Severe obstetric lacerations associated with postpartum depression among women with low resilience – a Swedish birth cohort study

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Objective Women’s levels of resilience and attitudes towards perineal lacerations vary greatly. Some women see them as part of the birthing process, while others react with anger, depressed mood or even thoughts of self-harm. A previous study has reported increased risk of postpartum depressive (PPD) symptoms in women with severe perineal lacerations. The aim of this study was to assess the association between severe obstetric perineal lacerations and PPD. A secondary objective was to assess this association among women with low resilience.

Design Nested cohort study.

Setting Uppsala, Sweden.

Sample Vaginally delivered women with singleton pregnancies (n = 2990).

Methods The main exposure was obstetric perineal lacerations. Resilience was assessed in gestational week 32 using the Swedish version of the Sense of Coherence Scale. A digital acyclic graph was used to identify possible confounders and mediators. Logistic regression was used to estimate odds ratios (OR) and 95% confidence intervals (CI). A sub-analysis was run after excluding women with normal or high resilience.

Main outcome measures Postpartum depression, assessed with the Depression Self-Reporting Scale, completed at 6 weeks postpartum.

Results There was no significant association between severe obstetric perineal lacerations and PPD at 6 weeks postpartum. However, a significant association was found between severe lacerations and PPD in women with low resilience (OR = 4.8, 95% CI 1.2–20), persisting even after adjusting for confounding factors.

Conclusion Healthcare professionals might need to identify women with low resilience, as they are at increased risk for PPD after a severe perineal laceration.

Keywords obstetric injuries, personalised postnatal support, postpartum depression, resilience, severe perineal lacerations, sphincter injuries, vacuum extraction.

Tweetable abstract Severe perineal lacerations associated with postpartum depression in women with low resilience in a Swedish cohort.

Linked article This article is commented on by CA Wilson and LM Howard, p. 1391 in this issue. To view this mini commentary visit https://doi.org/10.1111/1471-0528.16326

Introduction

More than 85% of women undergoing a vaginal birth suffer perineal lacerations, with 0.6–11% of all vaginal deliveries resulting in third- or fourth-degree lacerations, involving the anal sphincter and in some cases even the anorectal mucosa, referred to as obstetric anal sphincter injuries or severe perineal lacerations. In Sweden, the national prevalence of third- and fourth-degree lacerations is 2.9%, and within Uppsala county it is 2.8%. Most of the women with perineal lacerations recover within a few weeks, but some experience persistent short-term or long-term complications such as chronic pain, dyspareunia, urinary or anal incontinence and reduced quality of life, which may lead to avoidance of further pregnancies. Interestingly, women’s attitudes towards perineal lacerations differ greatly. For some women, perineal lacerations are seen as an unavoidable risk of delivery, whereas others experience them as a substantial psychological trauma.

*Both authors contributed equally to this manuscript.
Postpartum depression (PPD)\textsuperscript{14–16} is one of the most common obstetric complications occurring in the postnatal period. The estimated prevalence of PPD is 10–15\% yearly, with depressive symptoms lasting \textgreater{}6 months in 20–25\% of those affected.\textsuperscript{17–19} However, these values are probably an underestimation, as a large number of cases still go unreported.\textsuperscript{20} PPD has a multifactorial aetiology. Well-known risk factors are previous depression, stress and low socio-economic status.\textsuperscript{21–27} Women reporting high levels of physical symptomatology at 6 weeks postpartum, have also increased odds of screening positive for PPD.\textsuperscript{28}

Resilience is considered a moderator of pain and stress and is increasingly acknowledged in clinical practice as a positive psychological resource.\textsuperscript{29} Being resilient implies the ability to cope with negative life events by using various social, intellectual, physical and psychosocial factors. Individuals with low resilience may have a higher risk of developing depression and other psychological diseases,\textsuperscript{29,30} whereas resilient behaviours may provide protection.\textsuperscript{31–33} To our knowledge, no previous study has investigated the role of resilience as a moderator of PPD in women with perineal lacerations.

The overall aim of this study was to delineate a possible association between severe perineal lacerations and PPD. A secondary aim was to investigate this association among women with low resilience. It was hypothesised that severe perineal lacerations would be a risk factor for PPD, and that this association would be stronger in women with low resilience.

Methods

Study population and procedure

This study is part of a longitudinal population-based project – the BASIC (Biology, Affect, Stress, Imaging and Cognition) study\textsuperscript{34} – that investigates women’s psychological wellbeing during and after pregnancy, conducted at the Department of Obstetrics and Gynaecology, Uppsala University Hospital, Sweden. Along with the invitation to the routine ultrasound in gestational weeks 16–18, all pregnant, Swedish-speaking women in the Uppsala area who were \textgeq{}18 years of age and did not have confidential personal data, received a letter with information about the study and were invited to participate. Exclusion criteria were non-viable pregnancies, blood-borne infectious diseases and, for this sub-study, births via caesarean sections. All participants provided written informed consent.

