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Emergency cesarean section is a risk factor for depressive symptoms when breastfeeding is limited

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ABSTRACT

Objective: Previous studies indicated associations between cesarean section (CS), breastfeeding, and depressive symptoms. There is, however, little research integrating these variables into one model to analyze their interrelations. The aim of this observational prospective longitudinal study is to examine whether the effect of CS on postpartum depressive symptoms is mediated by difficulties with breastfeeding.
Methods: The participants were recruited in 5 maternity hospitals during their prenatal medical check-ups. Breastfeeding status was self-reported by the mothers six weeks postpartum. Screening for depressive symptoms was performed at six weeks ($N = 404$) and nine months ($N = 234$) postpartum using the Edinburgh Postnatal Depression Scale. Path analysis was used to model the relations between CS, breastfeeding, and depressive symptoms.
Results: No direct effects of CS on depressive symptoms at six weeks or nine months postpartum were found. CS was associated with a lower probability of exclusive breastfeeding, which was, in turn, associated with higher levels of depressive symptoms six weeks postpartum. The analysis stratified by type of CS revealed that the effect on breastfeeding only occurred with emergency, not planned, CS. The effect of CS on breastfeeding was noticeably stronger in women without versus with a history of depression.
Conclusion: Emergency CS predicts breastfeeding difficulties, which are, in turn, associated with higher levels of depressive symptoms. Support should be provided to mothers with emergency CS and breastfeeding problems to reduce the risk of postpartum depressive symptoms in the early postpartum period.

1. Introduction

Postpartum depression (PPD) is one of the most common complications of childbearing. The estimated prevalence ranges from 13 to 40% [13,14,19], with higher rates documented in low-income populations [11]. Given the severe impact of PPD not only on the health of mothers but also on the health and development of their children and their family functioning [15,17,24], the high prevalence of PPD is a major public health concern.

PPD has been linked with hormonal changes occurring in the perinatal period that are associated with the development of psychiatric disorders, especially in women with pre-existing vulnerabilities [5]. Indeed, previous research consistently shows that one of the strongest predictors of PPD is a history of depression (both pre-pregnancy and pregnancy) [1], but a number of psychosocial risk factors have been identified as well, including low social support [25], life stress events [22], unsatisfactory relationship with the partner [8], low socioeconomic status [16] or parenting stress and infant temperament [3,26].

PPD has also been associated with birth mode and early postnatal factors such as breastfeeding. However, the evidence for the effects of

cesarean section (CS) has been mixed. In their meta-analysis, Carter et al. [6] found no link between CS and PPD, but a more recent meta-analysis concluded that the risk of PPD is higher in women with emergency but not planned CS [29]. The association between maternal depression and breastfeeding is well established, however, the direction of causality has been interpreted in both ways in previous studies [20]. Some authors pointed out that successful breastfeeding may protect against PPD [10] and that breastfeeding difficulties can contribute to the incidence or severity of the PPD [27], whereas others reported that PPD might lead to breastfeeding difficulties or cessation [12]. In fact, there could be a cascade of effects where depression leads to breastfeeding difficulties, which, in turn, increase the levels of depression [10].

As previous studies also linked CS with breastfeeding difficulties [21], it may be presumed that the effect of CS on PPD might be mediated by breastfeeding. However, no study has tested this hypothesis so far. The aim of this study was to investigate longitudinal relations among CS, breastfeeding and PPD. We hypothesized that CS would be associated with higher levels of depressive symptoms, and that women who give birth via CS would be less likely to breastfeed exclusively, which would, in turn, lead to higher levels of depressive symptoms. As previous research reported differential results for planned and emergency CS in terms of their effects on breastfeeding [21] and PPD [29], we expected that the mediation model would be different for these two types of CS. Moreover, as the risk of PPD is presumed to be higher in psychologically vulnerable women, we expected the effects of both CS and breastfeeding on depressive symptoms to be stronger in women with a history of depression or above cut-off levels of depressive symptoms in pregnancy.

