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Fathers with PTSD and depression in pregnancies complicated by preterm preeclampsia or PPROM

Claire A. I. Stramrood · Bennard Doornbos · Ineke Wessel · Marloes van Geenen · Jan G. Aarnoudse · Paul P. van den Berg · Willibrord C. M. Weijmar Schultz · Maria G. van Pampus

Abstract

Purpose To assess prevalence and risk factors for post-traumatic stress disorder (PTSD) and depression in fathers after early preeclampsia (PE) or preterm premature rupture of membranes (PPROM).

Methods Partners of patients hospitalized for PE or PPROM and partners of healthy controls completed PTSD (PSS-SR) and depression (BDI-II) questionnaires during pregnancy \( t_1 \) and 6 weeks postpartum \( t_2 \). 85 of the 187 eligible men participated (51 partners of patients, 34 partners of control) at \( t_1 \), and 66 men participated both time points.

Results No significant differences were found between partners of patients and partners of controls in symptoms of PTSD and depression \( t_1: p = 0.28 \) for PTSD and \( p = 0.34 \) for depression; \( t_2: p = 0.08 \) for PTSD and \( p = 0.31 \) for depression). For partners of patients, correlation between PTSD and depression sum-scores was 0.48 \( (p < 0.001) \) at \( t_1 \) and 0.86 \( (p < 0.001) \) at \( t_2 \). Within-couple correlation was low and not significant during pregnancy, but strong at postpartum (PSS-SR: \( r = 0.62, p < 0.001 \); BDI-II: \( r = 0.59, p < 0.001 \)). Higher paternal age was associated with more symptoms of PTSD and depression postpartum in partners of patients. Symptoms of PTSD and depression during pregnancy predicted the occurrence of PTSD symptoms following childbirth in partners of patients.

Conclusions Symptoms of PTSD and depression occurred at a similar rate in partners of women with PE or PPROM and partners of healthy pregnant controls. Symptoms of PTSD and depression during pregnancy predicted the occurrence of PTSD symptoms following childbirth. Increased paternal age predicted more symptoms of PTSD and depression postpartum. At 6 weeks postpartum, a strong association was found between men and women in symptoms of PTSD and depression.

Keywords PTSD · Depression · Fathers · Postpartum · Preeclampsia · PPROM

Introduction

Depression affects roughly 12 % of women during pregnancy and 7 % postpartum [1], whereas posttraumatic stress disorder (PTSD) following childbirth and pregnancy occurs after 1–2 percent of deliveries [2, 3]. Next to affecting the well being of the woman, both postpartum depression (PPD) and PTSD may impair secure attachment of the infant and affect the partner relationship [4, 5]. Contrary to a commonly held belief, the birth of a child can
trigger the onset of mental problems and psychiatric illnesses in fathers as well [6], and their mental well being is known to affect the parent-child relationship, and child behavioral and emotional development [7–9].

Whether or not prevalence rates of depression are similar in men and women is under debate, as various studies find contradictory results [10–14]. A substantial amount of research has been carried out regarding postpartum depression in men, and a recent meta-analysis estimated the prevalence at 10.4 percent [15]. The strongest predictor for paternal depression is maternal postpartum depression, as it affects 24–50 % of the partners of women with postpartum depression [16].

A limited number of recent studies have investigated the occurrence of PTSD following childbirth in men. PTSD is an anxiety disorder that may develop following confrontation with a traumatic stressor, with three categories of characteristic symptoms: re-experiencing of the event, avoidance of stimuli associated with the event, and hyper-arousal [17]. The DSM-IV states that in order to qualify for PTSD, a traumatic event may also be witnessed (as partners do) rather than experienced (by the pregnant woman), but the actual experience of “threat to own life” is considered a strong predictor for the development of PTSD [18]. In a retrospective study by Bradley et al. [19], 199 fathers of healthy newborns who were present during the hospital birth were assessed 6 weeks following childbirth. No men were found to have PTSD, although 12 % reported symptoms on at least one of the three PTSD symptom categories. Clinically significant symptoms of depression and anxiety were found in 8 and 7 % of fathers, respectively. Skari et al. [10] included both mothers and fathers, and found significant levels of acute distress and intrusive symptoms (DSM-IV criterion C as measured with the Impact of Events Scale (IES) [20]) during the first 4 days after delivery. Symptoms were more frequent in women than in men, but no full constellation of PTSD symptoms was found in any subject. In a study by Ayers et al. [21], 5 % of women and men scored above the recommended cut-off for both avoidance and intrusion on the IES. Even though the similar rates in men and women are not in line with other literature, it is of interest that the six cases were two couples and two individuals, suggesting a concordance between couples, as is known from studies on postpartum depression. A recent study by Iles et al. [14] found that symptoms of PTSD were significantly related within couples, and that dissatisfaction with partner support and less secure attachment were associated with higher levels of posttraumatic stress and depression postpartum.

