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RESEARCH ARTICLE

Characteristics of women with different perinatal depression trajectories

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Abstract

Maternal perinatal depression (PND), a common mental disorder with a prevalence of over 10%, is associated with long-term health risks for both mothers and offspring. This study aimed at describing characteristics related to background and lifestyle, pregnancy, delivery, and postpartum of different PND trajectories defined according to the onset of depressive symptoms. Participants were drawn from a large population-based cohort study in Uppsala, Sweden (n = 2,466). Five trajectory groups of depressive symptom onset were created using the Edinburgh Postnatal Depression Scale ≥13 (pregnancy) or ≥12 points (postpartum): (a) *healthy* (60.6%), (b) *pregnancy depression* (8.5%), (c) *early postpartum onset* (10.9%), (d) *late postpartum onset* (5.4%), and (e) *chronic depression* (14.6%). In multinomial logistic regressions, the associations between trajectories and the included characteristics were tested using the healthy trajectory as reference. Background characteristics (younger age, lower education, unemployment) were primarily associated with *pregnancy depression* and *chronic depression*. Characteristics associated with all PND trajectories were smoking prior to pregnancy, migraine, premenstrual mood symptoms, intimate partner violence, interpersonal trauma, negative delivery expectations, pregnancy nausea, and symphysiolysis. Nulliparity, instrumental delivery, or a negative delivery experience was associated with *early postpartum onset*. Postpartum factors (e.g., infantile colic, lack of sleep, low partner support, and bonding difficulties) were associated with *early* and *late postpartum onset* together with *chronic depression*. The findings suggest that different PND trajectories have divergent characteristics, which could be used to create individualized treatment options. To find the most predictive characteristics for different PND trajectories, studies with even larger and more diverse samples are warranted.

KEYWORDS
depression, postpartum, depressive disorder, mental disorders, mothers, pregnancy, self-reports

*Joint last authorship

Significance

Depression during pregnancy and following childbirth is a common and potentially severe condition. This paper describes trajectories of women's depressive symptoms from pregnancy to six months after delivery regarding their associations with maternal characteristics. Certain background characteristics such as younger age and lower education were associated with depressive symptoms that started in pregnancy or already before. Furthermore, some characteristics were common for all depression trajectories, such as history of depression and premenstrual mood symptoms. Depressive symptoms emerging after childbirth were often preceded by complications during pregnancy and delivery. The results could be used as guidance for more individualized maternity care.

1 | INTRODUCTION

Perinatal depression (PND), a depressive episode that emerges during pregnancy or the early postpartum period, is a common mental disorder affecting women with potentially fatal consequences (Esscher et al., 2016). Antenatal depression (AND) affects between 7% and 13% of women (Bennett, Einarson, Taddio, Koren, & Einarson, 2004), whereas the prevalence of postpartum depression (PPD) varies between 10% and 20% (Gavin et al., 2005; O'Hara & McCabe, 2013; Vigod, Villegas, Dennis, & Ross, 2010; Woody, Ferrari, Siskind, Whiteford, & Harris, 2017).

Depression in the perinatal period is associated with retained maternal weight postpartum (Herring et al., 2012; Pedersen et al., 2012) as well as with decreased initiation and shorter duration of breastfeeding (Cato, Sylven, Lindback, Skalkidou, & Rubertsson, 2017; Dennis & McQueen, 2009; Figueiredo, Canário, & Field, 2014). The first few postpartum years are also a period of particularly high risk for maternal sick leave (AFA Insurance, 2014; Sandmark, 2007). PND, especially when coupled with thoughts of self-harm, is associated with long-term somatic and psychiatric morbidity (Iliadis et al., 2018). Pregnancies of depressed women are more prone to end preterm (Fransson, Örtenstrand, & Hjelmstedt, 2011) and infants are at risk of low birth weight and being small for their gestational age (Grote et al., 2010).

The presence of distinct trajectories of PND has been suggested (i.e., Altemus et al., 2012; Putnam et al., 2017), although these are yet not distinguished in current clinical diagnostic criteria (APA, 2013). At present, no one single method for determining trajectories has been adopted. Whereas some studies use advanced statistical methods to determine trajectories, others employ methods based on symptom profiles and severity. Different trajectories, e.g., depression exclusively during pregnancy, exclusively in the postpartum period, or throughout the pregnancy and postpartum, may have different pathogenesis and consequences for the mother as well as for her family. A recent systematic review of 22 longitudinal studies including more than 38,000 women found between two and six different symptom trajectories (Santos, Tan, & Salomon, 2017). In studies adopting elaborate statistical modeling when determining PND trajectories, a three-trajectory classes solution is most commonly reported, though many studies also support a five-trajectory classes solution. Notably, significant heterogeneity regarding onset, severity, and stability of trajectories has been identified across studies (Baron, Bass, Murray, Schneider, & Lund, 2017; Santos et al., 2017).

Despite differences observed between studies, the three most commonly reported trends in PND trajectories are: (a) a rapid decline in depressive symptoms from onset through the first year postpartum, (b) depressive symptoms that increase from pregnancy to postpartum and then decline, and (c) increasing depressive symptoms over time. Several studies distinguish between a low and high symptom severity trajectory, where the low symptom trajectory is characterized by low levels of symptoms, remaining stable over time. Across studies, most women are classified as belonging to a low symptom level trajectory, suggesting this pattern may be normative. The high symptom trajectory, characterized by severe depressive symptoms that remain stable over time, is less common (Santos et al., 2017). In a recent large-scale prospective study of PND trajectories from the United Kingdom, four distinct patterns were identified. The majority of women were classified as "resilient" (reporting stable, low levels of depressive symptoms over time; 77.6%). The remaining trajectories were "improving" (antenatal depressive symptoms, declining over time; 7.7%), "emergent" (low levels of antenatal depression, increasing during the postpartum period; 4.0%), and "chronic" (consistently elevated depressive symptoms before and after childbirth; 10.7%) (Denckla et al., 2018). Kimmel et al. (2015) defined four groups according to the presence of a major depressive episode based on the DSM-IV criteria during pregnancy and postpartum: (a) those that were never depressed, (b) those that were depressed during pregnancy only, (c) those that were depressed during pregnancy and continued postpartum, and (d) those depressed postpartum only.

Numerous predictors of various PND trajectories have been identified. Predictors of belonging to a high symptom level trajectory have been grouped into social risk factors (e.g., low education, negative life events, ethnic-minority status, unintended pregnancy, or ambivalence about pregnancy), psychological risk factors (e.g., stress, history of psychopathology), biological risk factors (e.g., younger age, sleep difficulties), and parenting expectations (e.g., negative expectations toward the child, low parenting satisfaction or self-efficacy) (Santos et al., 2017). Other studies have reported younger maternal age and lower socioeconomic position to predict a trajectory of improving depressive symptoms from pregnancy to postpartum, lower education to predict a chronic depression trajectory, and exposure to adversity to predict improving, emerging, and chronic depression trajectories (Denckla et al., 2018).

Despite the increased interest in trajectories of PND, there is still limited evidence on the pathogenesis of PND heterogeneity (Santos et al., 2017). In addition, some studies lack detailed background

information, particularly regarding previous history of mental illness (e.g., Vliegen, Casalin, & Luyten, 2014) and history of stressful life events, such as abuse and trauma (Putnam et al., 2017). Furthermore, at present, there are no studies examining PND trajectories in a Swedish setting, which may be of importance considering the majority of the larger PND trajectory studies has been conducted in the United States, Canada, or Australia (Bayrampour, Tomfohr, & Tough, 2016; Santos et al., 2017) while others in the United Kingdom, (Denckla et al., 2018). Only a few studies have been carried out in the Nordic countries (Drozd, Haga, Valla, & Slinning, 2018; Luoma, Korhonen, Salmelin, Helminen, & Tamminen, 2015; Vänskä et al., 2011) that have different health care and welfare systems to, e.g., the United States.

