Psychiatry Research 320 (2023) 115038

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Predictors and comorbidity patterns of maternal birth-related posttraumatic stress symptoms: A Latent Class Analysis

Andreas Staudt [a,b,*], Sophie Baumann [a,b], Danny Horesh [c,d], Malin Eberhard-Gran [e,f], Antje Horsch [g,h,1], Susan Garthus-Niegel [a,i,j,1]

[a] Institute and Policlinic of Occupational and Social Medicine, Faculty of Medicine, TU Dresden, Dresden, Germany
[b] Department of Methods in Community Medicine, Institute of Community Medicine, University Medicine Greifswald, Greifswald, Germany
[c] Department of Psychology, Bar-Ilan University, Ramat-Gan, Israel
[d] Department of Psychiatry, NYU Grossman School of Medicine, New York, USA
[e] Norwegian Research Centre for Women's Health, Women and Children's Division, Oslo University Hospital, Rikshospitalet, Oslo, Norway
[f] Institute of Clinical Medicine, University of Oslo, Oslo, Norway
[g] Institute of Higher Education and Research in Healthcare, University of Lausanne, Lausanne, Switzerland
[h] Department Woman-Mother-Child, Lausanne University Hospital, Lausanne, Switzerland
[i] Institute for Systems Medicine (ISM), Faculty of Medicine, Medical School Hamburg, Hamburg, Germany
[j] Department of Childhood and Families, Norwegian Institute of Public Health, Oslo, Norway

ARTICLE INFO

Keywords:
Birth
Mother
PTSD
LCA
Childbirth experience

ABSTRACT

Birth-related posttraumatic stress symptoms (PTSS) place a significant burden on mothers and their families. The aim was to (1) identify differential profiles of maternal birth-related PTSS; (2) determine the predictive value of established risk factors; (3) examine comorbidity patterns related to depression and anxiety symptoms. As part of the Norwegian Ahus Birth Cohort, 2,088 (expectant) mothers completed self-report questionnaires from 17 weeks of gestation to 2 years postpartum. The *Impact of Event Scale* was used to assess PTSS 8 weeks after birth. Latent class analysis revealed four latent classes: a *High birth-related PTSS* class (4%), a *Moderate birth-related PTSS* class (16%) particularly characterized by endorsement of intrusion symptoms, a *Mild birth-related PTSS class* (47%), as well as a *No birth-related PTSS* class (33%). We found similar (younger age, worse subjective birth experience, higher fear of childbirth) and differential predictors (prior posttraumatic stress disorder, lower education, birth complications). Women classified with *High, Moderate,* or *Mild birth-related PTSS* showed higher depression and anxiety symptoms compared to women with *No birth-related PTSS*. A considerable number of mothers experienced birth-related PTSS, most on a subclinical level, but these women still showed signs of mental distress 2 years postpartum, calling for more universal prevention approaches.

1. Introduction

Childbirth is a major life event that is of emotional, social, and cultural significance and that involves great physical stress (Horesh et al., 2021; Horsch and Garthus-Niegel, 2020). While representing a positive experience for most mothers, childbirth can also be potentially traumatic when it is experienced as threatening the health or life of the mother and/or the child. Consequently, women can suffer from birth-related posttraumatic stress disorder (PTSD), as defined in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013), which includes symptoms of re-experiencing, avoidance, negative cognitions and mood, and hyperarousal. A recent meta-analysis suggests that birth-related PTSD affects nearly 5% of women (Heyne et al., 2022). In addition, between 7–21% of women suffer from clinically significant posttraumatic stress symptoms (PTSS), even though their symptoms remain below diagnostic threshold level (Heyne et al., 2022; Horsch and Garthus-Niegel, 2020).

Being a significant public health issue (Bauer et al., 2014), birth-related PTSS may have negative implications for the health and the relationships of the entire family (Cook et al., 2018; Garthus-Niegel et al., 2018a, 2018b, 2018c, 2017). For example, birth-related PTSS has been shown to be prospectively related to not initiating breastfeeding

* Corresponding author.
E-mail address: andreas.staudt@tu-dresden.de (A. Staudt).
[1] Antje Horsch and Susan Garthus-Niegel contributed equally as last authors.

https://doi.org/10.1016/j.psychres.2022.115038
Received 21 July 2022; Received in revised form 8 December 2022; Accepted 27 December 2022
Available online 29 December 2022

(Garthus-Niegel et al., 2018a), mother-infant bonding difficulties (Stuijfzand et al., 2020), negative child development outcomes (Garthus-Niegel et al., 2017), and child sleep problems at the age of 2 (Garthus-Niegel et al., 2018b). It has also been found to be linked to reduced couple relationship satisfaction (Delicate et al., 2018; Garthus-Niegel et al., 2018c). However, while the last two decades have seen an increasing body of research on birth-related PTSS and its risk factors (Ayers et al., 2016), larger gaps remain regarding the *longitudinal course* of birth-related PTSS (Heyne et al., 2022). In general, studies tend to find a tendency of birth-related PTSS to decline over time, though a minority of women also experience that symptoms increase or persist during the same period, with follow-ups lasting between 6 months and up to 2 years postpartum (Alcorn et al., 2010; Garthus-Niegel et al., 2015; Haagen et al., 2015; Horsch et al., 2015; White et al., 2006).

Given the important variation in birth-related PTSS trajectories and in order to better provide targeted professional support to postpartum women, these different patterns and their underlying determining factors need to be more rigorously examined. So far, one study (Dikmen-Yildiz et al., 2018) identified four trajectory groups: resilient (women did not meet birth-related PTSD criteria at neither 4–6 weeks nor 6 months postpartum and scored below 11 on at least one Hospital Anxiety and Depression subscale), recovered (women met birth-related PTSD criteria at 4–6 weeks but not at 6 months postpartum), delayed-PTSD (women did not meet birth-related PTSD criteria at 4–6 weeks but at 6 months postpartum), and chronic-PTSD (women met birth-related PTSD criteria at 4–6 weeks and at 6 months postpartum). Resilient and non-resilient (recovered, delayed-PTSD, and chronic-PTSD) groups differed regarding delivery mode, gestational age, infant complications, intra- and postpartum complications, experience of further traumatic events, and receiving psychological help (Dikmen-Yildiz et al., 2018).

Whilst this study provided some important insights, more studies with larger sample sizes are needed in order to distinguish subgroups of birth-related PTSS that not only differ by presence or absence of PTSS but are able to reflect differential symptom profiles. Furthermore, the mixed evidence of different longitudinal trajectories implies that different combinations of sociodemographic, psychological, and obstetric factors play a role, thus determining different birth-related PTSS profiles. A detailed investigation of how established pre-, peri-, and posttraumatic factors predict these different birth-related PTSS profiles is therefore called for.

A meta-analysis of risk factors for birth-related PTSD found that prenatal depression, fear of childbirth, prior PTSD, negative birth experience, lack of support, and postpartum depression contribute to the development of birth-related PTSD (Ayers et al., 2016). Another study identified prenatal depressive symptoms, state anxiety, and perinatal dissociation as PTSD symptom risk factors 3 months postpartum and prenatal depressive symptoms and perinatal dissociation at 10 months postpartum (Haagen et al., 2015). However, this study did not control for prior PTSD and had a relatively small sample size. Finally, birth-related PTSD is highly comorbid with both depression and anxiety symptoms (Dikmen-Yildiz et al., 2017; White et al., 2006), which places an additional burden on the affected women and their families. These comorbidity patterns over time should therefore also be examined.

According to a diathesis-stress model, individual factors combine with a traumatic stressor intense enough to trigger PTSS (McKeever and Huff, 2003). Therefore, pre- (e.g., age, educational background, parity, prior PTSD, fear of childbirth) and peripartum factors (e.g., birth complications, subjective birth experience) might increase the risk for birth-related PTSS and will therefore be taken into account in the present study (Chan et al., 2020; Hernández-Martínez et al., 2019; Modarres et al., 2012; Polachek et al., 2012; Price et al., 2020).

In summary, more research regarding the longitudinal course of birth-related PTSS is needed. Some evidence from smaller samples suggests important variations in birth-related PTSS trajectories. These different symptom profiles thus need to be investigated in a large population-based sample. Finally, the role of theory-driven pre-, peri-, and posttraumatic risk factors in predicting these different birth-related PTSS profiles needs to be examined, as well as comorbidity patterns over time.

