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ORIGINAL ARTICLE

Posttraumatic stress symptoms following childbirth: associations with prenatal attachment in subsequent pregnancies

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Abstract

This longitudinal population-based study aimed to investigate the prospective relationship between PTSD symptoms following childbirth and prenatal attachment in the subsequent pregnancy. Data were derived from the Norwegian Akershus Birth Cohort (ABC), a large population-based prospective cohort study. Data from 1473 women who had given birth at least once before and who had completed questionnaires at 17 and 32 weeks of gestation were included. Confirmatory factor analysis of the short version of the Prenatal Attachment Inventory was conducted to validate the scale. Further, structural equation modeling techniques were used to estimate prospective associations of PTSD symptoms following childbirth with prenatal attachment. Finally, to explore potential mechanisms of the association, mediation and moderation analyses were conducted. PTSD symptoms following previous childbirth were found to be prospectively related to higher levels of prenatal attachment in the subsequent pregnancy, while controlling for important confounding factors, such as symptoms of maternal depression and anxiety, previous pregnancy loss, and sociodemographic factors (maternal age, educational level, marital status, and number of children). When fear of childbirth was included as a potential mediating variable, the prospective relationship between PTSD symptoms following childbirth and prenatal attachment in the subsequent pregnancy increased, thereby indicating a suppressor effect. Fear of childbirth did not act as a significant moderator. Our findings suggest that a subsequent pregnancy following a traumatic childbirth may for some women represent an opportunity for a higher level of prenatal attachment, whereas high levels of fear of childbirth may be detrimental for prenatal attachment.

Keywords Posttraumatic stress disorder · PTSD following childbirth · Prenatal attachment · Fear of childbirth · Akershus Birth Cohort

Susan Garthus-Niegel and Antje Horsch contributed equally to this work.

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Introduction

Attachment represents a bond that motivates a mother to provide care for her unborn child even during pregnancy (Bowlby 2005; Brandon et al. 2009; Figueiredo et al. 2009). Thoughts and feelings directed towards the expected baby initiate this attachment process (Brodén 2007), representing an important developmental task for the transition to parenthood (Van den Bergh and Simons 2009). This "prenatal attachment" or "maternal-fetal relationship" refers to the "extent to which women engage in behaviors that represent an affiliation or an interaction with their unborn child" (Cranley 1981, p. 282; Walsh 2010).

In contrast to attachment following birth, prenatal attachment is "uni-directional, embodying maternal or paternal cognitions and emotional responses to the pregnancy and the growing fetus" (Redshaw and Martin 2013, p. 220), and has been shown to increase as gestation progresses (Cannella 2005; Muller and Mercer 1993). In an attempt to develop a theory of maternal prenatal attachment, Rubin (1984) identified tasks women engage in before childbirth: one is the process of "binding-in" during which the woman needs to incorporate the idea of her child into her system of self, thus developing a sense of "we-ness." In fact, growing evidence underscores the importance of prenatal attachment, which is associated with, for example, the mother's health practices during pregnancy, neonatal outcomes, and postpartum attachment (Alhusen et al. 2012b).

Prenatal attachment has been shown to be influenced by several factors such as maternal mental health. For example, depression predicted lower intensity, lack of normal intensification with increasing gestation, and more negative content of prenatal attachment (Alhusen et al. 2012a; Hart and McMahon 2006; Hjelmstedt et al. 2006; Rubertsson et al. 2015). Similarly, trait anxiety was negatively related to prenatal attachment (Hart and McMahon 2006). A meta-analysis, however, found low effect sizes regarding the predictive power of maternal depression and anxiety in relation to prenatal attachment (Yarcheski et al. 2009). The same meta-analysis also illustrated low effect sizes for sociodemographic variables such as maternal age, education, and marital status when predicting prenatal attachment (Yarcheski et al. 2009). Still, to our knowledge, no study has specifically investigated the impact of maternal posttraumatic stress disorder (PTSD) following childbirth on prenatal attachment in a subsequent pregnancy.

