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Childbirth and symptoms of postpartum depression and anxiety: a prospective birth cohort study

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Abstract

We investigated associations between aspects of childbirth and elevated postpartum symptoms of depression and anxiety. We employed secondary analysis of perinatal data ($N=4657-4946$) from the Avon Longitudinal Study of Parents and Children (ALSPAC) birth cohort. Multivariable logistic regression models (adjusted for covariates) examined predictors of elevated symptoms of postpartum depression and anxiety. Predictors included the following: type of delivery (normal physiological vs. interventive non-physiological), immediate postpartum complications, and maternal perception of the recent birth experience. The Edinburgh Postnatal Depression Scale assessed elevated symptoms of depression (score 13), and the Crown-Crisp Experiential Index assessed elevated symptoms of anxiety (score 9) at 2 and 8 months after delivery. A more negative perception of the recent birth experience was associated with elevated symptoms of anxiety at 2 months [odds ratio (OR) 1.52, 95 % confidence interval (CI) 1.25–1.85] and 8 months (OR 1.30, 95 % CI 1.06–1.60) postpartum but was not associated with elevated symptoms of depression at either time point. Type of delivery (physiological vs. non-physiological) and

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immediate postpartum complications were not associated with elevated symptoms of depression or anxiety. Our findings suggest that improving women's childbirth experience may decrease the likelihood of postpartum anxiety, but not postpartum depression.

Keywords

Postpartum; Depression; Anxiety; Birth; ALSPAC

Introduction

Between 13 and 19 % of women report elevated symptoms of depression in the first year after childbirth (O'Hara and McCabe 2013). Similarly, high rates of anxiety occur after birth (Myers et al. 2013; Ross and McLean 2006; Yelland et al. 2010). While rates of postpartum depression may not be higher than at other times during women's lives, there are well-documented relationships between maternal depression and mothering behavior, quality of mother-infant interaction, and subsequent child development (Beck 1995, 1998; O'Connor et al. 2002; Tronick and Reck 2009).

Although some known risk factors of postpartum depression may be modifiable during pregnancy (e.g., social support, quality of partner relationship) (O'Hara and McCabe 2013), we may be able to modify women's risk by improving the experience of childbirth (Public Health Agency of Canada 2009; Waldenstrom et al. 2004). While the weight of the evidence supports no association between mode of delivery and elevated postpartum symptoms of depression (Adams et al. 2012; Carter et al. 2006), due to methodological limitations, there is insufficient evidence to know whether other types of birth events (such as interventions, complications, pain medication, and delayed mother-infant contact after birth) are related to elevated postpartum symptoms of depression (Astbury et al. 1994; Blom et al. 2010; Fairbrother and Woody 2007; Fisher et al. 1997; Gausia et al. 2012; Hiltunen et al. 2004; Johnstone et al. 2001; Murray and Cartwright 1993; Righetti-Veltema et al. 1998; Rowe-Murray and Fisher 2001). In contrast to objectively measured childbirth variables, the literature suggests that women's perception of their recent birth experience (measured by global scales of satisfaction and by specific elements within the experience) may be a predictor of elevated postpartum symptoms of depression (Cigoli et al. 2006; Gausia et al. 2012; Giakoumaki et al. 2009; Green and Baston 2003; Green et al. 1990; Gurber et al. 2012; Neter et al. 1995; Saisto et al. 2001; Sorenson and Tschetter 2010; Tuohy and McVey 2008; Weisman et al. 2010). Risk factors for postpartum anxiety are understudied; however, the weight of the limited evidence suggests no association between mode of delivery and risk of postpartum anxiety and there are no investigations we are aware of on the relationship between other types of birth events and postpartum anxiety (Bradley et al. 1983; Fatoye et al. 2006; Giakoumaki et al. 2009; Weisman et al. 2010). Likewise, studies are scarce and limited in design regarding whether women's perception of their recent birth experience predicts postpartum anxiety (Giakoumaki et al. 2009; Tuohy and McVey 2008; Weisman et al. 2010).