In the present study, we therefore aimed to (1) identify differential profiles of maternal birth-related PTSS; (2) determine the predictive value of risk factors such as the mother's age at childbirth, school education, parity, birth complications, prior PTSD, fear of childbirth, and subjective birth experience for the respective maternal birth-related PTSS profiles; and (3) examine comorbidity patterns, i.e., how the profiles relate to depression and anxiety symptoms, both cross-sectionally and longitudinally.

2. Method

2.1. Participants and procedure

Data stem from the Norwegian Ahus Birth Cohort (ABC), which is a large population-based prospective cohort study. Eligible participants were all women scheduled to give birth at Akershus University Hospital between November 2008 and April 2010. Those with insufficient Norwegian language skills to answer questionnaires were excluded. There were no exclusion criteria regarding obstetric risk factors.

The sample was recruited during the women's routine fetal ultrasound examination at 17 weeks of gestation. Participating women were asked to complete self-report questionnaires at this time point (T1), at 32 weeks of gestation (T2), at 8 weeks postpartum (T3), and at 2 years postpartum (T4). Additionally, information on the pregnancies and births was obtained from the electronic birth records, completed by the doctor or midwife in charge of the birth. Of all eligible women who agreed to participate ($N = 4662$), 80 percent ($N = 3752$) returned the first questionnaire, 63 percent ($N = 2936$) returned the questionnaire at T2, 48 percent ($N = 2217$) returned the questionnaire at T3, and 44 percent ($N = 2063$) returned the questionnaire at T4. All participating women provided written informed consent to take part in the study as executed. Further information on participation and reasons for study dropout can be found in Fig. 1 and elsewhere (Adler et al., 2021; Thiel et al., 2020). The sample used for the present study ($N = 2094$) encompassed women who provided self-report data at T3 excluding women who had an elective cesarian section ($N = 123$) or had a stillbirth. However, there were no women who returned the T3 questionnaire after stillbirth.

The ABC study was approved by the Norwegian Regional Committees for Medical and Health Research Ethics (approval number S-08013a). This study's design and its analysis were not preregistered. Before starting work on this paper, a formal data processor agreement was concluded in accordance with the EU General Data Protection Regulation (June 25th, 2020). The data processors (at TU Dresden) who performed the statistical analysis on behalf of the data controller (Akershus University Hospital) received access to pseudonymized health data from the Ahus Birth Cohort for the specific purpose of answering the research questions of this article. Simultaneously, the data processors were obliged to implement appropriate technical, physical, and organizational safety measures to safeguard the data. All statistical analyses for this article were conducted with a fully-anonymized dataset that contained no personal participant data.

2.2. Measures

2.2.1. Birth-related posttraumatic stress symptoms

The *Impact of Event Scale* (IES; Horowitz et al., 1979) was used to measure PTSS. The IES is a self-report scale that consists of 15 items asking for avoidance and intrusion symptoms. Participants were instructed to complete it in relation to their last childbirth. The items are answered on a four-point scale (0 = *not at all*, 1 = *rarely*, 3 = *sometimes*, 5 = *often*). The measure has been applied and validated in postpartum

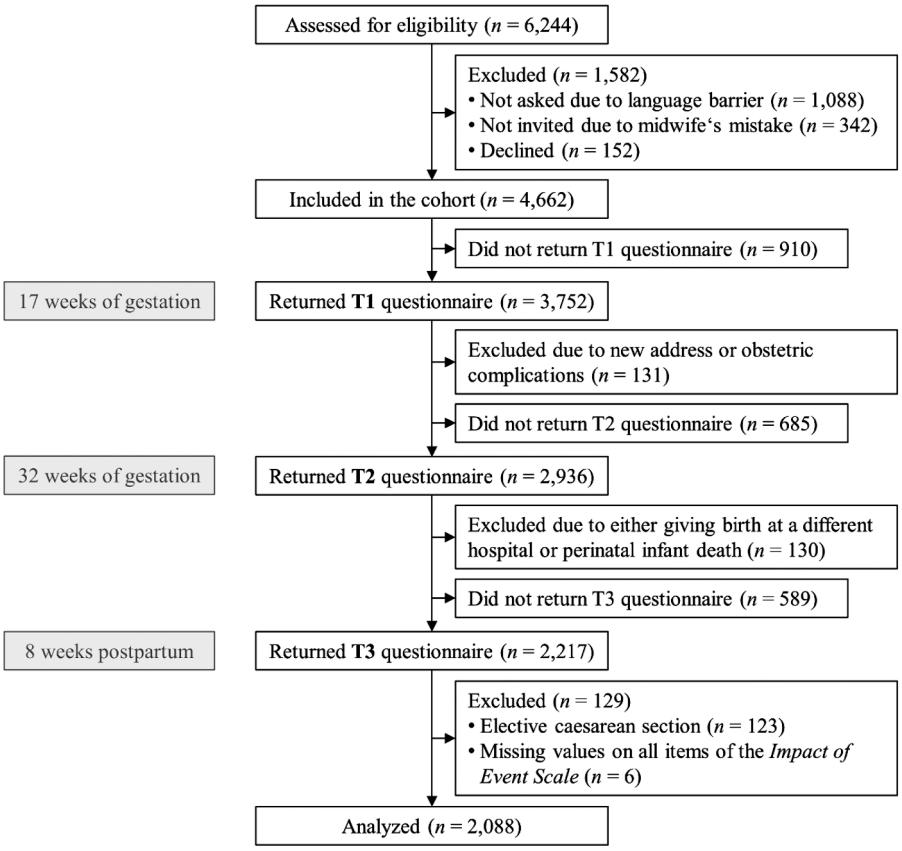

Fig. 1. Flow of participants.

women (Olde et al., 2006). Higher sum scores indicate greater degree of birth-related PTSS and a sum score of 35 or higher indicates PTSD to be likely present (Neal et al., 1994). The IES items were used as manifest indicators of latent maternal PTSS classes. Reliability in the present study was good (Cronbach's $\alpha = 0.84$).

2.2.2. Depression symptoms

The validated Norwegian version of the *Edinburgh Postnatal Depression Scale* (EPDS; Eberhard-Gran et al., 2001) was used to measure symptoms of depression at 8 weeks postpartum (T3) and at 2 years postpartum (T4). The EPDS is a 10-item self-report questionnaire assessing depressive symptoms in the past 7 days. The sum score ranges between 0 and 30, whereby higher scores indicate higher levels of depression symptoms. The EPDS has been shown to be a valid instrument to screen for symptoms of maternal perinatal depression (Hewitt et al., 2010) and showed good reliability in the present study ($\alpha = 0.85$ at T3 and $\alpha = 0.81$ at T4).

2.2.3. Anxiety symptoms

The 10-item anxiety scale of the *Hopkins Symptom Checklist* (Nettelbladt et al., 1993) was used to measure symptoms of anxiety in the past 7 days. The scale was administered at 8 weeks postpartum (T3) and 2 years postpartum (T4). The sum score ranges between 10 and 40, whereby higher scores indicate higher levels of anxiety symptoms. Reliability in the present study was good ($\alpha = 0.81$ at T3 and $\alpha = 0.84$ at T4).

2.2.4. Predictors

The mothers' age at childbirth, years of school education, parity, birth complications, prior PTSD, fear of childbirth, and subjective birth experience were used as predictors for latent maternal PTSS classes. Age at childbirth and years of school education were obtained from the electronic birth records, while parity was self-reported. School education (less than 12 years of school education and 12 or more years of school education) and parity (primiparous and parous) were dichotomized.

Birth complications were obtained from the electronic birth records. Obstetric complications such as perineal tears, excessive bleeding, unplanned instrumental delivery, long duration of birth (active phase of labor lasted longer than 12 h) etc. were assessed by the doctor or midwife in charge of the birth. We condensed the information from the electronic birth records into a categorical variable, differentiating women with no birth complications, those with one type of birth complication, and those with two or more types of birth complications.

Prior PTSD was assessed at 17 weeks of gestation. Women indicated whether they suffered from eight PTSD symptoms over the past month, in relation to a dramatic or terrifying event they potentially experienced. This PTSD symptom checklist was derived from the Mini-International Neuropsychiatric Interview (MINI; Sheehan et al., 1998). Each item was scored 0 (symptom absent) or 1 (symptom present) with total scores ranging from 0 (no symptoms) to 8. Prior PTSD was assumed when women met 4 or more symptoms (see Garthus-Niegel et al. (2014b) for a detailed description of this scale).