In women, several studies showed significantly higher PTSD rates after preterm delivery (due to various causes) compared to uncomplicated pregnancies [22–30]. Only one prior study has thus far looked at PTSD in partners of women with severe pregnancy complications. Pierrehumbert et al. [25] assessed PTSD in parents of infants born prematurely (25–33 weeks gestation). Both mothers and fathers were found to have more posttraumatic stress (symptoms) than parents of healthy infants born at term. In this retrospective study, parents were assessed 18 months after delivery. This is long, considering that the chance of other causes for PTSD increases with time, subsequent pregnancies and deliveries may have occurred in the mean time, and the longitudinal course of PTSD following childbirth is not sufficiently clear. Furthermore, the perinatal PTSD questionnaire (PPQ) used in Pierrehumbert’s study does not contain all DSM-IV criteria for PTSD, which has been noted as a point of concern [31]. In a study involving the current sample that we published recently [30], 14 % of women hospitalized for preeclampsia (PE) or preterm premature rupture of membranes (PPROM) fulfilled the DSM-IV criteria for PTSD on the PTSD Symptom Scale self-report questionnaire (PSS-SR) [32] at 6-week postpartum, and 11 % were at least moderately depressed based on the Beck Depression Inventory, second edition (BDI-II) [33]. These data, as well as the identified risk factors for women (history of depression, depressive symptoms during pregnancy, perinatal mortality) made us inquire into the mental well-being of partners of women with pregnancy complications.

The present study included three main research questions with corresponding hypotheses: (1) What is the occurrence of symptoms of PTSD and depression during pregnancy and postpartum, in partners of women with complicated pregnancies, as compared to partners of women with uneventful pregnancies. Based on the findings of our study of women with PE/PPROM and healthy pregnant controls [30], we hypothesized that partners of patients would report more symptoms of PTSD and depression than partners of controls; (2) Is there a relation between symptoms of PTSD and depression in women and men? We hypothesized a moderate to strong correlation between partners, both during pregnancy and postpartum; (3) Which factors predict the occurrence of symptoms of PTSD and depression in partners of patients at 6 weeks postpartum? Based on previous studies conducted among women, we hypothesized that demographic factors would not be related to psychiatric symptoms, but obstetric factors and symptoms of PTSD and depression during pregnancy would predict the occurrence of symptoms in men postpartum.

**Methods**

**Design and setting**

In this longitudinal study, pregnant women with PE or HELLP syndrome (hemolysis, elevated liver enzymes, low
platelets), and women with PPROM took part. PE was
defined according to the American Congress of Obstetri-
cians and Gynecologists’ (ACOG) practice bulletin on
preeclampsia and eclampsia [34]: a systolic blood pressure
of 140 mm Hg or more, or a diastolic blood pressure of
90 mm Hg or more, in a previously normotensive woman
after 20 weeks gestation, combined with the presence of
0.3 g or more of protein in a 24-h urine specimen [35].
HELLP syndrome was defined as aspartate aminotransfer-
ase (AST) and/or alanine aminotransferase (ALT) > 50 IU/
L, and platelets <100 × 10^9/L, and lactate dehydrogenase
>600 IU/L. Preterm premature rupture of membranes
(PPROM) was defined according to the ACOG practice
bulletin on PROM [36]: rupture of membranes prior to the
onset of labor and before 37 weeks of gestation. The female
patients were recruited in the obstetric clinic of a University
hospital in The Netherlands during a 3-year period. Healthy
female controls with uneventful pregnancies were recruited
in a community midwifery practice by means of posters
announcing the study. Results of the mothers (patients and
controls) have been published previously [30].