The purpose of the present study was to examine whether childbirth factors such as mode of birth, interventions, complications, and women's experience of the recent birth are associated with elevated postpartum symptoms of depression and anxiety. We hypothesized that exposure to interventive non-physiological childbirth [defined as cesarean section, forceps/vacuum extraction, induction, augmentation, or labor pain medication (other than nitrous oxide)] compared to normal physiological childbirth would be associated with elevated symptoms of depression and anxiety at 2 and 8 months postpartum. Additionally, we expected that immediate post-partum complications and a negative perception of the recent childbirth experience would be associated with elevated symptoms of depression and anxiety.

Methods

Design and study population

The sample was derived from the Avon Longitudinal Study of Parents and Children (ALSPAC), a prospective, ongoing, birth cohort from the UK (Boyd et al. 2013). ALSPAC was designed to investigate social, environmental, biological, and genetic influences on the health and development of children. Women living in the Avon region were invited to participate if they had an expected date of delivery between April 1991 and December 1992. The social and demographic characteristics of participating women were similar to the general UK population (Fraser et al. 2013).

Study methodology has been reported previously (Golding et al. 2001). Please note that the study website contains details of all the data that are available through a fully searchable data dictionary (<http://www.bris.ac.uk/alspac/researchers/data-access/data-dictionary/>). While the original database consisted of 15,445 women, detailed birth data were available from medical records for a non-random sample of 8295 pregnancies. Consequently, the sample with birth data for our analysis is neither representative of the Avon nor the general UK population. Participants were excluded from analysis if they had multiple pregnancies ($n=184$), a baby with gestational age of <34 or >42 weeks ($n=214$), or a baby who died <28 days after birth ($n=21$). These exclusions resulted in a sample size of 7876. For the current study, analysis was restricted to participants with complete data on outcome and predictor variables as follows: (A) symptoms of depression measured at 2 months (86.6 %) and 8 months (82.3 %) post-partum, (B) symptoms of anxiety measured at 2 months (85.3 %) and 8 months (82.3 %) postpartum, (C) type of delivery (96.5 %), (D) maternal perception of the recent birth experience (86.2 %), and (E) presence or absence of immediate postpartum complications (89.5 %). Thus, our final sample for analysis ranged from 4657 to 4946 women, representing 59.1–62.8 % of the overall study population with data extracted from medical records.

Measures

Outcome variables: symptoms of depression and anxiety

Symptoms of depression were assessed with the Edinburgh Postnatal Depression Scale (EPDS), a ten-item self-report measure (Cox et al. 1987). The EPDS is the most commonly

used depression-screening tool and demonstrates 80–90 % specificity and sensitivity at cutoffs ranging from 10 to 13 (on a 30-point scale) (Myers et al. 2013). To increase specificity, we used a cutoff of 13 to indicate greater likelihood of clinical depression (Myers et al. 2013). Elevated postpartum anxiety symptoms were assessed with a subsection of the Crown-Crisp Experiential Index (CCEI), an eight-item self-report measure (Namaky et al. 2011). While there is no standard clinical cutoff, we used a CCEI score 9 (on a 16-point scale) to indicate a higher likelihood of clinically relevant anxiety (Heron et al. 2004). This scale has correlated 0.70 and 0.76 with the Spielberger State-Trait Anxiety Inventory subscales, respectively, and demonstrated internal consistencies of >0.80 across assessments (Heron et al. 2004).

Primary predictor variables: three measures of the childbirth experience

Type of birth (interventive non-physiological birth versus normal physiological birth)—Given the wide range of differential birth events, birth procedures, and birth exposures, a global measure (type of birth) was chosen to capture the most common significant birth interventions. Participants were categorized as having an interventive non-physiological birth if they were exposed to labor induction (oxytocin or prostaglandin), oxytocin augmentation, labor pain medication (other than nitrous oxide termed gas/air), vaginal delivery with forceps or vacuum extraction, or cesarean delivery; otherwise, they were categorized as having a normal physiological birth (no drug exposures except for nitrous oxide).

Maternal perception of the recent birth experience—Participants were asked at 8 weeks after birth: “Was the birth a wonderful experience for you?” (with possible responses “yes,” “no,” and “not sure”) and “How did you feel while you were having the baby?” (with possible responses “neglected,” “okay,” “warmly supported,” and “other”). We excluded the *other* category from analysis. There was a significant association between responses to the two questions ($\chi^2=214$, $p<0.0001$). We report findings using a binary variable of maternal perception of the recent birth experience: *not wonderful/not sure versus wonderful* (Neter et al. 1995; Saisto et al. 2001).

