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Perinatal determinants of depressive disorder profile in high-income women: testing current cut-off thresholds

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Abstract

Background Although the Edinburgh Postnatal Depression Scale (EPDS) is not diagnostic for antenatal and postpartum depressive disorders, understanding perinatal risk factors is crucial for the early identification of women's risk profiles and for providing them with targeted support. This cross-sectional study aimed to identify determinants of depressive disorder risk in the early puerperium, utilizing EPDS cut-offs ≥ 9 and ≥ 12 .

Methods In a three-year period (January 2020 to August 2023), the self-reported EPDS questionnaire was distributed to 2,561 eligible at term women on the second day postpartum, prior to their discharge from the maternity ward of the Abano Polyclinic in Abano Terme (Italy). We estimated the risk of depressive disorder using the EPDS cut-off thresholds ≥ 9 and ≥ 12 and identified the concurrent obstetric and perinatal determinants of the maternal depressive profile using the Univariable Logistic Regression Model.

Results On the second day postpartum, the EPDS low cut-off ≥ 9 captured a larger group of puerperae (664/2,561; 25.14%) in comparison to the high cut-off ≥ 12 (279/2,561; 10.89). Statistically significant determinants of high depressive disorder risk in women with a cut-off ≥ 9 were younger maternal age (OR 0.97, 95% CI 0.96–0.99, $p=0.0004$), complementary feeding (OR 1.40, 95% CI 1.16–1.69, $p=0.0004$) and formula feeding (OR 1.83, 95% CI 1.21–2.77, $p=0.004$), whereas being employed was protective (OR 0.71, 95% CI 0.53–0.95, $p=0.023$). In contrast, the odds of belonging to the ≥ 12 group demonstrated that formula feeding was associated with a higher risk of depressive symptoms (OR 95% CI 2.35; 1.47–3.76, $p=0.0003$).

Conclusions These results suggest that adopting EPDS cut-off thresholds of ≥ 9 or ≥ 12 on the second day postpartum significantly influences the estimated rate of postpartum depressive symptoms and may aid in identifying obstetric and perinatal determinants associated with depressive symptom profiles.

Clinical trial number Not applicable.

Keywords EPDS, Edinburgh Postnatal Depression Scale, Cut-off thresholds, High-income women

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Introduction

The most common perinatal mental health disorder is depression, which can significantly affect a mother's ability to care for herself and her baby, her success with breastfeeding [1], as well as mother-infant bonding and the baby's cognitive and socio-emotional development [2]. Early intervention and support are crucial and may frequently require counselling, cognitive-behavioral therapy, support groups, and, if necessary, medication [3]. Risk factors for postpartum depression include history of mental health disorders, young age, lack of support, stressful life events, domestic violence, and complications during pregnancy or childbirth. These factors are proxies for increased rates of complications such as preterm birth, low birth weight, neonatal intensive care unit admission, and a higher likelihood of operative deliveries [4]. However, not all studies have replicated these findings, suggesting that the relationship between depression risk and adverse obstetric and perinatal outcomes associated with childbirth profile may not be entirely straightforward.

Several validated screening tools exist to help identify women either at risk of, or suffering from, perinatal depression. The 10-item Edinburgh Postnatal Depression Scale (EPDS) is widely used in many countries, including Italy [5], both as an antenatal and postpartum screening tool for depression risk in clinical practice and research [6, 7]. However, screening for the risk of depressive disorder in early postpartum remains controversial, as its effectiveness in improving outcomes has not been consistently demonstrated, particularly regarding the progression of depression risk from the antenatal to postnatal periods and the referral of women for treatment [8–10]. This uncertainty is partly due to the use of different thresholds to assess the risk of depressive disorder, with values >9 and >12 being commonly adopted.