2. Materials and methods

2.1. Participants

A total of 1190 women agreed to participate in the study, out of whom 1146 had data regarding health status in pregnancy and birth outcomes from the medical records available. In order to avoid confounding by health complications in the mother or the child, we set the following exclusion criteria: serious maternal health complications in pregnancy (hypertension, diabetes, thyroid pathology etc.) ($n = 297$), childbirth complications (blood loss of 1000 ml or more, postpartum laparotomy, perineal rupture degrees 3 or 4, or operation during the 3rd or 4th stage of labor) ($n = 174$), newborn 5-min Apgar score below 8 ($n = 11$), birth weight 2500 g or below ($n = 39$), preterm birth below 37th gestational week ($n = 40$), newborn hospitalization longer than ten days ($n = 20$). We also excluded women based on the following criteria: maternal age below 18 and above 45 ($n = 33$), multiple pregnancy (n = 17), instrumental vaginal birth ($n = 42$). After applying exclusion criteria, data from 625 women were available, and 422 of them also provided information about their breastfeeding status at six weeks postpartum. Out of those women, 404 participated in depression screening at six weeks and 234 at nine months after childbirth (see Flow-chart of participants, Fig. 1). A comparison of women who remained in the study with those who dropped out at nine months postpartum is shown in Table S1 (Supplementary material I).

2.2. Procedure

This study is a part of a longitudinal project investigating the effects of perinatal factors on maternal well-being and child behavior and development. The sample has been based on a birth cohort recruited
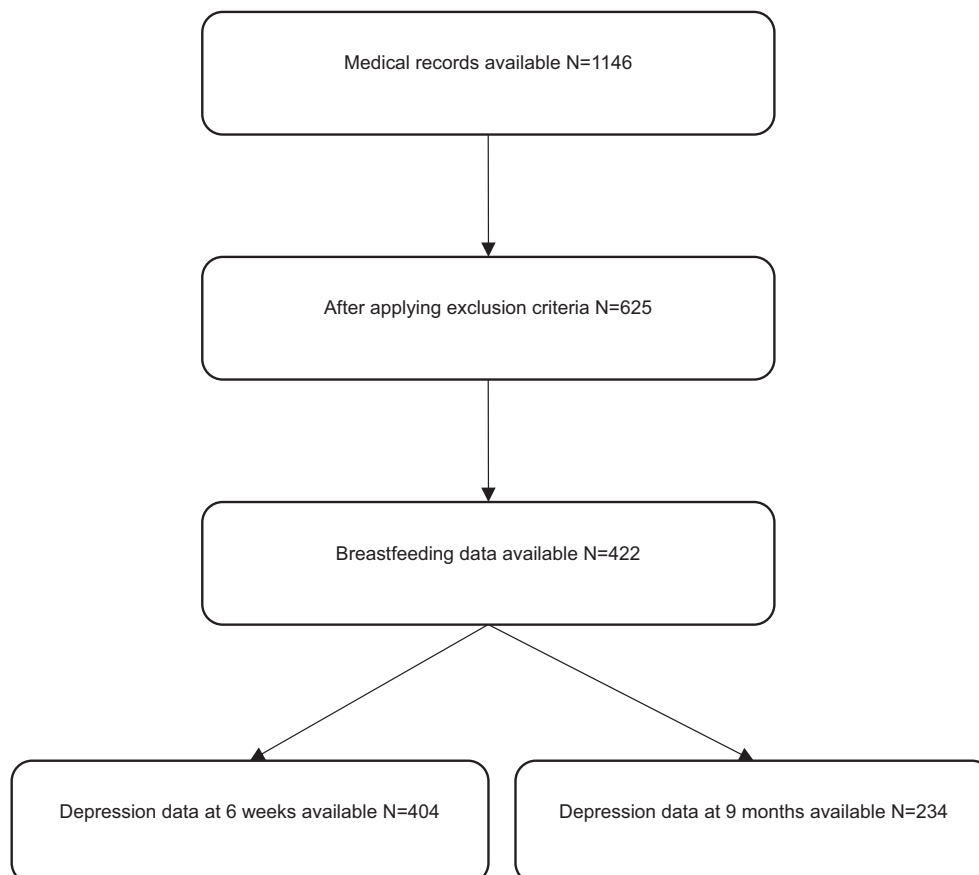