Immediate postpartum complication (1 complication vs. no complications)—Participants were categorized as having immediate postpartum complications if their infants were admitted for special care immediately after birth, had a postpartum hemorrhage or blood transfusion, or had third- or fourth-degree genital lacerations; otherwise, they were categorized as having no complications (Blom et al. 2010; O'Hara and McCabe 2013).

Covariates

We examined potential covariates for elevated symptoms of depression and anxiety based on the previous literature with ALSPAC and the postnatal depression/anxiety literature at large (Dennis and McQueen 2009; Golding et al. 2009; Heron et al. 2004; Myers et al. 2013; O'Hara and McCabe 2013). Sociodemographic variables included maternal age at birth (Golding et al. 2009) (35, 25–34, and <25 years) and level of education (Golding et al. 2009) (lower than advanced vs. advanced and higher). Psychosocial variables included elevated symptoms of depression at 32 weeks of pregnancy (Myers et al. 2013; O'Hara and

McCabe 2013) (EPDS = 13); elevated anxiety symptoms at 32 weeks of pregnancy (Heron et al. 2004) (CCEI = 9); history of alcoholism or drug addiction (Bystrova et al. 2009) (recent, past, never); smoking in pregnancy (Myers et al. 2013) (yes vs. no); self-reported history of a psychiatric diagnosis (Myers et al. 2013; O'Hara and McCabe 2013) (yes vs. no); level of social network (Myers et al. 2013; O'Hara and McCabe 2013) measured by scoring quantitative measures of connectedness with friends and family using the median value cutoff (<24 vs. ≥24) (Weisman et al. 2010); stressful life events in childhood using the median value cutoff (Golding et al. 2009) (>3 events vs. 0–3 events); and recent stressful life events at 18 weeks of pregnancy using the median value cutoff (Golding et al. 2009; O'Hara and McCabe 2013) (>3 events vs. 0–3 events). We also examined potential covariates related to reproductive and medical health including parity (Myers et al. 2013) (0 vs. ≥1), consumption in pregnancy of fish high in omega-3 (Golding et al. 2009) (yes vs. no), and method of infant feeding (Dennis and McQueen 2009) (not exclusive vs. exclusive breastfeeding) during the first month after birth for symptoms of depression and anxiety at 2 months and during the first 6 months after birth for symptoms of depression and anxiety at 8 months (Modarres et al. 2012).

Statistical analysis

A series of multivariable logistic regressions were conducted to examine associations between the primary predictor variables (type of delivery, maternal perception of the recent birth experience, and immediate postpartum complications) and elevated symptoms of depression and anxiety. Interactions were also examined between the primary predictor variables and covariates. Backward selection procedures (done manually) were performed using the likelihood ratio chi-square test to determine the best-fitting model. The Hosmer-Lemeshow test was used to assess the goodness of fit of the final models. Odds ratios (ORs) and 95 % confidence intervals (CIs) were calculated using maximum likelihood estimates from the logistic regression models. All *p* values are two-sided at a *p*<0.05 level of significance. Analyses were performed using SAS (version 9.3; SAS Institute Inc., Cary, NC, USA).

Results

Population characteristics

Table 1 shows the sociodemographic distribution of the study population (*n*=7876) and final sample (*n*=4657–4976). The ALSPAC study sample is predominately comprised of non-Hispanic Caucasian women (97.2 %), and the participants' age ranged from 15 to 44 years [mean (SD), 27.76 (5.23)]. Women in the final sample were predominately non-Hispanic Caucasian, aged 25–34 years, and married. They were more likely to have a level of education denoting that they had not stayed at school beyond the age of 16, a parity of zero, and a higher versus lower level of social network. In our final sample, the prevalence of elevated symptoms of postpartum depression was 14.4 % (*n*=714) at 2 months and 10.1 % (*n*=472) at 8 months and the prevalence of elevated symptoms of postpartum anxiety was 11.6 % (*n*=567) at 2 months and 11.3 % (*n*=527) at 8 months.