Fear of childbirth was measured using the *Wijma Delivery Expectancy/Experience Questionnaire* (W-DEQ; Wijma et al., 1998) at 32 weeks of gestation (T2). The W-DEQ is a validated and frequently used 33-item, self-report instrument to measure fear of childbirth, as operationalized by cognitive appraisal of the approaching birth. Sum scores may range between 0 and 165, whereby higher scores indicate higher fear of childbirth. Reliability in the present study was $\alpha = 0.91$.

Subjective birth experience was measured with one item ("*What was your experience of birth in general?*") with possible answers ranging from *0 = Very good* to *10 = Extremely bad.* This item was administered at 8 weeks postpartum (T3) and showed a high correlation ($r = 0.69$; *95%*

Confidence Interval CI [0.65; 0.73]) with the same measure of subjective birth experience which was administered 48 h after birth. Since considerably fewer women answered the item 48 h after birth ($n = 1244$ compared to $n = 2071$ at 8 weeks postpartum), we chose the latter measure as predictor for latent maternal PTSS.

2.3. Statistical analysis

To identify differential profiles of maternal birth-related PTSS, to determine the predictive value of risk factors, and to relate the profiles to depression and anxiety symptoms, mixture modeling was used. Observed indicator variables (IES items) were used to identify unobserved subgroups (latent classes of maternal birth-related PTSS). These subgroups were represented by a categorical latent variable that was then used for further analysis, i.e., exploring the relationships with other observed variables such as predictors and distal outcomes. For that purpose, we used the 3-step method for Latent Class Analysis (LCA), as described in Asparouhov and Muthén (2014).

As a first step, unconditional models with different numbers of latent classes were estimated. Model comparisons were based on the Bayesian Information Criterion (BIC; Schwarz, 1978), the Akaike Information Criterion (AIC; Akaike, 1998), the Vuong-Lo-Mendell-Rubin likelihood ratio test (VLMR; Vuong, 1989), class sizes as well as the conceptual meaning and distinctiveness of each latent class. Models with smaller BIC and AIC values are superior, as these information criteria balance fit and parsimony of a latent model. A statistically significant VLMR test favors a model with *k* latent classes over a model with *k-1* latent classes. The quality of classification was checked for every model using the average posterior classification probabilities and entropy, whereby values above 0.8 indicate good classification. Each model was calculated with 1000 starting values to ensure that the best solutions were replicated and not caused by local maxima. After deciding on the best model, the most likely latent class was saved for each observation. The measurement error for this most likely class variable was determined (Step 2). In the final and third step, a latent class model was estimated, in which (i) the latent classes were determined by the most likely latent class variable and its measurement error; (ii) the latent classes were predicted by the covariates in a multinomial logistic regression; (iii) the latent classes were compared regarding the distal outcomes (depression and anxiety symptoms).

Descriptive statistics were done in Stata version 14 (StataCorp, 2015). Latent variable models were calculated using Mplus version 7.4 (Muthén and Muthén, 2015). For the models, all available data were used under the assumption of missing at random using a full-information maximum likelihood estimator with robust standard errors. To avoid error type 1 cumulation in the analysis of distal outcomes, a Bonferroni correction was applied. Pairwise comparisons were reported with z-standardized depression and anxiety scores and confidence intervals adjusted for the number of comparisons (1 – 0.05 / number of pairwise comparisons x 4 distal outcomes).

Six women had missing values on all IES items and were therefore dropped from all analyses, leaving a final sample of 2088 women. In Step 3 of the latent class analysis, only women with complete data on the latent class predictors could be included ($n = 1591$). Logistic regression indicated that the 497 women who had to be excluded from Step 3 due to missing data did not differ from the analysis sample regarding birth-related PTSS (IES sum score; *OR* = 1.01, *95% CI* [0.99; 1.02]).

3. Results

3.1. Sample characteristics

Sample characteristics are outlined in Table 1. The women in our sample were between 19 and 46 years old ($M = 31.2$; $SD = 4.6$) at childbirth. For half of the women, it was the first childbirth. Obstetric complications occurred in 35% of deliveries, whereby the most frequent complications were long duration of birth ($n = 241$; 12% of the sample), unplanned instrumental vaginal delivery ($n = 237$; 11%), emergency cesarian section ($n = 198$; 9%), excessive bleeding ($n = 90$; 4%), umbilical cord complications ($n = 69$; 3%), and perineal tear of grade 3 or 4 ($n = 67$; 3%). The mean IES sum score was 7.0 ($SD = 8.2$) and 40 (2%) had an IES sum score above the threshold of 35 suggesting that these women may suffer from birth-related PTSD.

Table 1
Sample characteristics.

Variable	*N*		
Age, *M* (*SD*)	2072	31.2	(4.6)
Years of school education, *n* (%)	2002		
Less than 12 years		642	(32%)
More than 12 years		1360	(68%)
Parity, *n* (%)	2088		
Primiparous		1063	(51%)
Parous		1025	(49%)
Birth complications, *n* (%)	2088		
None		1341	(64%)
One type of birth complication		530	(25%)
Two or more types of birth complications		217	(10%)
Birth-related PTSS, IES sum score, *M* (*SD*)	2076	7.0	(8.2)
Birth-related PTSD likely, IES sum score ≥ 35, *n* (%)	2076	40	(2%)
Prior PTSD, *n* (%)	2079	22	(1%)
Subjective birth experience, *M* (*SD*)	2071	3.0	(2.7)
Fear of childbirth at 32 weeks of gestation (W-DEQ), *M* (*SD*)	1672	57.0	(19.1)
Depression symptoms (EPDS), *M* (*SD*)			
8 weeks postpartum	2082	4.5	(4.1)
2 years postpartum	1386	7.6	(3.1)
Anxiety symptoms, *M* (*SD*)			
8 weeks postpartum	2069	12.0	(2.8)
2 years postpartum	1386	12.8	(3.6)

Note. The different sample sizes are due to selective missing values. IES = Impact of Event Scale. W-DEQ = Wijma Delivery Expectancy/Experience Questionnaire. EPDS = Edinburg Postnatal Depression Scale.

3.2. Identification of latent classes

Table 2 shows the model comparisons for Step 1 of the LCA. BIC values and the VLMR test favored the model with four latent classes. All models showed good classification, as indicated by average posterior classification probabilities and entropy values above 0.8. AIC values favored the model with five latent classes. However, the best loglikelihood value could not be replicated for the five-class model, which indicates that the solution may not be trustworthy. Therefore, we selected the four-class model.

3.3. Characterization of latent classes

The four latent classes are characterized by class-specific item response probabilities. Fig. 2 shows the estimated probabilities of answering *Not at all, Rarely, Sometimes*, or *Often* to each item for every latent class. The first class ($n = 82$; 4%) was characterized by moderate to high probabilities of endorsing (*Sometimes* and *Often*) all IES items and was therefore labeled *High birth-related PTSS*. The second class ($n = 326$; 16%) was labeled *Moderate birth-related PTSS* that was particularly characterized by moderate probabilities of endorsing intrusion symptoms, i.e. IES items 1 (“*I thought about it when I didn’t mean to.*”), 4 (“*I had trouble falling asleep or staying asleep, because of pictures or thoughts about it that came into my mind.*”), 5 (“*I had waves of strong feelings about it.*”), 6 (“*I had dreams about it.*”), and 10 (“*Pictures about it popped into my mind.*”). Women in the *Moderate birth-related PTSS class* also endorsed some IES avoidance items, e.g. item 3 (“*I tried to remove it from memory.*”) and 12 (“*I was aware that I still had a lot of feelings about it, but I didn’t deal with them.*”), but had very low probabilities of reporting other avoidance symptoms (IES items 2, 7, 9, 13, and 15). The third class ($n = 982$; 47%) was the largest one and characterized by similar or

Table 2
Fit indices comparing latent class models with two to five classes.

	AIC	BIC	VLMR p-value	Entropy	Lowest apc-prob.	Class sizes, *n* (%) Class 1	Class 2	Class 3	Class 4	Class 5
2 classes	36,095.83	36,609.43	< 0.001	0.923	0.949	412 (20%)	1676 (80%)			
3 classes	35,142.22	35,915.44	< 0.001	0.798	0.899	917 (44%)	253 (12%)	918 (44%)		
4 classes	34,661.29	35,694.14	< 0.001	0.817	0.884	82 (4%)	698 (33%)	326 (16%)	982 (47%)	
5 classes	34,531.39	35,823.86	.33	0.805	0.856	47 (2%)	114 (5%)	352 (17%)	701 (34%)	874 (42%)

Note. Sample size for all models: $N = 2088$. AIC = Akaike Information Criterion. BIC = Bayesian Information Criterion. Lowest apc-prob. = lowest average posterior classification probability.