A better understanding of clinically relevant PND trajectories based on established cut-offs for depression, as well as the identification of their respective correlates, would make an important contribution for future clinical management and treatment options, with the aim of identifying women with the greatest risk at distinct time periods, in order to offer individualized treatment. Therefore, the aim of this study was to identify the associations between background- and lifestyle-, pregnancy-, delivery-, and postpartum-related characteristics and different PND trajectories from pregnancy through six months postpartum in a Swedish sample.

2 | METHODS

2.1 | Participants and procedure

Data were obtained from the Biology, Affect, Stress, Imaging and Cognition (BASIC) cohort, an ongoing prospective data collection of maternal health and well-being carried out at Uppsala University Hospital, Uppsala, Sweden (Eckerdal et al., 2017; Hellgren, Åkerud, Skalkidou, & Sundström-Poromaa, 2013; Iliadis, Comasco et al., 2015; Iliadis, Koulouris et al., 2015). All pregnant, Swedish-speaking women of ≥18 years of age without confidential personal data, who were scheduled for a routine ultrasound at Uppsala University Hospital, received a letter with an invitation to participate in the BASIC study at their first ultrasound appointment. Women who agreed to participate returned their written informed consent by post. The participants were asked to complete online surveys at gestational weeks 17 and 32, and at six weeks and at six months postpartum. Medical information regarding the pregnancy (e.g., pregnancy length and medical complications) was retrieved from medical records. Participants were also asked to provide biological samples (e.g., blood samples and placental biopsies). Ethical approval has been granted by the Regional Ethical Review Board in Uppsala, Sweden (Dnr 2009/171).

2.2 | Measures

2.2.1 | Depressive symptoms

Depressive symptoms were assessed with the Swedish version of the Edinburgh Postnatal Depression Scale, EPDS (Cox, Holden, & Sagovsky, 1987; Wickberg & Hwang, 1996), at gestational weeks 17 and 32, as well as at six weeks and six months postpartum. Each of the 10 items on the scale is scored from 0 to 3, with total scores ranging from 0 to 30 with higher scores indicating more severe symptoms. The EPDS has shown adequate reliability and validity (Affonso, De, Horowitz, & Mayberry, 2000). Scores of ≥13 during pregnancy and ≥12 postpartum on the EPDS indicate clinically relevant depressive symptoms, as previously validated in Swedish perinatal samples (Rubertsson, Börjesson, Berglund, Josefsson, & Sydsjö, 2011; Wickberg & Hwang, 1996), and were used as the clinical cut-offs for the analyses.

2.2.2 | Background- and lifestyle-related characteristics

At gestational week 17, participants reported their age (for the purposes of the analyses categorized as <26 years, 26–29 years, 30–34 years, and >34 years), education (≤12 years vs. >12 years), employment (unemployed vs. employed), and country of birth (foreign-born vs. Swedish-born). Premenstrual mood symptoms preceding pregnancy were also reported in the same survey and classified into premenstrual syndrome (PMS, yes vs. no), or, if having a negative effect on social activities or relationships, premenstrual dysphoric disorder (PMDD, yes vs. no). Participants also reported on a history of depression (yes vs. no) as well as information about intimate partner violence in a current or previous relationship (yes vs. no).

At six weeks postpartum, participants reported on stressful life events during the past year (Stressful Life Events Scale, SLES) (Rosengren, Orth-Gomer, Wedel, & Wilhelmsen, 1993), e.g., serious health conditions or death of a family member, significant concerns for a family member, separation or divorce, serious economic concerns, or problems with the law (one or more events vs. none). Information on interpersonal childhood trauma was derived from a questionnaire on childhood trauma (Lifetime Incidence of Traumatic Events, LITE) (Greenwald & Rubin, 1999) (one or more events vs. none). Possible interpersonal traumatic events were physical, emotional, or sexual acts perpetrated by another person with the intention to harm or intimidate, or without consideration of such harm (Kuczyńska, 2010), or witnessing others suffering such events.

Participants reported their height and weight before pregnancy for the calculation of body mass index (BMI) (underweight <18.5, normal weight 18.5–24.9, and overweight ≥25 kg/m^2). Further, they reported on smoking before pregnancy (ever vs. never) and snuff use before pregnancy (ever vs. never). From medical records, information was extracted concerning alcohol use three months before pregnancy, retrospectively reported (more than once per week vs. once per week or less). Current lack of sleep (at pregnancy week 17 and six weeks postpartum) was also self-reported (<6 hr vs. ≥6 hr per night).

2.2.3 | Pregnancy-related characteristics

From the delivery records, information was extracted regarding parity (nulliparous vs. multiparous), use of assisted reproductive

technology (yes vs. no, based on the ICD-10 code O26.8A), and infant sex (male vs. female). At gestational week 32, participants answered questions about delivery expectations (negative vs. positive) and fear of delivery (severe fear vs. less than severe fear or no fear). Participants also answered a question about pregnancy planning (unplanned vs. planned pregnancy). At gestational week 17, participants answered questions about nausea during pregnancy (nausea requiring medication, nausea without medication vs. no nausea). At gestational week 32, participants reported on symphysiolysis (yes vs. no) and about other pregnancy complications (anemia, diabetes, hypertension, or preeclampsia; any of these vs. none of these).

2.2.4 | Delivery-related characteristics

Information about induction of labor (yes vs. no), use of epidural anesthesia (yes vs. no), instrumental delivery (yes vs. no), postpartum hemorrhage (≥1,000 ml vs. <1,000 ml), manual placental removal (yes vs. no), severe laceration (grade III-IV vs. none or grade I-II), preterm delivery (<37 vs. ≥37 gestational weeks), birth weight (≥4 kg vs. <4 kg), APGAR score (<7 vs. 7–10, at 5 min), and new-born admission to neonatal unit (yes vs. no) was retrieved from medical records. At six weeks postpartum, participants self-reported their experience of the delivery (negative vs. positive).

2.2.5 | Postpartum-related characteristics

At six weeks postpartum, participants self-reported on current marital status (single vs. married or cohabiting), infantile colic (yes vs. no), breastfeeding (none or partial vs. exclusive), hours of sleep (<6 vs. ≥6 per night), partner support with infant (no support vs. some or a lot of support), partner support with household (no support vs. some or a lot of support), and partner's mental health (poor vs. good). Infant temper was categorized as difficult versus easy infant by a median split on the total score (range 7–49) on seven questions from the Infant Characteristics Questionnaire (Bates, Claire, & Lounsbury, 1979). Bonding difficulties were defined as scores above the cut-off (≥25, range 0–125) on the Postpartum Bonding Questionnaire (Brockington, Fraser, & Wilson, 2006) and categorized as yes versus no.

2.2.6 | Statistical analysis

Standard descriptive statistics were used to describe the sample. PND trajectories were determined based on the onset and duration of depressive symptoms, defined as scores above the clinical cut-off (≥13 during pregnancy, ≥12 postpartum) on the EPDS. Based on available data together with previous research and clinical experience, a distinction was made between postpartum onset at six weeks or six months. To reduce the risk of misclassification, participants scoring within 1 point below the cut-off were excluded from the analyses (see Figure 1). Five trajectory groups were created according to the onset and duration of depressive symptoms, representing groups of women defined as (a) *healthy* (i.e., no depressive symptoms during pregnancy or postpartum, no history of depression or ongoing selective serotonin reuptake inhibitor [SSRI] use), (b) *pregnancy depression* (i.e., EPDS scores above the cut-off at weeks 17 or 32 and no depressive symptoms postpartum), (c) *early postpartum onset* (i.e., no depressive symptoms during pregnancy but EPDS scores above the cut-off at six weeks postpartum *or* EPDS scores above the cut-off at six weeks postpartum and at six months postpartum), (d) *late postpartum onset* (i.e., no depressive symptoms during pregnancy and at six weeks postpartum but EPDS scores above the cut-off at six months postpartum), and (e) *chronic depression* (i.e., EPDS scores above the cut-off during pregnancy [week 17 *and/or* week 32] and postpartum [six weeks *and/or* six months]).