Elevated postpartum symptoms of depression

In both unadjusted (Table 2) and adjusted analyses (Table 3), type of birth, maternal perception of the recent birth experience, and immediate postpartum complications were not significantly associated with elevated symptoms of depression at 2 and 8 months after birth. However, elevated symptoms of depression and anxiety during pregnancy, having a self-reported history of a previous psychiatric diagnosis, higher numbers of stressful life events in pregnancy, and parity greater than zero were significantly associated with elevated symptoms of depression at both 2 and 8 months (Table 3). Additionally, having a lower social network was associated with elevated symptoms of both depression and anxiety at 2 and 8 months and being >34 years of age were associated with elevated symptoms of depression at 8 months.

Elevated postpartum symptoms of anxiety

In both unadjusted (Table 2) and adjusted analyses (Table 3), maternal perception of the recent birth experience was significantly associated with elevated symptoms of anxiety at both 2 and 8 months after birth (Table 3). Specifically, women who reported at 2 months that their birth experience was not wonderful were at increased odds of elevated anxiety symptoms at 2 and 8 months after birth compared to women who reported their birth experience as wonderful. In both the unadjusted and adjusted analyses, type of birth and immediate postpartum complications were not significantly associated with elevated anxiety symptoms at 2 and 8 months after birth. However, elevated symptoms of depression and anxiety in pregnancy, self-reported history of a previous psychiatric diagnosis, higher numbers of stressful life events in pregnancy, a lower social network, and parity greater than zero were significantly associated with elevated anxiety symptoms at both 2 and 8 months.

An exploratory follow-up analysis demonstrated that the results between predictors and outcomes did not significantly change (data not shown) when comparing the global versus specific operational measures of maternal perception of the recent birth experience (i.e., how wonderful the experience was vs. how well-supported women felt during labor).

Discussion

This UK cohort of nearly 5000 women demonstrated that a more negative perception of the recent birth experience was associated with elevated symptoms of postpartum anxiety, but not symptoms of depression. Postpartum depression and anxiety were not associated with exposure to the hypothesized predictors of a non-physiological type of birth (i.e., interventions of pain medication, oxytocin, cesarean) or with immediate postpartum complications. Our findings suggest that addressing predictors of a woman's birth experience may help to reduce postpartum anxiety symptoms.

Strengths of our study include the well-designed ALSPAC dataset offering numerous obstetric and psychosocial variables. Thus, in our analyses, we were able to control for likely covariates of postpartum depression and anxiety, such as antenatal depression and anxiety scores. Since roughly one half of the original ALSPAC samples had obstetric data extracted from the medical records, our findings may not be generalizable to the general UK

population. A limitation in the interpretation of our significant findings is that recollection of the birth experience was collected at 8 weeks after birth—the same time as the collection of anxiety level. Thus, it is possible that a negative recollection of the birth experience may have been caused by a woman's current anxiety level.

Caution is warranted in the interpretation of our findings due to ALSPAC's limited operational measures of women's perception of birth. The postpartum question “Was the birth a wonderful experience for you?” implies a euphoric experience, whereas women in 1991–1992 may have been pleased or satisfied with their experience without expectations of it being wonderful. In this dataset, we do not know much about the women's antenatal expectations of the birth experience, a likely predictor of the quality of women's actual birth experience (Hildingsson 2015; Hodnett 2002). The ALSPAC question most similar to a woman's expectation of birth was “How important is it to you that giving birth will be a wonderful experience?” While the construct *importance* differs from the construct *expectation*, upon further investigation, our data show that the importance of the upcoming experience as wonderful did not statistically modify the significant association between women's actual perceived birth experience and post-partum anxiety (Breslow-Day test for homogeneity of the odds ratios $p=0.60$, data not shown). There is no gold standard on measuring women's perception of the birth experience; thus, investigators have used global ratings (level of satisfaction or a positive vs. negative experience) or rating of specific dimensions within the experience (such as level of support or respect from care providers, control over labor management, involvement with decision-making, and difficulty of the birth) (Public Health Agency of Canada 2009; Waldenstrom et al. 2004). Since we found similar findings between predictors and outcomes using data from either “Was the birth a wonderful experience for you?” or “How did you feel while you were having the baby?,” a reasonable degree of construct validity is probable, as the feeling of being supported in labor is a fundamental aspect of a positive birth experience.