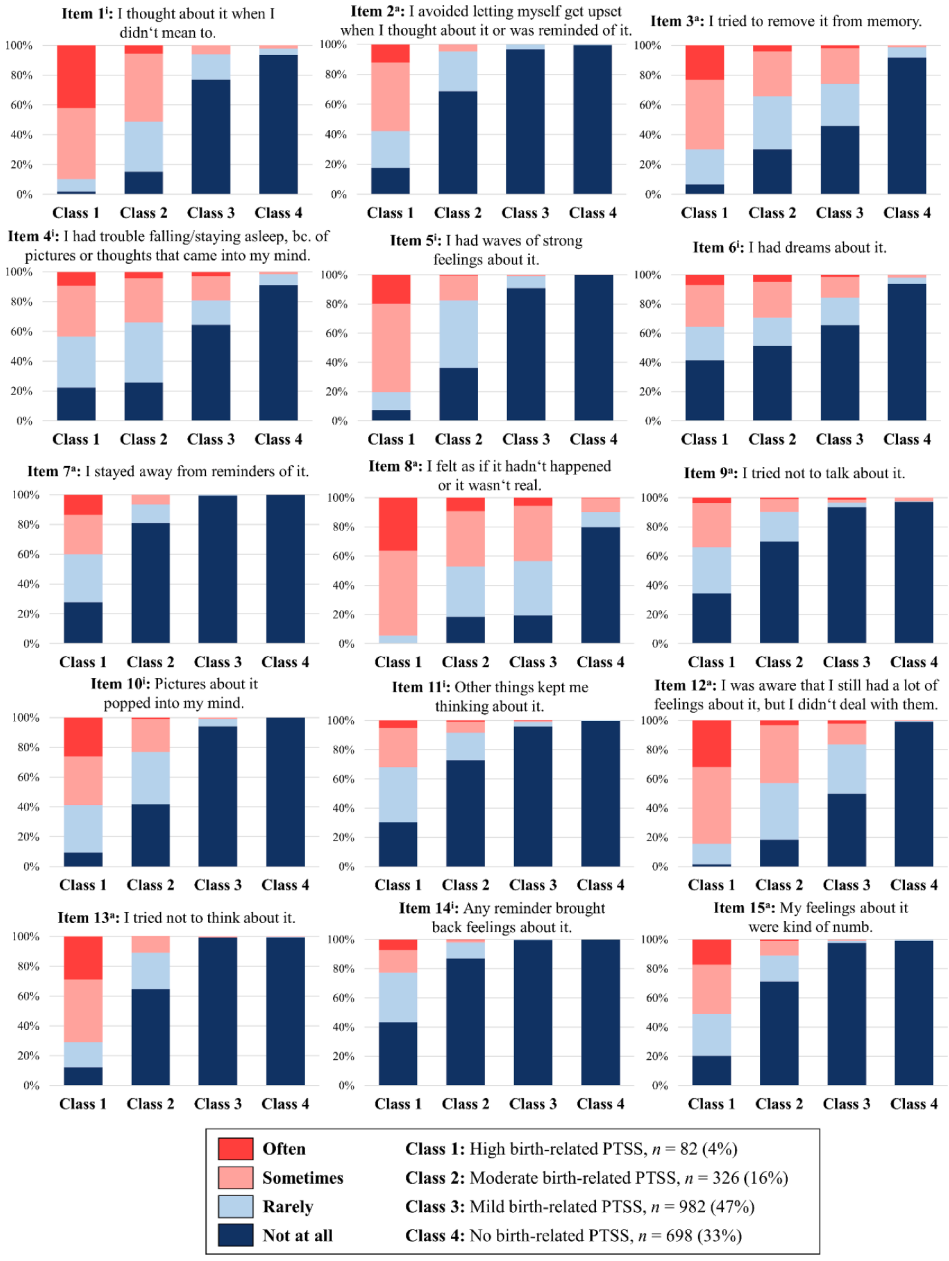

Fig. 2. a. (Online version). Estimated item response probabilities for latent maternal posttraumatic stress classes per item of the IES; *Note.* PTSS = post-traumatic stress symptoms, [a] IES avoidance symptom cluster, [i] IES intrusion symptom cluster. **b. (print version)**. Estimated item response probabilities for latent maternal posttraumatic stress classes per item of the IES; *Note.* PTSS = post-traumatic stress symptoms, [a] IES avoidance symptom cluster, [i] IES intrusion symptom cluster.

marginally lower probabilities for IES items 3, 6, 8, and 12 as the second class. However, the third class showed almost zero or very low probabilities of endorsing the remaining IES items, rendering this class the *Mild birth-related PTSS* class. The fourth class ($n = 698$; 33%) was labeled *No birth-related PTSS* class because it was characterized by probabilities of above 0.9 for responding *Not at all* to all IES items (except for item 8 "*I*

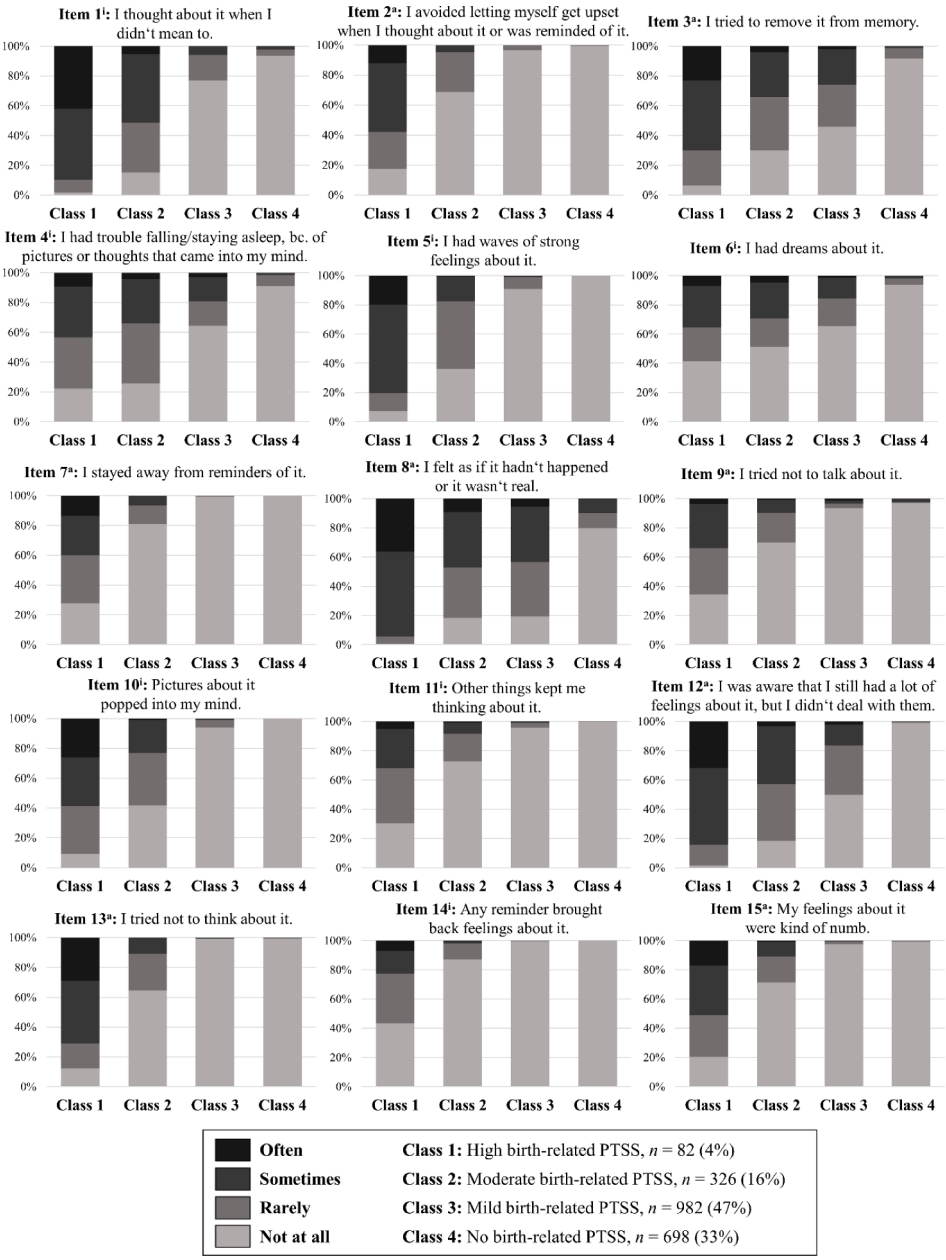

Fig. 2. (*continued*).

felt as if it hadn't happened or wasn't real.").