Following consent to participate, web-based questionnaires were sent to the participants at gestational weeks 17 and 32 and at 6 weeks postpartum. Pregnancy-related medical information was retrieved from medical records. All women who underwent a vaginal delivery were selected as the study sample. In total, BASIC recruited 6478 pregnancies between September 2009 and November 2019.\textsuperscript{24} For the current study, data from vaginally delivered women with valid information regarding the presence of lacerations and PPD (assessed by the Depression Self-Reporting Scale [DSRS] introduced in 2012 and described below), available at the time of analysis in autumn 2019 were used (not all women recruited into the BASIC study had reached the 6 weeks postpartum time-point). Further, the sub-analysis was performed among a smaller number of participants recruited during the years 2014–2019, when even resilience was assessed. A flowchart of women participating in the study and exclusion criteria at different time-points is presented in Figure 1.

Variables

Exposure

The main exposure was delivery-related perineal lacerations; the information was extracted from medical records. For the present study, obstetric perineal lacerations were classified into two subgroups, based on the extent of trauma: no or first- or second-degree perineal lacerations, and third- or fourth-degree perineal lacerations involving the anal sphincter, also termed as obstetric anal sphincter injuries (or severe perineal lacerations). Following vaginal delivery, the degree of perineal lacerations and other delivery characteristics were recorded by the midwife or doctor in charge, which is a routine procedure in Swedish health care.

Outcome

The study outcome was PPD, assessed using the DSRS and the Swedish version of Edinburgh Postnatal Depression scale (EPDS) at 6 weeks postpartum. The DSRS is a self-administered inventory designed to cover the A criterion for a major depressive disorder according to the Diagnostic and Statistical Manual of Mental Disorders 4th edition (DSM-IV).\textsuperscript{35,36} The DSRS has been developed by Ekselius and Svanborg in Sweden and has been systematically evaluated in psychiatric patients.\textsuperscript{36,37} It has been suggested that the scale can be used as an independent diagnostic tool in epidemiological studies. To increase its power, full criteria (A + B+C + E) and intermediate criteria (A + C) versions of the DSRS were also developed.\textsuperscript{36} The DSRS version including the A and C criteria for a major depressive disorder had sensitivity and specificity for an expert-rated diagnosis of 86\% and 75\%, respectively. Due to its higher sensitivity and specificity in comparison with the EPDS, the DSRS has been extensively used in psychiatric clinical settings and is closer to clinical diagnosis in accordance with DSM-IV.\textsuperscript{35,38} The A + C DSRS version was completed at 6 weeks postpartum. It comprised 29 two-point (yes/no)
questions divided into three sections. Section I (questions 1–14) measured physical and psychological symptoms of depression, section II (questions 15–19) covered past life events and duration of symptoms, and section III (questions 20–29) included questions on bipolar symptoms. All participants were administered section I and in case of a score ≥1, they proceeded to the following sections.

The EPDS is a self-administered ten-item instrument screening for PPD. It has high validity and is frequently used for epidemiological studies in the postpartum settings. The cut-off of 12 points is in line with Swedish validation studies.39,40

Resilience
In 2014, after the BASIC study had already recruited 3602 participants, the Sense of Coherence scale (SOC-29) for resilience was introduced and 2026 women reported resilience.

Figure 1. Flowchart of participants and causes of exclusion from analysis. *Scores on the DSRS at 6 weeks postpartum. †Logistic regression for the association between severe perineal lacerations and PPD at 6 weeks postpartum among all women. ‡Logistic regression for the association between severe perineal lacerations and PPD at 6 weeks postpartum among women with low resilience, assessed as a score of <128 points on the Sense of Coherence Scale SOC-29.
was assessed with the Swedish version of the SOC-29. The SOC-29 is a reliable and valid instrument that consists of 29 items and measures resilience based on questions regarding comprehensibility (eleven items), manageability (ten items) and meaningfulness (eight items).\textsuperscript{41} For each item, the respondent chooses an answer on a seven-point semantic differential scale, for example: When you think about your life, you very often: (from 'feel how good it is to be alive' to 'ask yourself why you exist at all'). Thirteen of the items have reversed scoring due to 'negative' formulation. The scores are summarised, resulting in a total score between 29 and 203 points, where a higher score correlates with a higher resilience. Suggested cut-off for low scores are summarised, resulting in a total score distribution). i.e. above one standard deviation below the mean in the BASIC data set,\textsuperscript{42} which in the BASIC data set correlates with a higher resilience. Suggested cut-off for low resilience is below one standard deviation from the mean SOC-29 score,\textsuperscript{42} which in the BASIC data set corresponds to $<128$ points; this was used as the cut-off for low resilience in this study.

**Biological, social, psychological and obstetric covariates**

At gestational week 17, participants reported on their age ($\leq35$ versus $>35$ years), education level ($\leq12$ versus $>12$ years) and history of depression (yes versus no). Information was extracted from medical records regarding parity (nulliparous versus multiparous) and body mass index (BMI) (underweight $<18.5$, normal weight $18.5-24.9$, overweight $\geq25$ kg/m$^2$). In addition, at week 32 of gestation, participants reported on fear of delivery (any fear versus no fear) and resilience (low versus high, according to the SOC-29 scale).