Differences in background and lifestyle characteristics between responders and nonresponders were analyzed using chi-square tests. Nonresponders were defined as those participants who provided responses on fewer than four EPDS assessments. A classify-and-analyze approach was adopted, whereby each participant was assigned to one of the five trajectories based on their EPDS score at each assessment point. Subsequently, univariate associations between the exposure variables (background- and lifestyle-related, pregnancy-related, delivery-related, and postpartum-related characteristics) and the outcome variable (PND trajectories) were carried out using unadjusted multinomial logistic regression analyses, where the healthy trajectory was used as the reference group. Results are presented as numbers (*n*) and percentages (%) and odds ratios (OR) with 95% confidence intervals (CI) for the PND trajectories. The statistical analyses were performed using SPSS Statistics for Windows, version 24 (IBM Corp., Armonk, N.Y., USA).

3 | RESULTS

Of the 4,073 women included in the BASIC study who were eligible for inclusion in the present analyses, 2,466 (60.5%) provided sufficient data to allow for determination of a PND trajectory and were included (Figure 1). Nonresponders were more likely than responders to report lower education (X^2 = 27.7 (1), p < 0.001), smoking (X^2 = 12.6 (1), p < 0.001), intimate partner violence (X^2 = 3.9 (1), p < 0.05), and fewer stressful life events (X^2 = 13.3, p < 0.001).

Figure 2 shows the mean EPDS scores at each assessment point for the different PND trajectories. The *healthy* trajectory included 1,494 (60.6%) women, 209 (8.5%) belonged to the *pregnancy depression* trajectory, 270 (10.9%) were defined as experiencing *early postpartum onset*, 132 (5.4%) *late postpartum onset*, and 361 (14.6%) as having a *chronic depression* trajectory. In the *healthy* trajectory, EPDS mean scores at weeks 17 and 32, and at six weeks and six months postpartum were 3.4 (*SD* = 2.8), 3.6 (*SD* = 3.0), 4.1 (*SD* = 2.9), and 3.4 (*SD* = 2.9), respectively. In the *pregnancy depression* trajectory, EPDS mean scores for the corresponding assessments were 12.8 (*SD* = 4.6), 11.9 (*SD* = 4.1), 5.9 (*SD* = 2.7), and 5.8 (*SD* = 2.8). The *early postpartum onset* trajectory had mean EPDS scores of 6.0 (*SD* = 2.9), 6.4 (*SD* = 2.8), 14.6 (*SD* = 2.7), and 9.1 (*SD* = 5.2). Mean EPDS scores in the *late postpartum onset* trajectory were 5.8 (*SD* = 3.1), 6.0 (*SD* = 3.0), 6.0 (*SD* = 2.5), and 14.4 (*SD* = 2.3) across assessments.

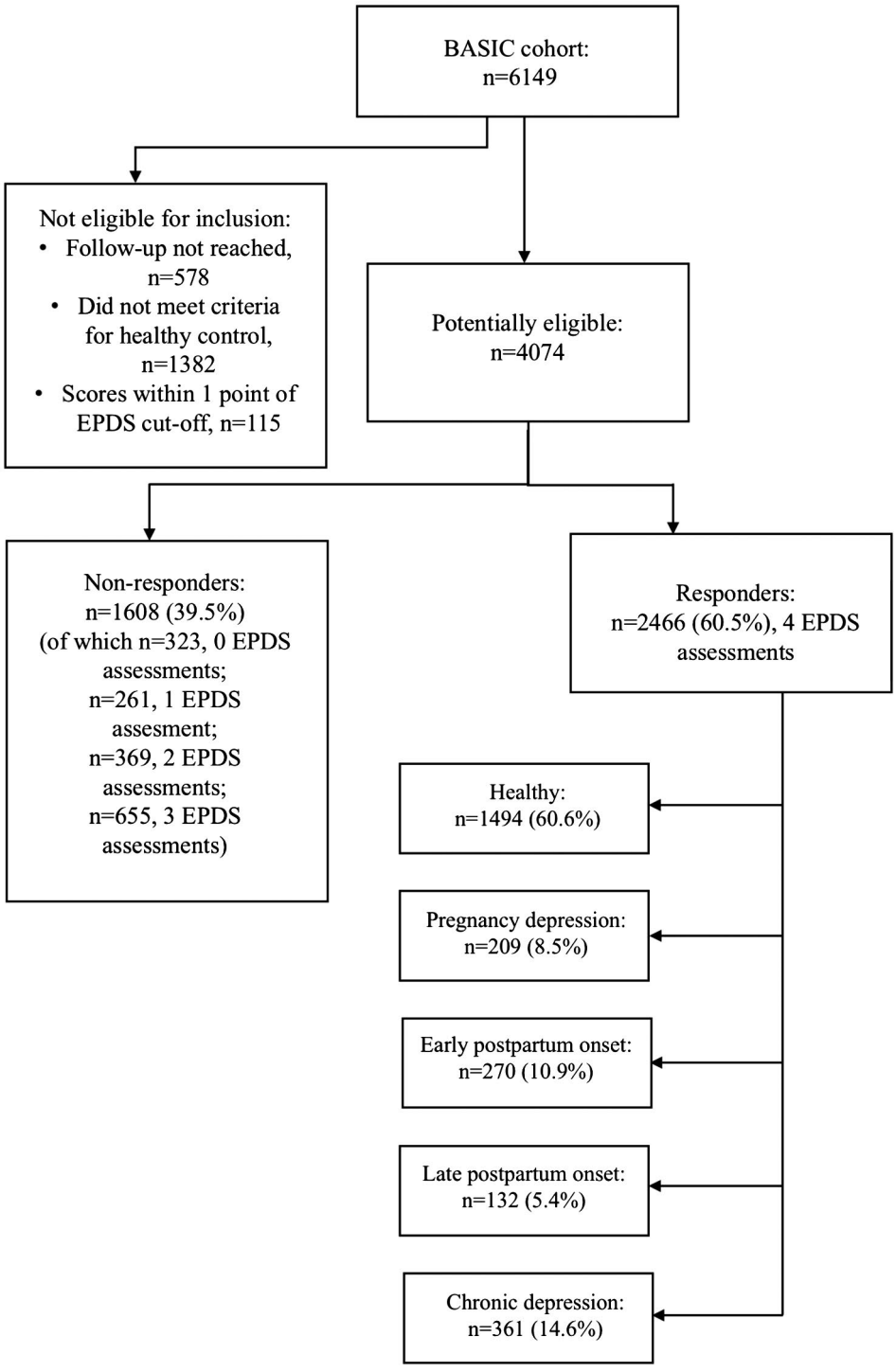

FIGURE 1 Flowchart of participants in the study shown as responders and nonresponders

The *chronic depression* trajectory had mean EPDS scores of 13.4 (*SD* = 5.0), 14.5 (4.2), 14.2 (*SD* = 4.6), and 13.4 (*SD* = 4.9).