A difficult birth experience can result in PTSD, including re-experiencing, avoidance of reminders of the traumatic event, negative mood and cognitions, and hyperarousal (APA 2013). Approximately 3–4% of women in low-risk samples meet diagnostic criteria, while around 16% of women in high-risk samples are diagnosed with PTSD after childbirth (Grekin and O'Hara 2014; Yildiz et al. 2017). A substantial number of women suffers from clinically significant PTSD symptoms, even though their symptoms remain below diagnostic threshold level (Horsch and Ayers 2016).

Women with a negative experience of their childbirth report a longer delay until the next pregnancy and have fewer subsequent children compared with women who had a positive birth experience, with median time until next pregnancy of 4.2 vs. 2.4 years (Gottvall and Waldenstrom 2002). Some research shows that PTSD following childbirth interferes with the mother-infant attachment relationship, although the evidence is still inconclusive (Cook et al. 2017). For example, one study found that maternal PTSD symptoms following childbirth were associated with distorted, inflexible, and negative mental representations of their children and a range of insensitive caregiving behaviors predictive of insecure attachment (Davies et al. 2008). However, studies focusing on the prenatal attachment relationship with the developing fetus during subsequent pregnancies are missing.

PTSD symptoms following childbirth may also lead to developing a fear of childbirth during subsequent pregnancies. Although apprehension regarding childbirth during pregnancy is natural, fear of childbirth is a continuum from no to extreme fear, and the extent of interference of functioning in the woman's daily life is a key criterion (Ryding et al. 2007). There is no universal definition of this phenomenon but the focus of the fear may revolve around different aspects of the birth process, such as fear of experiencing intolerable pain, fear of not being accompanied adequately by competent professionals, concerns about one's body failing, or concerns about the infant (Garthus-Niegel et al. 2011; Preis et al. 2018; Sjogren 1997). Fear of childbirth may also negatively impact prenatal attachment. So far, research investigating the complex role fear of childbirth plays in the effects of PTSD symptoms following childbirth on developing prenatal attachment in later pregnancies is lacking. On the one hand, fear of childbirth may be a mediator because PTSD symptoms following childbirth may lead to higher symptoms of fear of childbirth during subsequent pregnancies, which may negatively interfere with their prenatal attachment. On the other hand, fear of childbirth may function as a moderator, because PTSD symptoms following a previous birth may be particularly strongly related to reduced prenatal attachment for women who experience high levels of fear of childbirth.

This longitudinal population-based study aimed to investigate the prospective relationship between PTSD symptoms following childbirth and prenatal attachment in the subsequent pregnancy, while controlling for important confounding factors. Moreover, the study aimed to provide a detailed account of how whether fear of childbirth may have a mediating or moderating role in the association of PTSD symptoms following childbirth with prenatal attachment.

Materials and methods

Procedure and participants

Data were derived from the Norwegian Akershus Birth Cohort (ABC), a large population-based prospective cohort study. All women scheduled to give birth at Akershus University Hospital between November 2008 and April 2010, with sufficient Norwegian language skills to complete questionnaires, were eligible to participate. There were no exclusion criteria regarding obstetric risk factors. In fact, the proportion of obstetric complications was comparable with data reported in the Medical Birth Registry of Norway, indicating that with regard to obstetric complications, our study population is representative of the total population of women in Norway (Statistics Norway 2017; Storksen et al. 2013). Recruitment took place during the routine fetal ultrasound examination at 17 weeks of gestation and the participating women were asked to complete questionnaires at this time point and at several follow-ups. Additional information on the pregnancies and births was obtained by linkage to the electronic birth records. The doctor or midwife in charge of the birth completed the birth records. Of 4690 eligible women, 80% (n = 3752) agreed to participate and returned the first questionnaire. During the time between T1 (17 weeks of gestation) and T2 (32 weeks of gestation), some women had moved or were withdrawn from the study due to medical reasons. Of the remaining 3621 women, 81% (n = 2936) returned the second questionnaire. Regarding dropout, we performed attrition analyses. More specifically, we included relevant socio-demographic and mental health variables (i.e., maternal age, educational level, and symptoms of depression, anxiety, and general PTSD symptoms) as predictors of dropout between T1 and T2 in multiple logistic regression analyses. The results showed that older women were less likely to drop out of the study (odds ratio (OR) = 0.97, 95% confidence interval (CI) .94–1.0, $p < 0.05$), whereas women with higher symptom levels of depression were somewhat more likely to drop out (OR = 1.04, 95% CI 1.01–1.08, $p < 0.05$). Educational level and symptoms of anxiety and general PTSD were not significantly related to dropout ($p > 0.05$). Further information regarding participation and study dropout has been published elsewhere (Garthus-Niegel et al. 2015; 2017). For the current study, data from women who completed self-report questionnaires at 17 and 32 weeks of gestation and had given birth at least once before they were included, yielding a sample of 1473 women.