Information about delivery-related variables such as pregnancy length (post-term [$>41\text{th}$ weeks] versus normal or preterm [$<37\text{th}$]), use of epidural analgesia (yes versus no), vacuum extraction (yes versus no) and macrosomia (fetal birth weight $>4$ versus $\leq4$ kg) was retrieved from medical records. At 6 weeks postpartum, experience of delivery was reported (negative versus positive).

**Statistical analyses**

The associations of individual covariates with perineal lacerations and PPD were examined with Fisher’s exact test. All variables were treated as categorical covariates and significant associations with either laceration or PPD were selected for further analysis (listed in Table 1).

Online software (www.dagitty.net) was used to identify possible confounders and mediators using a directed acyclic graph (DAG) model including covariates from the bivariate analyses.\textsuperscript{43,44} The DAG analysis model is based on assumed associations between different variables affecting the exposure and outcome of the tested main association (in this study, between severe perineal lacerations and PPD at 6 weeks postpartum). This model also explores and distinguishes between direct, indirect and total effects, taking into account the complex interplay and effect of related factors (in this study, BMI, education, parity and vacuum extraction) on the final outcome.

Logistic regression models were then used for estimating odds ratios (ORs) and 95% CI for the association between severe perineal lacerations and PPD, before and after taking into account possible confounders (education, BMI, vacuum extraction, parity), identified from bivariate tests and the DAG described above.

To investigate the possible moderating role of resilience in the association between perineal lacerations and PPD, a sub-analysis was conducted, and the aforementioned logistic regression models were run after exclusion of women with normal and high resilience (those scoring $\geq128$ points, i.e. above one standard deviation below the mean in the SOC-29 sum of scores distribution).

Statistical significance level was set to $P < 0.05$ and confidence intervals were set to 95%. All calculations were performed using SPSS version 25.0 (SPSS Inc., IBM SPSS, Armonk, NY, USA) for Macintosh.

**Ethical approval, funding sources, patient involvement and core outcome set**

The study has been approved by the Regional Ethical Review Board in Uppsala, Sweden (Dnr. 2009/171). The study is supported by funds from the Swedish Research Council, the Swedish Society of Medicine, the Marianne and Marcus Wallenberg Foundation, Thuring Foundation and the Swedish Psychiatry Foundation. There was no patient or public involvement in this study. Currently, there are no core outcomes set for studies on perinatal mental health.

**Results**

**Descriptive data**

Of the total cohort of 2990 women, 26.3% experienced first-degree, 15.4% second-degree, 2.3% third-degree and 0.3% fourth-degree lacerations. The overall prevalence of PPD was 4.6%.

Associations with demographic, pregnancy and delivery covariates for all women suffering from PPD at 6 weeks postpartum are presented in Table 1.

**DAG modelling**

The DAG modelling was used to identify the possible confounders and mediators for the association between severe lacerations and PPD. When perineal laceration was set as exposure and PPD as the outcome, the DAG model suggested adjustment for education, BMI, parity and vacuum extraction in order to calculate total effects (Figure 2).
Logistic regression modelling
As presented in Table 2, no significant association was found between severe lacerations and PPD at 6 weeks post-partum, when using the DSRS (OR = 1.4, 95% CI 0.6–3.5; adjusted OR = 1.4, 95% CI 0.5–3.6) or EPDS case definition (OR = 0.8, 95% CI 0.4–1.7; adjusted OR = 0.7, 95% CI 0.3–1.7).

Sub-group analysis
A sub-group analysis was performed among women with low resilience. As presented in Table 2, third- and fourth-degree perineal lacerations were associated with higher odds of developing PPD among women with low resilience (OR = 4.8, 95% CI 1.2–20; aOR = 5.5, 95% CI 1.2–26). Similar results were obtained when women with pre-eclampsia and premature births were excluded from the analysis.

Discussion
Main findings
The present study’s results, from a large population-based Swedish cohort, did not demonstrate an association between severe lacerations and PPD, based on a self-rating instrument, in the total study sample; nevertheless, a strong association was found among women with low resilience.

