated disabilities.⁵ The World Health Organization (WHO) has characterized it as “a special state of mental health disorder and a variant of depression.”⁶ Women may experience a range of symptoms, including depression, tearfulness, guilt, anorexia, sleep disorders, feeling inadequate, detachment from the baby, poor concentration, forgetfulness, fatigue, and irritability.⁷

Twenty percent of expectant and new moms in India experience sadness and anxiety, and one in ten Indians suffer from these conditions, based on the National Mental Health Survey of 2016. PPD is found to be strongly predicted by several factors, including poor socioeconomic status, unemployment, an absence of social or psychological support, negative attitude towards the pregnancy, high parity, complications during pregnancy, delivery of a preterm or premature or underweight baby, first-born baby situation, child care stress, sleep problems, poor self-worth, antenatal anxiety or depressive disorders, a history of depressive disorders, disturbed marriages, a history of domestic violence, essential negative life experiences in the preceding year, neuroticism, and perfectionism.^{8,9}

Notwithstanding a National Mental Health Program, maternal psychological wellness is still not given priority. Health professionals lack mental health skills and awareness, and there are significant gaps in devoted maternal mental health treatments in current healthcare institutions. In outlying healthcare facilities, mental health professionals are either scarce or nonexistent.¹⁰

Very few meta-analytic studies evaluate the prevalence and risk factors associated with PPD in India. To ascertain the overall incidence of major depressive disorder in postpartum women and the risk factors associated with it, this study conducts a comprehensive meta-analysis of observational epidemiological studies in India from 2020 to 2024 across all age groups.

METHODOLOGY

This study was registered by the International Prospective Register of Systematic Reviews PROSPERO

(CRD42024513914) and prepared following PRISMA guidelines for systematic review and meta-analysis¹¹. Table 1 mentions PICOS criteria for study inclusion and exclusion.

Table 1: PICOS Criteria for Inclusion and Exclusion of Studies

Parameters	Inclusion Criteria
Population	Postnatal Mothers in India
Intervention	Depression and Depressive disorder
Comparison	Non-depressive mothers
Outcomes	Prevalence and risk factors
Study Design	Observational studies

Eligibility criteria

Research revealing the frequency or proportion of depression prevalence in Indian perinatal women in the form of original articles and observational articles (cohort studies, cross-sectional studies, etc.) having full-text access were included in the review.

Studies unrelated to the research question, research on animal subjects, papers presented to conferences, secondary studies, dissertations, interventional research (clinical, field, and social trials) and qualitative research (case series, case reports, and letters to the editor) were excluded from the review. The articles which were not available in full text, even after three emails to the respective writers, were also excluded.

Information sources: On 10 October 2024, various databases, such as PubMed, Scopus, Web of Sciences, Embase, and Google Scholar, were searched.

Search strategy: Various search terms and keywords were used for research in the above-mentioned databases which are shown in Table 2.

Selection process:

Once a study was located in the databases, all authors (Gupta B, Goel R, Mittal A, and Gupta K) evaluated its eligibility independently beginning in October 2024. To resolve any discrepancies amongst these writers, they thoroughly discussed them. Disagreements were resolved by consensus. Using Cohen's kappa statistic¹², the overall agreement rate (yes/no) based on whether to include or exclude) before adjudication was 0.86.

Data collection process:

Each study's abstract and title were utilized to establish eligibility. The authors then verified eligibility by looking at full-text versions of studies deemed or possibly eligible (see Figure 1). A pair of reviewers evaluated each trial's eligibility and extracted data regarding the trial's characteristics and outcomes. Disagreements between reviewers were resolved by consensus or by consulting a third reviewer. The writers contacted the original test author for any missing details or clarification.

Table 2: Search Strategy and search terms used in various databases

Database	Search Strategy
PubMed	("Post-partum depression" OR "Perinatal depression" OR "Depression after Pregnancy" OR "Postnatal depression") AND ("Prevalence" OR "Prevalence and Risk factors") AND ("India"))
Scopus	TITLE-ABS-KEY (("Post-partum depression" OR "Perinatal depression" OR "Depression after Pregnancy" OR "Postnatal depression") AND ("Prevalence" OR "Prevalence and Risk factors") AND ("India"))
Web of Sciences	TS= ("post-partum depression" OR "Perinatal depression" OR "Depression after Pregnancy" OR "Postnatal depression") AND TS= ("Prevalence" OR "Prevalence and Risk factors") AND TS= ("India")
Embase	'Post-partum depression' OR 'Perinatal depression' OR 'Depression after Pregnancy' OR 'Postnatal depression' AND 'Prevalence' OR 'Prevalence and Risk-factors' AND 'India'
Google Scholar	"Post-partum depression" OR "Perinatal depression" OR "Depression after Pregnancy" OR "Postnatal depression" AND "Prevalence" OR "Prevalence and Risk factors" AND "India"

Data items and extraction: The literature was imported into Endnote (version X9) to manage and preserve citations and streamline the review procedure. A standardized form was utilized to gather various data from the retrieved papers, including the name of the initial researcher, publishing year, state, region, sample size, population under investigation (age range and various cases), and major findings (Table 3). Using Cohen's kappa statistic¹², the overall agreement rate before correcting discrepant items was 0.92, considered to be almost perfect.

Study risk of bias assessment: The papers were qualitatively assessed during the meta-analysis phase using the Joanna Briggs Institute (JBI)¹³. The checklist includes nine inquiries about sampling frames, participation, size of the sample, detailed descriptions of study subjects and surroundings, data analysis, reliable techniques for identifying circumstances, scenario measurement, statistical analysis, and appropriate response rate.

Each publication was given a score of "Yes" if it was mentioned, "No" if it wasn't, and "NA" if it wasn't reported. The JBI criterion had minimum and maximum values of 0 and 9, respectively. According to Rajati et al. (2022)¹⁴, scores between 1-3 were considered low quality, 4-6 moderately good, and 7-9 excellent quality. All articles that satisfied the study's inclusion requirements and whose quality was assessed using the JBI criteria were included.

Effect measures: The proportion of depressive disorder prevalence in perinatal females across all regions of India served as the study's index, and relative percent or frequency was utilized to aggregate the findings of the many investigations. I^2 was used to measure the heterogeneity between trials; $I^2 < 50\%$ was regarded as "low heterogeneity," while $I^2 > 50\%$ as "high heterogeneity." The Random Effects model was employed in light of the significant heterogeneity among the studies. In comparison to a model with a fixed effect, the model's results have a better degree of generalizability in high heterogeneity settings since it computes modifications to the parameters between the experiments¹⁴. The association of risk factors with post-partum depression was assessed using pooled odds ratio and 95% confi-

dence interval from all the studies including that risk factor.

A sensitivity study using the leave-one-out method was performed to identify the cause of the heterogeneity. Using a funnel plot, publication bias was investigated. Furthermore, the association between age, sample size, and depression prevalence % in post-partum females was investigated using meta-regression. According to the JBI score, regions of the country, type of study area, study settings, study instruments used to measure post-partum depression and year of the publication, subgroup analysis was carried out. P-value < 0.05 data was analyzed using comprehensive meta-analysis (CMA).

Synthesis methods: The authors used R software version 4.3.0 to pool all of the studies for a random-effects meta-analysis, which allowed them to determine the prevalence rate and 95% CI (confidence interval) of the pooled prevalence estimate. A meta-analysis was conducted for all measurement types and follow-up periods since trial results were reported as a change in scores from baseline to follow-up or follow-up data.

Reporting bias assessment: Funnel plots were made to express publication bias. Publication bias was assessed for continuous variables by Egger's regression test for funnel plots (Sterne and Egger, 2006) and the trim and fill technique (Duval and Tweedie, 2000a, 2000b) was just to adjust the effect size for missing studies.

RESULTS

Study selection: Following the application of the keywords, 2725 articles were discovered; 442 of these articles were removed due to duplication. Articles not within the fixed research period limit were 812, therefore removed. 282 of the items were removed because they were not in English. Publications that did not meet the inclusion criteria (n=870) were also excluded from the analysis. After much consideration and study, the authors decided that 59 articles would be appropriate for the meta-analysis. The comprehensive selection procedure is shown in the PRISMA flow chart, which is shown in Figure 1.

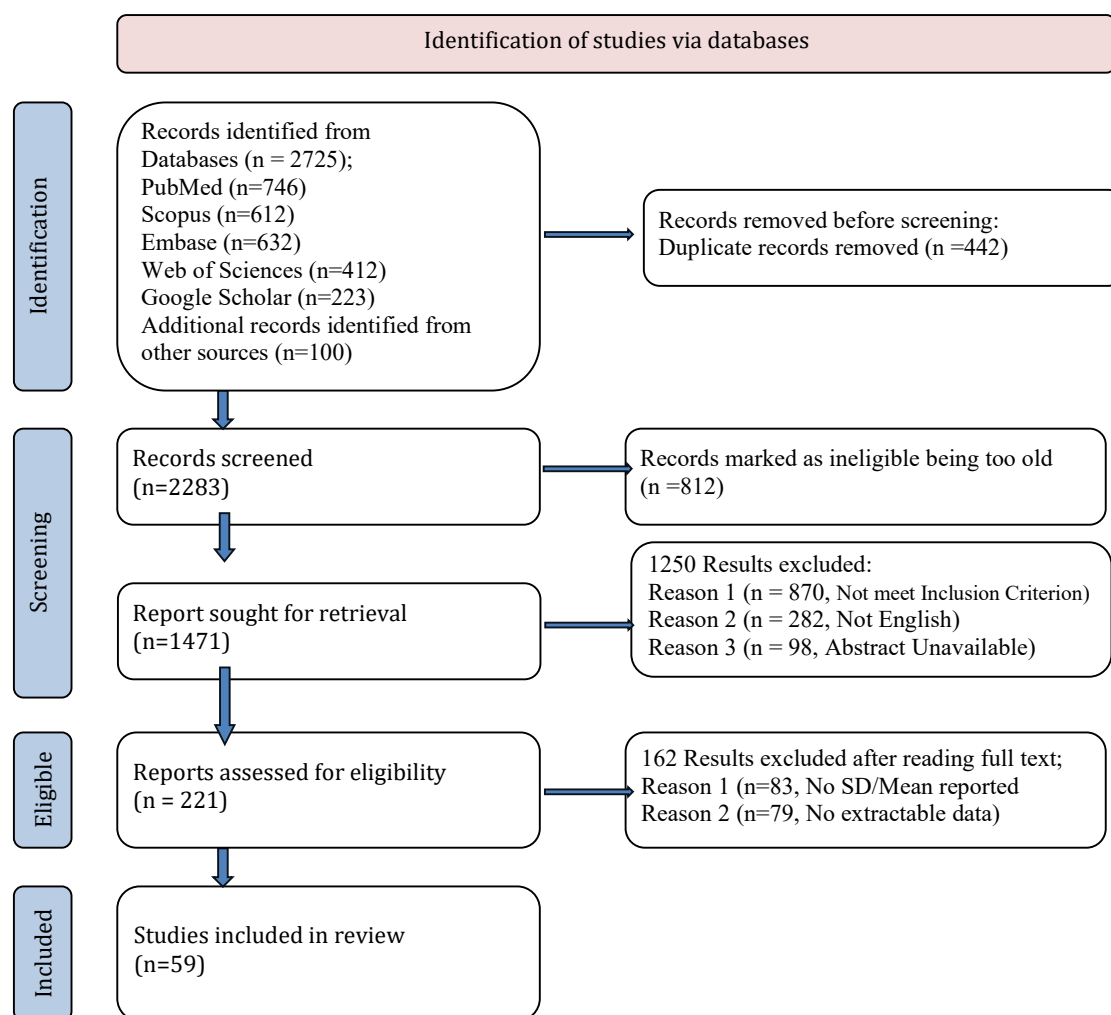


Figure 1: PRISMA Flow Diagram

Study characteristics: A total of 18,359 perinatal females were assessed across 59 observational studies that were included in the meta-analysis. Of them, the majority were conducted in Maharashtra (n=10), Karnataka (n=8), Tamil Nadu (n=6), Uttar Pradesh (n=4), and Gujarat (n=4) while, the rest were conducted in Odisha (n=3), Puducherry (n=3), Bihar (n=3), Andhra Pradesh (n=2), Madhya Pradesh (n=2), Haryana (n=2), Punjab (n=2), West Bengal (n=2), Kerala (n=2), Jammu (n=1), Jharkhand (n=1), Nagaland (n=1), Himachal Pradesh (n=1), Assam (n=1), and Delhi (n=1). 2020 and 2024 saw the publication of the earliest and newest papers, respectively. Every manuscript was examined using the JBI checklist, and its quality was rated between "Medium" and "High"¹⁴. The details of the reported studies are pre-

sented in Table 3.

Meta-analysis of Depression Prevalence in Postpartum Females: There was significant heterogeneity in the studies, as evidenced by the value of I^2 ($I^2 = 97\%$) for the prevalence of depression in postpartum females in India. For this reason, the Random Effects model (Figure 2.1) was used to analyze the data. Based on the random effect model, the combined results of the publications were used to estimate the prevalence of postpartum depression to be 19% (CI = 95: 15–23%). The confidence interval of 95% is shown by the whole length of a line above the black square, which represents the percentage in each study. The rhombus symbol (Figure 2.1) indicates the prevalence of depression in postpartum women.