The ABC study obtained ethical approval from the Regional Committees for Medical and Health Research Ethics (approval number S-08013a), and all participants provided written informed consent.

Measures

Prenatal attachment

Prenatal attachment was assessed at 32 weeks of gestation using a short version of the Prenatal Attachment Inventory (Muller 1993). The instrument is a self-rating scale designed to measure "the unique, affectionate relationship that develops between a woman and her fetus" (Muller 1993, p. 201). Response categories ranged from 1 (*almost never*) to 4 (*almost always*), with higher scores reflecting a greater degree of prenatal attachment to the unborn child. For the short version, items 1, 4, 7, 9, 10, 12, 14, 16, and 18 were included, and thus sum scores may range from 9 to 36. Reliability in the present study was $\alpha = 0.88$.

PTSD symptoms

At 17 weeks of gestation, the Impact of Event Scale (IES; Horowitz et al. 1979) was used to measure PTSD symptoms in relation to previous childbirth, among women who had given birth before. The instrument is a self-report scale that measures symptoms of intrusion (7 items) and avoidance (8 items). The scale has four response categories with the following weightings: 0 = *not at all*, 1 = *rarely*, 3 = *sometimes*, and 5 = *often*. Sum scores may range from 0 to 75, with higher scores reflecting a greater degree of posttraumatic stress, and a score above 34 indicates PTSD to be likely present (Neal et al. 1994). Reliability in the present study was $\alpha = 0.88$.

Fear of childbirth

Fear of childbirth was assessed at 32 weeks of gestation using the Wijma Delivery Expectancy/Experience Questionnaire (W-DEQ, version A; (Wijma et al. 1998). This is the most frequently used instrument to measure fear of childbirth. The W-DEQ, version A, measures fear of childbirth as operationalized by cognitive appraisal of the approaching delivery. The 33-item rating scale has six response categories ranging from 0 to 5. Sum scores can have a minimum score of 0 and a maximum score of 165, with higher scores reflecting a greater degree of fear of childbirth. Reliability in the current study was $\alpha = 0.96$.

Potential confounding factors

Information on maternal age, educational level (0 = < 12 years of education, 1 = ≥ 12 years), and marital status (0 = single/separated/divorced, 1 = married/cohabitating) was retrieved from electronic birth records. Moreover, information

regarding history of pregnancy loss was obtained from electronic birth records, that is, whether the women in our sample at some point in life had had a spontaneous abortion, any time from early pregnancy up to 23 weeks of gestation (0 = no, 1 = yes). Furthermore, number of children before the current pregnancy was assessed at 17 weeks of gestation, based on maternal report.

Symptoms of depression were measured using the validated Norwegian version of the Edinburgh Postnatal Depression Scale (EPDS; Eberhard-Gran et al. 2001) at 17 weeks of gestation. The EPDS is a 10-item self-report instrument used to assess depressive symptomatology in the last 7 days, during pregnancy and postpartum. Items are rated on a 4-point Likert scale from 0 to 3 to produce a sum score ranging from 0 to 30, with higher scores indicating more depressive symptoms and an elevated risk for perinatal depression (Cox et al. 1987). Reliability in the current study was $\alpha = 0.84$.