Population

All women hospitalized for PE and PPROM were asked to
participate in the study, unless their condition was so
critical (as assessed by the clinician admitting them) that
(a) they needed an immediate cesarean section, (b) they
received magnesium sulfate treatment, or (c) they were too
ill to complete questionnaires. Additional exclusion criteria
were current multiple pregnancy, a history of intrauterine
fetal death, and current alcohol or drugs dependence (of the
pregnant woman). Furthermore, women with pre-existing
medical conditions (diabetes mellitus, hypertension, car-
diovascular or renal diseases, systemic lupus erythemato-
sus) were excluded, as these women would be likely to
anticipate pregnancy complications due to their pre-existing
condition. Partners of patients and partners of controls
were invited to take part in the study, though women could
also take part if their partner refused. No further exclusion
criteria were applied for the partners. Participants had to be
fluent in Dutch and give written informed consent.
Approval was obtained from the Medical Ethics Commit-
tee (Institutional Review Board) of the University Medical
Center.

Procedure

Upon admission, patients and their partners were informed
about the study and were asked to consider their participa-
tion within 24 h. Female controls and their partners
could sign up for the study through their community
midwife. Following signed informed consent, they were
contacted by one of the researchers and asked to complete
questionnaires as soon as possible in order to minimize the
loss of participants due to delivery before testing. Particip-
ants were tested during pregnancy (t1) and 6 weeks postpartum (t2). In order to obtain comparable intervals
between t1 and t2 in the patient and control groups, female
controls and their partners were tested in the 38th week of
pregnancy.

Measures

At t1, all participants (male and female) completed a brief
self-report measure of general demographic information,
and answered questions about previous psychiatric history:
(a) whether they had ever had “one or more periods of
feeling depressed or down for most of the day, during which
they were not interested in activities that they enjoyed
before”, indicating depressive symptoms; (b) whether they
had “ever experienced something traumatic” (incl. some
examples) and “whether this influenced them afterwards,
for example through nightmares or flashbacks”, indicating
posttraumatic stress symptoms. Data regarding current and
past obstetric status were collected from the medical record
of the female patients and controls.

During both test-sessions, the PTSD Symptom Scale
self-report questionnaire (PSS-SR) [32] and the Beck
Depression Inventory, second edition (BDI-II) [33], were
completed. The PSS-SR is a frequently used self-report
measure of PTSD symptoms. The questionnaire contains 17
items corresponding to the 17 PTSD symptoms described in
the DSM-IV (criteria B, C and D). These items are rated
using 4-point scales asking for the occurrence of each
symptom over the past month (0 = never/not at all, 1 = once a week/a little bit, 2 = two to four times a week/
somewhat, 3 = more than five times a week/very much).
Symptoms were considered present if an item was rated 2 or
3. The PSS-SR sum-score ranges from 0 to 51. The PSS-SR
that was administered at t1 asked for PTSD symptoms in the
preceding month that were related to any stressful event
experienced before that still bothered the participants. At t2,
the PSS-SR referred to PTSD symptoms in the preceding
month that were specifically related to pregnancy and the
perinatal period. In addition, at t2, the participants rated the
extent to which they had felt fear, helplessness, or horror
during the pregnancy-related event they experienced as
most shocking on three 100 mm (3.9 inch) Visual Analogue
Scales (VAS). Using visual analogue scales is a reliable
method to assess pain, anxiety and mood disorders that
is frequently used in both research and hospital settings
[37–39]. The 100 mm strip depicts a linear continuum
from experiencing no pain or a certain emotion (0), to
experiencing the worst imaginable pain or most intense emotion (100). Recent research concludes that VAS scales approximate an interval-scale level, and therefore have superior psychometric properties as compared to ordinal-scale categorical measures such as Likert scales [40]. In the present study, PTSD diagnosis at $t_2$ was based on a symptom profile reflected by the PSS-SR and VAS scores that were consistent with the DSM-IV criteria. For this, we used the criteria as used in the study by Engelhard et al. [22]. More specifically, pregnancy-related PTSD was considered present when participants (a) scored 80 or more on one of the VAS for horror, fear, and/or helplessness at $t_2$ (subjective stress, DSM-IV A2 criterion); (b) reported at least one re-experiencing, three avoidance, and two hyperarousal symptoms on the PSS (DSM-IV, B, C, and D criterion, respectively); (c) obtained a total PSS-SR score of 18 or higher (severity, DSM-IV F criterion). It should be noted that the duration criterion of 4 weeks (DSM-IV E criterion) was met because follow-up assessment was at 6 weeks and postpartum. The test–retest reliability has been calculated $\alpha = 0.74$ [32]. The PSS-SR has been validated in the Netherlands in a non-pregnant population, with $\alpha = 0.93$, sensitivity between 0.80 and 0.90, and specificity between 0.84 and 0.88 [41]. The BDI-II [33] is a self-report measure of depressive symptoms during the preceding 2 weeks. It consists of 21 items containing four statements that reflect increasing symptom severity (scoring 0–3 per item). The sum-score ranges from 0 to 63. A cut-off score of 20 or more was used, corresponding with moderate depression according to the BDI manual [33]. The BDI-II is one of the most frequently used depression instruments in clinical psychological settings, and found to have good psychometric properties in both clinical samples and the general population [33, 42–44]. The Dutch version has been validated in non-pregnant patient groups [45, 46]. As opposed to some other depression questionnaires, the BDI includes all DSM-IV symptom criteria, and allows for differentiation between somatic and non-somatic symptoms.