Table 3: Characteristics of the study**(EPDS: Edinburgh Postnatal Depression Scale; HAMD: Hamilton Depression Rating Scale)**

Author, and Year of publication	Region, State (or Union Territory) and Sample Size	Mean Age± S.D. / Age Range (years)	Prevalence (%), Area, and settings	Type of study and Study Instrument used	Major Findings and Recommendations
Bala J et al, 2024 [15]	North India, Jammu, 750	27.24± 4.39	16.1, Urban, Hospital-based	Cross-sectional study, EPDS, HAM-D	Postpartum mothers particularly those, who have poor social support are highly vulnerable to depression.
Begum et al, 2024 [16]	South India, Karnataka, 65	21.58± 2.31	33.8, Urban, Hospital-based	Cross-sectional study, EPDS	Depression is very common in women who have just given birth. PPD is closely linked to modifiable psychosocial factors.
Fatima et al, 2024 [17]	East India, Jharkhand, 174	-	8.04, Urban, Hospital-based	Prospective study, EPDS	Women who gave birth to a female child had a higher prevalence of PPD.
Kapoor et al, 2024 [18]	North India, Uttar Pradesh, 280	24.1 ± 4.1	12.14, Urban, Hospital-based	Cross-sectional study, EPDS	Many women suffer from PPD, which highlights the need for efficient interventions.
Kar et al, 2024 [19]	East India, Odisha, 96	24.27 ± 4.08	54, Rural, Community-based	Cross-sectional study, EPDS	Familial stressors compound poor mental health and hence counseling of the family as a whole is necessary to achieve sound mental health in women in the postnatal period.
Mhamane et al, 2024 [20]	West India, Maharashtra, 314	26.5	38.5, Urban slums, Community-based	Cross-sectional study, EPDS	Measurement of the prevalence of PPD is essential to manage it.
Nyamagoud SB et al, 2024 [21]	South India, Karnataka, 210	-	74.7, Urban, Hospital-based	Prospective study, EPDS	Screening of PPD and providing suitable education should be encouraged during postpartum care or child-care visits for identifying and managing PPD, which in turn improves child development.
Pandey et al, 2024 [22]	West India, Maharashtra, 99	-	17.17, Urban, Hospital-based	Prospective study, EPDS	The study shows a high prevalence of PPD in Indian mothers.
Roy SK et al, 2024 [23]	East India, West Bengal, 189	-	29, Urban, Community-based	Cross-sectional study, EPDS	All mothers should be screened for PPD due to the prevalence of the disorder and its strong correlations with other variables.
Surati B et al, 2024 [24]	West India, Gujarat, 400	-	28, Urban, Hospital-based	Cross-sectional study, EPDS	The key findings indicate lower socioeconomic status and social support as major risk factors for postpartum depression among women in Gujarat.
Singh S et al, 2024 [25]	North India, Bihar, 200	-	32.5, Urban, Hospital-based	Retrospective study, Self-structured forms	This research emphasizes the critical importance of implementing specific programmes to reduce PPD in low-income metropolitan areas.
Tajwar Y et al, 2024 [10]	North India, Bihar, 300	28.3	19, Rural, Community-based	Cross-sectional study, EPDS	Key indicators of risk for PPD include unfavourable family dynamics, known neonatal medical conditions, and pregnancy complications.
More M et al, 2024 [26]	West India, Maharashtra, 246	-	20.32, Urban, Hospital-based	Prospective study, EPDS	Both the postpartum period and pregnancy pose increased risks for the onset of various psychiatric disorders.
Bhakta M et al, 2024 [27]	East India, Odisha, 121	26.98 ± 4	8.26, Rural, Community-based	Cross-sectional study, EPDS	Mode of delivery showed significance, with a higher prevalence of PPD observed among those who underwent a lower segment caesarean section.
Ruban JA et al, 2024 [28]	South India, Tamil Nadu, 741	-	32.25, Urban, Hospital-based	Cross-sectional Study, Self-structured forms	Early screening and intervention may drastically and significantly reduce mental disorders existing in the pregnant population.
Dadhwal V et al, 2023 [29]	North India, Haryana, 680	24	2.2, Rural, Community-based	Cross-sectional study, EPDS	PPD is a stressor that affects rural Indian women's functioning, ability to bond with their infant, and relationships with their parents and spouse.
Sunitha NH et al, 2023 [30]	South India, Karnataka, 164	-	42.7, Rural, Community-based	Cross-sectional study, EPDS	There was a significant association found between age of the mother and postpartum depression.

Author, and Year of publication	Region, State (or Union Territory) and Sample Size	Mean Age± S.D. / Age Range (years)	Prevalence (%), Area, and settings	Type of study and Study Instrument used	Major Findings and Recommendations
Kumar LS et al, 2023 [31]	South India, Andhra Pradesh, 110	23.7 ±2.6	19.1, Rural, Community-based	Cross-sectional study, EPDS	Postpartum depression is associated with age, SES, type of delivery, and immediate outcome of delivery.
Singh R et al, 2023 [32]	East India, Nagaland, 178	18	54.49, Rural, Community-based	Cross-sectional study, EPDS	The prevalence of PPD is very high in Northeast India, especially in urban areas.
Agarwal P et al, 2023 [33]	South India, Puducherry, 242	-	27.27, Urban, Hospital-based	Prospective study, EPDS	Women in the CS group experienced PPD at twice the rate of those in their Normal Delivery unit. PPD and domestic violence or abuse were highly strongly correlated.
Leela K et al, 2023 [34]	South India, Tamil Nadu, 427	-	26.2, Urban, Hospital-based	Cross-sectional study, EPDS	Several clinical factors and adverse events during pregnancy, including socio-demographic factors and pregnancy-related complications, can set the stage for PPD.
Malhotra JK et al, 2023 [35]	North India, Punjab, 185	-	22.2, Rural, Community-based	Cross-sectional study, EPDS	PPD was shown to be prevalent in 22.2% of cases and was linked to a number of characteristics, including age, obstetric history, child sex, desire for a male kid, and support from husbands and in-laws.
Tanna KJ et al, 2023 [36]	West India, Gujarat, 100	26.5 ± 4.05	23, Rural, Community-based	Cross-sectional study, EPDS	Very low Socioeconomic levels, history of Depression and Anxiety, mothers' education and occupation levels, family support during pregnancy, and mothers' stress levels are important predictors of PPD.
Akurathi P et al, 2023 [37]	South India, Andhra Pradesh, 60	-	15, Urban, Hospital-based	Cross-sectional study, EPDS	Though there is a wide difference in the prevalence of postnatal depression among worldwide studies, India needs many more studies. It must address socio-economic issues resulting in depression and behavioural changes in postnatal women.
Saraga K et al, 2023 [38]	South India, Tamil Nadu, 200	25.64±3.04	9, Urban, Hospital-based	Prospective study, EPDS	The prevalence of PPD was 9%, and interference with child rearing and perception of difficulty in daily activities were significantly associated with PPD
Dalal K et al, 2023 [39]	West India, Maharashtra, 213	-	15.02, Urban, Hospital-based	Cross-sectional study, EPDS	At our hospital, postpartum depression was so common that routine EPDS use for new moms was necessary.
Priya T et al, 2022 [40]	North India, Himachal Pradesh, 426	-	17.4, Urban, Hospital-based	Cross-sectional study, EPDS	It was discovered that the area without screening procedures for these patients had a significant frequency of PPD.
George M et al, 2022 [41]	South India, Karnataka, 150	23.31 ± 3.03	11.3, Rural, Community-based	Prospective study, EPDS	The study found that one in ten rural women is developing PPD and there is a strong link of PPD with antenatal psychiatric disorders and family factors.
Aslam M et al, 2022 [42]	North India, Uttar Pradesh, 304	-	9.5, Rural, Community-based	Cross-sectional study, EPDS	Approximately 10% of postpartum women had depression but chose not to seek treatment.
Chand S et al, 2022 [43]	South India, Karnataka, 130	-	12.30, Rural, Community-based	Cross-sectional study, EPDS	The results revealed that the overall prevalence rate of postpartum depression was 12.30 %, whereas urban mothers showed quite a higher (8.50%) rate of postpartum depression prevalence than rural (3.80%) mothers.
Baruah J et al, 2022 [44]	East India, Assam, 110	-	7, Urban, Hospital-based	Cross-sectional study, EPDS	Expectations regarding the present child's gender, birth order, and familial histories of depression were significantly correlated with the occurrence of postnatal depression. Expectations regarding the present child's gender, birth order, and familial histories of depression were significantly correlated with the occurrence of postnatal depression.

Author, and Year of publication	Region, State (or Union Territory) and Sample Size	Mean Age± S.D. / Age Range (years)	Prevalence (%), Area, and settings	Type of study and Study Instrument used	Major Findings and Recommendations
Ghormode PD et al, 2022 [45]	East India, West Bengal, 200	28.34 ± 4.98	8, Urban, Hospital-based	Cross-sectional study, EPDS	The stigma of referral to a psychiatrist can interfere with compliance with further treatment. The presence of a psychiatrist in the hospital would be beneficial.
Hadia R et al, 2022 [46]	West India, Gujarat, 120	24.39	34.17, Urban, Hospital-based	Prospective study, EPDS	A high prevalence rate of PPD was found in which socio-cultural factors play a major role.
Mishra A et al, 2022 [47]	North India, Haryana, 200	-	34, Urban, Hospital-based	Retrospective study, Whooley questionnaire	A statistically significant association was found between positive family history and PPD (p<0.05) while no such association of PPD was found with SES, education, religion, and type of family as p>0.05.
Vishal AK et al, 2022 [48]	West India, Maharashtra, 348	-	12.93, Urban, Hospital-based	Cross-sectional study, EPDS	Multiparity, poor obstetrical outcomes, prenatal abortions, postpartum depression, the baby's unwanted sex, a lack of social support, the recent death of a family member, stressful puberty, and chronic illness in a prior child were all factors linked to PPD, according to multivariate analysis.
Ghosh S et al, 2022 [49]	South India, Karnataka, 73	-	14.2, Urban, Hospital-based	Prospective study, Blues Questionnaire, MINI PLUS- International Neuro-Psychiatric Interview.	The study highlights the importance of post-partum blues as these women are at higher risk of developing post-partum depression.
Lanjewar S et al, 2021 [50]	West India, Maharashtra, 240	26.68	26.3, Urban, Hospital-based	Cross-sectional study, EPDS	Urban moms who experience greater levels of depressive symptoms following delivery have an impact on the health of both themselves and their kids.
Dubey A et al, 2021 [51]	West India, Maharashtra, 295	-	30.84, Urban, Hospital-based	Cross-sectional study, EPDS	Sociodemographic factors such as the low educational status of mothers, rural population, and low monthly family income were found to be associated with PPD.
Doke PP et al, 2021 [52]	West India, Maharashtra, 2831	23.96± 3.72	3.07, Urban, Hospital-based	Prospective study, EPDS	Women who had a delivery by caesarean section had a 3.79% postpartum depression rate at 6 weeks, whereas those who had a delivery via vaginal delivery had a 2.35% rate.
Randhawa A. et al, 2021 [53]	North India, Punjab, 250	26.16 ± 4.69	32.8, Urban, Community-based	Cross-sectional study, EPDS	Nearly one-third of postpartum women suffer from depression. Psychiatric morbidities have been linked to poverty, Caesarean sections, domestic abuse, and inadequate spousal support.
Basu S et al, 2021 [54]	North India, Delhi, 210	25.95 ± 3.74	29, Urban, Hospital-based	Cross-sectional study, EPDS	Postpartum depression represents a major public health challenge in India. Regular, mandatory screening for postpartum depression is needed at primary health facilities in resource-constrained settings for an extended period post-childbirth.
Neelakanthi A et al, 2021 [55]	South India, Karnataka, 115	25.2± 3.8	31.3, Urban, Hospital-based	Prospective study, EPDS	The prevalence of PDSs in the postpartum period is quite high—approximately one-third of the mothers screened had PDSs. Young age, low SES, and pregnancy-induced complications appeared to increase the odds of having PDSs.
Kamath V et al, 2021 [56]	South India, Karnataka, 950	-	15.78, Urban, Hospital-based	Cross-sectional study, EPDS	Mothers who have experienced NVD, are primigravida, belong to the lower middle class, or have IUD infants are more likely to have PPD.
Chainani EG et al, 2021 [57]	West India, Maharashtra, 200	27.5	34, Urban, Hospital-based	Cross-sectional study, EPDS	Thirty-four per cent of the cases had a score of more than 12, indicating the presence of postpartum depression.

Author, and Year of publication	Region, State (or Union Territory) and Sample Size	Mean Age± S.D. / Age Range (years)	Prevalence (%), Area, and settings	Type of study and Study Instrument used	Major Findings and Recommendations
Rahaney V et al, 2021 [58]	West India, Maharashtra, 60	25.53±3.2	6.7, Urban, Hospital-based	Cross-sectional study, EPDS, HAM-D	Although the prevalence is less, PPD is an important mental health issue.
Sita V K et al, 2021 [59]	South India, Tamil Nadu, 156	18-40	19.23, Urban, Hospital-based	Cross-sectional study, EPDS	The study shows prevalence of postpartum depression is quite high and none of those women seek appropriate medical help.
Nayak D et al, 2021 [60]	South India, Puducherry, 890	26.4 ± 4.9	21, Urban, Hospital-based	Prospective study, EPDS	One in five women who develop potentially life-threatening complications develops PPD.
KT NM et al, 2021 [61]	South India, Kerala, 500	-	8.6, Urban, Hospital-based	Cross-sectional study, EPDS	According to this study, the proportion of PND among women at 6 weeks postpartum is 8.6%.
Bhaskar P et al, 2021 [62]	West India, Madhya Pradesh, 100	-	23, Urban, Community-based	Cross-sectional study, EPDS	Mothers in urban Indore had a notably high prevalence of PPD symptoms, which were closely linked to risk factors.
Rajendran SS et al, 2021 [63]	South India, Tamil Nadu, 700	-	70.93, Urban, Hospital-based	Cross-sectional study, EPDS	According to the study's findings, women over 30, wedded for over thirty years, residing in an urban region, and suffering PIH, GDM, or anaemia were at a higher risk than other women. There was also a strong correlation between the severity of depression and sociodemographic and obstetric factors.
Raghavan V et al, 2021 [64]	North India, Bihar, 564	23.4± 3.7	23.9, Rural, Community-based	Cross-sectional study, EPDS	In North India's rural areas, perinatal depression is very common among women. A high likelihood for PND is conferred by a multiplicity of circumstances, including family, economic, obstetric, and physical.
Amipara T et al, 2020 [65]	West India, Gujarat, 116	-	6.8, Rural, Community-based	Cross-sectional study, EPDS	Sociodemographic factors such as the relationship of mothers with in-laws/husbands, help at home in childcare, literacy status, age at marriage and first child, and own desired/in-laws of sex of the child are found to be significantly associated with PPD.
Santhosh K et al, 2020 [66]	South India, Kerala, 250	24.9±4	27.6, Urban, Hospital-based	Cross-sectional study, EPDS	Postpartum women have a relatively high rate of depression. PPD is closely linked to modifiable psychosocial factors, which may present chances for intervention.
Mishra K et al, 2020 [67]	East India, Odisha, 60	24 ± 3.8	8.57, Urban, Community-based	Cross-sectional study, EPDS	PPD was statistically significantly to be religion. PPD was also found to be associated with other characteristics, such as the newborn's sex, manner of delivery, high parity, reading level, and socioeconomic status.
Rani K et al, 2020 [68]	North India, Uttar Pradesh, 175	-	11.4, Urban, Hospital-based	Cross-sectional study, EPDS	Lack of family support, postpartum difficulties, and intrauterine demise (IUD) or premature neonatal death were common risk factors.
Selvam G et al, 2020 [69]	South India, Puducherry, 200	-	12, Urban, Hospital-based	Cross-sectional study, EPDS	Due to the high rate of postpartum depression among first-time moms, we were able to improve the effectiveness of prenatal counselling for mothers about birth and its complications.
Priyanka S et al, 2020 [70]	South India, Tamil Nadu, 111	-	13.51, Urban, Hospital-based	Cross-sectional study, EPDS	The percentage of women suffering from post-partum depression in this region is significant.
Nigam S et al, 2020 [71]	West India, Madhya Pradesh, 300	-	10, Urban, Hospital-based	Cross-sectional study, Patient Health Questionnaire (PHQ-9)	According to the severity of depression, 10% of women had severe depression, 23.33% had moderate depression, 3.33% had moderately serious depression, and the remaining 40% had little depression.
Goyal S et al, 2020 [72]	North India, Uttar Pradesh, 281	25.9 ± 4.04	7.12, Urban, Hospital-based	Cross-sectional study, EPDS	The high prevalence of psychiatric disorders and the strikingly low help-seeking are noteworthy.