Anxiety symptoms during the previous week were measured at 17 weeks of gestation with the 10-item anxiety scale of the Hopkins Symptom Checklist (Nettelbladt et al. 1993). The scale has four response categories ranging from 1 to 4, with higher scores indicating higher levels of anxiety. The sum score for anxiety may range from 10 to 40. Reliability in our sample was $\alpha = 0.76$.

Data analysis

Analyses were conducted in the framework of structural equation modeling (Bollen 1989), using Mplus v8 (Muthén and Muthén 1998-2017). We conducted a confirmatory factor analysis to validate the short version of the PAI. Correlation analyses were conducted to study the bivariate associations among all included variables. Moreover, PTSD symptoms and those variables that were significantly correlated with prenatal attachment were entered simultaneously into structural equation analyses, thereby estimating unique contributions of predictor variables on the latent prenatal attachment factor as constructed by confirmatory factor analysis. Further, mediation and moderation analyses were carried out. Maximum likelihood estimations robust to deviations from normality were used. Missing analyses showed that item missingness for the psychometric variables (i.e., prenatal attachment, PTSD symptoms, fear of childbirth, and symptoms of depression and anxiety) ranged from 0.2% missing for symptoms of depression to 1.5% missing for fear of childbirth and symptoms of anxiety. The proportion of missing data for the sociodemographic variables (i.e., maternal age, educational level, marital status, history of pregnancy loss, and number of children) varied from 0% for history of pregnancy loss and number of children to 6.9% for educational level. Missing data were accounted for by using full information maximum likelihood (FIML) under the usual missing at random assumptions underlying longitudinal designs (Schafer and Graham 2002). We note that the correlates included in our models represent attrition informative variables and so helped to accommodate longitudinal selectivity under the assumption that incomplete data were missing at random, i.e., missingness may have been related to these variables (McArdle 1994).

Results

Mean maternal age at birth was 32.82 (SD = 4.21) years (see Table 1). A total of 65.3% of women had an educational level beyond high school, and 98.9% reported to be married or cohabiting. At 17 weeks of gestation, 3.2% ($n = 47$) of all participating women had self-reported PTSD symptoms following childbirth, defined by scores above 34, as has been suggested and done previously (Garthus-Niegel et al. 2013, 2014a, b, 2015, 2017, 2018a, b; c; Neal et al. 1994). The mean IES score was 7.43 (SD = 9.53), scores ranged between 0 and 65 in the entire study sample and between 34 and 65 among the women scoring above the cutoff of 34. The mean prenatal attachment score was 23.74 (SD = 5.02). *T* tests showed that women with high levels of self-reported PTSD symptoms following childbirth had a significantly higher mean prenatal attachment score compared to women scoring below the cutoff of 34 ($M = 25.67$, SD = 5.70 and $M = 23.67$; SD = 4.99, respectively, $t = 2.67$, $p < 0.01$). The difference between women with high levels of PTSD symptoms and other women was small to medium in size, as indicated by a Cohen's *d* of 0.37. Moreover, women with a high PTSD symptom load had significantly higher levels of fear of childbirth than those scoring below the cutoff ($M = 82.19$, SD = 22.08 and $M = 53.17$; SD = 20.11, respectively, $t = 9.40$, $p < .01$), with a large effect size of $d = 1.37$.

The confirmatory factor analysis of the short version of the PAI showed an acceptable fit for a one-factor solution (see Fig. 1; root mean square error of approximation (RMSEA) = 0.063, comparative fit index (CFI) = 0.95, Tucker–Lewis index (TLI) = 0.93). Symptoms of PTSD following previous childbirth were positively related to prenatal attachment in the subsequent pregnancy (i.e., women with higher PTSD symptom levels reported higher levels of future prenatal attachment). Moreover, symptoms of depression and anxiety were positively related to the outcome. On the other hand, fear of childbirth was negatively related to prenatal attachment. Further, higher maternal age and education were negatively related to the outcome (Table 1).