Statistical analysis

Data were analyzed with SPSS 16.0, using a significance level of .05 (two-tailed). For the dichotomous data, $\chi^2$ analyses were used. Exploration of the continuous data revealed that the PSS and BDI sum-scores were not normally distributed. Therefore, non-parametrical Spearman’s rho, Kruskal–Wallis and Mann–Whitney $U$ tests were used. In order to identify risk factors for PTSD and depression at $t_2$, stepwise multiple regression analyses (SMRA) were performed on the PSS and BDI sum-scores. Where appropriate, non-normally distributed variables were square root transformed (SQRT) to meet assumptions of normality, linearity, and homoscedasticity. Due to the relatively small sample size (and therefore low number of variables desired in the SMRA), we only included variables with a $p$ value lower than 0.05 as found in univariate analyses in the SMRA. In order to evaluate the contribution of mental well being of female patients and their partners at $t_2$ to the PSS-SR and BDI scores, a stepwise model was created, entering factors known at $t_1$ in the first step, followed by factors known at $t_2$ in the second step. Two sets of variables showed multicollinearity: PSS-SR and BDI scores at $t_2$ in partners of patients, and PSS-SR and BDI scores at $t_2$ in female patients. Therefore, the PSS-SR scores of female patients and partners of patients at $t_2$ were excluded from the depression model and similarly, the BDI scores of female patients and partners of patients at $t_2$ were excluded from the PTSD model.

Results

Patient characteristics

At $t_1$, 193 females (patients and controls) were included in the study, of whom 6 did not have a partner. Of the 187 eligible partners (all male), 85 agreed to participate at $t_1$ (45%). Non-responder analysis (using $t$ tests, Chi square and Fisher’s exact tests) demonstrated that women whose partners did and did not participate were comparable for demographic factors (age, education, marital status), obstetric factors (primiparity, cesarean rate, gestational age at delivery, perinatal mortality) and symptoms of PTSD and depression in history, at $t_1$ and at $t_2$.

At $t_2$, 66 men completed questionnaires, whereas 19 men declined further participation (see Fig. 1). No significant differences were found between partners of controls participating at both $t_1$ and $t_2$ versus partners of controls only participating at $t_1$. Between partners of patients participating at both $t_1$ and $t_2$ versus those only participating at $t_1$, the only significant difference was that the 37 full participants reported fewer PTSD symptoms at $t_1$ than the 14 men who dropped out after $t_1$ ($p = 0.021$). In absolute numbers, the three partners of patients with PTSD during pregnancy and the two partners of patients with depression during pregnancy did not participate at $t_2$. No differences were found in demographic, obstetric and psychological characteristics between men whose partner had PE and men whose partner was hospitalized with PPROM, except that primiparity and cesarean section were more common among women with PE than PPROM. Further analyses have therefore been performed with the two groups combined. Demographic and obstetric characteristics of the 66
Prevalence of symptoms of PTSD and depression