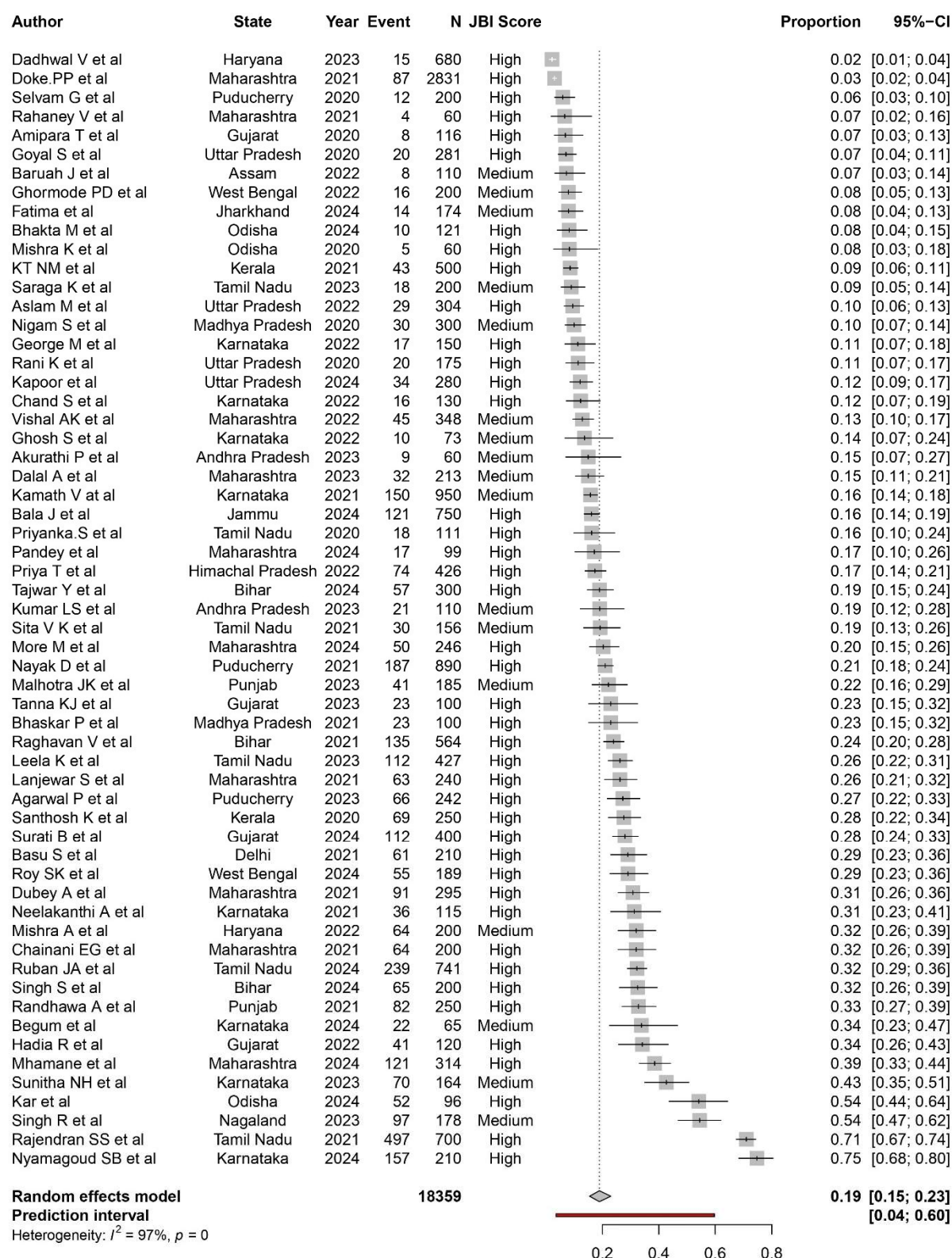


Figure 2.1: Forest Plot showing the prevalence of postpartum depression in India

Risk of bias in studies: The majority of studies were found to be high quality ($n=42$) while the rest were medium quality ($n=17$) when assessed using JBI score for cross-sectional and cohort studies as shown in Figure 2.1.

Meta-regression: Using Restricted Maximum Likeli

hood (REML) meta-regression, the association between the incidence of depression in postpartum females and the mean age (Figure 3) and sample size (Figure 4) was investigated. The results showed that the prevalence of depression decreased as both factors increased ($P < 0.01$).

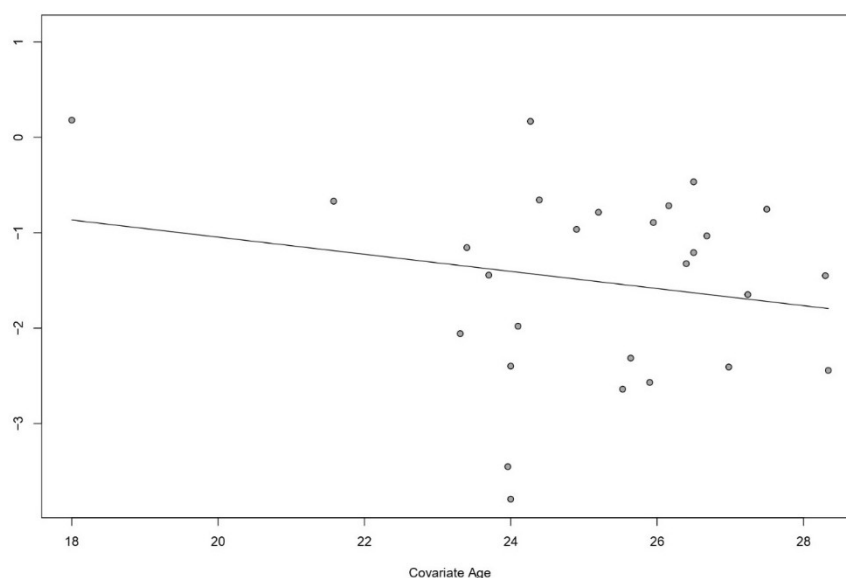


Figure 3: Meta-regression of the relationship between the mean age of participants and the prevalence of post-partum depression

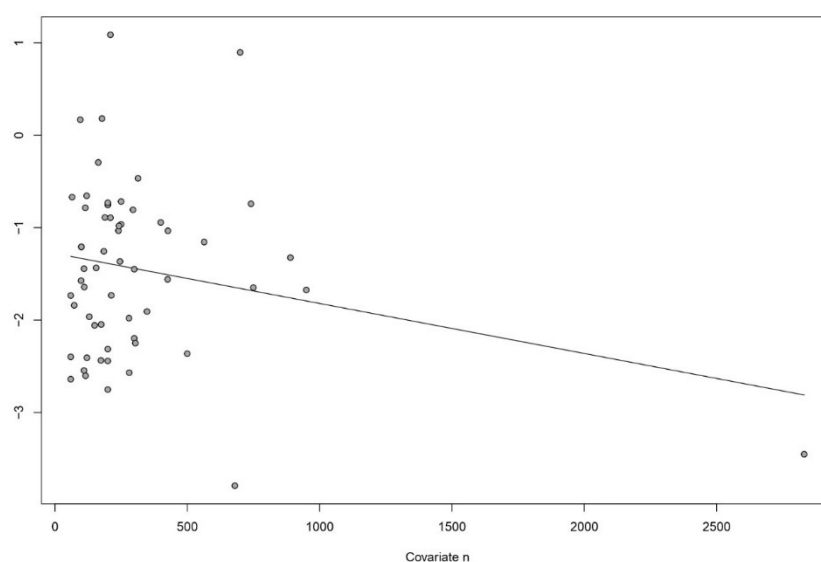


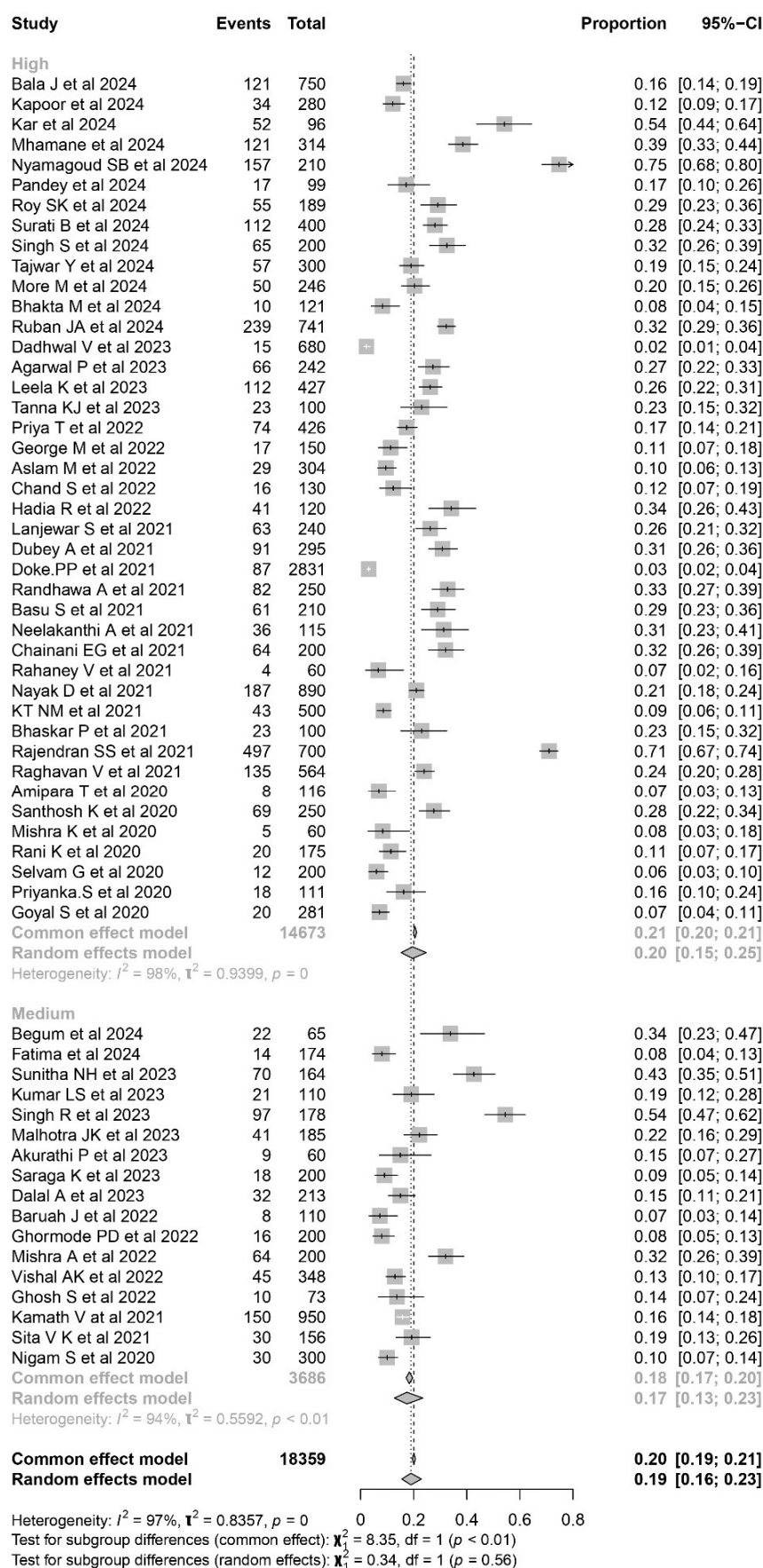
Figure 4: Meta-regression of the relationship between the sample size and the prevalence of post-partum depression

Subgroup analysis: A subgroup analysis based on the JBI score, regions of the country, type of study area, study settings, study instruments used to measure post-partum depression and year of the publication was conducted in light of the considerable degree of heterogeneity in the research. The largest rates of depression in postpartum females in India were observed in studies with an overall quality rating of “high” (19%; 95% CI: 15–24).