Next, the association between PTSD symptoms following childbirth and prenatal attachment was examined in more detail. First, a structural equation model was constructed, where PTSD symptoms predicted the latent factor of prenatal attachment without including covariates. Results showed a

Table 1 Descriptive statistics and intercorrelations for all variables under study

Measures	Mean ± SD or %	Intercorrelations								
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Prenatal attachment	23.74 ± 5.02									
(2) PTSD symptoms	7.38 ± 9.68	0.15***								
(3) Fear of childbirth	54.05 ± 20.77	− 0.08**	0.46***							
(4) Depression symptoms	4.20 ± 4.11	0.11***	0.30***	0.30***						
(5) Anxiety symptoms	12.78 ± 3.00	0.14***	0.32***	0.26***	0.65***					
(6) Previous pregnancy loss	29.6%	0.05	0.06*	0.07**	0.06*	0.03				
(7) Maternal age	32.82 ± 4.21	− 0.11***	− 0.09**	0.08**	− 0.11***	− 0.17***	0.16***			
(8) Educational level > 12 years	65.3%	− 0.15***	− 0.07**	0.01	− 0.10***	− 0.18***	− 0.02	0.24***		
(9) Marital status married/cohabitating	98.8%	0.04	− 0.05*	− 0.08**	− 0.17***	− 0.11***	− 0.01	0.02	0.10***	
(10) Number of children	1.28 ± 0.58	− 0.01	− 0.06*	− 0.06*	− 0.01	0.01	0.10***	0.26***	− 0.07*	0.00

SD = standard deviation

PTSD = posttraumatic stress disorder

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

significantly positive association ($\beta = 0.15$, $p < 0.01$). Second, we included all potential covariates that were significantly correlated with prenatal attachment as additional predictors to examine whether the association between PTSD symptoms and prenatal attachment remained significant, even when controlling for relevant covariates. The results showed a somewhat reduced relationship ($\beta = 0.11$, $p < 0.01$, see Table 2, model 1). Regarding the confounding factors, symptoms of depression and anxiety were no longer associated with prenatal attachment in the multivariate analyses, while maternal age and educational level remained significantly associated (Table 2, model 1). Third, fear of childbirth was additionally controlled for. In this model, only PTSD symptoms, fear of childbirth, and educational level were significantly associated with the outcome variable (see Table 2, model 2). Surprisingly, the positive association of PTSD symptoms with prenatal attachment increased substantially, from $\beta = 0.11$ to 0.19, when including fear of childbirth as an additional covariate (Table 2, model 2). The results thus indicated that fear of childbirth functioned as a suppressor. Consequently, we conducted indirect effect analyses, comparable to mediation analyses (MacKinnon et al. 2000) to test for a suppressor effect. This analysis yielded a significant indirect effect from PTSD symptoms to prenatal attachment via fear of childbirth, confirming a significant suppressor effect (Fig. 2). Finally, we examined whether the association of PTSD symptoms with prenatal attachment varied according to the level of fear of childbirth by including an interaction term as predictor in the structural equation model. Results showed no such moderation effect ($p = 0.26$).