Strengths and limitations
To our knowledge, this is one of the first studies investigating the association between obstetric lacerations and PPD. Data were drawn from the population-based, longitudinal

Table 1. Background, medical and pregnancy characteristics of all study participants, reported by depression at 6 weeks postpartum, presented as numbers (n) and percentages (%)

| Variables                        | n  | Not depressed at 6 weeks PP* n (%) | Depressed at 6 weeks PP* n (%) | P value* |
|----------------------------------|----|-----------------------------------|--------------------------------|----------|
| Severe perineal laceration       |    |                                   |                                |          |
| No                               | 2911 | 2777 (95)                         | 134 (5)                        | 0.4      |
| Yes                              | 79  | 74 (94)                           | 5 (6)                          |          |
| Total                            | 2990 |                                  |                                |          |
| Age (years)                      |    |                                   |                                |          |
| ≤35                              | 2311 | 2200 (95)                         | 111 (5)                        | 0.5      |
| >35                              | 678  | 650 (96)                          | 28 (4)                         |          |
| Total                            | 2989 |                                  |                                |          |
| BMI (kg/m²)                      |    |                                   |                                |          |
| <18.5                            | 83  | 79 (95)                           | 4 (5)                          | 0.02     |
| 18.5–24.9                        | 1946 | 1870 (96)                         | 76 (4)                         |          |
| ≥25                              | 760  | 712 (94)                          | 48 (6)                         |          |
| Total                            | 2789 |                                  |                                |          |
| Education (years)                |    |                                   |                                |          |
| >12                              | 2190 | 2105 (96)                         | 85 (4)                         | −0.001   |
| ≤12                              | 612  | 567 (93)                          | 45 (7)                         |          |
| Total                            | 2802 |                                  |                                |          |
| Resiliencec                      |    |                                   |                                |          |
| Low                              | 310  | 254 (82)                          | 56 (18)                        | −0.001   |
| Normal/high                      | 1716 | 1672 (97)                         | 44 (3)                         |          |
| Total                            | 2026 |                                  |                                |          |
| Previous depression              |    |                                   |                                |          |
| Yes                              | 1539 | 1431 (93)                         | 108 (7)                        | −0.001   |
| No                               | 1258 | 1236 (98)                         | 22 (2)                         |          |
| Total                            | 2797 |                                  |                                |          |
| Parity                           |    |                                   |                                |          |
| Nulliparous                      | 1415 | 1350 (95)                         | 65 (5)                         | 0.9      |
| Multiparous                      | 1568 | 1494 (95)                         | 74 (5)                         |          |
| Total                            | 2983 |                                  |                                |          |
| Fear of deliveryd                |    |                                   |                                |          |
| No fear                          | 2171 | 2097 (97)                         | 74 (3)                         | −0.001   |
| Any fear                         | 635  | 583 (92)                          | 52 (8)                         |          |
| Total                            | 2806 |                                  |                                |          |
| Post-term pregnancy              |    |                                   |                                |          |
| No                               | 2819 | 2686 (95)                         | 133 (5)                        | 0.6      |
| Yes                              | 171  | 165 (96)                          | 6 (4)                          |          |
| Total                            | 2990 |                                  |                                |          |
| Epidural analgesia               |    |                                   |                                |          |
| No                               | 1819 | 1756 (96)                         | 63 (4)                         | −0.001   |
| Yes                              | 1168 | 1092 (94)                         | 76 (6)                         |          |
| Total                            | 2987 |                                  |                                |          |
| Vacuum extraction                |    |                                   |                                |          |
| No                               | 2694 | 2572 (96)                         | 122 (4)                        | 0.3      |
| Yes                              | 293  | 276 (94)                          | 17 (6)                         |          |
| Total                            | 2987 |                                  |                                |          |
| Macrosomiae                      |    |                                   |                                |          |
| No                               | 1291 | 1236 (96)                         | 55 (4)                         | 0.3      |
| Yes                              | 1440 | 1366 (95)                         | 74 (5)                         |          |
| Total                            | 2731 |                                  |                                |          |

Table 1. (Continued)

| Variables                        | n  | Not depressed at 6 weeks PP* n (%) | Depressed at 6 weeks PP* n (%) | P value* |
|----------------------------------|----|-----------------------------------|--------------------------------|----------|
| Negative delivery experiencef    |    |                                   |                                |          |
| No                               | 2667 | 2560 (96)                         | 107 (4)                        | <0.001   |
| Yes                              | 172  | 151 (88)                          | 21 (12)                        |          |
| Total                            | 2839 |                                  |                                |          |

*Scores on the Depression Self Reporting Scale at 6 weeks postpartum.
BMI Body mass index was extracted from medical records, <18.5 kg/m² underweight, 18.5–24.9 kg/m² normal weight, ≥25 kg/m² overweight.
Sense of coherence score of ≥128.
Self-reported delivery fear at week 32, any fear versus no fear.
Infant birthweight >4000 g.
Self-reported delivery experience (negative versus positive) at 6 weeks postpartum.
P values calculated with Fischer exact test.

Asif et al.
BASIC cohort. Moreover, an instrument based on the DSM-IV criteria for major depression was used instead of a screening instrument. Further, the association between severe perineal lacerations and PPD was investigated for the first time among women with low resilience. Prospective collection of self-reported depressive symptoms and medical record data and a large number of biological, obstetric and psychological covariates was implemented to avoid recall bias and adjust for possible confounders. In addition, we selected confounders and mediators by using a DAG, based on a combination of literature search and associations in our data set. The prospective design and large sample size are additional strengths of this study.