3.4. Predictors of latent class membership

Women who reported prior PTSD (*Odds Ratio OR* = 26.00; *95% Confidence Interval CI* [4.00; 168.98]), higher degree of fear of childbirth at 32 weeks of gestation (*OR* = 1.04; *95% CI* [1.02; 1.06]), and worse subjective birth experience (*OR* = 1.78; *95% CI* [1.54; 2.04]) were more likely to be in the *High birth-related PTSS* class compared to the *No birth-related PTSS* class (Table 3). Increasing age (*OR* = 0.88; *95% CI* [0.81; 0.96]) and having 12 or more years of school education (compared to less than 12 years; *OR* = 0.34; *95% CI* [0.17; 0.68]) lowered the probability to belong to the *High birth-related PTSS* class. Predictors for the *Moderate birth-related PTSS* class (reference: *No birth-related PTSS*) were higher degree of fear of childbirth (*OR* = 1.04; *95% CI* [1.02; 1.05]), worse subjective birth experience (*OR* = 1.71; *95% CI* [1.56; 1.86]), birth complications (*OR* = 2.29; *95% CI* [1.40; 3.77] for one type of birth complication; and *OR* = 2.52; *95% CI* [1.33; 4.78] for two or more types of birth complications; Reference: no birth complications), as well as lower age (*OR* = 0.94; *95% CI* [0.90; 0.99]). Lower age (*OR* = 0.96; *95% CI* [0.92; 0.99]) also increased the probability to be classified into the *Mild birth-related PTSS* class (reference: *No birth-related PTSS*). Higher degree of fear of childbirth (*OR* = 1.01; *95% CI* [1.00; 1.02]) and worse subjective birth experience (*OR* = 1.15; *95% CI* [1.07; 1.24]) increased the probability of belonging to the *Mild birth-related PTSS* class, too. Table S1 includes additional logistic regression results using the *Moderate* and *Mild birth-related PTSS* classes as reference groups. In Table S2, the most frequent birth complications were included as dummy-coded variables to predict latent class membership.

3.5. Depression and anxiety symptoms

Women in the *High birth-related PTSS* class had consistently higher depression and anxiety scores at 8 weeks postpartum and at 2 years postpartum, compared to all other latent classes (Table 4). The *Moderate birth-related PTSS* class and the *Mild birth-related PTSS* class showed

Table 3
Predictors of latent class membership in a multinomial logistic regression analysis.

	Class 1 vs. Class 4	Class 2 vs. Class 4	Class 3 vs. Class 4
Age	**0.88 [0.81; 0.96]**	**0.94 [0.90; 0.99]**	**0.96 [0.92; 0.99]**
Twelve or more years of school education (Ref.: < 12 years)	**0.34 [0.17; 0.68]**	1.05 [0.64; 1.71]	1.20 [0.87; 1.65]
Prior PTSD (Ref.: No prior PTSD)	**26.00 [4.00; 168.98]**	3.08 [0.28; 34.56]	1.64 [0.20; 13.33]
Fear of childbirth at 32 weeks of gestation	**1.04 [1.02; 1.06]**	**1.04 [1.02; 1.05]**	**1.01 [1.00; 1.02]**
Parous (Ref.: Primiparous)	1.52 [0.68; 3.40]	0.99 [0.62; 1.58]	0.78 [0.57; 1.08]
Subjective birth experience	**1.78 [1.54; 2.04]**	**1.71 [1.56; 1.86]**	**1.15 [1.07; 1.24]**
Birth complications (Ref.: None)			
One type of birth complication	0.43 [0.16; 1.14]	**2.29 [1.40; 3.77]**	0.92 [0.64; 1.33]
Two or more types of birth complications	1.52 [0.56; 4.23]	**2.52 [1.33; 4.78]**	0.79 [0.45; 1.39]

Note. All cells are Odds Ratios with 95%-confidence intervals in parentheses. Sample size for this model is $N = 1591$. Class 1 = *High birth-related PTSS*. Class 2 = *Moderate birth-related PTSS*. Class 3 = *Mild birth-related PTSS*. Class 4 = *No birth-related PTSS*.

Table 4
Pairwise comparisons of latent classes regarding depression and anxiety symptoms.

	Depression at 8 weeks pp	Anxiety at 8 weeks pp	Depression at 2 years pp	Anxiety at 2 years pp
Class 1 vs. Class 2	**1.05 [0.32; 1.79]**	**1.97 [0.52; 3.42]**	**1.62 [0.49; 2.75]**	**2.80 [1.48; 4.12]**
Class 1 vs. Class 3	**1.54 [0.86; 2.22]**	**2.20 [0.79; 3.60]**	**1.75 [0.61; 2.90]**	**2.94 [1.58; 4.29]**
Class 1 vs. Class 4	**1.83 [1.14; 2.51]**	**2.46 [1.06; 3.85]**	**2.01 [0.86; 3.16]**	**3.19 [1.84; 4.53]**
Class 2 vs. Class 3	**0.49 [0.16; 0.82]**	0.23 [-0.07; 0.52]	0.14 [-0.24; 0.52]	0.13 [-0.17; 0.43]
Class 2 vs. Class 4	**0.77 [0.44; 1.11]**	**0.49 [0.19; 0.78]**	**0.39 [0.01; 0.78]**	**0.39 [0.08; 0.70]**
Class 3 vs. Class 4	**0.28 [0.11; 0.46]**	**0.26 [0.12; 0.40]**	**0.26 [0.06; 0.45]**	**0.25 [0.06; 0.44]**

Note. All cells are estimated z-standardized differences with 99.8%-confidence intervals in parentheses. Pairwise comparisons were adjusted for age, education, prior PTSD, fear of childbirth, parity, subjective birth experience, and birth complications. pp = postpartum. Class 1 = *High birth-related PTSS*. Class 2 = *Moderate birth-related PTSS*. Class 3 = *Mild birth-related PTSS*. Class 4 = *No birth-related PTSS*.

higher depression and anxiety scores compared to the *No birth-related PTSS* class, at 8 weeks postpartum and at 2 years postpartum. These differences were smaller in magnitude than between the *High birth-related PTSS* and the other classes. Women in the *Moderate birth-related PTSS* class had higher depression scores at 8 weeks postpartum, compared to the *Mild birth-related PTSS* class. However, these two classes did neither differ in their anxiety scores at 8 weeks postpartum, nor in their depression and anxiety scores at 2 years postpartum.

4. Discussion

Following a Norwegian sample of (expectant) mothers from 17 weeks of gestation through 2 years postpartum, this study aimed at identifying differential profiles of birth-related posttraumatic stress symptoms. Three main findings emerged. First, four distinct latent classes of maternal birth-related PTSS were found: About a third of women did not report any birth-related PTSS (*No birth-related PTSS*), while nearly half of the women belonged to the *Mild birth-related PTSS* class. In addition, 16 percent of women belonged to the *Moderate birth-related PTSS* class and 4 percent were likely to experience birth-related PTSD (*High birth-related PTSS*). The differences between the latent classes were not only quantitative (symptom severity), but also qualitative (e.g., presence or absence of intrusion symptoms when comparing women with *Moderate* and *Mild birth-related PTSS*). Second, the predictive value of risk factors for the latent classes was determined. Younger age at childbirth, higher degree of fear of childbirth, and worse subjective birth experience increased the probability of belonging to the latent classes *High birth-related PTSS, Moderate birth-related PTSS* and *Mild birth-related PTSS*, compared to a latent class with *No birth-related PTSS*. Moreover, lower education and prior PTSD were predictive of membership in the *High birth-related PTSS* class. Birth complications increased the probability of being classified into the *Moderate birth-related PTSS* class. Third, the latent classes of maternal birth-related PTSS differed in their depression and anxiety symptoms at 8 weeks and at 2 years postpartum. The largest differences were found between the *High birth-related PTSS* class and the other three latent classes. Women in the *Moderate birth-related PTSS* class and the *Mild birth-related PTSS* class showed higher depression and anxiety scores compared to women in the *No birth-related PTSS* class, even at 2 years postpartum.