Our findings of a null relationship between type of birth (normal physiological vs. interventional non-physiological) and postpartum mood may be in agreement with the literature; however, the state of the science is severely limited by studies typically not measuring potential covariates of depression such as mood during pregnancy, not using multivariable modeling, or not using a well-validated instrument. Mode of delivery has been studied extensively, with a 2006 literature review concluding that there was no association with elevated symptoms of depression (Carter et al. 2006). Since 2006, a methodologically strong study ($n=55,814$) by Adams et al. (2012) has corroborated this null relationship between mode of delivery and elevated symptoms of depression. Similarly, most authors report no increased likelihood of elevated symptoms of depression after exposure to birth complications or interventions; however, studies differ widely in their defining variables and how variables are scored (e.g., labor dystocia, eclampsia, infection, epidural, artificial rupture of membranes, labor induction/augmentation, episiotomy, hemorrhage, newborn in special care) (Blom et al. 2010; Fairbrother and Woody 2007; Fisher et al. 1997; Gausia et al. 2012; Johnstone et al. 2001; Murray and Cartwright 1993; Rowe-Murray and Fisher 2001). Only a few authors have reported on elevated symptoms of depression after exposure to labor pain medication; findings are inconsistent and inconclusive due to wide variation in sample size, assessment of antenatal mood, and bivariate versus multivariate analyses

(Astbury et al. 1994; Hiltunen et al. 2004; Righetti-Veltema et al. 1998). Delayed mother-infant contact soon after birth has been suggested to increase the likelihood of elevated symptoms of depression, but more rigorous studies are warranted (Righetti-Veltema et al. 1998; Rowe-Murray and Fisher 2001).

It is difficult to compare our findings of a null relationship between women's subjective experience of birth and elevated symptoms of depression due to the methodological limitations of most studies, although two well-designed studies suggest that higher satisfaction with the birth experience reduces the likelihood of elevated symptoms (Neter et al. 1995; Saisto et al. 2001). Likewise, many studies suggest that the likelihood of elevated symptoms of depression is lower in women reporting birth as a positive birth experience (Gausia et al. 2012; Giakoumaki et al. 2009; Gurber et al. 2012; Sorenson and Tschetter 2010; Weisman et al. 2010), greater labor support from care providers (Cigoli et al. 2006; Sorenson and Tschetter 2010), greater involvement with labor management decisions (Green and Baston 2003; Green et al. 1990), and a less difficult birth (Tuohy and McVey 2008), although the studies typically did not control for antenatal symptoms of depression.

Our significant findings between women's perception of birth and postpartum anxiety are an important addition to the literature due to the small number of studies on risk of postpartum anxiety. Our findings corroborate three studies showing significant associations between lower likelihood of postpartum anxiety after a positive birth experience (Giakoumaki et al. 2009; Weisman et al. 2010) and a less difficult birth (Tuohy and McVey 2008), although all three studies were greatly limited by not assessing anxiety during pregnancy. There have only been a few investigations on the mode of delivery and postpartum anxiety (Bradley et al. 1983; Fatoye et al. 2006; Giakoumaki et al. 2009; Weisman et al. 2010), with one study showing an increased likelihood of anxiety after cesarean surgery (Weisman et al. 2010), but all of the studies had significant design limitations. There are no studies to our knowledge on other types of birth events related to postpartum anxiety.

When studying birth events and women's perception of birth, it is important to appreciate the strong modifying effect (both positive and negative) that a caregiver can have on a woman's birth experience. In both normal and complicated births, women can have enduring negative memories of their birth experience when they did not feel supported, nurtured, or respected during childbirth (Stadlmayr et al. 2006). Likewise, women can report a positive birth experience when feeling supported by care providers in the midst of a difficult or complicated birth (Hodnett 2002).

Conclusion

We report a null relationship between type of birth (normal physiological vs. interventional non-physiological) and postpartum depression and anxiety. Our findings suggest that improving women's childbirth experience may decrease the likelihood of postpartum anxiety, but not postpartum depression. Reducing postpartum anxiety will likely improve mother-infant interaction and infant development (Bifulco et al. 2004; Logsdon and Usui 2001) and may even reduce the incidence of post-traumatic stress related to childbirth (Andersen et al. 2012). Given the known psychosocial risk factors of postpartum depression

(Myers et al. 2013; O'Hara and McCabe 2013); the emerging research on hormonal, genetic, and epigenetic bio-markers of depression (Gaynes et al. 2005; Heim and Binder 2012; Wang et al. 2013); and the frequent comorbidity of post-partum depression and anxiety (Bystrova et al. 2009; Myers et al. 2013; Reck et al. 2008; Tuohy and McVey 2008), future research is warranted to identify psychosocial and biological risk factors unique to postpartum anxiety.