According to Table 2, the southern area of the country had the greatest estimated overall pooled prevalence (22%; 95% CI: 15–31), followed by the western (18%; 95% CI: 12–25) and eastern regions (17%; 95% CI: 7–35). The lowest prevalence (16%; 95% CI: 10–24) was found in northern India. While not statistically significant, the pooled prevalence was greater for studies carried out in urban versus rural regions

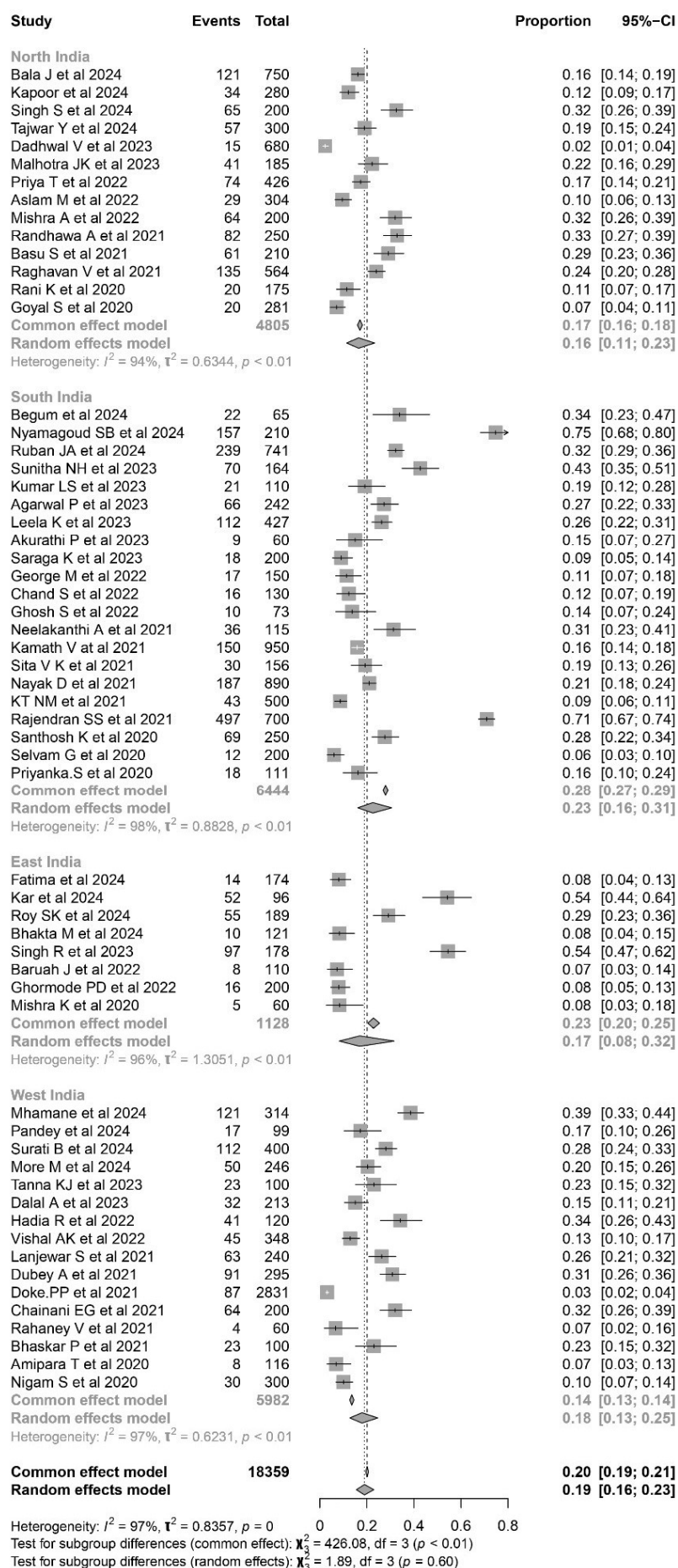
(19%; 95% CI: 15–24 versus 17%; 95% CI: 10–28) and in community settings (19%; 95% CI: 12–28) as opposed to those in hospitals (18%; 95% CI: 14–23; Table 4).

Pooling of studies that used the Edinburgh postnatal depression scale as the study instrument produced a prevalence of 18% (95% CI: 15–22) compared with 22% (95% CI: 11–39) in those that used other study instruments (Table 4). The sub-group analyses of pooled prevalence of post-partum depression were also done according to publication year from 2020–2025, which found the post-partum depression in India to be highest in year 2024 (25%; 95% CI: 17–36) and 2021 (21%; 95% CI: 13–32), followed by 2023 (19%; 95% CI: 11–32), 2022 (14%; 95% CI: 9–20) and 2020 (10%; 95% CI: 6–16). Forest plots of subgroup analysis are shown in Figure 2.2.

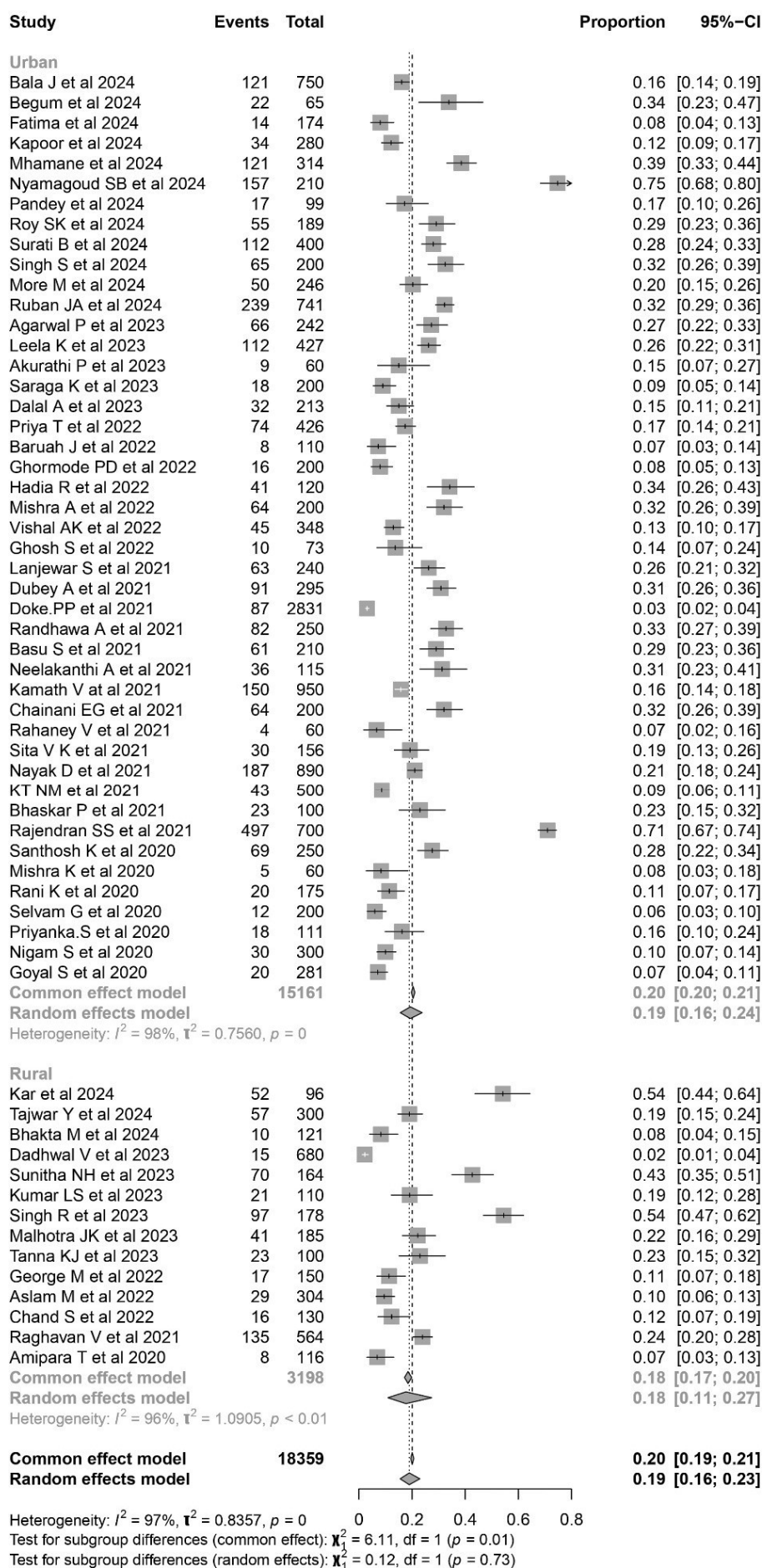


(a) JBI Score

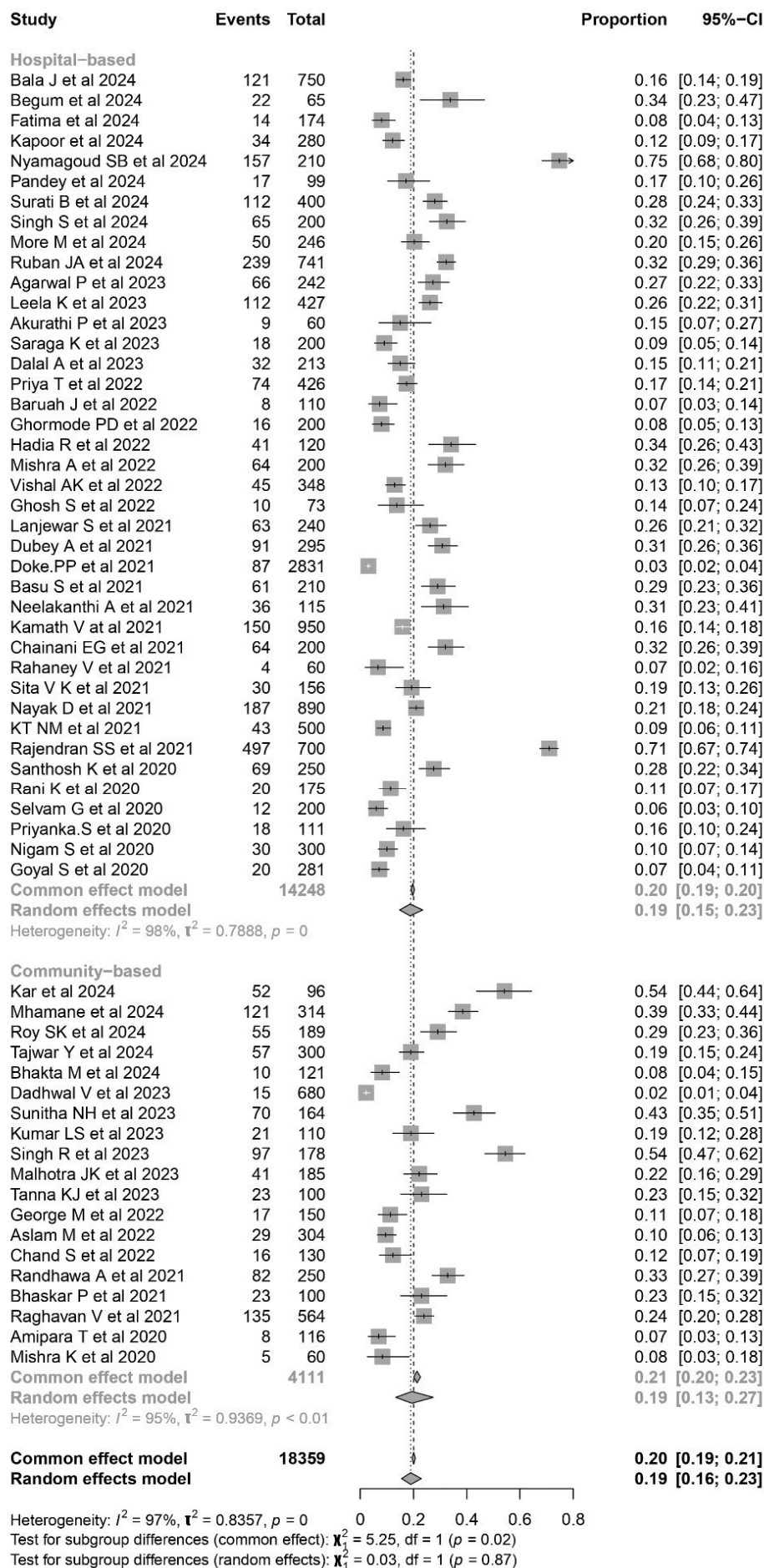
Figure 2.2 Forest Plots showing subgroup analysis according to (a) JBI Score, (b) Zones or Regions, (c) Area, (d) Settings, (e) Study Instrument, and (f) Publication Year