Similar patterns for the prediction of latent class membership were observed. All three profiles with at least some birth-related PTSS (i.e., the *High, Moderate, and Mild birth-related PTSS* classes) had higher levels of fear of childbirth during pregnancy and reported a more negative subjective birth experience at 8 weeks postpartum. This is in line with previous research showing that both fear of childbirth and subjective birth experience constitute key variables in predicting birth-related PTSD (Ayers et al., 2016; Garthus-Niegel et al., 2014a, 2013). Our results suggest that they may be important for subclinical PTSD levels, too, and thereby underline their central role as risk factors. Older maternal age at childbirth served as a protective factor for the three profiles with at least some birth-related PTSS. Similarly, in a meta-analysis by Ayers and colleagues (2016), older maternal age had a small protective effect. However, further analyses supported the notion that this age effect might be subject to publication bias (Ayers et al., 2016). Older age was found to be a protective factor in the face of various stressful and traumatic events (Horesh et al., 2020), including childbirth-related trauma (Horesh et al., 2018). Women with no prior birth experience may be particularly vulnerable to unexpected or stressful events during birth, as they encounter those for the first time and might not have yet developed adaptive coping mechanisms for these circumstances. Thus, putting things in perspective, regulating negative cognitions and emotions, and comparing to previous ways of coping may be particularly hard for them, compared to older women who have both wider life experience, and experience related to childbirth. This is in line with research showing that emotion regulation develops across the life span and is influenced by challenges and opportunities that arise in life (Cole, 2014) and as a product of "learning, practice, selective reinforcement, and personal preference exercised over a lifetime" (Lawton, 2001, p. 121).

Further, we also found some differential predictors for birth-related PTSS profiles. Prior PTSD and lower education served as risk factors for the *High birth-related PTSS* class only. This class of women appears to be especially vulnerable, characterized by moderate to high probabilities of endorsing all birth-related PTSS. Even though prior PTSD symptoms related to *general* PTSS as measured in pregnancy, high symptom load of *birth-related* PTSS during the postpartum period might indicate a potential chronification of PTSS (Oliveira et al., 2017). In addition, the particularly vulnerable women in this group might get more easily re-traumatized by a major life event, such as birth, with the birth triggering memories of previous threats to their physical integrity.

Regarding educational background as a risk factor for birth-related PTSD, prior studies yielded ambiguous findings (Modarres et al., 2012; Shaban et al., 2013). Our own results suggest that lower education – possibly as a proxy of less resources and again heightened vulnerability (Harrison et al., 2021) – might only be relevant in the most severely

affected women (i.e., the *High birth-related PTSS* class). Education has been shown to be an important resilience factor in many PTSD studies (e.g. Carmassi et al., 2018). Higher education may be associated with more knowledge about the birth process as well as better access to healthcare services before and after birth. Drawing from Hobfoll's Conservation of Resources Theory (Hobfoll 1989), one may assume that better education may entail a "spiral of gains", where more and more resources (financial resources, healthcare-related resources) may follow, together contributing to psychological well-being.

Birth complications turned out to be another differential predictor, increasing the probability of being classified into the *Moderate birth-related PTSS* class only. While the subjective birth experience has been established as a crucial risk factor of birth-related PTSD, also *objective* aspects of the birth experience (i.e., birth complications) can increase the risk for PTSD symptomatology independently (Harrison et al., 2021). However, the existing evidence regarding a "dose-response" model of PTSD (i.e., exposure predicts outcome) is inconclusive, suggesting that pre-, peri-, and post-traumatic factors other than exposure itself may contribute more to psychopathology (e.g. Bowman and Yehuda, 2004). This may in fact be particularly true for the more distressed/symptomatic women in our sample. Among these women, many more factors may come into play in predicting PTSS, other than birth complications. These factors may reflect a much deeper, preexisting vulnerability to traumatic stress (e.g., genetic, hormonal, personality-related), which may outweigh the role of any specific event characteristics, including birth complications. Hence, exposure to birth complications might not necessarily result in high symptom load (as in the more vulnerable *High birth-related PTSS* class) but maybe rather lead to the development of subclinical symptom presentations (as in the *Moderate birth-related PTSS* class).

The comorbidity patterns that we found with the *High birth-related PTSS* class having the highest depression and anxiety scores further support the notion of an especially vulnerable class. Our results are in line with prior findings from both the general and birth-related PTSD literature showing clear comorbidity and symptom overlap between PTSD symptoms and symptoms of depression and anxiety (Harrison et al., 2021). In that regard, it is logical that the classes with *Moderate* and *Mild* birth-related PTSS also showed heightened depression and anxiety compared to the latent class with *No birth-related PTSS*, with the latter appearing to be a psychologically healthy and unburdened class.

4.1. Strengths and limitations

To our knowledge, this prospective population-based cohort study is the first to identify latent maternal birth-related PTSS profiles together with their predictors and comorbidity patterns up to 2 years postpartum. We used state-of-the-art latent variable modeling; this technique allowed us to use all available data of a large sample of (expectant) mothers, to classify them into meaningful (a priori unknown) subgroups representing unobserved heterogeneity in the larger population, and to identify underlying covariates and mechanisms which likely caused the heterogeneity.

Readers should also note some limitations to our findings. Both, birth-related PTSS as well as symptoms of depression and anxiety were based on self-report and psychological symptoms may be under-reported due to social desirability. Even though the psychometric scales used in our study have been validated in numerous studies (Eberhard-Gran et al., 2001; Garthus-Niegel et al., 2011; Nettelbladt et al., 1993; Olde et al., 2006; Sheehan et al., 1998; Wijma et al., 1998), it is well-established that they represent screening instruments rather than clinical diagnostic tools. Further, subjective birth experiences were measured retrospectively, at 8 weeks postpartum. Ideally, subjective birth experiences should have been measured as soon as possible after birth. Measuring subjective birth experiences and birth-related PTSS simultaneously may obscure the causal direction between these two constructs. Emerging PTSS could influence subsequent memories and thus color ratings of the subjective birth experience. However, it seems reasonable to assume that the birth experience would affect the stress response rather than vice versa (Garthus-Niegel et al., 2013; Kjeldgaard et al., 2019). The high correlation between subjective birth experience assessed 48 h after birth and the measure we used (8 weeks postpartum) supports this assumption (see Method section). Finally, generalizability of the results may be limited by selection bias and the fact that only Norwegian-speaking women were included, resulting in a relatively homogeneous, mainly Caucasian sample. Different results might be obtained for other ethnic groups.

This prospective population-based cohort study is the first to identify four distinct latent classes of maternal birth-related posttraumatic stress symptoms together with their respective predictors and comorbidity patterns from 8 weeks to 2 years postpartum. To this end, we used latent variable modeling to classify our large sample of (expectant) mothers into four meaningful subgroups. A high number of women (67%) exhibited at least some birth-related PTSS (women belonging to the *High, Moderate,* or *Mild birth-related PTSS* class). The clinical relevance of membership in these latent classes is supported by the comorbidity patterns of the classes, i.e., their elevated depression and anxiety symptom levels. Hence, even though it seems particularly important to target women belonging to the vulnerable *High birth-related PTSS* class, prevention approaches seem very relevant for *Moderate* and *Mild birth-related PTSS* classes, too, whose members also showed significant signs of distress. The risk factors identified in our study may help develop appropriate intervention strategies; and although our data do not allow for causal inferences, the identification of these differential predictors may have implications for the development of future mental health interventions tailored to the respective birth-related PTSS profile. In future research it would be interesting to see if our identified latent classes can be replicated in other populations. In addition, it would be highly relevant to include other modifiable predictors as well as other exposure characteristics of the birth experience and to examine whether the identified birth-related PTSS profiles lead to differential outcomes for the children, the fathers or partners, and/or the entire family.

Role of the funding source

The study was funded by the Norwegian Research Council (grant number 191098 to Malin Eberhard-Gran) who had no influence on design, analysis, and data interpretation.