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Table 1

Distribution of childbirth and sociodemographic variables of the study population with obstetric records abstracted and of the final sample used in the present analyses

	<u>Study population^a</u>		<u>Final sample^b</u>			
	<i>N^a</i>	<i>n (%)</i>	<u>Elevated symptoms of depression (EPDS 13)</u>		<u>Elevated symptoms of anxiety (CCEI 9)</u>	
			<i>At 2 months N=4946 n (%)</i>	<i>At 8 months N=4657 n (%)</i>	<i>At 2 months N=4901 n (%)</i>	<i>At 8 months N=4672 n (%)</i>
Type of birth	7601					
Non-physiological birth		6645 (87.4)	4946 (86.7)	4028 (86.5)	4249 (86.7)	4043 (86.5)
Physiological birth		956 (12.6)	656 (13.3)	629 (13.5)	652 (13.3)	629 (13.5)
Birth experience	6785					
Not wonderful/not sure		2806 (41.4)	2097 (42.4)	1986 (42.7)	2077 (42.4)	1987 (42.5)
Wonderful experience		3976 (58.6)	2849 (57.6)	2671 (57.4)	2824 (57.6)	2685 (57.4)
Immediate postpartum complications	7045					
1 complication		1590 (22.6)	1045 (21.1)	979 (21.0)	1034 (21.1)	980 (21.0)
No complications		5455 (77.4)	3901 (78.9)	3678 (79.0)	3867 (78.9)	3692 (79.0)
Maternal age (years) ^c	7876					
<25		2020 (25.6)	958 (19.4)	849 (18.2)	949 (19.4)	851 (18.2)
25–34		5062 (64.3)	3451 (69.7)	3299 (70.8)	3417 (69.7)	3308 (70.8)
35		794 (10.1)	537 (10.9)	508 (11.0)	535 (10.9)	513 (11.0)
Marital status	7417					
Married		4949 (66.7)	3494 (71.5)	3327 (72.2)	3463 (71.5)	3343 (72.3)
Not married		2468 (33.3)	1392 (28.5)	1279 (27.8)	1380 (28.5)	1278 (27.7)
Level of education	7154					
CSE/none		1433 (20.0)	776 (15.8)	697 (15.0)	756 (15.5)	695 (14.9)
Vocational		713 (10.0)	475 (9.6)	442 (9.5)	472 (9.7)	445 (9.6)
Ordinary level		2460 (34.4)	1802 (36.6)	1712 (36.9)	1792 (36.7)	1711 (38.8)
Advanced level		1635 (22.8)	1204 (24.4)	1145 (24.7)	1199 (24.5)	1153 (24.8)
Degree		913 (12.8)	669 (13.6)	642 (13.9)	662 (13.6)	649 (13.9)
Parity	7332					
0		3739 (51.0)	2522 (51.0)	2393 (51.4)	2493 (50.9)	2402 (51.4)
1		3593 (49.0)	2424 (49.0)	2264 (48.6)	2408 (49.1)	2270 (48.6)
Social network	6926					
Low		3348 (48.4)	2289 (46.3)	2116 (45.4)	2257 (46.1)	2129 (45.6)
High		3577 (51.6)	2657 (53.7)	2541 (54.6)	2644 (53.9)	2543 (54.4)
Ethnicity	7102					
Caucasians		6900 (97.2)	4819 (98.0)	4550 (98.2)	4778 (98.1)	4565 (98.2)
Non-Caucasians		202 (2.8)	100 (2.0)	83 (1.8)	95 (1.9)	84 (1.8)

^aThe study population size was 7876. *N* varies among the sociodemographic variables because of missing data

^bThe final sample included only the participants with no missing data in any of the variables used in each of the final models

^cThe range of participants' age at birth was 15–44 years, and the mean age was 27.8 years

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Table 2

Unadjusted associations of childbirth variables and elevated symptoms of depression and anxiety at 2 and 8 months postpartum