The choice of cut-off can impact a woman's risk profile and has implications for both clinical and research settings. Data suggest that different thresholds result in different values of sensitivity, specificity, and in positive and negative predictive values [10]. Selecting a threshold involves balancing sensitivity and specificity, and this decision is influenced by cultural, social, and contextual factors, available resources, and the specific population being served [11]. However, there are relatively few studies examining the obstetric and perinatal factors that contribute to depressive symptoms in the acute postpartum period, a time often influenced by the "baby blues", a temporary condition that can mask or overlap with symptoms of more severe mood disorders [4].

To address the limitations of previous studies, the primary aim of this cross-sectional study was to separately estimate the rate of depressive disorder risk in the early postpartum period using EPDS cut-off thresholds ≥ 9

and ≥ 12 , in a robust sample of low-risk Italian puerperae. A secondary aim was to determine the concurrent magnitude and direction of obstetric and perinatal determinants of women's depressive disorder risk profiles, by separately testing current cut-off thresholds ≥ 9 and ≥ 12 .

Materials and methods

All women presenting at term of gestation at the maternity ward of the Abano Polyclinic, Abano Terme (Italy), between January 2020 to August 2023 were screened for inclusion in the study, in accordance with the principles set forth in the Helsinki Declaration. The hospital where the study took place is located in an industrialized area of Northeast Italy and supports approximately 1,000 births per year among low-risk pregnant women, characterized by low and late fertility, high socioeconomic status, high employment rate, and advanced educational levels.

Pregnant women were first informed about the study at the antenatal healthcare centre and again prior to discharge, at which point they provided written informed consent to complete the EPDS questionnaire [6]. Exclusion criteria included the presence of, and/or treatment for, prepartum psychological disorders, as well as having an inability to sufficiently read and understand Italian. Demographic data collected included age, marital status, educational level, and obstetric characteristics, such as vaginal delivery or elective/emergency cesarean section. Additional data regarding neonatal outcomes — such as gender, birth weight, and feeding modality at discharge (categorized as exclusive breastfeeding, complementary feeding [breast milk with additional formula], and formula feeding according to WHO definitions) — were retrieved from medical records.

In accordance with clinical routine, two-step delivery, delayed cord clamping "not earlier than one minute", and short hospitalization (discharge on day two after both vaginal and cesarean delivery) were standard procedures for uncomplicated pregnancies at the hospital during the study period. All healthy newborns are placed skin-to-skin with their mothers immediately after birth and remained on the mother's chest until the first breastfeeding session was established or until the infant fell asleep. Typically, the mother's partner was present during and after childbirth to promote a homelike environment and to facilitate early bonding. Throughout their stay, newborns roomed in with their mothers, who were encouraged to breastfeed on demand. Complementary formula milk was provided if breast milk intake was deemed insufficient. In the absence of obstetric complications, the maternity stay lasted 48 h following both a vaginal and a cesarean deliveries.

Women completed the EPDS on the second postpartum day, prior to discharge. The EPDS is a self-administered questionnaire consisting of 10 items, each scored

on a 4-point Likert scale (0–3) designed to screen for post-partum depression (PPD) symptoms [6]. PPD represents the most severe end of a continuum of symptom severity. We stratified our study cohort based on two EPDS cut-off thresholds: ≥ 9 and ≥ 12 , as both have been shown to be predictive of elevated risk for major depressive symptomatology in high-income women [11].

Statistical analysis

Descriptive statistics were reported as medians (interquartile range) for continuous variables and absolute numbers (percentages) for categorical variables. The Wilcoxon test was used to compare the distribution of continuous variables. To control for multiple testing, the Benjamini-Hochberg correction was applied to manage the false discovery rate. To assess the association between selected factors and the risk of obtaining a high EPDS score (≥ 9 or ≥ 12), Univariable Logistic Regression Models were employed. Results were reported as Odds Ratios, 95% Confidence Intervals, and p-values with statistical significance set at $p < 0.05$. All statistical analyses were performed using R software, version 4.4.0 (R Core

Team, 2023), developed by the R Foundation for Statistical Computing, Vienna, Austria.