No significant differences were found between partners of patients and partners of controls in symptoms of PTSD and depression. At t1, the mean sum-score on the 17 PSS-SR items was 6.9 for partners of patients and 4.6 for partners of controls \( (p = 0.28) \), and the mean sum-score on the 21 BDI-II items was 7.0 for partners of patients and 5.6 for partners of controls \( (p = 0.34) \); at t2, the mean sum-score on the 17 PSS-SR items was 6.5 for partners of patients and 3.1 for partners of controls \( (p = 0.08) \), and the mean sum-score on the 21 BDI-II items was 5.6 for partners of patients and 3.9 for partners of controls \( (p = 0.31) \). In partners of patients, the correlation between PTSD and depression sum-scores was 0.48 \( (p < 0.001) \) during pregnancy, and 0.86 \( (p < 0.001) \) postpartum. For partners of controls, the correlation between PTSD and depression sum-scores was 0.60 \( (p < 0.001) \) during pregnancy, and 0.73 \( (p < 0.001) \) postpartum. No men met the DSM-IV criteria for both disorders simultaneously.

Relation between paternal and maternal symptoms

Within-couple correlation of PTSD and depression symptom severity was low and not significant during pregnancy (PSS-SR: \( r = 0.24, p = 0.159 \); BDI-II: \( r = 0.17, p = 0.303 \)), but strong postpartum (PSS-SR: \( r = 0.62, p < 0.001 \); BDI-II: \( r = 0.59, p < 0.001 \)).

Tables 2 and 3 display the associations between symptoms of PTSD/depression in partners of patients at t2 and several demographic, obstetric and psychiatric factors. In partners of patients, PTSD and depressive symptoms postpartum (t2) were associated with PTSD and depression at t1, with concurrent PTSD and depression (at t2) in their female partners, but not with a history of depression or PTSD in either female patients or their partners. Furthermore, lower gestational age at delivery, infant death and

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Partners of patients (n = 37)</th>
<th>Partners of controls (n = 29)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Mean (SD)</td>
<td>31 (5.3)</td>
<td>34 (3.5)*</td>
</tr>
<tr>
<td>Higher education % (N/total)</td>
<td>33 (12/36)</td>
<td>90 (26/29)*</td>
</tr>
<tr>
<td>Employed % (N/total)</td>
<td>100 (35/35)</td>
<td>97 (28/29)</td>
</tr>
<tr>
<td>Psychiatric history</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reported history of depression % (N/total)</td>
<td>25 (9/36)</td>
<td>35 (10/29)</td>
</tr>
<tr>
<td>Reported history of PTSD % (N/total)</td>
<td>14 (5/36)</td>
<td>24 (7/29)</td>
</tr>
<tr>
<td>Previous treatment for psychiatric problems % (N/total)</td>
<td>11 (4/37)</td>
<td>24 (7/29)</td>
</tr>
<tr>
<td>Current treatment for psychiatric problems % (N/total)</td>
<td>0 (0/37)</td>
<td>17 (5/29)*</td>
</tr>
<tr>
<td>Obstetric characteristics (females)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primipara % (N/total)</td>
<td>64 (23/36)</td>
<td>72 (21/29)</td>
</tr>
<tr>
<td>Cesarean section % (N/total)</td>
<td>59 (22/37)</td>
<td>3 (1/29)*</td>
</tr>
<tr>
<td>Gestational age (weeks) Mean (SD)</td>
<td>31 + 6 (3 + 2)</td>
<td>40 + 5 (0 + 6)*</td>
</tr>
<tr>
<td>Infant death % (N/total)</td>
<td>8 (3/37)</td>
<td>0 (0/29)</td>
</tr>
</tbody>
</table>

Demographics and psychiatric history collected at t1, obstetric characteristics collected at t2

* \( p \leq 0.05 \)
higher paternal age were associated with more symptoms of PTSD and depression at t2, whereas parity and mode of delivery were unrelated to PTSD/depression postpartum in partners of patients.

Evaluation of possible risk factors

Finally, we evaluated the partners of patients for the contribution of risk factors to the PSS-SR and BDI scores at t2 using two stepwise multiple regression analyses (SMRA). All variables with a p value of 0.05 or lower in the univariate analyses (Table 3) were included.