CRediT authorship contribution statement

Andreas Staudt: Conceptualization, Methodology, Formal analysis, Writing – original draft. **Sophie Baumann:** Conceptualization, Methodology, Writing – review & editing. **Danny Horesh:** Conceptualization, Writing – original draft. **Malin Eberhard-Gran:** Investigation, Project administration, Funding acquisition, Writing – review & editing. **Antje Horsch:** Conceptualization, Writing – original draft. **Susan Garthus-Niegel:** Conceptualization, Investigation, Writing – original draft.

Declaration of Competing Interest

None.

Acknowledgements

We thank all participants for their participation, all research and study assistants for data collection and management. Further, this paper contributes to the EU COST Action 18211 (DEVoTION - Perinatal Mental Health and Birth-Related Trauma: maximizing best practice and optimal outcomes) supported by COST (European Cooperation in Science and Technology). DH, AH, and SGN are management committee members of COST Action CA18211.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2022.115038.

References

Adler, I., Weidner, K., Eberhard-Gran, M., Garthus-Niegel, S., 2021. The Impact of maternal symptoms of perinatal insomnia on social-emotional child development: a population-based, 2-year follow-up study. Behav. Sleep Med. 19, 303–317. https://doi.org/10.1080/15402002.2020.1746661.

Akaike, H., 1998. Information theory and an extension of the maximum likelihood principle. In: Parzen, E., Tanabe, K., Kitagawa, G. (Eds.), Selected Papers of Hirotugu Akaike. Springer, New York, New York, NY, pp. 199–213.

Alcorn, K.L., O'Donovan, A., Patrick, J.C., Creedy, D., Devilly, G.J., 2010. A prospective longitudinal study of the prevalence of post-traumatic stress disorder resulting from childbirth events. Psychol. Med. 40, 1849–1859. https://doi.org/10.1017/s0033291709992224.

American Psychiatric Association, 2013. Diagnostic and Statistical Manual of Mental Disorders, 5th ed. American Psychiatric Association, Arlington, VA.

Asparouhov, T., Muthén, B., 2014. Auxiliary variables in mixture modeling: three-step approaches using M plus. Struct. Equ. Model. 21, 329–341. https://doi.org/10.1080/10705511.2014.915181.

Ayers, S., Bond, R., Bertullies, S., Wijma, K., 2016. The aetiology of post-traumatic stress following childbirth: a meta-analysis and theoretical framework. Psychol. Med. 46, 1121–1134. https://doi.org/10.1017/s0033291715002706.

Bauer, A., Parsonage, M., Knapp, M., Iemmi, V., Adelaja, B., 2014. The costs of perinatal mental health problems. 10.13140/2.1.4731.6169.

Bowman, M.L., Yehuda, R., 2004. Risk factors and the adversity-stress model. In: Rosen, G.M. (Ed.), Posttraumatic Stress Disorder. John Wiley & Sons Ltd, Chichester, UK, pp. 15–38. https://doi.org/10.1002/9780470713570.ch2.

Carmassi, C., Gesi, C., Corsi, M., Cremone, I.M., Bertelloni, C.A., Massimetti, E., Olivieri, M.C., Conversano, C., Santini, M., Dell'Osso, L., 2018. Exploring PTSD in emergency operators of a major University Hospital in Italy: a preliminary report on the role of gender, age, and education. Ann. Gen. Psychiatry 17, 17. https://doi.org/10.1186/s12991-018-0184-4.

Chan, S.J., Ein-Dor, T., Mayopoulos, P.A., Mesa, M.M., Sunda, R.M., McCarthy, B.F., Kaimal, A.J., Dekel, S., 2020. Risk factors for developing posttraumatic stress disorder following childbirth. Psychiatry Res. 290, 113090 https://doi.org/10.1016/j.psychres.2020.113090.

Cole, P.M., 2014. Moving ahead in the study of the development of emotion regulation. Int. J. Behav. Dev. 38, 203–207. https://doi.org/10.1177/0165025414522170.

Cook, N., Ayers, S., Horsch, A., 2018. Maternal posttraumatic stress disorder during the perinatal period and child outcomes: a systematic review. J. Affect. Disord. 225, 18–31. https://doi.org/10.1016/j.jad.2017.07.045.

Delicate, A., Ayers, S., Easter, A., McMullen, S., 2018. The impact of childbirth-related post-traumatic stress on a couple's relationship: a systematic review and meta-synthesis. J. Reprod. Infant Psychol. 36, 102–115. https://doi.org/10.1080/02646838.2017.1397270.

Dikmen-Yildiz, P., Ayers, S., Phillips, L., 2018. Longitudinal trajectories of post-traumatic stress disorder (PTSD) after birth and associated risk factors. J. Affect. Disord. 229, 377–385. https://doi.org/10.1016/j.jad.2017.12.074.

Dikmen-Yildiz, P., Ayers, S., Phillips, L., 2017. Depression, anxiety, PTSD and comorbidity in perinatal women in Turkey: a longitudinal population-based study. Midwifery 55, 29–37. https://doi.org/10.1016/j.midw.2017.09.001.

Eberhard-Gran, M., Eskild, A., Tambs, K., Schei, B., Opjordsmoen, S., 2001. The Edinburgh Postnatal Depression Scale: validation in a Norwegian community sample. Nord. J. Psychiatry 55, 113–117. https://doi.org/10.1080/08039480117684.

Garthus-Niegel, S., Ayers, S., Martini, J., Soest, T., Eberhard-Gran, M., 2017. The impact of postpartum post-traumatic stress disorder symptoms on child development: a population-based, 2-year follow-up study. Psychol. Med. 47, 161–170. https://doi.org/10.1017/s003329171600235x.

Garthus-Niegel, S., Ayers, S., Soest, T., Torgersen, L., Eberhard-Gran, M., 2015. Maintaining factors of posttraumatic stress symptoms following childbirth: a population-based, two-year follow-up study. J. Affect. Disord. 172, 146–152. https://doi.org/10.1016/j.jad.2014.10.003.

Garthus-Niegel, S., Horsch, A., Ayers, S., Junge-Hoffmeister, J., Weidner, K., Eberhard-Gran, M., 2018a. The influence of postpartum PTSD on breastfeeding: a longitudinal population-based study. Birth 45, 193–201. https://doi.org/10.1111/birt.12328.

Garthus-Niegel, S., Horsch, A., Bickle Graz, M., Martini, J., Soest, T., Weidner, K., Eberhard-Gran, M., 2018b. The prospective relationship between postpartum PTSD and child sleep: a 2-year follow-up study. J. Affect. Disord. 241, 71–79. https://doi.org/10.1016/j.jad.2018.07.067.

Garthus-Niegel, S., Horsch, A., Handtke, E., Soest, T., Ayers, S., Weidner, K., Eberhard-Gran, M., 2018c. The impact of postpartum posttraumatic stress and depression symptoms on couples' relationship satisfaction: a population-based prospective study. Front. Psychol. 9, 1728. https://doi.org/10.3389/fpsyg.2018.01728.

Garthus-Niegel, S., Knoph, C., Soest, T., Nielsen, C.S., Eberhard-Gran, M., 2014a. The role of labor pain and overall birth experience in the development of posttraumatic stress symptoms: a longitudinal cohort study. Birth 41, 108–115. https://doi.org/10.1111/birt.12093.

Garthus-Niegel, S., Soest, T., Knoph, C., Simonsen, T.B., Torgersen, L., Eberhard-Gran, M., 2014b. The influence of women's preferences and actual mode of delivery on post-traumatic stress symptoms following childbirth: a population-based, longitudinal study. BMC Pregnancy Childbirth 14, 191. https://doi.org/10.1186/1471-2393-14-191.

Garthus-Niegel, S., Soest, T., Vollrath, M.E., Eberhard-Gran, M., 2013. The impact of subjective birth experiences on post-traumatic stress symptoms: a longitudinal study. Arch. Womens Ment. Health 16, 1–10. https://doi.org/10.1007/s00737-012-0301-3.

Garthus-Niegel, S., Størksen, H.T., Torgersen, L., Soest, T., Eberhard-Gran, M., 2011. The Wijma delivery expectancy/experience questionnaire: a factor analytic study. J. Psychosom. Obstet. Gynaecol. 32, 160–163. https://doi.org/10.3109/0167482X.2011.573110.

Haagen, J.F.G., Moerbeek, M., Olde, E., van der Hart, O., Kleber, R.J., 2015. PTSD after childbirth: a predictive ethological model for symptom development. J. Affect. Disord. 185, 135–143. https://doi.org/10.1016/j.jad.2015.06.049.