Ethical approval

Ethical approval and consent for publication were granted by the Abano Polyclinic Scientific Human Research Committee (Ref. N. 24/2018; 09.11.2018).

Results

Among the total number of women screened, 2,561 puerperae were included in the analysis. Of these, 664 (25.14%) had EPDS total scores ≥ 9 and 279 (10.89%) had scores ≥ 12 Fig. 1.

These individuals were predominantly characterized by low-risk pregnancies, despite advanced maternal age, defined in Italy as over 31.3 years at first childbirth [12], high socioeconomic status — typically reflected in higher income, educational attainment, occupational status, living conditions, and access to resources and healthcare — and a relatively high rate of cesarean deliveries. Additionally, while the prevalence of pre-pregnancy BMI > 25

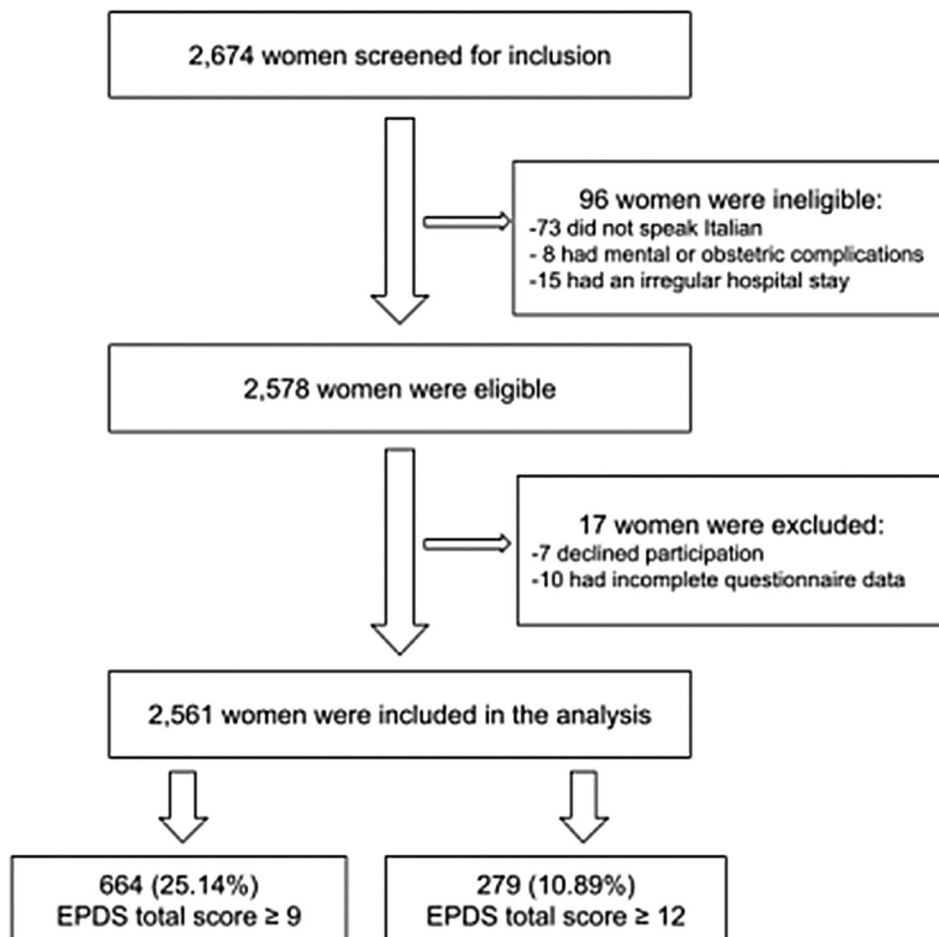


Fig. 1 Screening and analysis flowchart

was low (19,80%), smoking and alcohol use during pregnancy were notably elevated. Table 1.

Baseline characteristics and obstetric and perinatal determinants of women's depressive risk profiles, based on EPDS cut-off scores <9 or ≥ 9 were included in the Table 2.