3.1 | Background- and lifestyle-related characteristics

The results of the multinomial logistic regression analyses of background- and lifestyle-related characteristics in relation to the PND trajectories, using the healthy trajectory as the reference group, are shown in Table 1. Younger age, lower educational attainment, unemployment, and using snuff prior to pregnancy were characteristics associated with the *pregnancy depression* and *chronic depression* trajectories. Smoking prior to pregnancy, migraine, PMS, PMDD, intimate partner violence, and interpersonal trauma were significantly associated with all PND trajectories compared with the *healthy* trajectory. Lack of sleep in early pregnancy was significantly

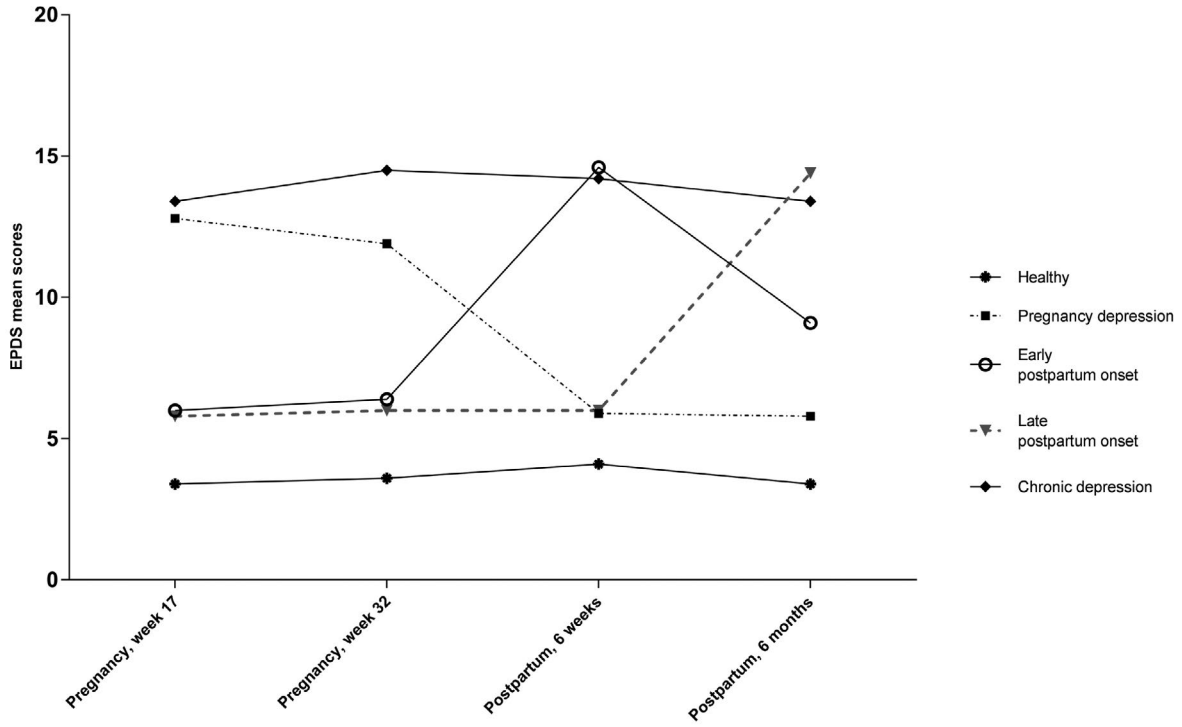

FIGURE 2 Edinburgh Postnatal Depression Scale mean scores at each assessment shown for five distinct trajectories from pregnancy to six months postpartum

associated with *pregnancy depression*, *early postpartum onset*, and *chronic depression*, but not with the *late postpartum onset* trajectory. Being foreign-born and overweight were characteristics associated with *chronic depression* compared with the *healthy* reference group. Irritable Bowel Syndrome (IBS) was significantly associated with the *early postpartum onset* and *chronic depression* trajectories.

3.2 | Pregnancy-related characteristics

Table 2 shows the results from the multinomial logistic regression analysis of pregnancy-related characteristics and PND trajectories. Negative delivery expectations and having suffered from symphysiolysis or nausea during pregnancy were characteristic of all PND trajectories compared with the *healthy* group. Women who experienced other pregnancy complications (i.e., anemia, diabetes, hypertension, or preeclampsia) had significantly greater odds of *early postpartum onset* and *chronic depression*, but not *pregnancy depression* or *late postpartum onset*. An unplanned pregnancy and severe fear of delivery were associated with *pregnancy depression*, *early postpartum onset*, and *chronic depression*, but not *late postpartum onset*. Nulliparity was associated with *early postpartum onset*.

3.3 | Delivery-related characteristics

Instrumental delivery or a negative delivery experience was associated with *early postpartum onset* and *chronic depression*. New-born admission to a neonatal unit was associated with the *pregnancy depression*, *early postpartum onset*, and *chronic depression* trajectories, but not with *late postpartum onset*. Receiving epidural anesthesia was significantly associated with the *early* and *late postpartum onset* trajectories as well as *chronic depression* but not with *pregnancy depression*. These results are shown in Table 3.

3.4 | Postpartum-related characteristics

Postpartum characteristics in relation to the PND trajectories are shown in Table 4. Being a single parent, having a partner who did not help with the infant, and not breastfeeding were characteristics associated with all PND trajectories. Infantile colic, lack of sleep, no partner support with household, and bonding difficulties were significantly associated with *early postpartum onset*, *late postpartum onset*, and *chronic depression*. Women whose partner suffered poor mental health and those having a baby with a more difficult temper had increased odds of *early postpartum onset* and *chronic depression*.

4 | DISCUSSION

This study examined the associations between background- and lifestyle-, pregnancy-, delivery-, and postpartum-related characteristics and five PND trajectories from pregnancy to six months postpartum in a Swedish sample. It is of interest that the different PND trajectories often have distinct correlates.

Several characteristics were common for all PND trajectories, compared with the *healthy* trajectory, e.g., smoking prior to pregnancy, having experienced intimate partner violence and childhood

TABLE 1 Background- and lifestyle-related characteristics of the five perinatal depression trajectories, presented as numbers (n) and percentages (%), and odds ratios (OR) with 95% confidence intervals (CI), derived from the multinomial logistic regression analysis using the healthy trajectory as the reference group