Harrison, S.E., Ayers, S., Quigley, M.A., Stein, A., Alderdice, F., 2021. Prevalence and factors associated with postpartum posttraumatic stress in a population-based maternity survey in England. J. Affect. Disord. 279, 749–756. https://doi.org/10.1016/j.jad.2020.11.102.

Hernández-Martínez, A., Rodríguez-Almagro, J., Molina-Alarcón, M., Infante-Torres, N., Donate Manzanares, M., Martínez-Galiano, J.M., 2019. Postpartum post-traumatic stress disorder: associated perinatal factors and quality of life. J. Affect. Disord. 249, 143–150. https://doi.org/10.1016/j.jad.2019.01.042.

Hewitt, C.E., Gilbody, S.M., Mann, R., Brealey, S., 2010. Instruments to identify post-natal depression: which methods have been the most extensively validated, in what setting and in which language? Int. J. Psychiatry Clin. Pract. 14, 72–76. https://doi.org/10.3109/13651500903198020.

Heyne, C.-S., Kazmierczak, M., Souday, R., Horesh, D., Lambregtse-van den Berg, M., Weigl, T., Horsch, A., Oosterman, M., Dikmen-Yildiz, P., Garthus-Niegel, S., 2022. Prevalence and risk factors of birth-related posttraumatic stress among parents: a comparative systematic review and meta-analysis. Clin. Psychol. Rev. 94, 102157 https://doi.org/10.1016/j.cpr.2022.102157.

Hobfoll, S.E., 1989. Conservation of resources: a new attempt at conceptualizing stress. Am. Psychol. 44, 513–524. https://doi.org/10.1037/0003-066X.44.3.513.

Horesh, D., Garthus-Niegel, S., Horsch, A., 2021. Childbirth-related PTSD: is it a unique post-traumatic disorder? J. Reprod. Infant Psychol. 39, 221–224. https://doi.org/10.1080/02646838.2021.1930739.

Horesh, D., Kapel Lev-Ari, R., Hasson-Ohayon, I., 2020. Risk factors for psychological distress during the COVID-19 pandemic in Israel: loneliness, age, gender, and health status play an important role. Br. J. Health Psychol. 25, 925–933. https://doi.org/10.1111/bjhp.12455.

Horesh, D., Nukrian, M., Bialik, Y., 2018. To lose an unborn child: post-traumatic stress disorder and major depressive disorder following pregnancy loss among Israeli women. Gen. Hosp. Psychiatry 53, 95–100. https://doi.org/10.1016/j.genhosppsych.2018.02.003.

Horowitz, M., Wilner, N., Alvarez, W., 1979. Impact of Event Scale: a measure of subjective stress. Psychosom. Med. 41, 209–218. https://doi.org/10.1097/00006842-197905000-00004.

Horsch, A., Garthus-Niegel, S., 2020. Posttraumatic stress disorder following childbirth. In: Pickles, C., Herring, J. (Eds.), Childbirth, Vulnerability and Law. Routledge, London and New York,, pp. 49–66.

Horsch, A., Jacobs, I., McKenzie-McHarg, K., 2015. Cognitive predictors and risk factors of PTSD following stillbirth: a short-term longitudinal study. J. Trauma Stress 28, 110–117. https://doi.org/10.1002/jts.21997.

Kjeldgaard, H.K., Vikanes, Å., Benth, J.Š., Junge, C., Garthus-Niegel, S., Eberhard-Gran, M., 2019. The association between the degree of nausea in pregnancy and subsequent posttraumatic stress. Arch Womens Ment Health 22, 493–501. https://doi.org/10.1007/s00737-018-0909-z.

Lawton, M.P., 2001. Emotion in later life. Curr. Dir. Psychol. Sci. 10, 120–123. https://doi.org/10.1111/1467-8721.00130.

McKeever, V.M., Huff, M.E., 2003. A diathesis-stress model of posttraumatic stress disorder: ecological, biological, and residual stress pathways. Rev. Gen. Psychol. 7, 237–250. https://doi.org/10.1037/1089-2680.7.3.237.

Modarres, M., Afrasiabi, S., Rahnama, P., Montazeri, A., 2012. Prevalence and risk factors of childbirth-related post-traumatic stress symptoms. BMC Pregnancy Childbirth 12, 88. https://doi.org/10.1186/1471-2393-12-88.

Muthén, L.K., Muthén, B.O., 2015. Mplus User's Guide, 6th ed. Muthén & Muthén, Los Angeles, CA.

Neal, L.A., Busuttil, W., Rollins, J., Herepath, R., Strike, P., Turnbull, G., 1994. Convergent validity of measures of post-traumatic stress disorder in a mixed military and civilian population. J. Trauma Stress 7, 447–455. https://doi.org/10.1007/BF02102789.

Nettelbladt, P., Hansson, L., Stefansson, C.G., Borgquist, L., Nordström, G., 1993. Test characteristics of the Hopkins Symptom Check List-25 (HSCL-25) in Sweden, using the Present State Examination (PSE-9) as a caseness criterion. Soc. Psychiatry Psychiatr. Epidemiol. 28, 130–133. https://doi.org/10.1007/BF00801743.

Olde, E., Kleber, R.J., van der Hart, O., Pop, V.J.M., 2006. Childbirth and posttraumatic stress responses. Eur. J. Psychol. Assess. 22, 259–267. https://doi.org/10.1027/1015-5759.22.4.259.

Oliveira, A.G.E.S., Reichenheim, M.E., Moraes, C.L., Howard, L.M., Lobato, G., 2017. Childhood sexual abuse, intimate partner violence during pregnancy, and posttraumatic stress symptoms following childbirth: a path analysis. Arch. Womens Ment. Health 20, 297–309. https://doi.org/10.1007/s00737-016-0705-6.

Polachek, I.S., Harari, L.H., Baum, M., Strous, R.D., 2012. Postpartum post-traumatic stress disorder symptoms: the uninvited birth companion. Isr. Med. Assoc. J. 14, 347–353.

Price, L., Centifanti, L., Slade, P., 2020. Personality factors and vulnerability to post-traumatic stress responses after childbirth. Br. J. Clin. Psychol. 59, 480–502. https://doi.org/10.1111/bjc.12262.

Schwarz, G., 1978. Estimating the dimension of a model. Ann. Stat. 6 https://doi.org/10.1214/aos/1176344136.

Shaban, Z., Dolatian, M., Shams, J., Alavi-Majd, H., Mahmoodi, Z., Sajjadi, H., 2013. Post-Traumatic Stress Disorder (PTSD) following childbirth: prevalence and contributing factors. Iran Red. Crescent Med. J. 15, 177–182. https://doi.org/10.5812/ircmj.2312.

Sheehan, D.v, Lecrubier, Y., Sheehan, K.H., Amorim, P., Janavs, J., Weiller, E., Hergueta, T., Baker, R., Dunbar, G.C., 1998. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. J. Clin. Psychiatry 59 (Suppl 20), 22–33.

StataCorp, 2015. Stata Statistical Software: Release 14.

Stuijfzand, S., Garthus-Niegel, S., Horsch, A., 2020. Parental birth-related PTSD symptoms and bonding in the early postpartum period: a prospective population-based cohort study. Front. Psychiatry 11. https://doi.org/10.3389/fpsyt.2020.570727.

Thiel, F., Iffland, L., Drozd, F., Haga, S.M., Martini, J., Weidner, K., Eberhard-Gran, M., Garthus-Niegel, S., 2020. Specific relations of dimensional anxiety and manifest anxiety disorders during pregnancy with difficult early infant temperament: a longitudinal cohort study. Arch. Womens Ment. Health 23, 535–546. https://doi.org/10.1007/s00737-019-01015-w.

Vuong, Q.H., 1989. Likelihood ratio tests for model selection and non-nested hypotheses. Econometrica 57, 307. https://doi.org/10.2307/1912557.

White, T., Matthey, S., Boyd, K., Barnett, B., 2006. Postnatal depression and post-traumatic stress after childbirth: prevalence, course and co-occurrence. J. Reprod. Infant Psychol. 24, 107–120. https://doi.org/10.1080/02646830600643874.

Wijma, K., Wijma, B., Zar, M., 1998. Psychometric aspects of the W-DEQ; a new questionnaire for the measurement of fear of childbirth. J. Psychosom. Obstet. Gynaecol. 19, 84–97. https://doi.org/10.3109/01674829809048501.