Maternal demographics, intrapartum outcomes, and neonatal outcomes were generally comparable between women with a total EPDS score ≥ 9 and those with a score <9 . However, among the significantly larger subgroup of puerperae with an EPDS score ≥ 9 , the depressive disorder risk profile was associated with four key

obstetric and perinatal risk factors: younger maternal age (OR 0.97, 95% CI 0.96–0.99, $p=0.0004$), with each additional year of age linked to a 3% reduction in depressive symptoms risk, the use of complementary feeding (OR 1.40, 95% CI 1.16–1.69, $p=0.0004$), the use of formula feeding (OR 1.83, 95% CI 1.21–2.77, $p=0.004$), and employment status, with employed women showing a lower likelihood of depressive symptoms compared to housewives (OR 0.71, 95% CI 0.53–0.95, $p=0.023$).

Baseline characteristics and associated risk factors based on EPDS cut-off scores <12 or ≥ 12 are included in the Table 3.

Maternal demographics, intrapartum outcomes, and neonatal outcomes were comparable between women with a total EPDS score ≥ 12 and those with a score <12 . However, women with EPDS scores ≥ 12 were significantly more likely to use formula feeding which was associated with a higher risk of depressive symptoms (OR 95% CI 2.35; 1.47–3.76, $p=0.0003$).

To compare risk factors across different levels of depressive symptom severity, we stratified the sample into three groups based on EPDS scores: 0–8 (control group), 9–11 (mild depressive symptoms), 12 or above (severe depressive symptoms). This stratification, combined with multivariable regression analysis, identified significant associations with marital status ($X_{26}=18.76$, $p<0.012$), neonatal birth weight ($F_{2,2558}=3.24$, $p=0.04$), and feeding modality ($X_{24}=23.00$, $p<0.01$). (Supplementary file1).

Discussion

The puerperium is a period of heightened vulnerability for the woman, marked by intense psycho-emotional changes [12]. The results from this study demonstrated that approximately one in four women giving birth in an industrialized area of Northeast Italy exhibit a risk of depression in the early postpartum period, based on an EPDS with a cut-off ≥ 9 . Approximately one in ten women met the threshold for risk with an EPDS cut-off ≥ 12 . Among the significantly larger subgroup of puerperae with an EPDS score >9 , the depressive disorder risk profile was associated with four key obstetric and perinatal risk factors: younger maternal age, the use of complementary and formula feeding, and, conversely, a lower likelihood of depressive symptoms among employed mothers compared to housewives. For those with EPDS scores ≥ 12 , the only significant determinant of risk was the use of formula feeding.

The EPDS is a widely used screening tool for postpartum depression and different studies have applied varying cut-off scores to identify women at risk, with ≥ 9 and ≥ 12 being common [8]. Key considerations when comparing these two EPDS cut-offs include differences in prevalence estimates and variations in sensitivity and

Table 1 Anthropometrical and clinical features of study women' population

| Women, n. 2,561 | Number (%) or Median (Inter-quartile range) |
|-----------------------------|---|
| Age, years | 33.0 (30.0–37.0) |
| Pre-pregnancy BMI | 21.7 (19.8–24.2) |
| Smoking | 222 (8.7%) |
| Alcohol | 255 (10.0%) |
| Education: | |
| Intermediate level | 240 (9.4%) |
| High school | 1,206 (47%) |
| Bachelor's degree | 366 (14%) |
| Master's degree | 748 (29%) |
| Marital status: | |
| Single | 18 (0.7%) |
| Married | 1,386 (54%) |
| Cohabiting | 970 (38%) |
| Other | 186 (7.3%) |
| Occupation: | |
| Housewife | 203 (7.9%) |
| Student | 311 (12%) |
| Unemployed | 170 (6.6%) |
| Employed | 1,876 (73%) |
| Parity | 1.00 (1.00–2.00) |
| Length of gestation, days | 278 (273–283) |
| Delivery mode: | |
| Vaginal | 2,011 (79%) |
| Elective cesarean | 287 (11%) |
| Emergency cesarean | 262 (10%) |
| Neonate: | |
| Male | 1,368 (53%) |
| Birth weight, g | 3,370 (3,080–3,640) |
| Feeding modalities: | |
| Exclusive breastfeeding | 1,691 (66%) |
| Complementary breastfeeding | 768 (30%) |
| Formula feeding | 102 (4%) |
| EPDS: | |
| Cut-off ≥ 9 | 664 (25.14%) |
| Cut-off ≥ 12 | 279 (10.89%) |