This study entails limitations. The participation rate in the BASIC study is around 20%, probably because of the study’s comprehensive nature, with multiple questionnaires and biological sampling. The low participation rate may compromise the generalisability of the results. In addition, the participants were informed beforehand about the primary focus of this study, that being antenatal mental health, which may have introduced a selection bias. The prevalence of EPDS-based PPD in the study population is nevertheless in accordance with national estimates. The questionnaires in BASIC were in Swedish, so there is an underrepresentation of women not born in Sweden. Hence, results are not generalisable to migrant women.

For practical reasons and considering the high number of participants, symptoms of depression were assessed using self-reports, not psychiatric examinations. However, the DSRS, taking into account the A and C criteria for a major depressive episode according to DSM-IV, has a sensitivity and a specificity for an expert-rated diagnosis of 86% and 75%, respectively. Because of its high sensitivity and specificity, psychiatrists use the DSRS extensively in clinical settings.

Furthermore, despite the generally large study sample size of this population-based study, the number of women with severe lacerations suffering later from depression was low ($n = 5$), compromising the power of the study. It is interesting nevertheless to note that a strong association was detected among women with low resilience, even among a smaller number of participants, and also that results did not confirm any significant association even when considering EPDS-based depression status, for which the study had sufficient power. The BASIC cohort is one of the biggest mother–infant cohorts focusing on perinatal mental health internationally. Given the relatively low occurrence of both exposure and outcome, cohort or case–control studies might be preferable, but would in their turn entail other sources of bias. Future studies in different settings and in even larger samples are needed to replicate these results.

**Figure 2.** DAG on the association between perineal lacerations and PPD. Pink arrows show possibly confounded paths between the exposure and the outcome. The green arrows represent causal paths where there is a flow from the exposure (laceration), possibly via a mediator, to the outcome (PPD).
of the prevalence and incidence of perinatal depression,17 DSM-IV diagnostic criteria. In a recent systematic review and clinically reliable diagnostic tool, as it is based on the DSRS, a self-report scale considered to be a more stringent the older study, which only included 153 participants, ever, these two studies are not readily comparable, because the methods used by Dunn et al.,9 results still pointed to a non-statistical association (OR = 1.1, 95% CI 0.8–1.4). It is nevertheless important to note that in the present study, when we specifically analysed the data among women with low resilience, a strong association between severe lacerations and PPD was observed, suggesting a strong moderating role of resilience in this association.

Dunn et al. suggested that inflammation could be part of the mechanism behind the association between severe obstetric lacerations and PPD.7 Other potential pathways are through pain and practical impact of severe lacerations on daily life, such as poor sexual function and incontinence symptoms. Our results did not change even when including these possible mediators in the adjusted models. Resilience on the other hand is likely to be an important factor in tackling such daily stressors.45,46 Resilience has previously been reported to protect women from peripartum mood disorders in presence of both previous life stressors and stressful events associated with pregnancy and childbirth.46,47

In our cohort, education >12 years was found to be a protective factor for PPD at 6 weeks postpartum, for the total study cohort. This is well in accordance with results from a recently published study on peripartum trajectories, which reported that lower education and lack of social support were associated with depressive symptoms with early onset in pregnancy.23 It has also been shown that high education may be associated with high resilience.32

Many earlier studies have earlier show that adverse life events are strong risk factors for PPD.33,45 Results from this study nevertheless illustrate the importance of resilience in moderating the risk for PPD after an obstetric adverse outcome.

Interpretation
One previous study by Dunn et al. found an association between lacerations of second degree or higher and PPD symptoms, based on the total score on the EPDS.3 However, these two studies are not readily comparable, because the older study, which only included 153 participants, focused only on depressive symptoms assessed with a continuous scale, whereas the present study used results from DSRS, a self-report scale considered to be a more stringent and clinically reliable diagnostic tool, as it is based on the DSM-IV diagnostic criteria. In a recent systematic review of the prevalence and incidence of perinatal depression,17–19 the reported prevalence of PPD was 10–15%, which is higher than the 4.6% figure found in our cohort. Most of these studies are nevertheless based on screening instruments like the EPDS, which has high sensitivity but low specificity. The DSRS, used in the current study, is more closely related to the clinical DSM-based criteria for the diagnosis of major depression; this would explain the lower prevalence. Another difference refers to the categorisation within the laceration groups, which in the older study included second-, third- and fourth-degree lacerations whereas the present one included only the severe ones, of third- ad fourth-degree as exposure, making the studies even harder to compare. Nevertheless, when we specifically analysed for the development of depressive symptoms based on an EPDS cut-off of 12 points after a laceration of second-, third- or fourth-degree, more in accordance with the methods used by Dunn et al.,9 results still pointed to a non-statistical association (OR = 1.1, 95% CI 0.8–1.4). It is nevertheless important to note that in the present study, when we specifically analysed the data among women with low resilience, a strong association between severe lacerations and PPD was observed, suggesting a strong moderating role of resilience in this association.