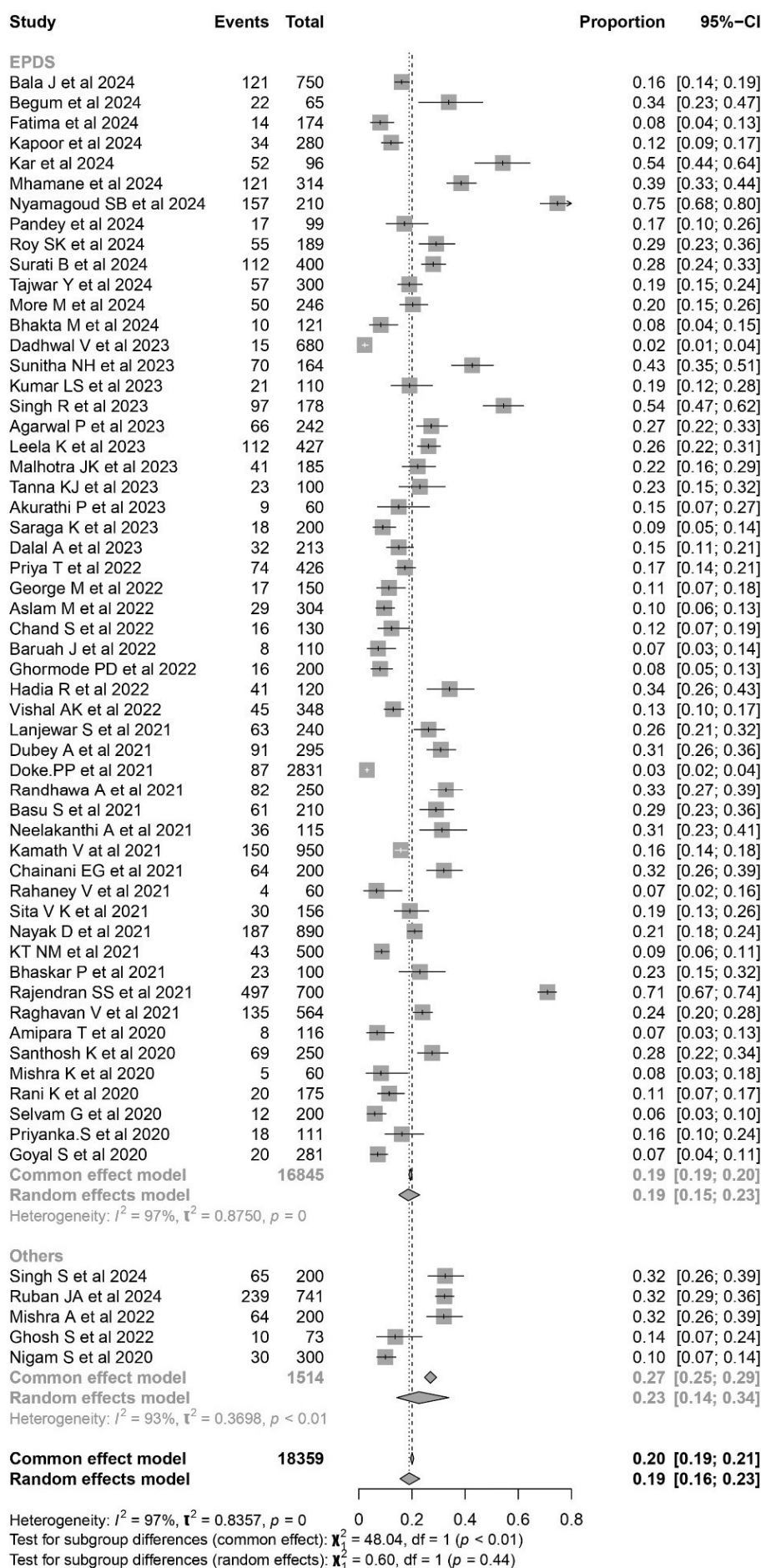
(b) Zones or Regions



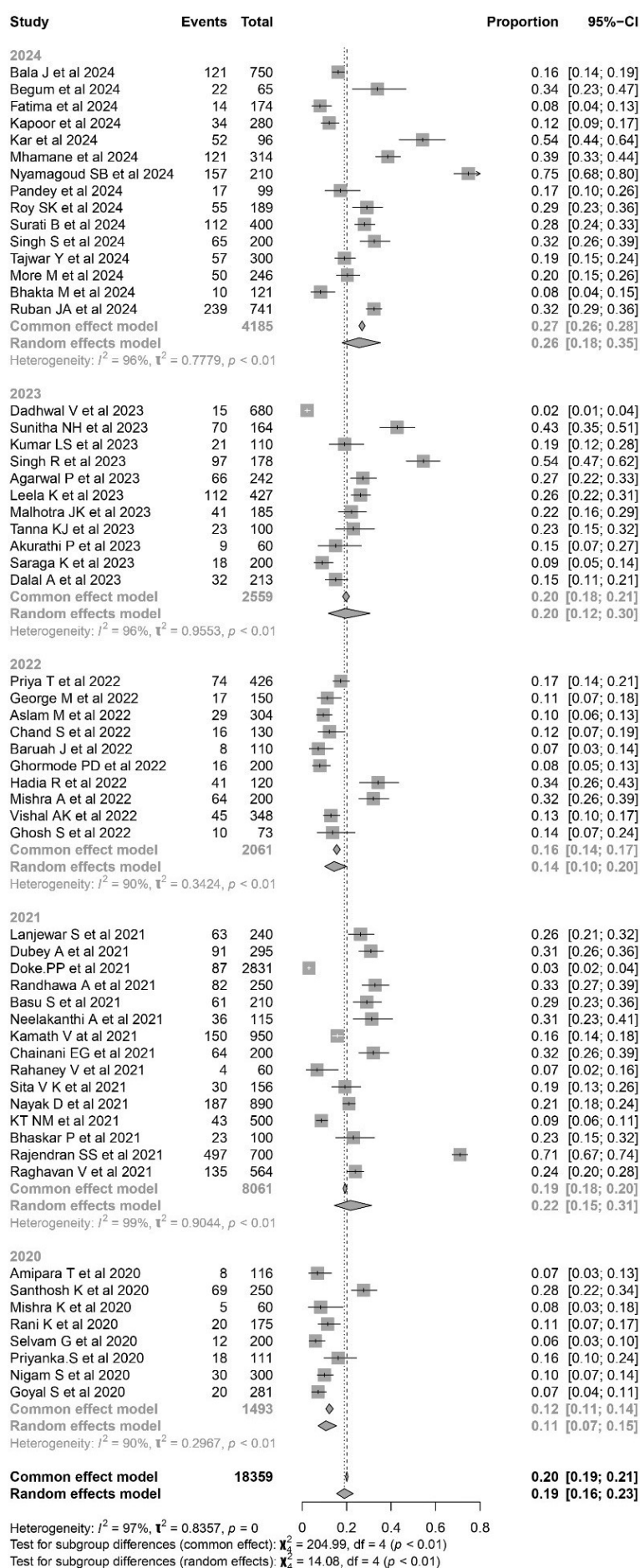
(c) Area



(d) Setting



(e) Study Instrument



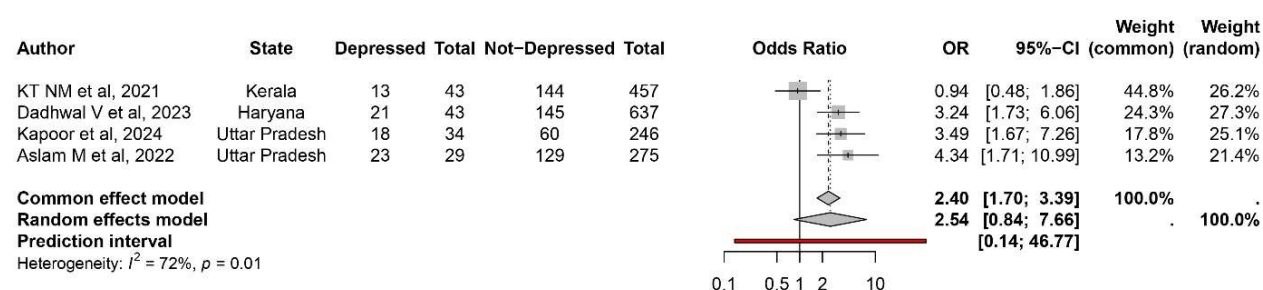
(f) Publication Year

Table 4: Subgroup analysis to estimate the prevalence of depression in postpartum females in India

Subgroup	Number of Studies	Point Estimate	95%CI	I ² (%)	tau	p (subgroup)
JB1 Score						
High	42	0.19	0.15- 0.24	97.7	0.96	0.55
Medium	17	0.17	0.12- 0.24	94.3	0.74	
Regions						
North India	14	0.16	0.10-0.24	94.5	0.79	0.59
South India	21	0.22	0.15-0.31	97.9	0.93	
East India	8	0.17	0.07-0.35	96.2	1.14	
West India	16	0.18	0.12-0.25	97.3	0.78	
Area						
Urban	45	0.19	0.15- 0.24	97.5	0.86	0.72
Rural	14	0.17	0.10- 0.28	96.2	1.04	
Setting						
Hospital	40	0.18	0.14-0.23	97.7	0.88	0.86
Community	19	0.19	0.12-0.28	95.4	0.96	
Study Instrument						
EPDS	54	0.18	0.15-0.22	97.4	0.93	0.43
Others	5	0.22	0.11-0.39	93.2	0.60	
Publication Year						
2024	15	0.25	0.17-0.36	96.3	0.88	0.007
2023	11	0.19	0.11-0.32	95.9	0.97	
2022	10	0.14	0.09-0.20	90.3	0.58	
2021	15	0.21	0.13-0.32	98.8	0.95	
2020	8	0.10	0.06-0.16	89.7	0.54	

Risk factors: A total of 20 risk factors were identified for postpartum depression. The association of post-partum depression with the risk factors was reported using forest plots. These were addiction in the husband or family (2.54; 95%CI: 0.84-7.66), any comorbidity or medical illness in the mother (2.19; 95%CI: 0.86-5.57), caesarean section or interventional delivery (1.34; 95% CI: 0.96-1.87), complications during or after the current pregnancy (1.87; 95%CI: 1.13-3.07), conflict with in-laws or no support from family (5.96; 95%CI: 3.58-9.93), early postnatal period (2.54; 95%CI: 0.67-9.69), absence of exclusive breast-feeding (2.16; 95% CI: 1.37-3.40), family history of psychiatric illness (5.38; 95% CI: 3.66-7.92), female child born in the current pregnan-

cy (1.27; 95%CI: 0.96-1.67), high parity (1.09; 95% CI: 0.83-1.44), illiteracy or low education (1.54; 95%CI: 1.10-2.16), marital disharmony or no support from husband (8.82; 95%CI: 3.42-22.76), mood swings during pregnancy or history of psychiatric illness or addiction (4.49; 95% CI:1.67-12.08), nuclear family (1.03; 95% CI:0.81-1.30), poverty or financial difficulties or low SE status (1.34; 95% CI: 0.96-1.87), preterm or low-birth-weight baby (2.16; 95%CI: 1.47-3.17), primigravida (0.78; 95%CI: 0.44-1.36), self-unemployment or husband Unemployment (0.87; 95% CI: 0.57-1.33), sickness or death of baby (2.41; 95%CI: 1.70-3.42), unplanned or unwanted pregnancy (1.58; 95% CI: 0.88-2.84).

**Figure 5: Forest plot showing the association between post-partum depression and Addiction in Husband or Family**

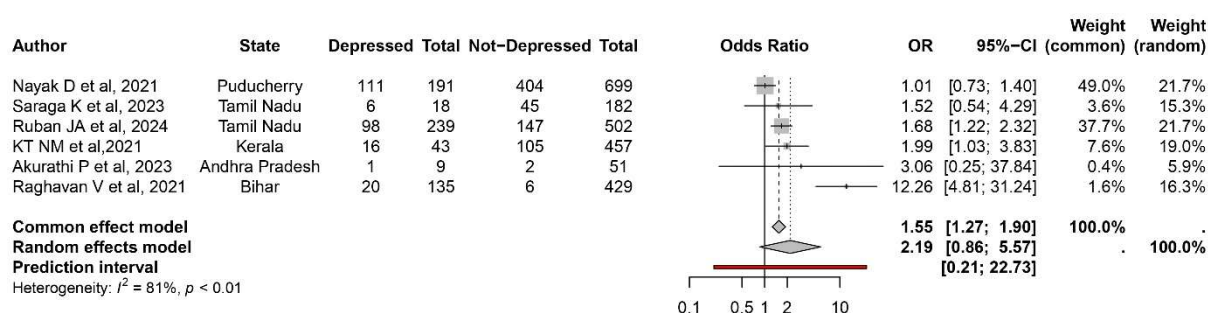


Figure 6: Forest plot showing the association between post-partum depression and Any Comorbidity or Medical Illness in mother

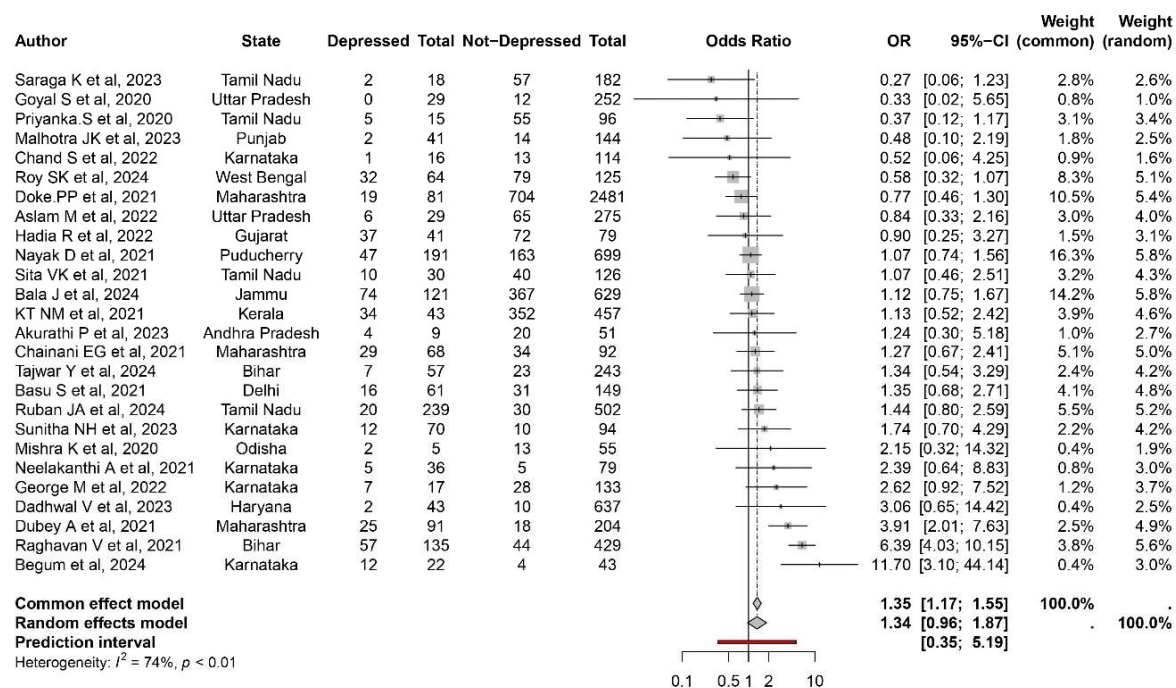


Figure 7: Forest plot showing the association between post-partum depression and Caesarean section or Interventional delivery

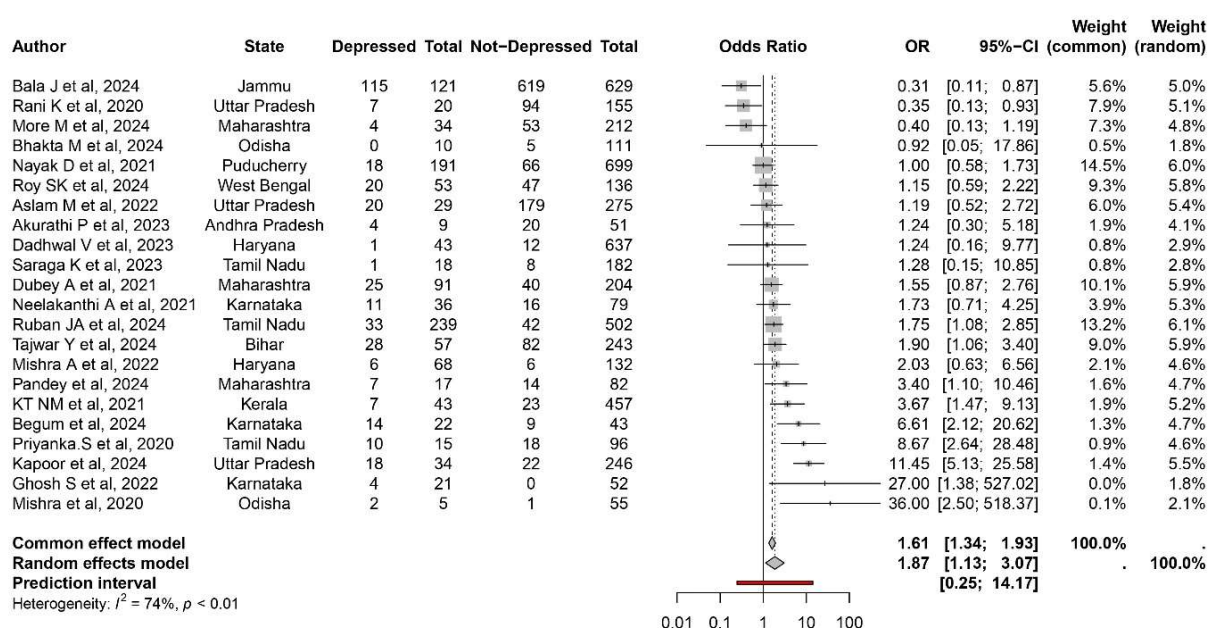


Figure 8: Forest plot showing the association between post-partum depression and Complications during or after the current pregnancy