BMI, body mass index. Edinburg Postnatal Depression Score, EPDS

Table 2 Perinatal moderators of women's depression profile with an EPDS Cut-Off Score ≥ 9 : univariable logistic regression model

| Variable | Odds Ratio | [95%CI] | p-value |
|-----------------------------|------------|-------------|---------|
| Maternal age (years) | 0.97 | [0.96;0.99] | 0.0004 |
| Pre-pregnancy BMI | 1.02 | [0.99;1.04] | 0.145 |
| Parity | 0.96 | [0.85;1.09] | 0.562 |
| Delivery modalities | | | |
| Labor induction | Ref | | |
| Vaginal | 1.08 | [0.73;1.60] | 0.701 |
| Elective cesarean | 1.08 | [0.69;1.69] | 0.743 |
| Emergency cesarean | 1.35 | [0.85;2.12] | 0.200 |
| Newborn Gender | | | |
| Female | Ref | | |
| Male | 0.96 | [0.81;1.13] | 0.613 |
| Gestational age (days) | 1.00 | [0.99;1.01] | 0.845 |
| Educational level | | | |
| Intermediate level | Ref | | |
| High school | 1.11 | [0.83;1.50] | 0.471 |
| Bachelor's degree | 1.07 | [0.76;1.52] | 0.696 |
| Master's degree | 1.02 | [0.75;1.39] | 0.907 |
| Smoking | | | |
| Yes | Ref | | |
| No | 0.76 | [0.58;1.02] | 0.0634 |
| Alcohol | | | |
| Yes | Ref | | |
| No | 1.21 | [0.91;1.61] | 0.182 |
| Marital status | | | |
| Single | Ref | | |
| Married | 0.48 | [0.19;1.21] | 0.119 |
| Cohabitant | 0.54 | [0.21;1.37] | 0.196 |
| Other | 0.50 | [0.19;1.32] | 0.167 |
| Occupation | | | |
| Housewife | Ref | | |
| Student | 0.81 | [0.56;1.16] | 0.2499 |
| Unemployed | 0.76 | [0.50;1.17] | 0.2129 |
| Worker | 0.71 | [0.53;0.95] | 0.023 |
| Neonatal birth weight | 1.00 | [1.00;1.00] | 0.706 |
| Feeding modalities | | | |
| Exclusive breastfeeding | Ref | | |
| Complementary breastfeeding | 1.40 | [1.16;1.69] | 0.0004 |
| Formula feeding | 1.83 | [1.21;2.77] | 0.004 |

Results were reported as Odds Ratios, 95% Confidence Intervals, and p-values. Ref, reference group. Statistical significance at $p < 0.05$

specificity in detecting obstetric and perinatal risk factors associated with postpartum depressive symptoms. Our prevalence estimates are consistent with those observed in systematic reviews, including studies conducted during the COVID-19 pandemic [13]. A recent review by Camoni et al. on screening for postnatal depression in Italian women reported a pooled prepartum depression risk of 20.2%, with a postpartum prevalence of 27.5% for EPDS ≥ 9 and 11.1% for EPDS ≥ 12 [14]. However, the authors noted significant publication bias, due to one small study with low prevalence and another large study with a high prevalence. Notably, our findings contribute to this literature by showing that, among high-income,

low-risk women, using different cut-offs (≥ 9 or ≥ 12) not only influences prevalence rates but also identifies different obstetric and perinatal determinants in the maternal depressive risk profile.