	Healthy *n* = 1,494 (60.6%)	Pregnancy depression *n* = 209 (8.5%)		Early postpartum onset *n* = 270 (10.9%)		Late postpartum onset *n* = 132 (5.4%)		Chronic depression *n* = 361 (14.6%)	
	n (%)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)
Age									
<26 (vs. 30–34)	106 (7.1)	28 (13.4)	2.3 (1.4–3.6)**	25 (9.3)	1.4 (0.9–2.4)	8 (6.1)	0.9 (0.4–2.0)	54 (15.0)	2.4 (1.7–3.5)**
26–29 (vs. 30–34)	381 (25.5)	66 (31.6)	1.5 (1.0–2.1)*	65 (24.1)	1.1 (0.8–1.5)	38 (28.8)	1.2 (0.8–1.9)	93 (25.8)	1.2 (0.9–1.6)
>34 (vs. 30–34)	359 (24.0)	39 (18.7)	0.9 (0.6–1.4)	77 (28.5)	1.3 (1.0–1.9)	34 (25.8)	1.2 (0.8–1.9)	78 (21.6)	1.0 (0.8–1.4)
30–34 (ref.)	648 (43.4)	76 (36.4)	1	103 (38.1)	1	52 (39.4)	1	136 (37.7)	1
Education ≤12 years (vs. >12)	270 (18.1)	61 (30.0)	1.9 (1.4–2.7)**	59 (21.9)	1.3 (0.9–1.7)	26 (19.7)	1.1 (0.7–1.7)	116 (33.6)	2.3 (1.8–3.0)**
Unemployed (vs. employed)	32 (2.1)	21 (10.4)	5.3 (3.0–9.4)**	11 (4.1)	1.9 (1.0–3.9)	4 (3.0)	1.4 (0.5–4.1)	68 (19.6)	11.1 (7.2–17.2)**
Foreign-born (vs. Swedish-born)	119 (8.0)	15 (7.4)	0.9 (0.5–1.6)	19 (7.1)	0.9 (0.5–1.5)	8 (6.2)	0.8 (0.4–1.6)	45 (13.1)	1.7 (1.2–2.5)*
Migraine (vs. no)	184 (12.3)	40 (19.7)	1.7 (1.2–2.6)*	52 (19.4)	1.7 (1.2–2.4)*	32 (24.2)	2.3 (1.5–3.5)**	82 (23.9)	2.2 (1.7–3.0)**
IBS (vs. no)	35 (2.3)	6 (3.0)	1.3 (0.5–3.1)	14 (5.2)	2.3 (1.2–4.3)*	5 (3.8)	1.6 (0.6–4.3)	31 (9.0)	4.1 (2.5–6.8)**
PMS (vs. no)	65 (4.4)	41 (20.9)	5.7 (3.8–8.8)**	49 (18.4)	4.9 (3.3–7.2)**	25 (18.9)	5.1 (3.1–8.4)**	79 (23.2)	6.6 (4.6–9.3)**
PMDD (vs. no)	22 (1.5)	28 (14.3)	11.0 (6.2–20.0)**	28 (10.5)	7.7 (4.4–13.7)**	14 (10.6)	7.8 (3.9–15.7)**	62 (18.2)	14.7 (8.9–24.3)**
Medical history of depression (yes vs. no)	0 (0.0)	100 (49.3)	–	116 (43.3)	–	64 (48.5)	–	218 (63.6)	–
Intimate partner violence in current or previous relationship (vs. no)	64 (4.5)	36 (18.0)	4.7 (3.0–7.3)**	38 (14.4)	3.6 (2.4–5.5)**	19 (14.6)	3.7 (2.1–6.3)**	87 (25.7)	7.4 (5.2–10.5)**
Stressful life events, ≥ 1 (vs. none)	293 (19.7)	47 (22.5)	1.2 (0.8–1.7)	60 (22.2)	1.2 (0.9–1.6)	28 (21.2)	1.1 (0.7–1.7)	73 (21.0)	1.1 (0.8–1.5)
Childhood trauma, interpersonal ≥1 (vs. none)	483 (49.5)	95 (66.9)	2.1 (1.4–3.0)**	100 (66.2)	2.0 (1.4–2.9)**	58 (70.7)	2.5 (1.5–4.0)**	168 (79.2)	3.9 (2.7–5.5)**
BMI before pregnancy									
Underweight (vs. normal weight)	34 (2.3)	8 (3.9)	1.7 (0.8–3.8)	7 (2.6)	1.2 (0.5–2.8)	6 (4.5)	1.9 (0.8–4.7)	9 (2.6)	1.3 (0.6–2.8)
Overweight (vs. normal weight)	392 (26.3)	50 (24.5)	0.9 (0.7–1.3)	85 (31.7)	1.3 (1.0–1.7)	28 (21.2)	0.8 (0.5–1.2)	123 (36.1)	1.6 (1.2–2.0)**
Normal weight (ref.)	1,062 (71.4)	146 (71.6)	1	176 (65.7)	1	98 (74.2)	1	209 (61.3)	1

(*Continues*)

TABLE 1 (Continued)

	Healthy *n* = 1,494 (60.6%)	Pregnancy depression *n* = 209 (8.5%)		Early postpartum onset *n* = 270 (10.9%)		Late postpartum onset *n* = 132 (5.4%)		Chronic depression *n* = 361 (14.6%)	
	n (%)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)
Smoking[a] (ever) (vs. never)	354 (24.0)	76 (37.4)	1.9 (1.4–2.6)**	90 (33.6)	1.6 (1.2–2.1)**	42 (31.8)	1.5 (1.0–2.2)*	148 (43.3)	2.4 (1.9–3.1)**
Snuff[a] (vs. never snuff)	69 (5.0)	21 (11.1)	2.4 (1.4–3.9)**	16 (6.3)	1.2 (0.7–2.2)	10 (8.0)	1.6 (0.8–3.3)	33 (10.2)	2.1 (1.4–3.3)**
Alcohol more than once/week[†] (vs. once/week or less)	49 (7.9)	7 (9.6)	1.2 (0.5–2.8)	11 (10.9)	1.4 (0.7–2.8)	5 (10.9)	1.4 (0.5–3.8)	6 (5.0)	0.6 (0.3–1.5)
Lack of sleep (vs. ≥6 h/night)	49 (3.3)	21 (10.3)	3.4 (2.0–5.7)**	26 (9.7)	3.1 (1.9–5.1)**	3 (2.3)	0.7 (0.2–2.2)	50 (14.5)	5.0 (3.3–7.5)**

Notes. BMI = Body mass index; IBS = Irritable bowel syndrome; PMS = Pre-menstrual syndrome; PMDD = Pre-menstrual dysphoric disorder. Numbers (*n*) and percentages (%) missing on: education *n* = 26 (1.1), employment *n* = 26 (1.1), country of birth *n* = 37 (1.5), migraine *n* = 26 (1.1), IBS *n* = 26 (1.1), PMS *n* = 57 (2.3), PMDD *n* = 57 (2.3), medical history of depression *n* = 26 (1.1), intimate partner violence *n* = 102 (4.1), stressful life events *n* = 18 (0.7), childhood trauma *n* = 904 (36.7), BMI *n* = 33 (1.3), smoking *n* = 43 (1.7), snuff *n* = 197 (8.0), alcohol *n* = 1506 (61.1), and lack of sleep *n* = 31 (1.3).

[†]Prior to pregnancy $^{*}p < 0.05$ $^{**}p < 0.001$.

trauma, being a single parent, or having no support from a partner with the infant. Different forms of low social support as well as relationship violence are known risk factors for mental health problems in the perinatal period (reviewed in Howard et al., 2014), factors that also could be feasible to screen for, enabling a better base for interventions and treatment. Suffering from migraine, PMS, or PMDD was also associated with all PND trajectories compared with the *healthy* trajectory. This is in line with previous studies indicating that women who develop PND as well as PMS and PMDD are sensitive to hormonal changes (Bloch et al., 2000; Guintivano, Arad, Gould, Payne, & Kaminsky, 2013; Mehta et al., 2014; Osborne et al., 2016). Similarly, migraine has also been related to changes in sex hormones (Chai, Peterlin, & Calhoun, 2014).

Many of the characteristics of women with *pregnancy depression* were similar to those of women with *chronic depression* including lower SES, as indicated by younger age, lower education, unemployment, together with having a history of depression or experience of childhood trauma. Depression with onset during pregnancy has previously been pointed out to more often be associated with psychosocial stressors compared with postpartum onset depression (Altemus et al., 2012). The present findings are in line with previous studies suggesting that more psychosocially vulnerable women, i.e., those with previous mental health morbidity or low SES, more often have depression during pregnancy or even chronic symptoms during the perinatal period (Biaggi, Conroy, Pawlby, & Pariante, 2016; Denckla et al., 2018; Howard et al., 2014).