Fig. 1. Flow-chart of participants.

between 2013 and 2014 in five maternity hospitals (Havlíčkův Brod, Jihlava, Třebíč, Pelhřimov, Nové Město na Moravě) in the Vysočina Region, Czech Republic. Pregnant women were approached by the midwives and invited to participate in the study. The data used in this study were collected via online or mail-distributed questionnaires administered at three time points: third trimester of pregnancy (T1), six weeks (T2), and nine months postpartum (T3). At T1, women completed a questionnaire regarding their sociodemographic background and health and the Edinburgh Postnatal Depression Scale (EPDS). At T2, they completed the EPDS again along with a questionnaire about their postpartum experiences, including breastfeeding. At T3, they once again completed the EPDS. This research project was approved by the Ethics Committee of the Jihlava Hospital, which is responsible for the Vysočina Region where the study took place. All women provided written informed consent before entering the study.

2.3. Mode of birth

Data regarding the birth mode were extracted from the medical records in cooperation with the maternity hospitals. Cesarean section (CS) was differentiated into planned (scheduled in advance, performed before the contractions started) and emergency CS performed after trial of labor.

2.4. Breastfeeding

At six weeks after childbirth, mothers reported about their infant's breastfeeding status on a 3-point scale: fully breastfed, partially breastfed, not breastfed.

2.5. Maternal depressive symptoms

Maternal depressive symptoms were measured in the third trimester of pregnancy and then again at six weeks and nine months postpartum using the Edinburgh Postnatal Depression Scale (EPDS) [7]. The EPDS is a 10-item self-report measure for postpartum depression that has also been used with a population of pregnant women [2]. The items are rated on a 4-point scale from 0 to 3. The total score may range from 0 to 30, with higher scores indicating higher levels of depressive symptoms.

2.6. Statistical analysis

As a preliminary analysis, we examined the association between cesarean section (CS) and depressive symptoms at six weeks and nine months postpartum using simple linear regression models. Subsequently, we used structural equation models with observed variables (path analysis) to model the relations between CS, breastfeeding, and depressive symptoms. The path models were fit using the lavaan package [23] in R, and they modeled depressive symptoms at six weeks or nine months postpartum as predicted by birth mode as well as breastfeeding status at six weeks. In addition, the model included the regression path of breastfeeding on birth mode.

In all analyses, the depressive symptom levels were included as a continuous variable. Breastfeeding was treated as a binary variable, contrasting exclusive breastfeeding against partial or none. In the initial path models, each variable was regressed on four covariates: maternal age, parity, educational level, and marital status. After fitting the initial model, the covariates for which the p-values were above 0.1 were excluded from the model. This procedure was repeated if, after refitting the models, the remaining covariates had p-values above 0.1. All analyses were performed first on the whole sample of women for whom data for the corresponding time point were available. In order to assess the effects of cesarean section and breastfeeding on new onset of depressive symptoms in the postpartum period, we performed a sensitivity analysis excluding women with a history of depression and refit the models. History of depression was defined as either having the EPDS score in

pregnancy above 12 or responding "yes" to the question "Have you been treated for depression in the past" in the background questionnaire administered during pregnancy. In the supplementary materials, we also report the analyses stratified by type of CS performed (planned and emergency CS), separately for all women and for those without a history of depression. We also examined whether the results remain the same for the medically more diverse sample and repeated the analyses using the whole original sample before introducing the exclusion criteria based on health status, excluding only women with multiple pregnancy and those with vaginal operative delivery.

3. Results

3.1. Sample characteristics

Healthy women with no perinatal complications who gave birth to healthy children were included in the analysis. Data from 404 and 234 women were available at six weeks and nine months postpartum, respectively. The characteristics of the participants are shown in Table 1. Approximately 12% of women gave birth via planned and 13% via emergency cesarean section (CS). The indications for CS are shown in Table 2. The mean score on the EPDS was 6.15 at six weeks and 4.82 at nine months postpartum. At six weeks after birth, 84% of mothers fully breastfed their infant. The mean maternal age at child's birth was 30.5 (SD = 4.3) years. Almost 45% of mothers were primiparous, and 73% of them were married.