Comparing the use of low and high EPDS cut-offs may have implications for practice and/or policy beyond differences in prevalence, sensitivity, and specificity [15]. The optimal cut-off score may vary depending on the clinical context [15]. While the EPDS is useful for initial assessment, psychiatrist's evaluation remains essential for accurate diagnosis and a thorough understanding of each woman's symptoms and clinical history. It's also important to note that the exact cut-off scores may also

Table 3 Perinatal moderators of women's depression profile with an EPDS Cut-Off Score ≥ 12 : univariable logistic regression model

| Variable | Odds Ratio | 95% CI | p-value |
|-----------------------------|------------|------------|---------------|
| Maternal age (years) | 0.98 | 0.96;1.00 | 0.119 |
| Pre-pregnancy BMI | 1.01 | 0.98–1.04 | 0.439 |
| Parity | 1.09 | 0.93–1.28 | 0.302 |
| Delivery modalities | | | |
| Labor induction | Ref | | |
| Vaginal | 1.17 | 0.68–2.00 | 0.576 |
| Elective cesarean | 1.22 | 0.66–2.26 | 0.522 |
| Emergency cesarean | 1.44 | 0.78–2.66 | 0.246 |
| Newborn Gender | | | |
| Female | Ref | | |
| Male | 0.96 | 0.77–1.19 | 0.722 |
| Gestational age (days) | 0.99 | 0.98–1.00 | 0.0705 |
| Educational level | | | |
| Intermediate level | Ref | | |
| High school | 1.25 | 0.8–;1.88 | 0.270 |
| Bachelor's degree | 1.08 | 0.67–1.73 | 0.760 |
| Master's degree | 1.06 | 0.69–1.62 | 0.783 |
| Smoking | | | |
| Yes | Ref | | |
| No | 0.78 | 0.5–1.13 | 0.188 |
| Alcohol | | | |
| Yes | Ref | | |
| No | 1.12 | 0.77–1.63 | 0.548 |
| Marital status | | | |
| Single | Ref | | |
| Married | 0.62 | 0.20–1.92 | 0.411 |
| Cohabitant | 0.61 | 0.20–1.86 | 0.381 |
| Other | 0.59 | [0.18–1.94 | 0.389 |
| Occupation | | | |
| Housewife | Ref | | |
| Student | 0.87 | 0.54–1.39 | 0.555 |
| Unemployed | 1.03 | 0.61–1.76 | 0.900 |
| Worker | 0.77 | 0.53–1.13 | 0.187 |
| Neonatal birth weight | 1.00 | 1.00–1.00 | 0.418 |
| Feeding modalities | | | |
| Exclusive breastfeeding | Ref | | |
| Complementary breastfeeding | 1.23 | 0.96–1.57 | 0.100 |
| Formula feeding | 2.35 | 1.47–3.76 | 0.0003 |

Results were reported as Odds Ratios, 95% Confidence Intervals, and p-values. Ref, reference group. Statistical significance at $p < 0.05$

be adjusted based on specific population needs and research findings to allow valid comparisons across studies. Regardless of the chosen cut-off, the relationship between maternal age, employment status, breastfeeding success, and postnatal depression remains a subject of ongoing debate. In the multivariate model, beyond feeding modalities, marital status also played a role in the risk of depressive symptoms. These findings are consistent with prior research highlighting the protective role of social and emotional support provided by marital

relationships. Marital status, particularly the presence of a supportive partner, has long been recognized as a key social determinant of maternal mental health. In the context of breastfeeding success, partner support may play a crucial protective role [16]. Understanding these dynamics is important for providing women with targeted support. Increasing breastfeeding rates is a global public health priority for two main reasons: First, formula-fed infants are at increased risk of several health problems [1]; and second, women who struggle to breastfeed face a heightened risk of postpartum depression. This relationship is bidirectional, as postpartum depression can also contribute to breastfeeding difficulties [17].