In contrast, our findings indicate that depression groups with *postpartum onset* had relatively fewer indications for low SES. Rather, women with *early postpartum onset* of depression were typically first-time mothers, who experienced pregnancy complications, an instrumental delivery, negative delivery experience, and babies with a more difficult temper. *Late postpartum onset* on the other hand appears particularly associated with postpartum characteristics such as lack of sleep, poor partner support, and bonding difficulties. Being foreign-born, overweight, having induction of labor, and a negative delivery experience were characteristics of *chronic* depression. These results suggest a need for interventions for women with more complicated deliveries. Notably, a subjective negative experience does not necessarily correspond to objective assessments and may not be recorded as a complicated birth, highlighting the importance of postpartum follow-up based on subjective ratings as well. In addition, it is important to consider that ratings of delivery experience may be influenced by concurrent depressive symptoms. Postpartum hemorrhage was also borderline significant for *early postpartum onset*. A previous study has shown that hemorrhage was directly associated with postpartum depression, but path analysis revealed mediating roles for anemia at discharge and negative delivery experience (Eckerdal et al., 2016). Perhaps more surprisingly, the use of epidural analgesia was more common in all three groups with postpartum symptoms (i.e., *early or late postpartum* onset and *chronic depression*). However, it should be taken into account that the underlying reasons for epidural use, such as a longer and more difficult delivery, history of depression, and childbirth fear, were not adjusted for.

TABLE 2 Pregnancy-related characteristics of the five perinatal depression trajectories, presented as numbers (*n*) and percentages (%), and odds ratios (OR) with 95% confidence intervals (CI), derived from the multinomial logistic regression analysis using healthy trajectory as the reference group

	Healthy *n* = 1,494 (60.6%)	Pregnancy depression *n* = 209 (8.5%)		Early postpartum onset *n* = 270 (10.9%)		Late postpartum onset *n* = 132 (5.4%)		Chronic depression *n* = 361 (14.6%)	
	n (%)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)
Nulliparous (vs. multiparous)	700 (47.9)	96 (46.8)	1.0 (0.7–1.3)	152 (58.5)	1.5 (1.2–2.0)**	67 (50.8)	1.1 (0.8–1.6)	164 (47.4)	1.0 (0.8–1.2)
Assisted reproductive technology (vs. no)	9 (1.0)	2 (1.4)	1.5 (0.3–7.0)	2 (1.1)	1.2 (0.3–5.4)	1 (1.3)	1.3 (0.2–10.3)	3 (1.2)	1.2 (0.3–4.7)
Male infant (vs. female infant)	761 (52.0)	105 (51.2)	1.0 (0.7–1.3)	130 (50.0)	0.9 (0.7–1.2)	62 (47.0)	0.8 (0.6–1.2)	182 (52.6)	1.0 (0.8–1.3)
Negative delivery expectations (vs. positive expectations)	154 (10.4)	55 (27.5)	3.3 (2.3–4.7)**	51 (19.0)	1.9 (1.4–2.7)**	23 (17.4)	1.8 (1.1–3.0)*	117 (35.3	4.7 (3.6–6.2)**
Severe fear of delivery (vs. less than severe fear/no fear)	40 (2.7)	27 (13.2)	5.5 (3.3–9.2)**	21 (7.8)	3.0 (1.8–5.3)**	5 (3.8)	1.4 (0.6–3.7)	48 (14.2)	6.0 (3.9–9.3)**
Unplanned pregnancy (vs. planned pregnancy)	176 (11.9)	36 (18.0)	1.6 (1.1–2.4)*	53 (19.7)	1.8 (1.3–2.6)**	17 (12.9)	1.1 (0.6–1.9)	91 (26.8)	2.7 (2.0–3.6)**
Pregnancy nausea									
Requiring medication (vs. no nausea)	128 (8.6)	42 (21.1)	3.3 (1.0–5.4)**	39 (14.6)	2.7 (1.7–4.4)**	18 (13.6)	2.8 (1.4–5.5)*	78 (22.9)	6.0 (3.9–9.4)**
Without medication (vs. no nausea)	1,001 (67.5)	122 (61.3)	1.2 (0.8–1.8)	189 (70.5)	1.7 (1.2–2.4)*	96 (72.7)	1.9 (1.1–3.2)*	227 (66.6)	2.2 (1.5–3.2)**
No nausea (ref.)	355 (23.9)	35 (17.6)	1	40 (14.9)	1	18 (13.6)	1	36 (10.6)	
Symphysiolysis (vs. no)	452 (30.3)	105 (50.2)	2.3 (1.7–3.1)**	116 (43.0)	1.7 (1.3–2.3)**	53 (40.2)	1.5 (1.1–2.2)*	177 (49.0)	2.2 (1.8–2.8)**
Other pregnancy complications† (vs. no)	144 (9.6)	26 (12.4)	1.3 (0.9–2.1)	43 (15.9)	1.8 (1.2–2.6)*	17 (12.9)	1.4 (0.8–2.4)	52 (14.4)	1.6 (1.1–2.2)*

Note. Numbers (*n*) and percentages (%) missing on: parity *n* = 61 (2.5), assisted reproductive technology *n* = 905 (36.7), infant sex *n* = 60 (2.4), delivery expectations *n* = 52 (2.1), fear of delivery *n* = 36 (1.5), pregnancy planning *n* = 45 (1.8), SSRI *n* = 43 (1.7), and nausea *n* = 42 (1.7).

†Anemia and/or diabetes and/or hypertension and/or preeclampsia $^{*}p < 0.05$ $^{**}p < 0.001$.

TABLE 3 Delivery-related characteristics of the five perinatal depression trajectories, presented as numbers (*n*) and percentages (%), and odds ratios (OR) with 95% confidence intervals (CI), derived from the multinomial logistic regression analysis using healthy trajectory as the reference group

	Healthy *n* = 1,494 (60.6%)	Pregnancy depression *n* = 209 (8.5%)		Early postpartum onset *n* = 270 (10.9%)		Late postpartum onset *n* = 132 (5.4%)		Chronic depression *n* = 361 (14.6%)	
	n (%)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)
Induction of labor (vs. no)[†]	262 (18.8)	47 (24.6)	1.4 (1.0–2.0)	57 (23.1)	1.3 (0.9–1.8)	23 (19.0)	1.0 (0.6 – 1.6)	76 (24.2)	1.4 (1.0 – 1.8)[*]
Epidural anesthesia (vs. no)[†]	466 (33.4)	78 (40.8)	1.4 (1.0–1.9)[*]	116 (47.0)	1.8 (1.3–2.3)[**]	56 (46.3)	1.7 (1.2 – 2.5)[**]	157 (50.0)	2.0 (1.6 – 2.6)[**]
Instrumental delivery (vs. no)	324 (22.1)	56 (27.3)	1.3 (0.9–1.8)	77 (29.6)	1.5 (1.1–2.0)[*]	30 (22.7)	1.0 (0.7 – 1.6)	95 (27.4)	1.3 (1.0 – 1.7)*
Postpartum hemorrhage ≥1,000 ml (vs. <1,000 ml)	93 (6.4)	13 (6.3)	1.0 (0.5–1.8)	25 (9.6)	1.5 (1.0–2.5)	10 (7.6)	1.2 (0.6 – 2.4)	26 (7.5)	1.2 (0.8 – 1.9)
Manual placental removal (vs. no)	39 (2.9)	3 (1.5)	0.5 (0.2–1.7)	9 (3.8)	1.3 (0.6–2.7)	6 (5.1)	1.8 (0.7 – 4.3)	9 (2.9)	1.0 (0.5 – 2.0)
Severe laceration, grade III–IV (vs. none or grade I–II)[‡]	43 (3.4)	5 (3.0)	0.9 (0.4–2.3)	5 (2.3)	0.7 (0.3–1.8)	2 (1.9)	0.5 (0.1–2.3)	10 (3.6)	1.1 (0.5–2.1)
Self-reported negative experience of delivery, six weeks postpartum (vs. positive experience)	71 (5.0)	14 (7.1)	1.5 (0.8–2.6)	47 (18.4)	4.3 (2.9–6.4)[**]	8 (6.5)	1.3 (0.6–2.8)	48 (14.8)	3.3 (2.2–5.9)[**]
Preterm delivery, <37 weeks (vs. ≥37 weeks)	50 (3.4)	9 (4.4)	1.3 (0.6–2.7)	13 (5.0)	1.5 (0.8–2.8)	5 (3.8)	1.1 (0.4–2.8)	19 (5.5)	1.6 (1.0–2.8)
Infant birth weight, ≥4 kg (vs. <4 kg)	305 (21.2)	47 (23.3)	1.1 (0.8–1.6)	56 (22.2)	1.1 (0.8–1.5)	21 (16.2)	0.7 (0.4–1.2)	73 (21.4)	1.0 (0.8–1.3)
APGAR <7, at 5 min (vs. 7–10)	26 (1.8)	6 (2.9)	1.7 (0.7–4.1)	3 (1.2)	0.7 (0.2–2.2)	3 (2.3)	1.3 (0.4–4.3)	11 (3.2)	1.8 (0.9–3.8)
Newborn to neonatal unit (vs. no)	107 (7.3)	27 (13.2)	1.9 (1.2–3.0)[*]	38 (14.6)	2.2 (1.5–3.2)[**]	10 (7.6)	1.0 (0.5–2.0)	39 (11.2)	1.6 (1.1–2.4)[*]