3.2. Preliminary analyses

Regression analyses showed no significant effect of CS on depressive symptoms (EPDS scores) either at six weeks (t(402) = 1.34, p = 0.18) or at nine months after birth (t(233) = 0,18, p = 0.86).

Table 1
Characteristics of the sample.

	6-week sample (N = 404)	9-month sample (N = 234)
Age at childbirth, years	30.5 (4.3)	30.7 (4.0)
Parity, n (%)		
Primipara	180 (44.6)	110 (47.0)
Multipara	224 (55.4)	124 (53.0)
Maternal education, n (%)		
Elementary or vocational	39 (9.7)	22 (9.4)
High-school degree	214 (52.9)	111 (47.4)
Post-secondary	147 (36.4)	101 (43.2)
Missing	4 (1)	0
Marital status, n (%)		
Single	92 (22.8)	62 (26.5)
Married	294 (72.8)	165 (70.5)
Divorced	16 (3.9)	7 (3.0)
Widowed	2 (0.5)	0
Child sex, n (%)		
Female	205 (50.7)	114 (48.7)
Male	199 (49.3)	120 (51.3)
Birth weight (grams)	3466 (443)	3497 (466)
Apgar score at 5 min.	9.68 (0.5)	9.66 (0.5)
Length of postpartum hospital stay of the newborn (days)	4.69 (1.2)	4.63 (1.1)
Epidural, n (%)		
Yes	22 (5.4)	13 (5.6)
No	382 (94.6)	221 (94.4)
Birth mode, n (%)		
Vaginal	305 (75.5)	175 (74.8)
Planned CS	47 (11.6)	21 (9.0)
Emergency CS	52 (12.9)	38 (16.2)
EPDS	6.15 (4.6)	4.82 (3.9)
Breastfeeding at 6 weeks, n (%)		
Exclusive	340 (84.2)	208 (88.9)
Partial or none	64 (15.8)	26 (11.1)

Table 2

Indications for cesarean section.

	6-week sample ($N = 99$)	9-month sample ($N = 59$)
Fetal hypoxia, n (%)	36 (36)	27 (46)
Previous CS, n (%)	27 (27)	11 (19)
Fetal macrosomia, n (%)	15 (15)	9 (15)
Labour dysfunctions, n (%)	18 (18)	13 (22)
Breech presentation, n (%)	19 (19)	12 (20)
Failure to progress, n (%)	5 (5)	5 (9)

Note: the indications are not mutually exclusive.

3.3. Path analyses

We examined whether CS is related to EPDS scores indirectly via breastfeeding, even though such a relation was undetectable when examining direct effects. Fig. 2 shows the associations between CS, breastfeeding at six weeks, and EPDS scores at six weeks after childbirth. There was no significant direct effect of CS on EPDS scores at six weeks. CS was significantly associated with a decrease in the likelihood of full breastfeeding at six weeks, which was, in turn, significantly associated with higher EPDS scores at six weeks. The likelihood of full breast-feeding was higher, and the depressive symptoms scores were lower in multiparous women. The depressive symptom scores were decreasing with increasing maternal age and were lower in married women.

Fig. 3 shows associations between CS, breastfeeding at six weeks, and EPDS scores at nine months postpartum. We found no significant asso-ciation between CS and EPDS scores. Although the variables CS and breastfeeding are identical with those in the previous model shown in Fig. 2, the sample size is smaller (as it is limited by the number of women who completed the EPDS at nine months postpartum), which resulted in changes in indices for the relations between CS and breastfeeding. CS predicted a significantly lower probability of full breastfeeding at six weeks, while the association between breastfeeding at six weeks and EPDS scores at nine months was only marginally significant. None of the potential covariates was found to affect significantly any of the main variables.