Table 4 shows the SMRA for PTSD symptoms (PSS-SR sum-scores) of partners of patients at t2. The model for SQRT PSS-SR at t2 explained 53 % (adjusted R²) of the variance in the PSS-SR sum-scores in the first step (Sig. F change < 0.001), while the second step was not significant (sig. F change = 0.074). Significant predictors of high paternal PSS-SR sum-scores at t2 were PSS-SR and BDI sum-scores in men at t1 and higher paternal age (Table 4).

Table 5 shows the SMRA for depressive symptoms (BDI-II sum-scores) of partners of patients at t2. The model for SQRT BDI explained 55 % (adjusted R²) of the variance in BDI sum-scores in the first step (Sig. F change < 0.001) and an additional 9.7 % in step 2 (Sig. F change = 0.023). The only significant predictor of high BDI sum-scores at t2 was higher paternal age (Table 5).

Discussion

Considering that women with PE and PPROM are more prone to developing PTSD than women with uncomplicated pregnancies [30], the aim of this study was to investigate whether this difference was also found in their partners. We found no significant differences between partners of patients and partners of controls. On the other hand, symptoms of PTSD and depression in men and women often co-occurred at 6 weeks postpartum, which adds to the emerging evidence that fathers should not be overlooked when it comes to the psychological impact of pregnancy and childbirth.

Table 2 Spearman’s Rho correlations between PTSD/depressive symptoms and demographic, obstetric and psychiatric characteristics for partners of patients participating at t2 (n = 37)

<table>
<thead>
<tr>
<th>Demographic and obstetric variables</th>
<th>PTSD symptoms</th>
<th>Depressive symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p</td>
</tr>
<tr>
<td>Age</td>
<td>0.376</td>
<td>0.026*</td>
</tr>
<tr>
<td>Gestational age (weeks)</td>
<td>−0.471</td>
<td>0.003**</td>
</tr>
<tr>
<td>Psychiatric history (partners of patients)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD symptoms t₁</td>
<td>0.456</td>
<td>0.005**</td>
</tr>
<tr>
<td>Depressive symptoms t₁</td>
<td>&lt;0.001***</td>
<td>0.671</td>
</tr>
<tr>
<td>PTSD symptoms t₂</td>
<td>−</td>
<td>0.858</td>
</tr>
<tr>
<td>Depressive symptoms t₂</td>
<td>0.858</td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>Psychiatric history (female patients)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD symptoms t₁</td>
<td>0.357</td>
<td>0.030*</td>
</tr>
<tr>
<td>Depressive symptoms t₁</td>
<td>0.149</td>
<td>0.378</td>
</tr>
<tr>
<td>PTSD symptoms t₂</td>
<td>0.624</td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>Depressive symptoms t₂</td>
<td>0.625</td>
<td>&lt;0.001***</td>
</tr>
</tbody>
</table>

* Significant at p = 0.05 level
** Significant at p = 0.01 level
*** Significant at p < 0.001 level

Table 3 Associations between PTSD/depressive symptoms and demographic, obstetric and psychiatric characteristics for partners of patients participating at t2 (n = 37)

<table>
<thead>
<tr>
<th>Demographic and obstetric variables</th>
<th>PTSD symptoms</th>
<th>Depressive symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p</td>
<td></td>
</tr>
<tr>
<td>Higher/lower education (partners)</td>
<td>0.245</td>
<td></td>
</tr>
<tr>
<td>Primipara</td>
<td>0.585</td>
<td></td>
</tr>
<tr>
<td>Cesarean section</td>
<td>0.926</td>
<td></td>
</tr>
<tr>
<td>Infant death</td>
<td>0.016*</td>
<td></td>
</tr>
<tr>
<td>Psychiatric history (partners of patients)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD symptoms in history</td>
<td>0.232</td>
<td></td>
</tr>
<tr>
<td>Depressive symptoms in history</td>
<td>0.226</td>
<td></td>
</tr>
<tr>
<td>Psychiatric history (female patients)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD symptoms in history</td>
<td>0.494</td>
<td></td>
</tr>
<tr>
<td>Depressive symptoms in history</td>
<td>0.133</td>
<td></td>
</tr>
</tbody>
</table>