**Table 2. Logistic regression derived odds ratios and 95% CI for the association between perineal lacerations and PPD symptoms assessed using the DSRS at 6 weeks postpartum, in all women and in women with low resilience, as assessed using the Sense of Coherence scale (SOC).**

| Crude | Adjusted |
|-------|----------|
| **All women** (n = 2990) | OR (95% CI) | OR (95% CI) |
| Severe perineal lacerations* | 1.4 (0.6–3.5) | 1.4 (0.5–3.6) |
| BMI (kg/m²) | | |
| <18.5 (versus 18.5–24.9) | 0.6 (0.4–1.0) | 0.6 (0.3–2.3) |
| ≥25 (versus 18.5–24.9) | 0.8 (0.3–2.3) | 0.6 (0.4–0.8) |
| Education >12 years (versus lower education) | 0.6 (0.4–0.8) | 0.6 (0.4–0.8) |
| Nulliparous (versus multiparous) | 1.1 (0.7–1.5) | 1.1 (0.7–1.5) |
| Vacuum extraction | 1.3 (0.7–2.3) | 1.3 (0.7–2.3) |
| **Women with low resilience** (n = 310) | OR (95% CI) | OR (95% CI) |
| Severe perineal lacerations | 4.8 (1.2–20) | 5.5 (1.2–26) |
| BMI (kg/m²) | | |
| <18.5 (versus 18.5–24.9) | 0.8 (0.4–1.4) | 0.8 (0.4–1.4) |
| ≥25 (versus 18.5–24.9) | 1.5 (0.3–8.0) | 1.5 (0.3–8.0) |
| Education >12 years (versus lower education) | 0.5 (0.3–1.0) | 0.5 (0.3–1.0) |
| Nulliparous (versus multiparous) | 1.1 (0.6–2.0) | 1.1 (0.6–2.0) |
| Vacuum extraction | 0.8 (0.2–2.5) | 0.8 (0.2–2.5) |

*Defined as third- and fourth-degree perineal lacerations or obstetric lacerations involving the anal sphincter. In total, 79 women with severe perineal lacerations.

**Sub-analysis among women with Sense of Coherence Scale score <128. In total, eight women with low resilience and severe perineal lacerations.**

**Table 2. Logistic regression derived odds ratios and 95% CI for the association between perineal lacerations and PPD symptoms assessed using the DSRS at 6 weeks postpartum, in all women and in women with low resilience, as assessed using the Sense of Coherence scale (SOC).**

**Conclusion**
In this large, population-based study, although the risk of PPD was not associated with perineal lacerations in the whole sample, it was much higher among women reporting low resilience during pregnancy.

Perineal lacerations and PPD are well-known complications of pregnancy and labour. Moreover, the postpartum period is associated with increased risk of comorbidities between PPD, post-traumatic stress disorder and anxiety. Our findings may enable early identification of women at risk of PPD, which could facilitate direct and individualised postnatal support to prevent the occurrence of this condition.
Psychological interventions have been shown to be effective in preventing PPD but are cost-effective only among high-risk groups.\textsuperscript{48} Interventions such as interpersonal therapy, cognitive behavioural therapy, non-directive counselling, and peer and partner support aim to build social support and lead to behavioural changes that enhance coping and reduce distress.\textsuperscript{49,50} Ideally, prophylactic measures in terms of prospective support for all pregnant and newly delivered mothers should be offered, and would most likely result in reducing disease severity and burden for women and families. However, large-scale population-based interventions often confer a substantial load on the healthcare system. Facing the need of prioritising, to attain cost-effectiveness, it seems plausible to focus primarily on high-risk groups; interventions such as antenatal counselling and professional home visits\textsuperscript{47,48} may help in the prevention of PPD among women with low resilience in general, and especially if they suffer a severe laceration.

Disclosure of interests
The authors report no conflict of interest. Completed disclosure of interests forms are available to view online as supporting information.

Authors contribution
SA, EF and AS participated in the literature search, study design, analysis and drafting of the manuscript. SI contributed to manuscript writing and analysis. AML, CA and PE contributed to manuscript writing and proofreading.

Details of ethical approval
The study has been approved in 2009 by the Regional Ethical Review Board in Uppsala, Sweden (Dnr. 2009/171).