Although this study has implied that lower maternal age, unemployment and breastfeeding difficulties increase the risk of postnatal depression [18], these are broad associations. The specific obstetric and perinatal determinants of depressive disorder among women with low and late fertility, living in highly industrialized socio-economically advantaged regions, remain underexplored. The findings of this study offer new insight into the role of formula and complementary feeding, particularly concerning maternal emotional responses during early puerperium. Notably, mothers with EPDS scores exceeding 9 or 12 were more likely to report lower self-efficacy in initiating breastfeeding, leading to early supplementation or exclusive formula feeding [19]. Further analysis of early feeding behaviours revealed that heightened depressive symptoms were associated with increased reliance on formula [20].

We acknowledge several limitations in this study. Its generalizability is constrained by the sample, which included only women from Northeast Italy, a socially and economically advantaged region. Moreover, the use of two parallel comparisons (EPDS < 9 vs. ≥ 9 and < 12 vs. ≥ 12) allows only a separate analysis of factors associated with scores above each cut-off, which may not reliably capture the progression from mild to severe postpartum depression. This interpretation aligns with clinical guidelines recommending EPDS screening between 6 and 12 weeks postpartum to enhance predictive validity [4]. Elevated EPDS scores on the second postpartum day may reflect transient “baby blues”, a common, self-limiting emotional response that affects up to 70% of new mothers. Characterized by emotional lability, tearfulness, anxiety, and irritability, baby blues typically resolve within two weeks [21, 22]. Nevertheless, their severity may carry clinical significance, as some studies suggest that intense early emotional disturbances may indicate vulnerability to more persistent mood disorders. Women with higher maternity blues scores may represent a subgroup at elevated risk for anhedonia, anxiety, and depression components of the EPDS [23]. Conversely, longitudinal studies have confirmed an association between elevated EPDS

scores at 2–3 days postpartum and the persistence of clinically significant depressive symptoms, as well as the development of postpartum depression later in the first year [24, 25]. While a growing body of evidence supports a bidirectional relationship between maternal depressive symptoms and breastfeeding difficulties, using formula or complementary feeding on the second day postpartum as potential markers of depressive disorder risk may be premature. Early feeding choices may not reliably reflect enduring maternal mental health states, limiting the strength of interferences that can be drawn from such early observations.

Conclusion

These results suggest that adopting EPDS cut-off thresholds ≥ 9 or ≥ 12 significantly influences the estimated risk of postpartum depressive symptoms and leads to the identification of different obstetric and perinatal determinants within women's depression risk profiles. These findings underscore the importance of interpreting early postpartum EPDS scores within the broader emotional and clinical context of the postpartum period. At the more severe end of the maternal emotional response spectrum, a deeper examination of the associations with maternal age, employment status, and breastfeeding success is crucial for providing anticipatory guidance and targeted support to women at elevated risk.

Abbreviations

| | |
|------|-------------------------------------|
| EPDS | Edinburg postnatal Depression Scale |
| PPD | Post-partum depression |
| WHO | World Health Organization |

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12888-025-07580-y>.

Supplementary Material 1

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Not applicable.

Author contributions

VZ, SS, and GS contributed to data acquisition, analysis, interpretation, draft, and review. TB, AS and LB contributed with the statistical analysis, and review. DR and AC contributed to the conception, study design, analysis, interpretation, and review. All authors have approved the submitted version.

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Data availability

Available on reasonable request available at the Abano Polyclinic, Abano Terme, Italy.

Declarations

Ethics approval and consent to participate

Ethical approval and consent to publication were granted by the Abano Polyclinic Scientific Human Research Committee (Ref. N. 24/2018; 09.11.2018).

The term of free and informed consent was obtained from all individual participants included in the voluntary study. In addition, this study adhered to the Declaration of Helsinki.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

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