Notes. Numbers (*n*) and percentages (%) missing on: instrumental delivery *n* = 59 (2.4), postpartum hemorrhage *n* = 59 (2.4), manual placental removal *n* = 283 (11.5), delivery experience *n* = 142 (5.8), preterm delivery *n* = 59 (2.4), birth weight *n* = 105 (4.3), APGAR *n* = 75 (3.0), and newborn to neonatal unit *n* = 59 (2.4).
[†]Excluding elective caesarean section [‡]Excluding caesarean section [*]$p < 0.05$ [**]$p < 0.001$.

TABLE 4 Postpartum characteristics of the five perinatal depression trajectories, presented as numbers (n) and percentages (%), and odds ratios (OR) with 95% confidence intervals (CI), derived from the multinomial logistic regression analysis using healthy trajectory as the reference group

	Healthy *n* = 1,494 (60.6%)	Pregnancy depression *n* = 209 (8.5%)		Early postpartum onset *n* = 270 (10.9%)		Late postpartum onset *n* = 132 (5.4%)		Chronic depression *n* = 361 (14.6%)	
	n (%)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)
Single parent (vs. married or cohabiting)	8 (0.5)	6 (2.9)	5.5 (1.9–16.0)*	5 (1.9)	3.5 (1.1–10.8)*	3 (2.3)	4.4 (1.1–16.6)*	9 (2.6)	4.9 (1.9–12.9)*
Infantile colic (vs. no)	127 (17.8)	24 (23.3)	1.4 (0.9–2.3)	55 (37.9)	2.8 (1.9 – 4.1)**	19 (28.4)	1.8 (1.0–3.2)*	51 (27.7)	1.8 (1.2–2.6)*
Breastfeeding									
No breastfeeding (vs. Exclusive)	72 (4.8)	19 (9.1)	2.0 (1.2–3.4)*	35 (13.0)	3.5 (2.3 – 5.4)**	12 (9.1)	2.1 (1.1–4.0)*	54 (15.6)	4.2 (2.8–6.1)**
Partial (vs. Exclusive)	208 (14.0)	31 (14.8)	1.1 (0.8–1.7)	66 (24.5)	2.3 (1.7 – 3.1)**	24 (18.2)	1.4 (0.9–2.3)	75 (21.6)	2.0 (1.5–2.7)**
Exclusive (ref.)	1,208 (81.2)	159 (76.1)	1	168 (62.5)	1	96 (72.7)	1	218 (62.8)	1
Lack of sleep, <6 h/night (vs. ≥6 h/night)	786 (52.8)	120 (58.0)	1.2 (0.9–1.7)	203 (75.2)	2.7 (2.0–3.6)**	82 (62.1)	1.5 (1.0–2.1)*	254 (73.0)	2.4 (1.9–3.1)**
No partner support with infant (vs. some or a lot of support)	28 (1.9)	9 (4.3)	2.4 (1.1–5.1)*	12 (4.5)	2.4 (1.2–4.7)*	6 (4.6)	2.5 (1.0–6.2)*	27 (7.8)	4.4 (2.6–7.6)**
No partner support with household (vs. some or a lot of support)	54 (7.6)	11 (10.8)	1.5 (0.7–2.9)	19 (13.3)	1.9 (1.1–3.3)*	12 (17.9)	2.7 (1.3–5.3)*	28 (15.4)	2.2 (1.4–3.6)*
Partner mental health, poor (vs. good)	57 (9.8)	13 (15.7)	1.7 (0.9–3.3)	34 (30.4)	4.0 (2.5–6.5)**	9 (16.7)	1.8 (0.9–3.9)	45 (32.6)	4.4 (2.8–6.9)**
Infant temper, difficult (vs. easy)	272 (47.2)	40 (47.6)	1.0 (0.6–1.6)	82 (71.9)	2.9 (1.9–4.4)**	27 (50.0)	1.1 (0.6–2.0)	91 (64.1)	2.0 (1.4–2.9)**
Bonding difficulties (vs. no)	5 (0.4)	1 (0.5)	1.4 (0.2–12.2)	14 (6.5)	19.1 (6.8–53.5)**	10 (8.5)	25.6 (8.6–76.2)**	28 (10.2)	31.0 (11.9–81.2)**

Notes. Numbers (*n*) and percentages (%) missing on: marital status *n* = 15 (0.6), infantile colic *n* = 1,252 (50.8), breastfeeding *n* = 21 (0.9), lack of sleep *n* = 20 (0.8), partner support with infant *n* = 30 (1.2), partner support with household *n* = 1,257 (51.0), partner mental health *n* = 1,500 (60.8), infant temper *n* = 1,496 (60.7), and bonding *n* = 291 (11.8).
*$p < 0.05$ **$p < 0.001$.

Newborn admission to a neonatal unit was more common for women both in the *pregnancy* and *chronic* symptoms trajectories, in addition to women with *early postpartum* symptoms. Thus, one could hypothesize that poor health of the baby might be one consequence of *pregnancy depression*, as well as a risk factor for postpartum depression (Gulamani, Premji, Kanji, & Azam, 2013; Szegda, Markenson, Bertone-Johnson, & Chasan-Taber, 2014). Preterm delivery has previously been related to both antenatal and postpartum depression (Fransson et al., 2011; Vigod, Villegas, Dennis, & Ross, 2010); however, in the present study, this association was only borderline significant for *chronic depression*. One reason for this might be the rather low preterm birth rates in the sample, and furthermore that mothers with preterm babies may be less likely to complete follow-up.

Previous review studies investigating PND have concluded that parity is an ambiguous risk factor, with primiparity either being protective or a risk factor (Biaggi et al., 2016; Howard et al., 2014). However, when looking at the time of depression onset, being a first-time mother (i.e., nulliparity) was associated with *early postpartum* onset only. All three postpartum symptom groups (i.e., *postpartum onset* or *chronic* symptoms) were less likely to breastfeed compared with healthy mothers. Breastfeeding has previously been shown to be less common in depressed women (Cato et al., 2017), and there are also studies indicating reverse causality with successful breastfeeding being protective against PPD (Figueiredo et al., 2014). However, women who medicate against mental illness might choose not to breastfeed, further making the direction of the association difficult to ascertain. Poor partner health was also associated with the *early postpartum onset* and *chronic depression* trajectories. It is increasingly acknowledged that parental depression is correlated (Paulson & Bazemore, 2010; Sundström Poromaa, Comasco, Georgakis, & Skalkidou, 2017), which may make it more difficult for the mother to rely on the support from her partner.