Mann–Whitney U tests: comparison between those with and without the characteristic
* Significant at p = 0.05 level

Table 4 Stepwise hierarchical multiple regression analysis of PTSD symptoms in partners of patients at t2 (n = 37)

<table>
<thead>
<tr>
<th>Adj. R²</th>
<th>ΔR²</th>
<th>Beta</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1: Factors known at t₁</td>
<td>0.533</td>
<td>0.553</td>
<td></td>
</tr>
<tr>
<td>Depressive symptoms at t₁ (partners)</td>
<td>0.338</td>
<td>0.017*</td>
<td></td>
</tr>
<tr>
<td>PTSD symptoms at t₁ (partners)</td>
<td>0.289</td>
<td>0.030*</td>
<td></td>
</tr>
<tr>
<td>PTSD symptoms at t₁ (patients)</td>
<td>0.208</td>
<td>0.104</td>
<td></td>
</tr>
<tr>
<td>Paternal age</td>
<td>0.343</td>
<td>0.009**</td>
<td></td>
</tr>
</tbody>
</table>

PSS-SR sum-scores were logarithmically transformed (log(sum-score + 1))

R² explained variance
* Significant at p = 0.05 level
** Significant at p = 0.01 level
of depression and PTSD at early postpartum. Older fathers reported significantly more symptoms of depression or PTSD postpartum in this study. Interestingly, psychiatric history was not strongly associated with symptoms of OCD and psychosis. Contrary to expectations [47], symptoms of PTSD in partners of patients were found to be 6% at t1 and 3% at t2, and 0% among partners of controls both in pregnancy and postpartum. Other studies of postpartum PTSD in men found prevalence rates varying from 0 to 5% [10, 19, 21]. In our current study, the prevalence of depression among fathers was 4% in pregnancy and 5% postpartum, which is lower than the 10% recently estimated in a large meta-analysis [15]. While this may have to do with our population, it is also important to note that the t1 findings should not be seen as baseline measurements, as female patients and their partners were likely to be already stressed due to the hospitalization and imminent preterm birth. A larger study may reveal whether the trend observed in this study (more PTSD symptoms in partners of patients than in partners of controls) is found significant with a higher number of participating patients and partners. One may also consider to include baseline measurements and a longer follow-up, as we know from the literature that women may also develop PTSD later than 6 weeks postpartum, and the highest incidence of male postpartum depression seems to be 3–6 months postpartum [15].

The prevalence of PTSD in partners of patients was found to be 6% at t1 and 3% at t2, and 0% among partners of controls both in pregnancy and postpartum. Other studies of postpartum PTSD in men found prevalence rates varying from 0 to 5% [10, 19, 21]. In our current study, the prevalence of depression among fathers was 4% in pregnancy and 5% postpartum, which is lower than the 10% recently estimated in a large meta-analysis [15]. While this may have to do with our population, it could also be due to our strict adherence to the cut-off value listed in the BDI-II manual (sum-score ≥ 20) for moderate or severe depression [33]. If we would have also included mild depression (cut-off value of 10) as many previous studies did [13, 48–50], the prevalence of depression in men would be 33% (partners of patients) and 12% (partners of controls) in pregnancy and 14% (partners of patients) and 7% (partners of controls) postpartum. While the benefits of the BDI have previously been mentioned, one may also consider using a questionnaire that has been specifically designed for the pregnancy and postpartum period, such as the Edinburgh Postnatal Depression Scale.

### Table 5

<table>
<thead>
<tr>
<th>Step 1: factors known at t1</th>
<th>Adj.$R^2$</th>
<th>$\Delta R^2$</th>
<th>Beta</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressive symptoms at t1 (partners)</td>
<td>0.252</td>
<td>0.061</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD symptoms at t1 (partners)</td>
<td>0.171</td>
<td>0.055</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education (lower/higher)</td>
<td>0.166</td>
<td>0.147</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paternal age</td>
<td>0.253</td>
<td>0.034*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Step 2: factors known at t2

<table>
<thead>
<tr>
<th>Step 2: factors known at t2</th>
<th>Adj.$R^2$</th>
<th>$\Delta R^2$</th>
<th>Beta</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational age at delivery</td>
<td>−0.015</td>
<td>0.908</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perinatal infant death</td>
<td>0.256</td>
<td>0.053</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depressive symptoms at t2 (patients)</td>
<td>0.221</td>
<td>0.134</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05