We conducted a sensitivity analysis by excluding women with a history of depression to eliminate potential confounding by maternal psychological vulnerability. The results were similar to those calculated for the whole sample, however, the association between CS and breastfeeding at six weeks was noticeably stronger in the subsample of

women without a history of depression (standardized regression path 0.22 vs. 0.14 in the model including EPDS scores at six weeks; Fig. 2).

As a next step, we stratified the analyses by type of CS (planned and emergency CS), while performing sensitivity analyses excluding women with a history of depression (see Supplementary material I, Figs. S1 – S4). There were no direct effects of planned or emergency CS on EPDS scores at six weeks or nine months postpartum in any of the models. Emergency but not planned CS was associated with a lower likelihood of full breastfeeding at six weeks postpartum, an effect that appears to be stronger in the subsample of women without a history of depression. For both emergency and planned CS models, full breastfeeding at six weeks postpartum predicted significantly lower scores on EPDS measured concurrently at six weeks postpartum; this was true for both the whole sample and the subsample of women without a history of depression. There was no significant association between breastfeeding at six weeks and EPDS scores at nine months in any of the models.

In addition, we repeated the analyses using the original, medically more diverse sample, i.e., without excluding mother-child pairs based on compromised health status. The results were similar except for the significant association between CS and depressive symptoms measured at six weeks postpartum that was, however, only observed in the sample where mothers with prior depression were included, not in the sub-sample of mothers without prior depression. In addition, we found similar effects of planned and emergency CS on breastfeeding in this higher risk sample, suggesting that the effect of CS on breastfeeding was not specific for emergency CS as in the healthy sample. For the results based on the original sample, see Supplementary material II, Figs. S1–S6.

4. Discussion and conclusions

In this study, we tested the hypothesis that the effect of cesarean section (CS) on maternal postpartum depressive symptoms is mediated by breastfeeding, assessing breastfeeding status at six weeks and depressive symptoms at six weeks and nine months after the child's birth. We found no direct effects of CS on depressive symptoms at either six weeks or nine months in our healthy sample. Nevertheless, our data suggest an indirect path from CS to depressive symptoms at six weeks through breastfeeding. CS was associated with a lower probability of exclusive breastfeeding at six weeks, which was, in turn, associated with higher levels of depressive symptoms at the same time point.
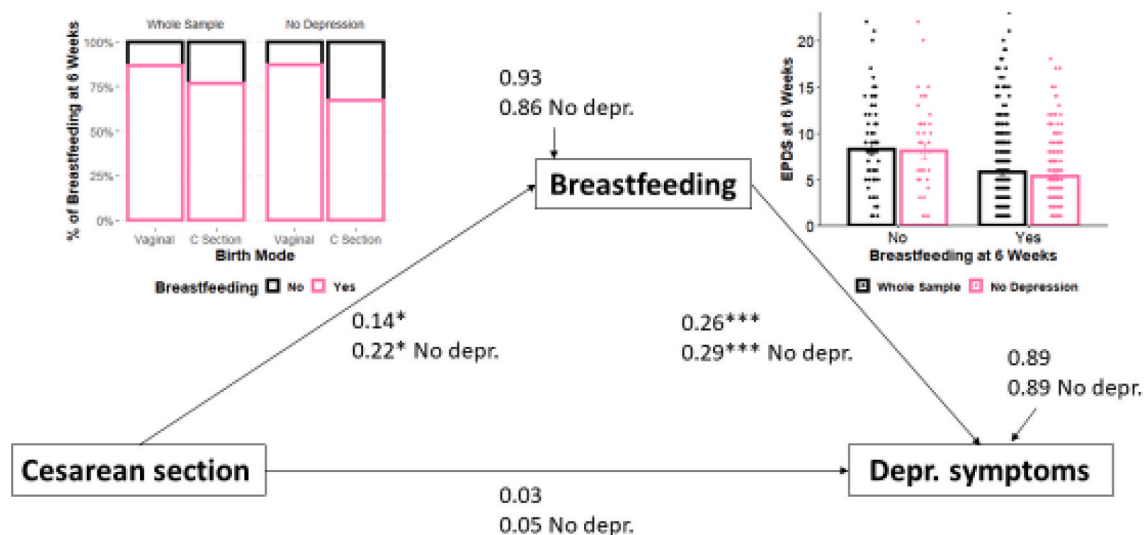

Fig. 2. Associations between CS, breastfeeding at six weeks and EPDS scores at six weeks postpartum; the whole sample and a subsample of women without a history of depression.