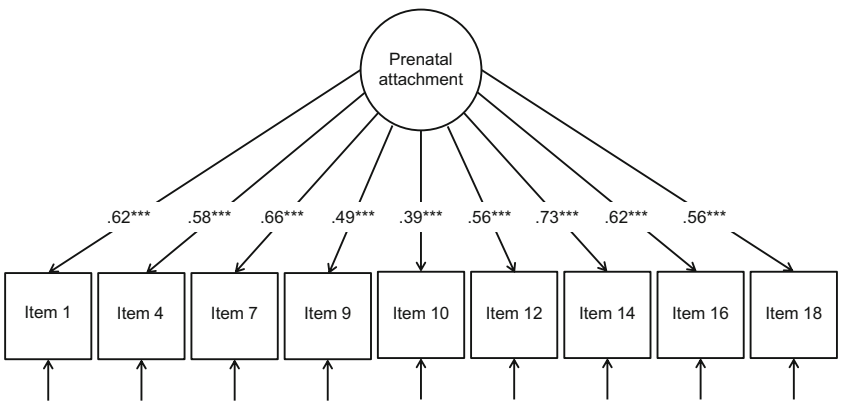

Fig. 1 Confirmatory factor analysis of the short version of the Prenatal Attachment Inventory. RMSEA = 0.063, CFI = 0.95, TLI = 0.93; ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$. Item 1: "I wonder what the baby looks like now." Item 4: "I think that my baby already has a personality." Item 7: "I plan the things I will do with my baby." Item 9: "I imagine what part of the baby I'm touching." Item 10: "I know when the baby is asleep." Item 12: "I feel love for the baby." Item 14: "I dream about the baby." Item 16: "I stroke the baby through my tummy." Item 18: "I get very excited when I think about the baby."

Table 2 Results from structural equation modeling predicting the latent factor of prenatal attachment

Predictors	Model 1 β	Model 2 β
PTSD symptoms	**0.11****	**0.19*****
Depression symptoms	0.01	0.05
Anxiety symptoms	0.06	0.07
Maternal age	− 0.07*	− 0.04
Educational level	− 0.11***	− 0.11***
Fear of childbirth	–	− 0.19***

Model 1: multivariate model examining the association between PTSD symptoms and prenatal attachment, simultaneously adjusting for covariates that were significantly correlated with prenatal attachment (i.e., depression symptoms, anxiety symptoms, maternal age, and educational level)

Model 2: multivariate model examining the association between PTSD symptoms and prenatal attachment, simultaneously adjusting for covariates that were significantly correlated with prenatal attachment (i.e., depression symptoms, anxiety symptoms, maternal age, and educational level) plus additionally controlling for fear of childbirth

β = standardized regression coefficient

PTSD = posttraumatic stress disorder

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Discussion

The results of this longitudinal population-based study showed self-reported PTSD symptoms following previous childbirth prospectively predicted higher levels of prenatal attachment in the subsequent pregnancy, while controlling for important confounding factors, such as symptoms of maternal depression and anxiety and sociodemographic factors. Moreover, we found fear of childbirth suppressed this effect, thereby increasing the positive prospective relationship between PTSD symptoms following childbirth and prenatal attachment in the subsequent pregnancy. Interaction analyses showed further that fear of childbirth did not function as a moderator, thereby indicating that the relationship between PTSD symptoms following childbirth and prenatal attachment is stable, independent of changing levels of fear of childbirth.

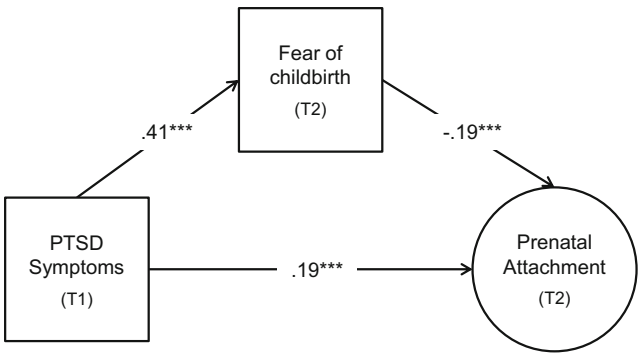

Fig. 2 Mediation model with fear of childbirth mediating the effect of PTSD symptoms on prenatal attachment. RMSEA = 0.046, CFI = 0.94, TLI = 0.92; ***$p \leq 0.001$, **$p \leq 0.01$, *$p \leq 0.05$. Standardized indirect effect from PTSD symptoms to prenatal attachment via fear of childbirth = −0.078***. Measurement points: PTSD symptoms were assessed at T1, 17 weeks of gestation, and fear of childbirth as well as prenatal attachment were assessed at T2, 32 weeks of gestation. The mediation model has been adjusted for the following covariates: depression symptoms, anxiety symptoms, maternal age, and educational level