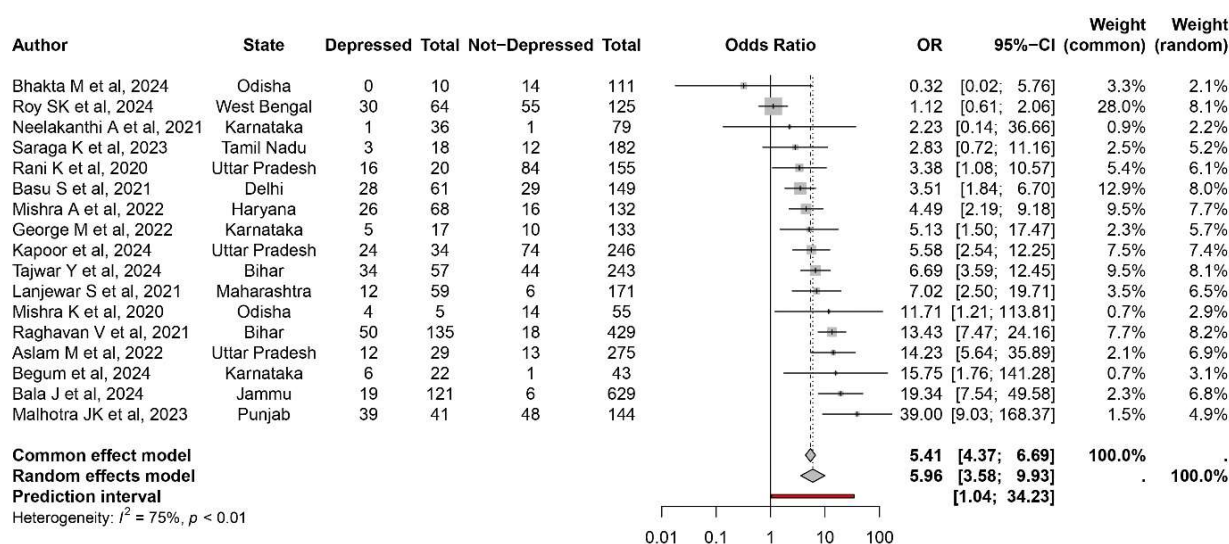


Figure 9: Forest plot showing the association between post-partum depression and Conflict with in-laws or No support from family

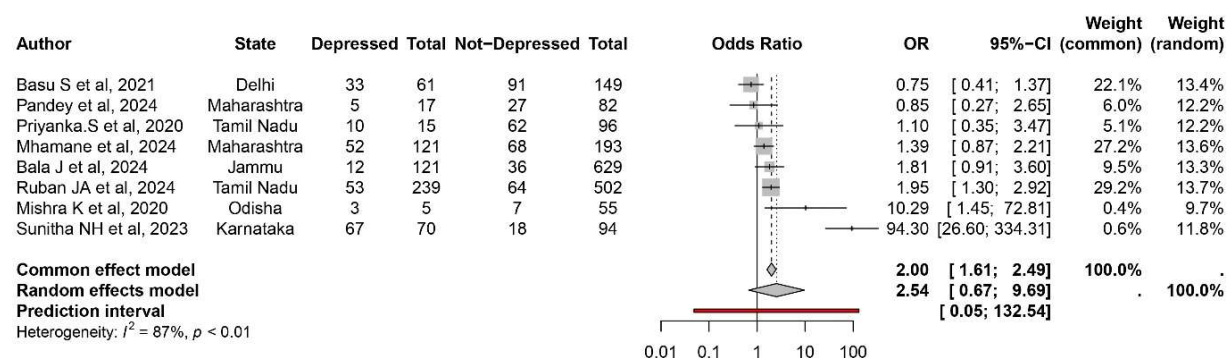


Figure 10: Forest plot showing the association between post-partum depression and the Early Postnatal period

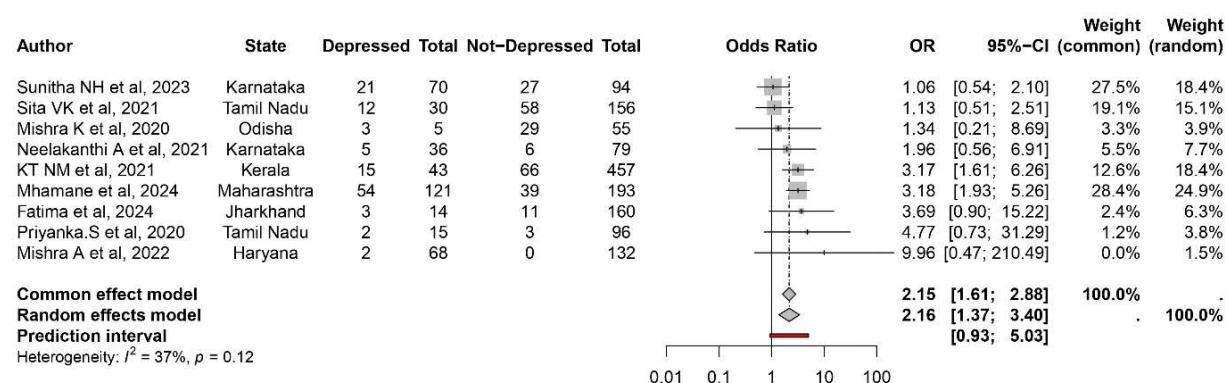


Figure 11: Forest plot showing the association between post-partum depression and absence of Exclusive Breast-Feeding

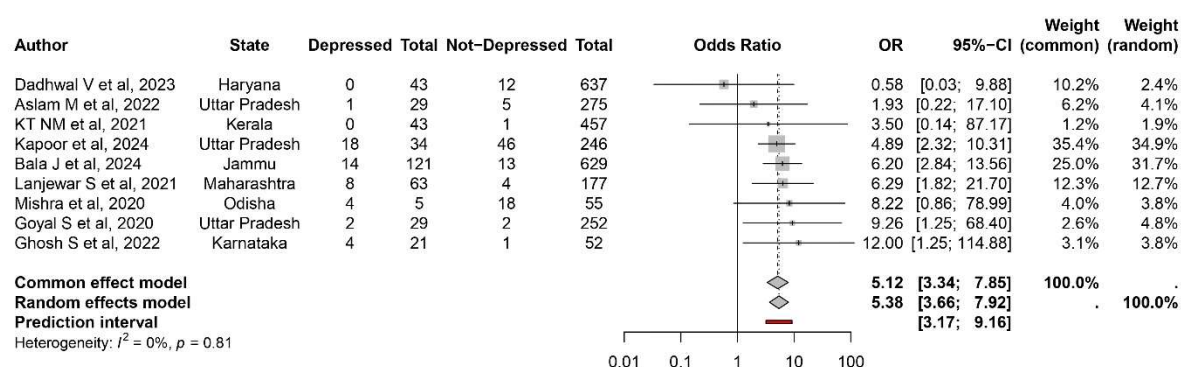


Figure 12: Forest plot showing the association between post-partum depression and Family history of psychiatric illness

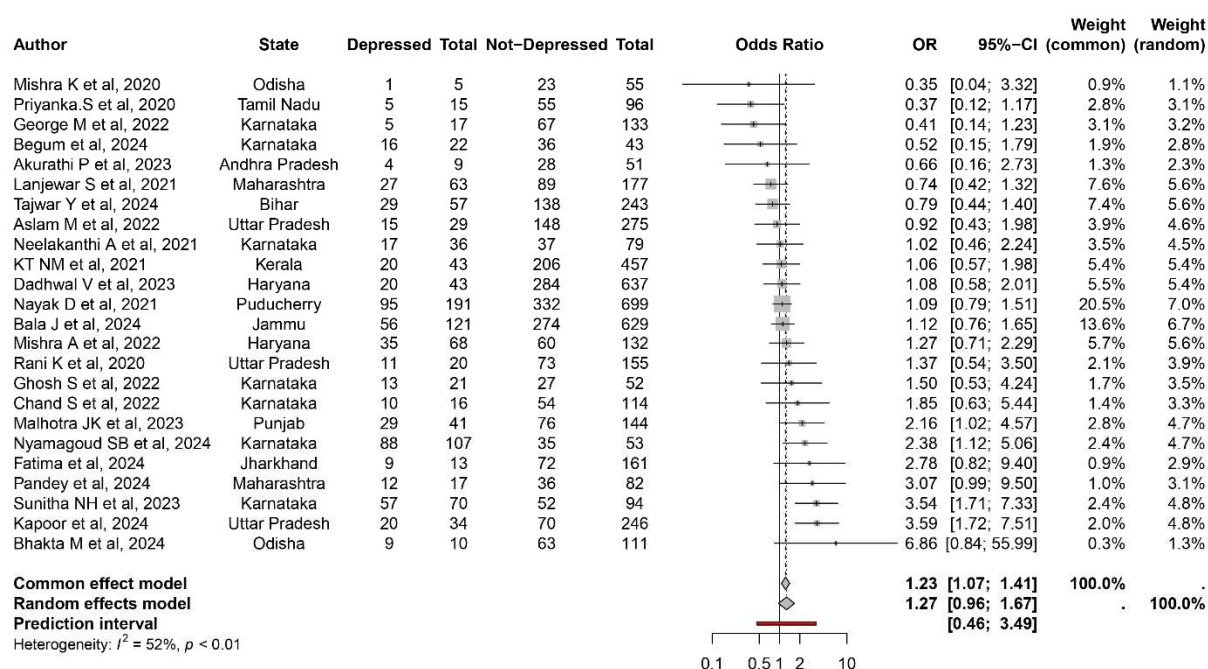


Figure 13: Forest plot showing the association between post-partum depression and Female child born in the current pregnancy

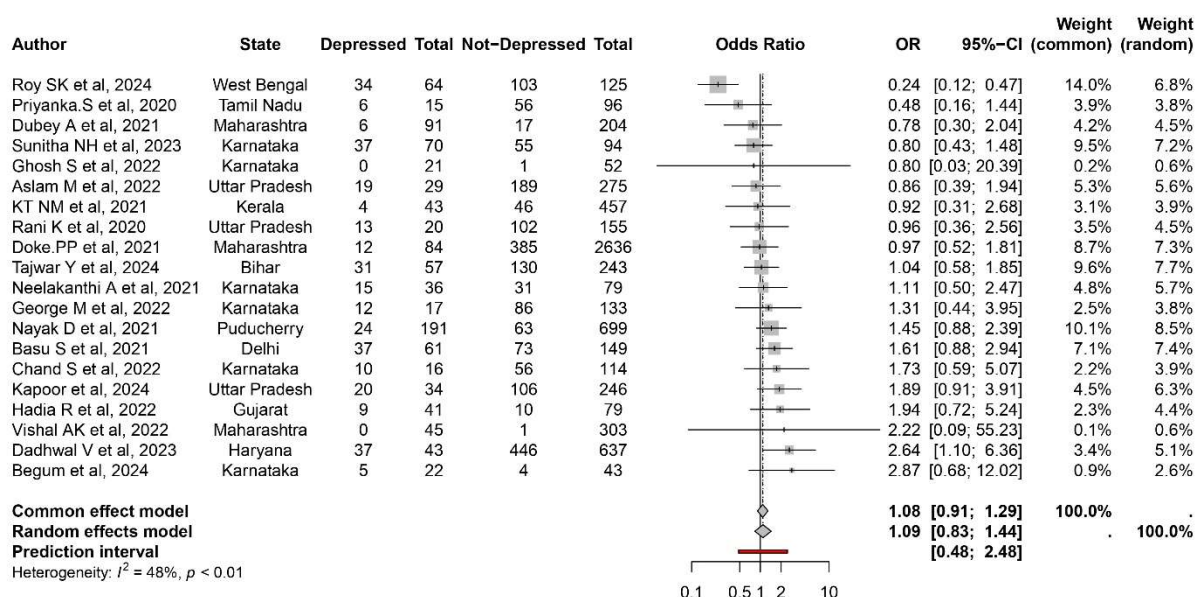


Figure 14: Forest plot showing the association between post-partum depression and High Parity

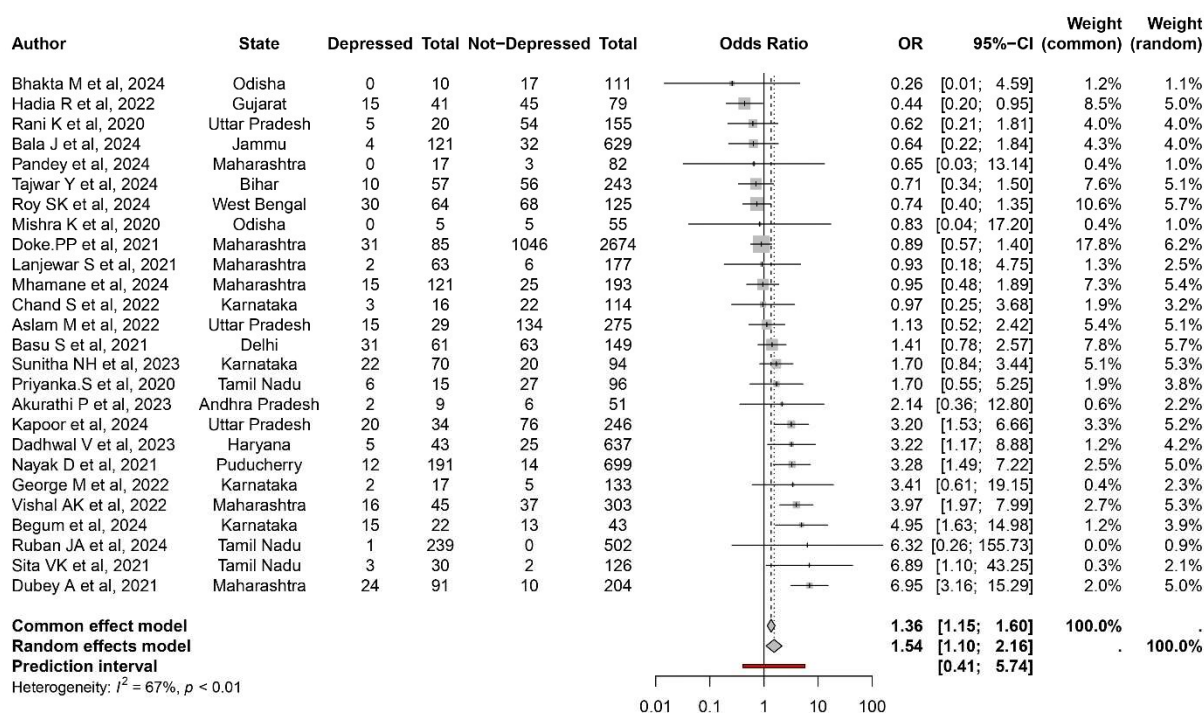


Figure 15: Forest plot showing the association between post-partum depression and Illiteracy or Low Education