Variables	Depression ^a		Anxiety ^b	
	At 2 months (N=4946) OR (95 % CI)	At 8 months (N=4657) OR (95 % CI)	At 2 months (N=4901) OR (95 % CI)	At 8 months (N=4672) OR (95 % CI)
Type of birth				
Non-physiological birth vs. physiological birth	0.81 (0.65–1.01)	0.70 (0.65–1.21)	0.99 (0.77–1.28)	0.96 (0.74–1.25)
Birth experience				
Not wonderful/not sure vs. wonderful experience	1.21 (1.03–1.42) *	1.10 (0.91–1.33)	1.58 (1.32–1.88) ***	1.33 (1.11–1.59) **
Immediate postpartum complications				
1 complication vs. no complications	0.84 (0.69–1.03)	0.78 (0.61–1.00)	1.10 (0.89–1.36)	0.93 (0.74–1.17)

^aEdinburgh Postnatal Depression Scale scores ≥ 13 indicated elevated symptoms of depression

^bCrown-Crisp Experiential Index scores ≥ 9 indicated elevated symptoms of anxiety

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

Table 3

Final models for elevated symptoms of depression and anxiety at 2 and 8 months postpartum

Variables	Depression ^a		Anxiety ^b	
	At 2 months (N=4946) OR (95 % CI)	At 8 months (N=4657) OR (95 % CI)	At 2 months (N=4901) OR (95 % CI)	At 8 months (N=4672) OR (95 % CI)
Type of birth				
Non-physiological birth vs. physiological birth	0.89 (0.70–1.15)	1.16 (0.86–1.58)	1.02 (0.76–1.37)	1.09 (0.81–1.47)
Birth experience				
Not wonderful/not sure vs. wonderful experience	1.16 (0.97–1.38)	1.05 (0.85–1.29)	1.52 (1.25–1.85) ***	1.30 (1.06–1.60) *
Immediate postpartum complications				
1 complication vs. no complications	0.92 (0.74–1.15)	0.90 (0.68–1.18)	1.22 (0.96–1.54)	1.07 (0.83–1.37)
Elevated symptoms of depression (EPDS 13) in pregnancy				
Elevated vs. not elevated	2.84 (2.28–3.54) ***	2.91 (2.22–3.81) ***	2.04 (1.60–2.60) ***	2.32 (1.80–2.99) ***
Elevated symptoms of anxiety (CCEI 9) in pregnancy				
Elevated vs. not elevated	2.71 (2.17–3.37) ***	2.51 (1.93–3.27) ***	4.75 (3.73–6.04) ***	4.37 (3.41–5.61) ***
History of psychiatric disorder				
History vs. no history	1.58 (1.12–2.21) **	2.44 (1.68–3.53) ***	1.88 (1.32–2.69) ***	1.88 (1.29–2.72) ***
Stressful life events in childhood				
>3 vs. 0–3 events	1.17 (0.98–1.40)	0.97 (0.78–1.20)	1.20 (0.98–1.47)	1.19 (0.97–1.46)
Stressful life events in pregnancy				
>3 vs. 0–3 events	1.64 (1.37–1.97) ***	1.34 (1.07–1.68) *	1.53 (1.25–1.88) ***	1.53 (1.24–1.87) ***
Social network				
Low vs. high	1.70 (1.43–2.03) ***	1.31 (1.06–1.63) *	1.69 (1.39–2.06) ***	1.43 (1.17–1.75) ***
Maternal age (vs. 25–34 years)				
<25 years	0.97 (0.78–1.12)	0.98 (0.74–1.30)	1.10 (0.86–1.40)	1.18 (0.91–1.53)
35 years	1.24 (0.95–1.62)	1.47 (1.08–2.00) *	1.19 (0.88–1.61)	1.17 (0.85–1.60)
Parity				
0 vs. 1	0.72 (0.60–0.87) ***	0.64 (0.51–0.80) ***	0.77 (0.63–0.95) *	0.63 (0.50–0.78) ***

See “Statistical analysis” section for model building procedures

^aEdinburgh Postnatal Depression Scale scores 13 indicated elevated symptoms of depression^bCrown-Crisp Experiential Index scores 9 indicated elevated symptoms of anxiety*
 $p < 0.05$ **
 $p < 0.01$ ***
 $p < 0.001$