BDI/II sum-scores were logarithmically transformed ($\log$(sum-score + 1)). Final step is shown

$R^2$ explained variance

Strengths of the study include its prospective longitudinal design, a population that has not often been researched (partners of women with pregnancy complications), and the fact that a representative group of males was willing to participate at t1. Differences between partners of patients and partners of controls (Table 1) were in part as expected, as more cesarean sections and a lower gestational age were found in the patient group. However, partners of controls were on average older and higher educated than partners of patients. Partners of controls also more often indicated current psychiatric treatment than partners of patients (0/37 vs. 5/29; p = 0.013). This discrepancy may either be due to a higher prevalence of mental health problems in this group, or fewer (personal or financial) barriers in seeking treatment. While we cannot say with certainty, the fact that partners of patients and partners of controls groups report a similar percentage of a history of depression and PTSD is indicative for a difference in treatment-seeking behavior. In all cases of current treatment, men already received treatment prior to the birth of their child for a range of indications including depression, OCD and psychosis. Contrary to expectations [47], psychiatric history was not strongly associated with symptoms of depression or PTSD postpartum in this study. Interestingly, older fathers reported significantly more symptoms of depression and PTSD at t2 as shown in the SMRA, which is a finding that cannot easily be explained based on previous research and therefore may warrant additional investigation.

Unfortunately, the sample of partners was fairly small (n = 85 at t1 and n = 66 at t2), and partners of patients who dropped out of the study after t1 had more PTSD symptoms (on average) than partners of patients who participated during both time points. Both factors may at least partially explain why no differences were found between partners of patients and partners of controls in prevalence rates and sum-scores of PTSD and depression, and they could possibly have resulted in an underestimation of prevalence rates at t2. On the other hand, one could also argue that the drop-out of those with more symptoms at t1 means that symptoms at t2 are not merely the result of pre-existing psychopathology. One may hypothesize that, related to “avoidance” as one of the symptom categories of a PTSD diagnosis, the men with PTSD at t1 declined further participation in the study because reflecting on the birth of their child and the early postpartum period was too confronting for them. Interestingly enough, both for PTSD and depression, prevalence rates are not significantly higher (or even lower) postpartum than during pregnancy. This too may be an effect of selective drop-out, and it is also important to note that the t1 findings should not be seen as baseline measurements, as female patients and their partners were likely to be already stressed due to the hospitalization and imminent preterm birth. A larger study may reveal whether the trend observed in this study (more PTSD symptoms in partners of patients than in partners of controls) is found significant with a higher number of participating patients and partners. One may also consider to include baseline measurements and a longer follow-up, as we know from the literature that women may also develop PTSD later than 6 weeks postpartum, and the highest incidence of male postpartum depression seems to be 3–6 months postpartum [15].

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observed significant overlap between symptoms of PTSD and depression in partners of patients. In both groups, paternal age was associated with more symptoms of PTSD partners of patients and partners of controls. Higher occurrence of symptoms of PTSD and depression between men and women with severe pregnancy complications. Contrary to expectations, no differences were found in the occurrence of symptoms of PTSD and depression in partners of patients with postpartum depression also get postpartum depression [16].

Instead of solely focussing on the new mother, these findings call for a system-oriented approach, evaluating the well being of woman and partner. For future studies we would therefore recommend to always include fathers, and consider the dyad rather than individuals, as partners’ symptoms of PTSD and depression postpartum are strongly associated. Early identification and intervention could possibly prevent families from entering a downward spiral, with potentially adverse consequences for the partner relationship and parent–infant bonding, and avoidance of future pregnancies [57]. In summary, this study is one of the first to provide data on PTSD and depression in partners of women with severe pregnancy complications. Contrary to expectations, no differences were found in the occurrence of symptoms of PTSD and depression between partners of patients and partners of controls. Higher paternal age was associated with more symptoms of PTSD and depression in partners of patients. In both groups, we observed significant overlap between symptoms of PTSD and depression, as well as between partners.

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Conflict of interest We declare that we have no conflict of interest.

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