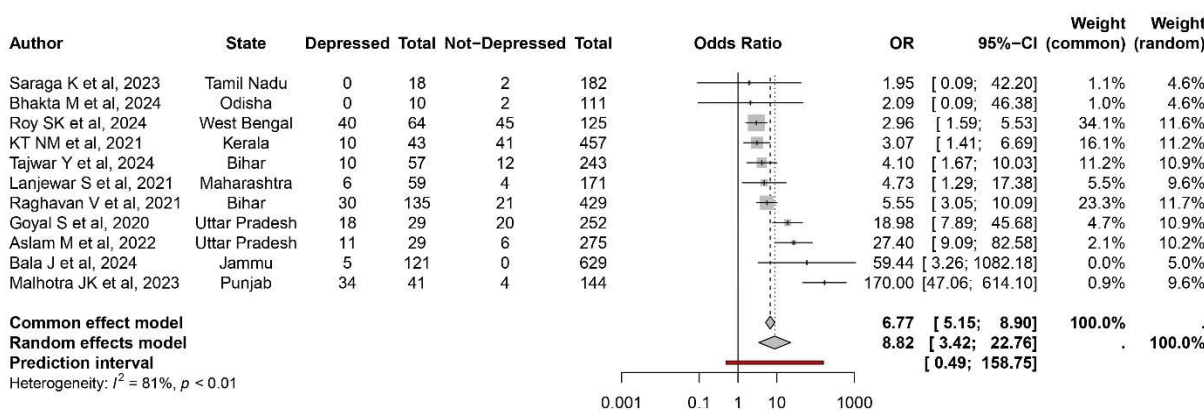


Figure 16: Forest plot showing the association between post-partum depression and Marital Disharmony or No support from husband

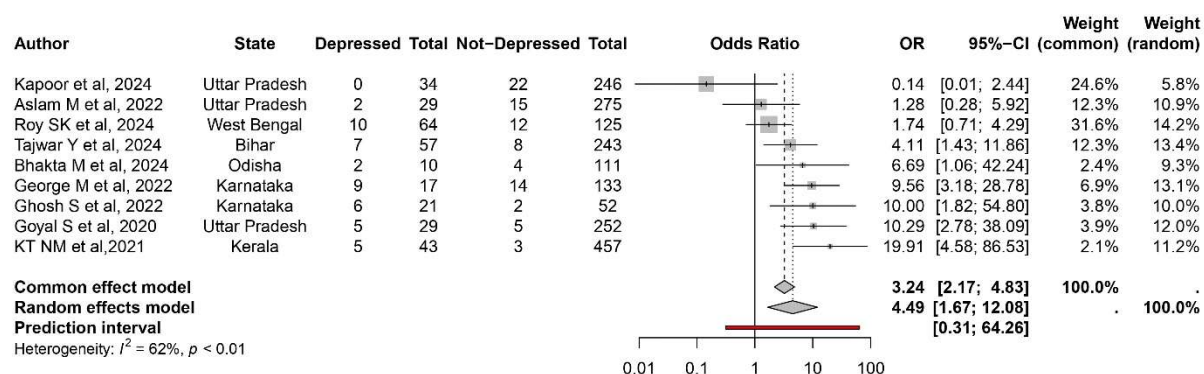


Figure 17: Forest plot showing the association between post-partum depression and Mood swings during pregnancy or history of psychiatric illness or Addiction

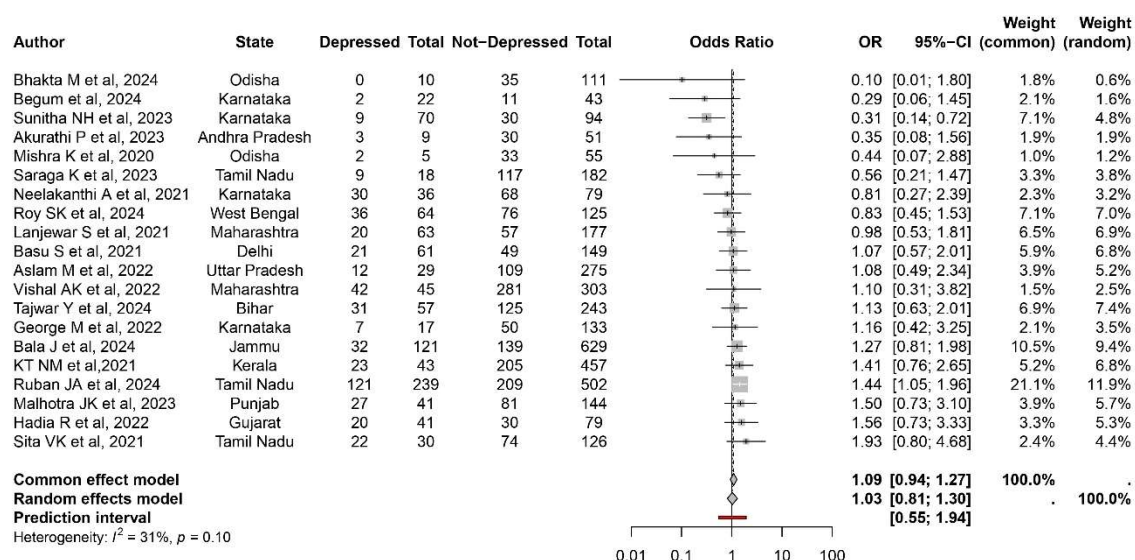


Figure 18: Forest plot showing the association between post-partum depression and Nuclear Family

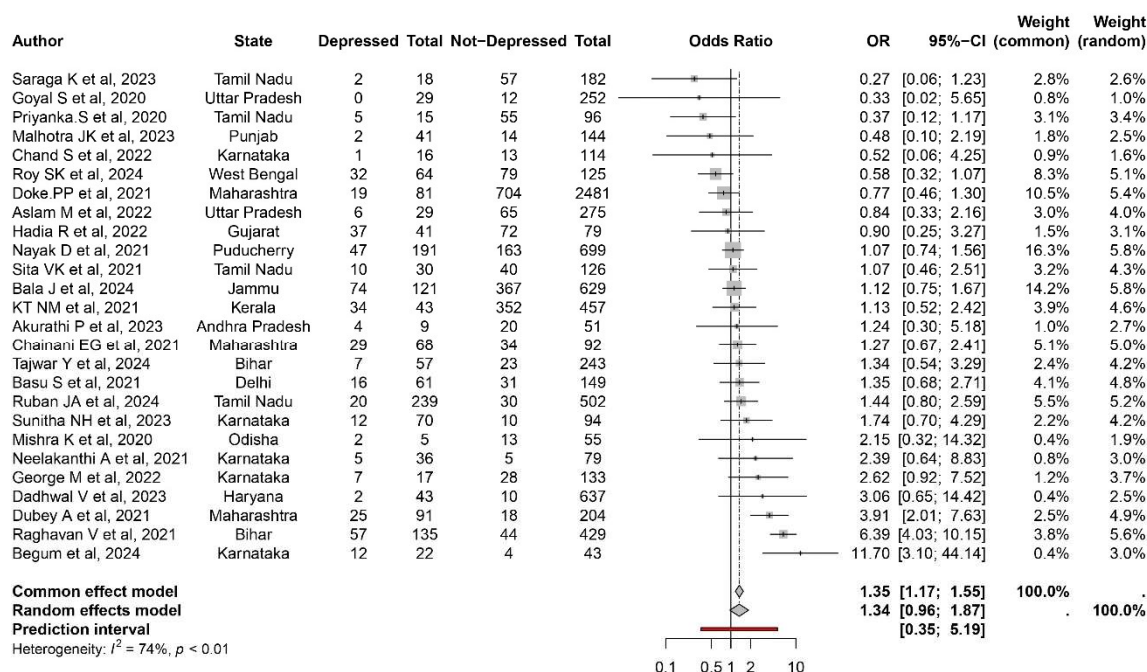


Figure 19: Forest plot showing the association between post-partum depression and Poverty or Financial Difficulties or Low SE status

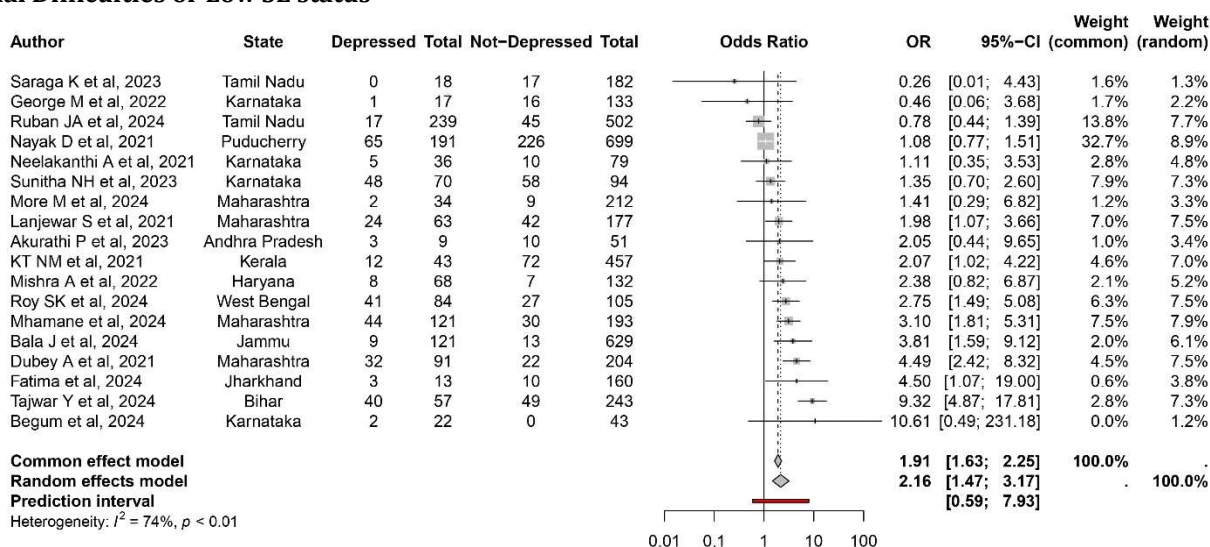


Figure 20: Forest plot showing the association between post-partum depression and Preterm or low-birth-weight baby

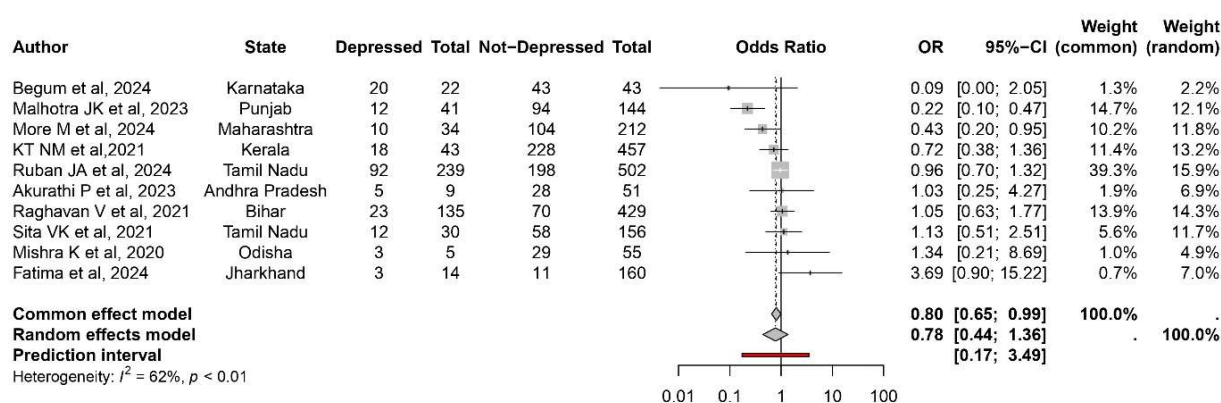


Figure 21: Forest plot showing the association between post-partum depression and primigravida