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References
1. Andrews V, Thakar R, Sultan AH. Management of third and fourth degree tears. Rev Gynaecol Pract 2003;3:188–95.
2. Blomberg M. Maternal body mass index and risk of obstetric anal sphincter injury. Biodem Res Int 2014;2014:1–8.
3. Gylshagen M, Bullarbo M, Nielsen TF, Milson I. Prevalence and risk factors for pelvic organ prolapse 20 years after childbirth: a national cohort study in singleton primiparae after vaginal or caesarean delivery. BJOG. 2013;120:152–60.
4. Blondel B, Alexander S, Bjarnadóttir RI, Giessler M, Roos JL, Antolíc ŽN, et al. Variations in rates of severe perineal tears and episiotomies in 20 European countries: a study based on routine national data in Euro-PenStat Project. Acta Obstet Gynecol Scand 2016;95:746–54.
5. Leader-Cramer A, Kenton K, Davé B, Gossett DR, Mueller M, Lewicky-Gaupp F. Factors associated with timing of return to intercourse after obstetric anal sphincter injuries. J Sex Med 2016;13:1523–9.
6. Laine K, Rotvold W, Staff AC. Are obstetric anal sphincter ruptures preventable? Large and consistent rupture rate variations between the Nordic countries and between delivery units in Norway. Acta Obstet Gynecol Scand 2013;92:94–100.
7. Hudelst G, Gelle’n J, Singer C, Ruecklinger E, Czerwenka K, Kandolf O, et al. Factors predicting severe perineal trauma during childbirth: role of forceps delivery routinely combined with mediolateral episiotomy. Am J Obstet Gynecol 2005, 192:875–81.
8. Stanksen HT, Garthrus-Niegel S, Vangen S, Eberhard-Gran M. The impact of previous birth experiences on maternal fear of childbirth. Acta Obstet Gynecol Scand 2013;92:318–24.
9. Dunn AB, Paul S, Ware LZ, Convin EI. Perineal injury during childbirth increases risk of postpartum depressive symptoms and inflammatory markers. J Midwifery Womens Health 2015;60:428–36.
10. Skinner EM, Dietz HP. Psychological and somatic sequelae of traumatic vaginal delivery: a literature review. Aust N Z J Obstet Gynaecol 2015;55:309–14.
11. Priddis H, Schmied V, Dahlen H. Women’s experiences following severe perineal trauma: a qualitative study. BMC Womens Health 2014;14:32.
12. Chang S-R, Chen K-H, Lee C-N, Shyu M-K, Lin M-I, Lin W-A. Relationships between perineal pain and postpartum depressive symptoms: a prospective cohort study. Int J Nurs Stud 2016;1:68–78.
13. Williams A, Lavender T, Richmond DH, Tincello DG. Women’s experiences after a third-degree obstetric anal sphincter tear: a qualitative study. Birth 2005;32:129–36.
14. Stewart DE, Vigod S. Postpartum depression. N Engl J Med 2016;375:2177–86.
15. Evans GG, Theofrastous JP, Galvin SL. Postpartum depression: a comparison of screening and routine clinical evaluation. Am J Obstet Gynecol 2000;182:1080–2.
16. O’Hara MW, McCabe JE. Postpartum depression: current status and future directions. Ann Rev Clin Psychol 2013;9:379–407.
17. Gaynes BN, Gavin N, Meltzer-Brody S, Lohr KN, Swinson T, Gartlehner G, et al. Perinatal Depression: Prevalence, Screening Accuracy, and Screening Outcomes: Summary. In: AHRQ Evidence Report Summaries. Agency for Healthcare Research and Quality (US); 2005.
18. Shorey S, Chee CYI, Ng ED, Chan YH, Tam WWS, Chong YS. Prevalence and incidence of postpartum depression among healthy mothers: a systematic review and meta-analysis. J Psychiatr Res 2018;123:45–48.
19. Anokye R, Acheampong E, Budu-Ainooson A, Obeng EI, Akwasi AG. Prevalence of postpartum depression and interventions utilized for its management. Ann Gen Psychiatry 2018;17:18.
20 Anderson FM, Hatch SL, Comacchio C, Howard LM. Prevalence and risk of mental disorders in the perinatal period among migrant women: a systematic review and meta-analysis. Arch Womens Ment Health 2017;20:449–62.

21 Heller HM, Ravelli ACJ, Bruning AHL, de Groot CJM, Scheele F, van Pampus MG, et al. Increased postpartum haemorrhage, the possible relation to serotonergic and other psychopharmacological drugs: a matched cohort study. BMC Pregnancy Childbirth 2017;17:166.

22 Eckerdal P, Georgakis MK, Kollia N, Wikström A-K, Högborg U, Skalkidou A. Delineating the association between mode of delivery and postpartum depression symptoms: a longitudinal study. Acta Obstet Gynecol Scand 2018;97:301–11.

23 Wikman A, Axfors C, Iliadis SI, Cox J, Fransson E, Skalkidou A. Characteristics of women with different perinatal depression trajectories. J Neurosci Res 2019;6:1.

24 Simic M, Cnattingius S, Petersson G, Sandström A, Stephansson O. Duration of second stage of labor and instrumental delivery as risk factors for severe perinatal lacerations: population-based study. BMC Pregnancy Childbirth 2017;17:72.

25 Steing J, Nagl M, Linde K, Zietlow G, Kersting A. Antenatal and postnatal depression in women with obesity: a systematic review. Arch Womens Ment Health 2017;20:569–85.

26 Hain S, Oddo-Sommerfeld S, Bahlmann F, Louwen F, Schermelleh-Engel K. Risk and protective factors for antenatal and postpartum depression: a prospective study. J Psychosom Obstet Gynaecol 2016;37:119–29.