The results from this study must be interpreted in light of a number of strengths and limitations. Although, in a majority of previous studies, depression trajectories have been determined using advanced data clustering methods appropriate for use with big data, e.g., reviewed in (Baron et al., 2017; Santos et al, 2017), these methods will produce divergent results depending on how many clusters are defined and findings can be difficult to replicate in other data sets (Mousavi, Bakar, & Vakilian, 2015). Baron et al. (2017) conclude, in their systematic review of growth curve mixture modeling trajectories, that none of the demographic or clinical characteristics investigated systematically differentiated groups of women with different symptom trajectories, within or across studies, suggesting that the clinical relevance of such methods may be low. Addressing such limitations, the present study defined PND trajectories that more easily could be applicable in a clinical setting by using an established screening instrument (EPDS; Cox et al., 1987) and cut-offs available for use among clinicians (Wickberg & Hwang, 1996). Nevertheless, the present findings correspond well with previous studies defining trajectories with statistical methods (Bayrampour et al., 2016; Denckla et al., 2018; McCall-Hosenfeld, Phiri, Schaefer, Zhu, & Kjerulff, 2016; Mora et al., 2009; Vänskä et al., 2011). In line with previous studies, the *healthy* trajectory in the present study was most common, suggesting this trajectory may be normative (Baron et al., 2017; Santos et al., 2017). Among the PND trajectories, the *chronic* depression group was the largest, as observed in some previous studies (Kingsbury et al., 2015; Kuo, Chen, & Tzeng, 2014; Luoma et al., 2015), although others with a longer follow-up period have found a chronic trajectory to be the smallest group (Barker, 2013; Bayrampour et al., 2016; Campbell, Morgan-Lopez, Cox, & McLoyd, 2009; Cents et al., 2013; Hammerton et al., 2015). In the present study, the *postpartum* trajectory was further divided into two postpartum trajectories: *early postpartum onset* and *late postpartum onset*. This study was based on a number of previous studies that used data clustering methods for identifying trajectories. We had the possibility to define similar patterns with distinct antenatal depression, early versus late postpartum, and one chronic trajectory (McCall-Hosenfeld et al., 2016; Mora et al., 2009) without the clustering methods.

The EPDS is a widely used instrument and validated cut-offs for identifying potential major depression in perinatal samples have been established (Gelaye, Rondon, Araya, & Williams, 2016; Rubertsson et al., 2011; Santos et al., 2017; Wickberg & Hwang, 1996). However, despite good psychometric properties (Affonso et al., 2000), the EPDS is not a diagnostic tool and symptom severity has not been evaluated in relation to clinically diagnosed severe versus mild depression. It is important to acknowledge that simply screening for the absence or presence of symptoms above the cut-off is not enough to address the complexities of PND trajectories and the sum of the EPDS scores does not translate to the actual symptom profile. We have also not taken into consideration whether women were given treatment that could have altered the natural course of symptoms, which could lead to some misclassification. However, the *healthy* group was defined as having no SSRI use or previous depression in order to create a distinct reference category. Furthermore, women with EPDS points just below the cut-off were excluded.

The majority of studies have identified a high and low symptom level trajectory (Santos et al., 2017). Similarly, we identified a *chronic depression* trajectory and a *healthy* trajectory. Follow-up of depressive symptoms, including either or both pregnancy and postpartum assessments, varies greatly between studies, and may account for some of the differences observed in the number and patterns of depression trajectories observed. Notably, many of the previous studies on depression trajectories have focused on postpartum trajectories only (Santos et al., 2017; Vliegen et al., 2014). In the present study, women were followed from the first trimester through six months postpartum addressing criticism in the literature that PPD reflects a vulnerability that occurs before pregnancy or delivery. Including both antenatal and postnatal follow-up assessments is important as it may be difficult to distinguish who might improve postpartum (i.e., *pregnancy depression* only) and who will remain depressed (i.e., *postpartum onset* or *chronic depression*) and symptoms that remit naturally over the course of the first few months may not need intervention. As such, it would have been valuable to include

a longer follow-up. Unfortunately, in this study, the EPDS was not included in the questionnaire at 12 months postpartum. Although many longitudinal studies have not assessed pre-pregnancy mental health (Vliegen et al., 2014; Denckla et al., 2018), we obtained information on history of psychopathology and were thus able to define a healthy trajectory group free of previous depression or current SSRI treatment. However, it is important to note that a history of depression was self-reported and it is possible that some participants did not disclose information.

In order to determine PND trajectories, EPDS responses were required from each assessment from pregnancy through six months postpartum, which is reflected in the proportion of nonresponders (39.5%), including those who might eventually have only missed to fill out just one of the four surveys. Although few differences in background and lifestyle characteristics were observed between participants and nonresponders, lower education, smoking, and intimate partner violence were more common among nonresponders. This suggests that those not included may represent a more vulnerable group. It is important to note that the BASIC cohort overall is characterized by Swedish-born women and high SES, which may influence the generalizability of the results to women with, e.g., lower income, low educational attainment, or minority groups. This is particularly relevant considering evidence which suggests a three to fourfold higher prevalence of PND among women with low SES or minority status (Falah-Hassani, Shiri, Vigod, & Dennis, 2015; Halbreich & Karkun, 2006). Despite this limitation, distinct patterns of depressive symptomatology during the perinatal period were identified and associated with different characteristics. However, one major limitation of the study is that although we had enough data to investigate crude relationships between each PND trajectory and a healthy comparison group, we did not have enough data to investigate multivariably adjusted associations. Although several interesting crude associations between potential risk characteristics and PND trajectories were identified, further studies are needed to establish independent risk factors. Further, it is important to note that the analyses were of an explorative nature and do not indicate causal associations.

In conclusion, a broad range of background- and lifestyle-, pregnancy-, delivery-, and postpartum-related characteristics were found to be associated with different PND trajectories to varying degrees and may be amenable to intervention. As an extension of this research, patients with risk of pregnancy onset or even chronic PND might be identified early on. General questions regarding, e.g., sensitivity to hormones expressed as PMS or previous migraine, history of depression, and experience of relationship violence are possible to investigate and could motivate specific advice. Regarding postpartum care, extra attention could be offered to first-time mothers as well as women with negative experiences of the delivery. During the first months of motherhood, women expressing relationship problems or difficulties in bonding or handling the infant temper should be offered extra support. Rather than grouping heterogeneous groups into a single PND group as may be the case in many contexts at present, these results point to the importance of communicating to relevant health care settings the presence of different PND trajectories. Further, results highlight the importance of looking at the different characteristics of these PND groups that may indicate varying mental health care needs during the perinatal period. However, further studies are needed to establish appropriate psychological or medical treatments tailored to the needs of different PND groups.

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CONFLICT OF INTEREST

The authors declared that they have no conflict of interest.

AUTHOR CONTRIBUTIONS

All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Conceptualization*, A.S., A.W., and E.F.; *Methodology*, A.S., A.W., and E.F.; *Formal analysis*, A.W. and E.F.; *Resources*, A.S.; *Writing – Original Draft*, A.W. and E.F.; *Writing – Review and Editing*, A.S., A.W., C.A., E.F., J.C., and S.I.I.; *Supervision*, A.S.; *Project Administration*, A.W. and E.F.; *Funding acquisition*, A.S.

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