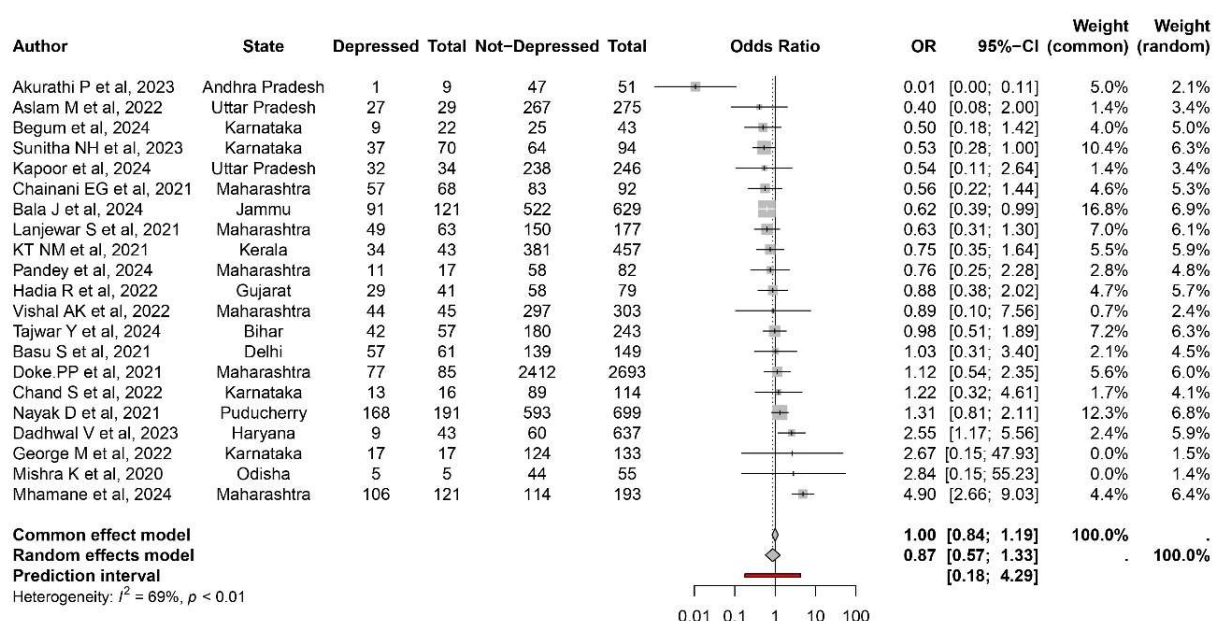


Figure 22: Forest plot showing the association between post-partum depression and Self Unemployment or Husband Unemployment

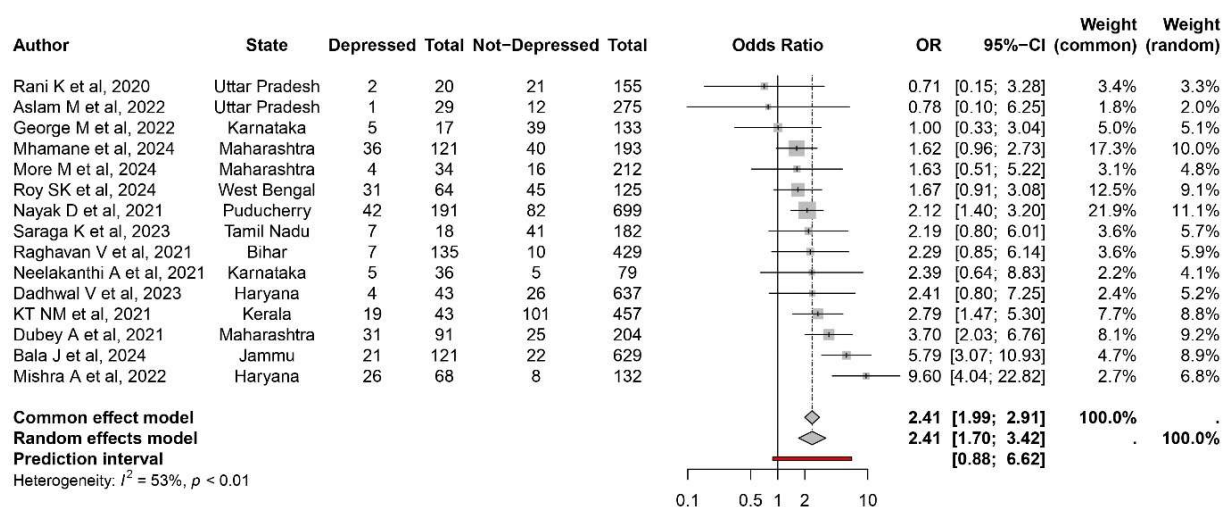


Figure 23: Forest plot showing the association between post-partum depression and Sickness or death of baby

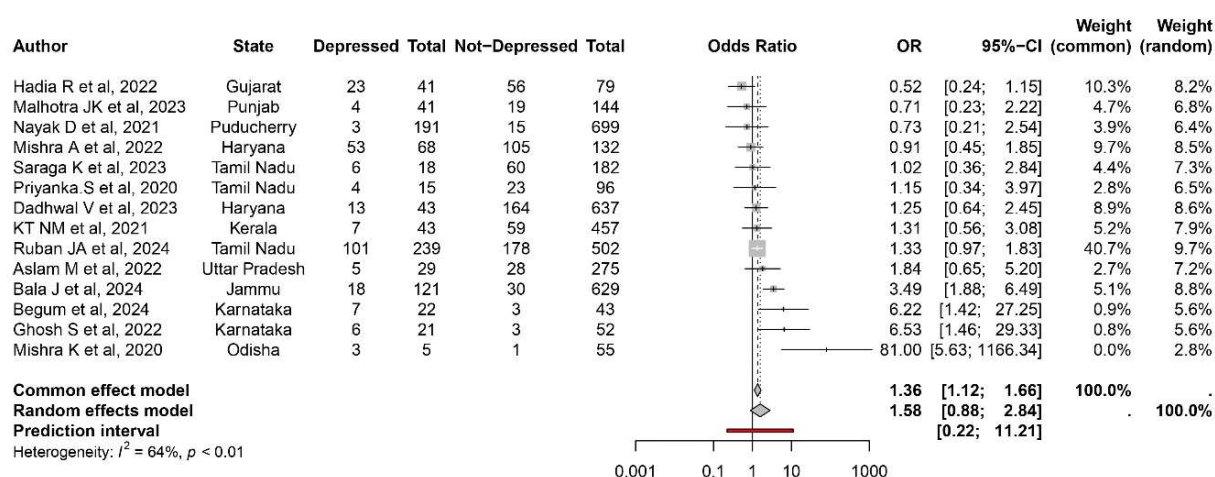


Figure 24: Forest plot showing the association between post-partum depression and Unplanned or unwanted pregnancy

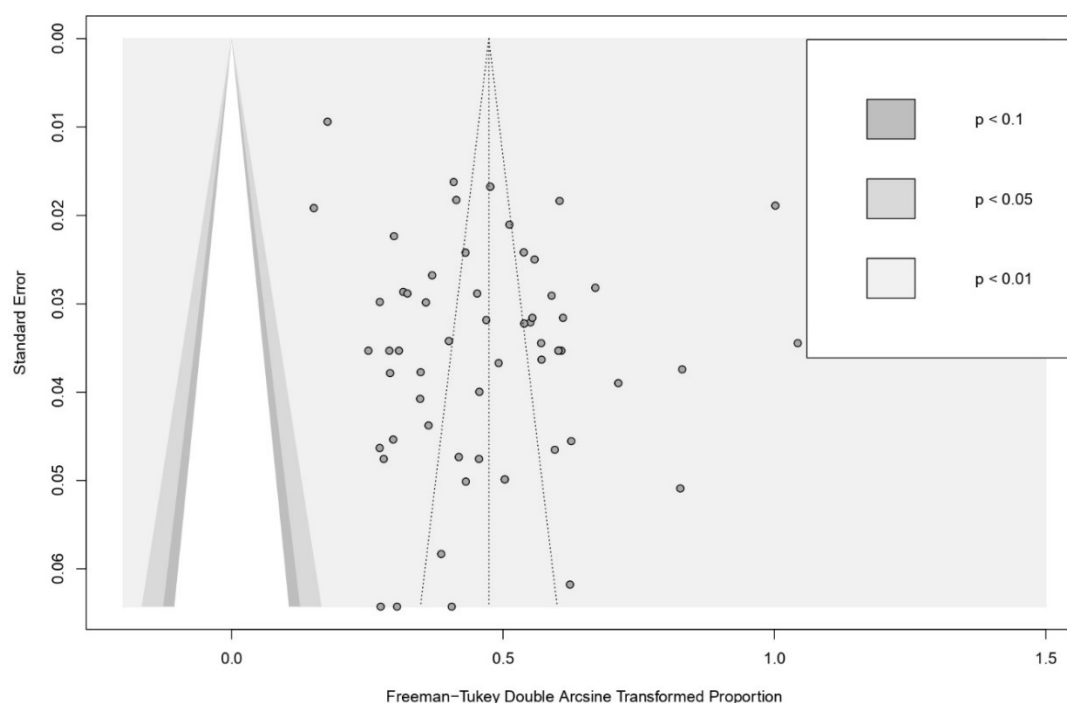


Figure 25: Funnel Plot showing Publication Bias

Reporting biases: The funnel plot shown in Figure 25 was symmetrical, indicating no publication bias. The funnel plot shown in Figure 25 was symmetrical, indicating no publication bias. This symmetry was confirmed by Egger's test with $p < 0.001$.

Certainty of evidence: Sensitivity analysis results showed that eliminating every study did not significantly alter the conclusions indicating that the conclusion is accurate and the data demonstrate stability and sensitivity

DISCUSSION

The meta-analysis found the prevalence of postpartum depression (PPD) among mothers in India dur-

ing the years 2020-2024 to be 19% after pooling of results from 59 observational studies. Our research's conclusions are almost in line with the findings of other meta-analytic studies carried out in India (Upadhyay et al., 2017)². Postpartum depression prevalence in India was estimated to be 22% overall, according to a 2017 WHO bulletin that contained findings from a meta-analysis and a systemic review of studies carried out in the country between 2000 and 2016 (Upadhyay et al., 2017)².

This demonstrates that despite all these years, not many adjustments or modifications have been made to the health system to lower the frequency of PPD. Better screening, as opposed to a real increase in cases, could be another explanation for this. In order for policymakers to take the proper actions to lower

PPD in India, further research on the subject is required. Postpartum depression was shown to be 22.89% prevalent in Ethiopia, according to another meta-analysis.⁷³

The high heterogeneity among studies ($I^2 = 97\%$) represents a significant interpretative challenge resulting in low to very low-quality evidence. High heterogeneity means a significant amount of variability or diversity exists between different studies or groups being compared, potentially making it difficult to draw meaningful, unified conclusions. Differences in study populations, interventions, measurement methods, or analytical approaches can contribute to high heterogeneity. In this research, various methods were employed to deal with high heterogeneity such as the application of a random effect model for carrying out a meta-analysis and further meta-regression and sub-group analysis were also carried out to explore the reasons for heterogeneity.

While some states like Maharashtra are well represented with 10 studies, others, especially in the northeastern region, are underrepresented. This emphasizes over need for more research to be done in such areas. Since our meta-analysis includes only published studies into consideration therefore certain biases cannot be ruled out.

Risk factors found by our meta-analysis for postpartum depression were found to be higher age, addiction in the husband or family, any comorbidity or medical illness in the mother, caesarean section or interventional delivery, complications during or after the current pregnancy, conflict with in-laws or no support from family, early postnatal period, absence of exclusive breast-feeding, family history of psychiatric illness, a female child born in the current pregnancy, high parity, illiteracy or low education, marital disharmony or no support from husband, mood swings during pregnancy or history of psychiatric illness or, nuclear family, poverty or financial difficulties or low SE status, preterm or low-birth-weight, primigravida, self-unemployment or husband Unemployment, sickness or death of baby, and unplanned or unwanted pregnancy.

Unplanned pregnancy, domestic violence, lack of social support, previous history of depression, infant loss, and dissatisfaction in marriage showed a statistically significant association with postpartum depression in the meta-analysis conducted in Ethiopia by Tolossa T et al, 2020⁷³. These discrepancies could be caused by variations in research contexts, terminology, techniques, and reporting practices for postpartum depression among cultures.

Our work adds to the body of knowledge by demonstrating the persistence of PPD in Indian women. The necessity of including postnatal depression screening for mothers in standard prenatal and postnatal services is underscored by the high frequency of PPD shown in our study and by others, as well as its strong correlation with several other factors.

STRENGTHS AND LIMITATIONS

The first striking aspect is the extremely rigorous methodology. The authors have meticulously adhered to PRISMA guidelines for systematic reviews, clearly defining inclusion and exclusion criteria. Particularly commendable is the use of validated tools, such as the JBI score for assessing study quality, and robust statistical analyses, including meta-regression and sensitivity analysis. The systematic evaluation of heterogeneity among studies completes this solid methodological framework.

A second significant strength concerns the breadth and representativeness of the sample. With 18,359 women involved and coverage of 20 states and territories in India, the study offers a truly comprehensive view of the phenomenon. The recent study period (2020-2024) and the inclusion of both urban and rural settings further enhance the research's validity.

The depth of analysis conducted is particularly noteworthy. The authors have identified and analyzed 20 risk factors in detail, supporting their conclusions with comprehensive forest plots for each factor. The subgroup analysis is well structured, and the publication bias assessment demonstrates a mature methodological approach.

Finally, the practical relevance of the study must be emphasized. The recommendations provided are concrete and implementable, protective factors are identified, and valuable insights for future research are offered.

There are some notable limitations to our meta-analysis. Initially, information on depression in postpartum females of each state of India was not present due to the absence of required literature. Secondly, there is no mention of postpartum depression in fathers. This study emphasizes more research on the concerned topic to increase transparency and cover every region of the country in future.

CONCLUSION AND RECOMMENDATIONS

To ensure prompt intervention and support for postpartum women, healthcare practitioners should integrate routine depression screenings into their standard treatment protocols. To identify co-occurring mental health disorders, comprehensive mental health evaluations that consider stress and anxiety should be conducted. To reduce the stigma associated with mental health issues among postpartum women, psychosocial support programs, patient education, multidisciplinary treatment teams, crisis management techniques, and public health campaigns should be initiated.

Further research on the topic should include the standardization of tools and guidelines. Key strategies for conducting research in underrepresented areas involve building community partnerships, addressing cultural barriers with culturally sensitive

approaches, developing targeted recruitment plans, prioritizing community engagement, and actively including diverse research teams to better understand the unique needs of underrepresented populations, all while ensuring ethical practices and respecting the involved communities.

Implementation barriers can include a lack of resources, resistance to change, and cultural differences. Resource barriers that need to be addressed include:

Lack of funds: Financial resources are essential for developing strategies and implementing programs.

Lack of personnel: Human resources are crucial for carrying out programs.

Lack of technical skills: Technical resources are necessary for program implementation.

Author's Contribution: BG, RG, and KG: the article's conception, design, and typographical logic. BG, AM, and KG: literature selection and acquisition of data. BG, RG, and KG: Analyzing and interpreting data and editing the article. BG, AM, and KG: study supervision and revising the article. All authors contributed to the article and approved the submitted version.

Registering Authority: This study was registered by the International Prospective Register of Systematic Reviews PROSPERO (CRD42024513914).

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