It is not clear why PTSD symptoms following childbirth are associated with greater prenatal attachment in a subsequent pregnancy but there are many possible explanations. One possible explanation may be that women who felt they and/or their baby's lives were threatened during a previous birth feel more strongly protective and attached to the fetus/baby during their next pregnancy. Prenatal attachment also represents positive cognitions and emotional responses to the pregnancy, the developing fetus, and the future baby, in other words, future-related mental imagery (Favrod et al. 2018). This positive vision of the future is in stark contrast to the negative and distressing intrusive images linked to the previous traumatic childbirth experience in women with PTSD. It is possible that engaging in positive future-related mental imagery in relation to the pregnancy and fetus may serve as a stimulus discrimination technique (Ehlers et al. 2005) that helps women manage their previous traumatic childbirth experience by grounding them in the "here and now." This may, in turn, increase a sense of healing and hope in relation to future childbirth and their relationship with their future baby.

It is also possible that women in our sample experienced posttraumatic growth (i.e., "positive changes in beliefs or functioning as a result of challenging life events or circumstances"; (Tedeschi et al. 1998), which may have positively impacted the prenatal attachment relationship. Posttraumatic growth is higher in women who report higher levels of PTSD following childbirth (Sawyer et al. 2012, 2015) and includes a greater appreciation of life and relationships with others (Sawyer and Ayers 2009; Sawyer et al. 2012). This might also include the prenatal attachment relationship. Our findings suggest that, for some women, a subsequent pregnancy following a traumatic childbirth may also represent an opportunity for healing, particularly for those with lower levels of fear of childbirth. This would be in line with findings of a qualitative study reporting themes such as "strategizing: attempts to reclaim their body and complete the journey to motherhood," "bringing reverence to the birthing process and empowering women," and "still elusive: the longed-for healing birth experience" (Beck and Watson 2010). Evidence shows that following a negative childbirth experience, women delay having children (Gottvall and Waldenstrom 2002). However, those who decide to become pregnant again may consciously invest in this new pregnancy and attachment with the growing fetus to compensate for a previous traumatic experience and to give their baby "a good start." Evidence shows that unique prenatal and postnatal attachment relationships are formed during each

pregnancy (Brandon et al. 2009). Investing in the prenatal attachment during this new pregnancy may help compensate for the traumatic birth experience and possible attachment difficulties the mother may have experienced with her previous child resulting from the traumatic childbirth experience (Cook et al. 2017).

Further, the suppressor effect of fear of childbirth may indicate yet another pathway as to how PTSD symptoms following childbirth are related to prenatal attachment. Mediation analyses in fact showed that PTSD symptoms following childbirth had an indirect negative effect on prenatal attachment, because PTSD symptoms following childbirth were substantially related to higher levels of fear of childbirth, which in turn were negatively related to prenatal attachment. Findings from the mediation analyses thus indicate that aspects of PTSD symptoms following childbirth may lead to lower degrees of prenatal attachment through indirect paths, even though PTSD symptoms following childbirth are overall positively related to prenatal attachment. The negative association may partly be explained by the fact that the focus of the fear revolves not only around different aspects of the birth process, such as fear of experiencing intolerable pain, fear of not being accompanied adequately by competent professionals, or concerns about one's body failing, but also around concerns about the unborn infant (Garthus-Niegel et al. 2011; Preis et al. 2018; Sjogren 1997). It is possible that these concerns regarding the unborn infant may interfere with developing a prenatal attachment relationship, particularly in women following traumatic childbirth who are prone to have higher symptoms of fear of childbirth in the subsequent pregnancy (Storksen et al. 2013).