27 Jøsefsson A. Obstetric, somatic, and domestic risk factors for postpartum depression. Obstet Gynecol 2002;99:223–8.

28 Darius Tandon S, Les IA, Ward EA, Snyder H, Mendelson T, Perry DF, et al. Adaptation of an evidence-based postpartum depression intervention: feasibility and acceptability of mothers and babies 1-on-1. BMC Pregnancy Childbirth 2018;18:93.

29 Southwick SM, Bonanno GA, Masten AS, Panter-Brick C, Yehuda R. Resilience definitions, theory, and challenges: interdisciplinary perspectives. Eur J Psychotraumatol 2014;5:25338.

30 Laird KT, Krause B, Funes C, Lavretsky H. Psychobiological factors of resilience and depression in late life. Transl Psychiatry 2019;9:1–18.

31 Kermott CA, Johnson RE, Sood R, Jenkins SM, Sood A. Is higher resilience predictive of lower stress and better mental health among corporate executives? PLoS ONE. 2019;14:e0218092.

32 Guest Y. Reflections on resilience: a psycho-social exploration of the life long impact of having been in care during childhood. J Soc Work Pract 2012;26:109–24.

33 García-León MA, Caparrós-González RA, Romero-González B, González-Pérez R, Peralta-Ramírez I. Resilience as a protective factor in pregnancy and puerperium: its relationship with the psychological state, and with hair cortisol concentrations. Midwifery 2019;1:138–45.

34 Axfors C, Bränn E, Henriksson HE, Helligren C, Kunovac Kallak T, Fransson E, et al. Cohort profile: the Biology, Affect, Stress, Imaging and Cognition (BASIC) study on perinatal depression in a population-based Swedish cohort. BMJ Open 2019;9:e031514.

35 Svansson P, Ekelius L. Self-assessment of DSM-IV criteria for major depression in psychiatric out- and inpatients. Nord J Psychiatry 2003;57:291–6.

36 Sonnby K, Aslund C, Leppert J, Nilsson KW. Symptoms of ADHD and depression in a large adolescent population: co-occurring symptoms and associations to experiences of sexual abuse. Nord J Psychiatry 2011;65:315–22.

37 Ivansson T, Lidberg A, Gillberg C. The Birleson Depression Self-Rating Scale (DSRS). Clinical evaluation in an adolescent inpatient population. J Affect Disord 1994, 32:115–25.

38 Boyd RC, Le HN, Somberg R. Review of screening instruments for postpartum depression. Arch Womens Ment Health 2005;8:141–53.

39 Wickberg B, Hwang CP. Screening for postnatal depression in a population-based Swedish sample. Acta Psychiatr Scand 1997;95:62–6.

40 Vivilaki VG, Dafermos V, Kogeivinas M, Bitsios P, Lions C. The Edinburgh postnatal depression scale: translation and validation for a Greek sample. BMC Public Health 2009;9:329.

41 Eriksson M, Lindström B. Validity of Antonovsky’s sense of coherence scale: a systematic review. J Epidemiol Commun Health 2005;59:460–6.

42 Olsson M, Socialhögskolan LU. Unga vuxna med en historia av uppförandeboende. 2006. 1 p.

43 Machado-Rivera R, Mezones-Holguín E. Are directed acyclic graphs (DAGs) an important tool to perform observational studies? reflections from a case in burned patients. Ann Burns Fire Disasters 2018, 31:73–4.

44 Tejtor J, Liskiewicz M. Adjustment Criteria in Causal Diagrams: An Algorithmic Perspective. Conference: UAI 2011, Proceedings of the Twenty-Seventh Conference on Uncertainty in Artificial Intelligence, Barcelona, Spain, July 14-17, 2011.

45 Savage-McGlynn E, Redshaw M, Heron J, Stein A, Quigley MA, Evans J, et al. Mechanisms of resilience in children of mothers who self-report with depressive symptoms in the first postnatal year. PLoS ONE. 2015;10:e0142898.

46 Meltzer-Brody S, Larsen JT, Petersen I, Guintersano J, Florio AD, Miller WC, et al. Adverse life events increase risk for postpartum psychiatric episodes: a population-based epidemiologic study. Depress Anxiety 2018;35:160–7.

47 Kishore MT, Satyanarayana V, Ananthanpillai ST, Desai G, Bhaskarapillai B, Thippeswamy H, et al. Life events and depressive symptoms among pregnant women in India: moderating role of resilience and social support. Int J Soc Psychiatry 2018;64:570–7.

48 O’Connor E, Senger CA, Henninger ML, Coppola E, Gaynes BN. Interventions to prevent perinatal depression: evidence report and systematic review for the US Preventive Services Task Force. JAMA 2019;321:588–601.

49 Moshki M, Beydokhti TB, Cheravi K. The effect of educational intervention on prevention of postpartum depression: an application of health locus of control. J Clin Nurs 2014;23:2256–63.

50 Felder JN. Implementing the USPSTF recommendations on prevention of perinatal depression—opportunities and challenges. JAMA 2019, 179:467–8.