Covariates: for the model including mothers with a history of depression: age, parity and marital status on EPDS; parity on breastfeeding; for the model including mothers without a depression history only: maternal age on EPDS; parity on breastfeeding.
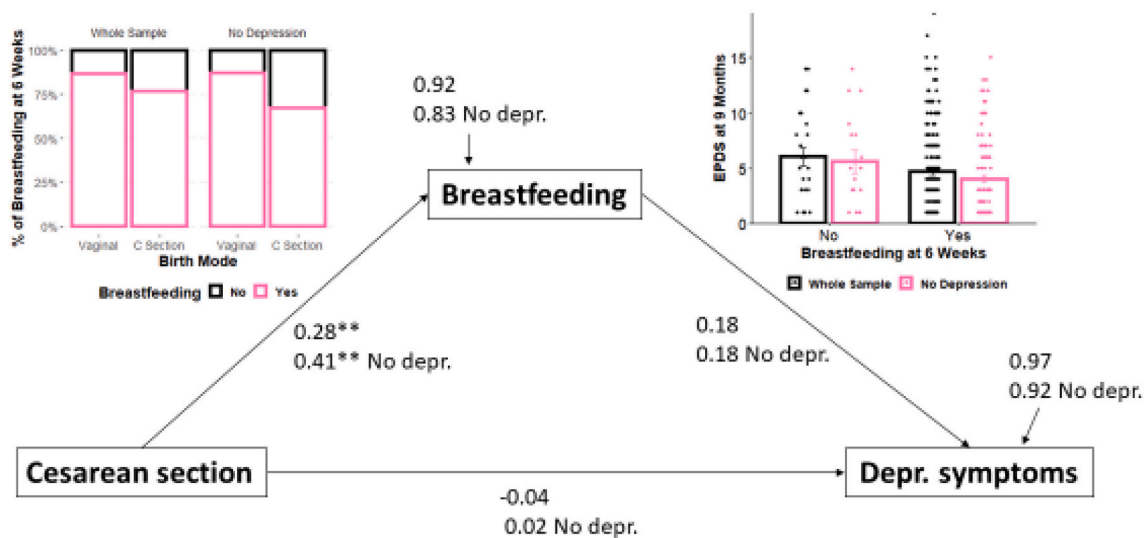
Fig. 3. Associations between CS, breastfeeding at six weeks and EPDS scores at nine months postpartum; the whole sample and a subsample of women without a history of depression.
Covariates: for the model including mothers with a history of depression: none; for the model including mothers without a depression history only: maternal age on EPDS.

Interestingly, after removing women with a history of depression from the sample, the effect of CS on breastfeeding became stronger. Moreover, the analysis stratified by the type of CS revealed that the effect on breastfeeding only applies to emergency but not to planned CS.

To the best of our knowledge, only one study except for the present one integrated CS, breastfeeding, and PPD into one model to examine their interrelations [18]. The authors observed that both CS and early discontinuation of breastfeeding increased the risk of PPD; they also reported that the risk of PPD was disproportionally higher in mothers with both CS and early cessation of breastfeeding. In contrast to Nam et al. [18], we did not observe a direct effect of CS on depressive symptoms in our healthy sample. Nevertheless, depressive symptom scores were generally low in our sample (the mean score on the EPDS was 6.15 at six weeks and 4.82 at nine months postpartum), whereas Nam et al. [18] defined depression as a newly diagnosed affective disorder.

Similarly to Nam et al. [18], we found an association between breastfeeding and depressive symptoms, although the group of non-breastfeeding women was quite different in our sample from that of Nam et al. [18]. While we assessed breastfeeding status relying on a maternal report, Nam et al. [18] used a prescription for lactation suppression drugs as an indicator of breastfeeding cessation, leaving out the women who wished but could not continue breastfeeding. In our study, the association between breastfeeding and concurrently measured depressive symptoms at six weeks postpartum was similar after excluding women with a history of depression and women with emergency or planned CS from the analysis, suggesting that there is a relatively robust association between breastfeeding and depressive symptoms several weeks postpartum. However, we detected only a marginally significant association between breastfeeding at six weeks and depressive symptoms at nine months, which indicates that the effect of breastfeeding on depressive symptoms does not persist beyond the early postpartum period.