One limitation of our study is our relatively homogeneous, Norwegian-speaking, mainly Caucasian sample. Also, compared to the general population of women giving birth in Norway, participants in the Akershus Birth Cohort Study were older, more often first-time mothers, and less likely to smoke or to be single than non-participants. The prevalence of elective cesarean section was slightly lower compared to national data from the Medical Birth Registry (Statistics Norway 2017). Nevertheless, it is important to bear in mind that selection bias does not necessarily influence the results when associations between variables are investigated (Nilsen et al. 2009). Moreover, there was somewhat selective attrition during the longitudinal course of the study, as demonstrated by attrition analyses. However, analyses were performed with missing data routines that have been recommended in the methodological literature in order to accommodate such longitudinal selectivity (Schafer and Graham 2002). Our sample may also suffer from a survivorship bias, i.e., women who coped relatively well following their traumatic childbirth, as women with severe PTSD symptoms may have chosen not to have another baby.

Further, measurement issues need to be considered. We employed the Prenatal Attachment Inventory, for which a previous study published after the conception of the current study identified a three-factor solution. However, our short version showed a good fit in the confirmatory factor analysis, thus indicating a reliable measure of prenatal attachment. The level of current PTSD symptoms in our sample was relatively low. It is possible that a sample exhibiting higher PTSD symptoms may have reported more negative effects on their prenatal attachment (Bosquet Enlow et al. 2014). Moreover, our measure of PTSD provides limited information about whether the trauma was associated to threats to the baby or the mother's own life. It is possible that the association between PTSD symptoms and prenatal attachment may differ depending on the nature of the threat and whether the baby was associated with the trauma or not. Moreover, although the W-DEQ is a standard and validated questionnaire for the assessment of fear of childbirth, it does not measure the extent of interference of functioning in the woman's daily life, even though such interference has previously been highlighted as an important characteristic of fear of childbirth (Ryding et al. 2007). Also, while the independent variable (i.e., PTSD symptoms following childbirth) was assessed before the mediator (i.e., fear of childbirth), a limitation of our study is that the mediator and the outcome variable (i.e., prenatal attachment) were assessed concurrently. Hence, the study design does not provide conclusive information about the temporal order of the two variables.

Finally, we cannot exclude that participants received treatment following their previous traumatic childbirth. It is possible that those with elevated PTSD symptoms received some form of treatment or are currently in treatment. Therefore, it would be important to test that the positive association between PTSD and prenatal attachment still holds when controlling for treatment status. Nevertheless, the likelihood of study participants having received treatment for PTSD following childbirth is rather small, given the short interval between the two assessment points and the fact that birth trauma is usually undetected and women do not receive timely and adequate treatment (Ayers et al. 2018).

Our results have important clinical implications, as they suggest that a subsequent pregnancy following a traumatic childbirth experience may for some women represent an opportunity for greater prenatal attachment in a subsequent pregnancy. This represents a positive message for women in this situation who hesitate to embark on another pregnancy, and may give them much needed hope. Future studies are needed to investigate whether PTSD following childbirth is not only related to prenatal attachment but also influences the mother-child attachment.

Conclusions

This study found a prospective positive relationship between PTSD symptoms following previous childbirth and prenatal attachment in the subsequent pregnancy, while controlling for important confounding factors. In the mediation model, with fear of childbirth as mediating variable, a significant suppressor effect was found, increasing the positive prospective relationship between PTSD symptoms following childbirth and prenatal attachment in the subsequent pregnancy. Our findings may suggest that a subsequent pregnancy following a traumatic childbirth may, for some women, also represent an opportunity for good prenatal attachment.

Contributors' statements SGN and AH contributed to the conception and design of the study; AH did the literature search; SGN performed the statistical analysis; SGN and AH wrote the first draft of the manuscript; TvS contributed with his statistical expertise and his expertise in the research field; SA, SMH, and FD contributed with their expertise in the research field; MEG designed the data collection instruments, coordinated, and supervised data collection. All authors contributed to manuscript revision, read, and approved the submitted version.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent Informed consent was obtained from all individual participants included in the study.

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