Previous research suggests that planned but not emergency CS increases the risk of less favorable breastfeeding outcomes [21,28], whereas we observed that the effect on breastfeeding only remained significant for emergency CS after stratifying the analysis by the type of CS. In contrast to our expectations, the effect of CS on breastfeeding was stronger in the subsample of women without a history of depression. However, it is possible that prior depression exerts such a strong effect on breastfeeding that it obscures the effect of CS, and accordingly, the

effect of CS on breastfeeding becomes particularly apparent in psychologically healthy women. While studies on the effects of breastfeeding on maternal postnatal mood often account for maternal mood in pregnancy or/and in the pre-pregnancy period [9], this is not true for studies assessing the effects of CS on breastfeeding [4,28]. In this regard, our observation may shed light on the conflicting results of the studies examining the link between CS and breastfeeding, as differential effects on breastfeeding may be found in mothers who had been depressed in the past compared to those who had not.

Our study has several strengths, including a repeated screening for depressive symptoms and breastfeeding status assessment based on maternal report, which enabled us to identify women with elevated levels of depressive symptoms and breastfeeding problems with high sensitivity. It should be noted, however, that maternal depressive symptom levels were generally low in our sample, while the breastfeeding rate was high, with 84% of women breastfeeding their infant exclusively at six weeks postpartum. This is in accordance with the breastfeeding rate in the Czech Republic as reported by the Institute of Health Information and Statistics of the Czech Republic (uzis.cz). Both a low mean depressive symptom level and a high breastfeeding rate in our sample may limit the generalizability of our findings that may not be valid for clinical populations.

Another strength of our study is that we stratified the analysis by type of CS and performed sensitivity analyses excluding women with a history of depression to avoid confounding by maternal psychological vulnerability. This way, we were able to report the effects of CS and breastfeeding on newly developed depressive symptoms in the postpartum period, i.e., on symptoms that did not manifest as a continuation of prior depression.

The strengths of this study also include the use of a sample of healthy mothers and children, which enabled us to avoid confounding by compromised health status. On the other hand, such an approach could further limit the generalizability of our findings. Therefore, we repeated the analyses using the original sample before introducing the whole set of exclusion criteria based on health status, excluding only women with multiple pregnancy and operative vaginal delivery. The results were similar to those obtained for the healthy sample, except for a significant association between CS and depressive symptoms at six weeks postpartum; in addition, the effect of CS on breastfeeding was no longer specific for emergency CS but was similar for emergency and planned CS. However, given that serious health problems (in the mother and the

child) may be associated with both CS and breastfeeding problems, and, directly or indirectly, with maternal depressive symptoms, these results might be driven by health-related confounding variables and should be therefore considered less plausible and valid than the results based on the healthy sample.

In conclusion, we found that emergency CS is associated with lower rates of exclusive breastfeeding at six weeks postpartum, which in turn predicts higher levels of concurrently measured depressive symptoms. One possible explanation why emergency (and not planned) CS was associated with breastfeeding difficulties is that unanticipated delivery mode generates greater stress for the mother than spontaneous vaginal delivery or planned CS, which may result in more difficulties in postpartum adjustment. Women after emergency CS should therefore receive special attention from maternity care providers as they appear to constitute a vulnerable group in terms of breastfeeding difficulties, which may, in turn, increase the risk of postpartum depression. Although we failed to provide evidence for any long-term effects of breastfeeding on maternal depressive symptoms, the association between concurrently reported breastfeeding status and depressive symptoms was relatively robust, highlighting the importance of breastfeeding support and prevention of postpartum depression with a specific focus on non-breastfeeding women.

Conflicts of interest and source of funding

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychores.2021.110691.

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