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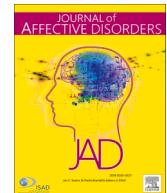
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## Prevalence and factors associated with postpartum posttraumatic stress in a population-based maternity survey in England

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### ABSTRACT

**Background:** Studies on prevalence and factors associated with postpartum posttraumatic stress (PTS) typically do not distinguish between PTS related to childbirth (PTS-C) and PTS related to other stressors (PTS-O). This study aimed to describe the prevalence, clinical characteristics, and factors associated with PTS-C and PTS-O in postpartum women.

**Methods:** The study was a cross-sectional population-based survey of 16,000 postpartum women, selected at random from birth registrations in England to receive a postal questionnaire, including the Primary Care Posttraumatic Stress Disorder Screen.

**Results:** Questionnaires were returned by 4,509 women. The median age was 32 years (IQR=29–36), 64% were married, 77% were UK-born, and 76% were White-British. Prevalence of PTS-C was 2.5% (95%CI:2.0–3.0) and prevalence of PTS-O was 6.8% (95%CI:6.0–7.8). Women with PTS-C were significantly more likely to report re-experiencing symptoms ( $\chi^2=7.69, p<0.01$ ). Factors associated with PTS-C were: higher level of deprivation, not having a health professional to talk to about sensitive issues during pregnancy, and the baby being admitted for neonatal intensive care. Factors associated with PTS-O were: age  $\leq 24$  years, depression during pregnancy, and having a pregnancy affected by long-term health problems. Factors associated with both were: living without a partner, anxiety during pregnancy, pregnancy-specific health problems, and lower birth satisfaction.

**Conclusions:** PTS during the postpartum period is relatively common and, for many women, unrelated to childbirth. Increased awareness among health professionals of prevalence, clinical characteristics and factors associated with postpartum PTS-C and PTS-O will aid the development of appropriate management protocols to identify and support women during the perinatal period.

Posttraumatic stress, posttraumatic stress disorder, postpartum PTSD/PTS, birth-related PTSD/PTS, birth trauma, perinatal mental health

### 1. Introduction

Every year more than 130 million women give birth (World Health Organization, 2005) and it is estimated that up to one in five of these women will suffer from mental health problems during pregnancy or the postpartum period (Howard et al., 2014). Perinatal mental health problems can have a severe and enduring impact on women, their children, partners and wider families, with substantial cost to society. For example, the cost to the UK is estimated to be £8.1 billion for every annual cohort of women (Bauer et al., 2014).

There is substantial evidence that women can suffer from post-traumatic stress (PTS) during the perinatal period. PTS occurs following exposure to an event perceived to be traumatic and is characterised by symptoms of re-experiencing the trauma, emotional numbing and avoidance, and hyperarousal. Symptoms of PTS may be experienced

which do not meet the diagnostic criteria for posttraumatic stress disorder (PTSD) or full PTSD may be diagnosed (Bailham and Joseph, 2003). There is variability in the terminology used in the literature and also in how PTS is assessed across studies. Therefore, in the current paper, PTS is used as an overarching description of PTS symptoms and PTSD.

According to a recent review and meta-analysis of 59 studies of postpartum PTS, 4% of women develop PTS after childbirth, which equates to at least 21,000 women per year in the UK (Yildiz et al., 2017). PTS in the postpartum period may be a direct response to a birth perceived to be traumatic but may also be a continuation of pre-existing PTS, a reactivation of PTS that had previously remitted, or new-onset PTS in response to an event unrelated to childbirth. One of the difficulties with the existing literature on postpartum PTS is that studies typically do not distinguish between PTS that is related to childbirth

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(PTS-C) and PTS that is related to other current or past traumatic events (PTS-O). By identifying the stressor, we can better understand the magnitude of childbirth as a traumatic event, provide reliable prevalence estimates, and indicate how PTS related to different stressors may require assessment and intervention protocols which differ in timing and focus.

The effect of previous PTS in the perinatal period was explored in a recent review, which found that postpartum PTS rates dropped significantly, yet did not diminish completely, when pre-existing PTS was controlled for (Geller and Stakso, 2017). Another review and meta-analysis of 41 community samples reported an overall PTS prevalence of 3.1% and also separate prevalence estimates for PTS-C (2.9%) and PTS-O (4.1%) (Grekin and O'Hara, 2014). The review highlighted that the traumatic event is often poorly specified in studies and emphasised the need to robustly establish the nature of the stressor when evaluating PTS in the postpartum period.

Numerous risk factors and correlates of postpartum PTS have emerged in the literature. A meta-analysis of 50 studies identified key risk factors for PTS following childbirth, which were depression in pregnancy, fear of childbirth, poor health or complications in pregnancy, a history of PTS, and counselling for pregnancy or childbirth-related factors. Childbirth-related risk factors were a negative subjective birth experience, an operative birth (assisted vaginal or caesarean section), lack of support, and dissociation during birth. Following the birth, PTS was associated with poor coping and stress (Ayers, et al., 2016). These findings were consistent with previous reviews of risk factors and correlates of postpartum PTS (Grekin and O'Hara, 2014; Andersen et al., 2012). Early identification of women with risk factors for postpartum PTS, either related to childbirth or other stressors, is key to ensure that timely care and support is offered throughout the perinatal period. Little is known about whether PTS-C and PTS-O have common or different risk factors, which might be important in terms of identifying women and tailoring support.

In summary, PTS is increasingly recognised as a potential postpartum complication, but further research is needed to describe the prevalence, clinical characteristics and risk factors for postpartum PTS that distinguishes between childbirth and other stressors as the traumatic event.

## 2. Objectives

1. To estimate prevalence of PTS-C and PTS-O in women six months after childbirth.
2. To describe the clinical characteristics of women with PTS-C and PTS-O.
3. To explore factors associated with PTS-C and PTS-O.

## 3. Methods

### 3.1. Study design and sample

This paper is based on findings from a larger national study of maternal and infant health carried out by the National Perinatal Epidemiology Unit (NPEU) in England. Full details about the larger study are available elsewhere (Harrison et al., 2020). Briefly, the study was a cross-sectional, population-based postal survey of postpartum women. The women were selected at random by the Office for National Statistics (ONS) using birth registration records. The sample included 16,000 women who were aged 16 years and over, who were living in England, and who had given birth during a two-week interval in October 2017. Women whose babies had died were excluded from the sample to avoid the possibility of the survey invitation causing additional distress. Questionnaires were posted to the identified women six months after they had given birth. The women could take part: 1) on paper; 2) online; or 3) by telephone with an interpreter, if required. Reminder letters and additional questionnaires (up to a maximum of two) were posted to non-respondents using a tailored reminder system.

### 3.2. Posttraumatic stress

The Primary Care Posttraumatic Stress Disorder Screen for DSM-IV (PC-PTSD-IV) (Prins et al., 2004) was included in the questionnaire to identify women with symptoms of PTS. The PC-PTSD-IV is a brief measure that was designed for use in primary care settings and is one of two measures recommended in a review of PTS self-report tools (Spoont et al., 2015). Respondents are asked about symptoms experienced in the past month that are related to a traumatic event occurring anytime in their lifetime. For the women in the current study, this one-month period was between 26 and 49 weeks (median 31 weeks, interquartile range=31-34 weeks) after childbirth (Harrison et al., 2020). The PC-PTSD-IV includes four items, each mapping onto one of the symptom factors proposed to underlie the construct of PTS in DSM-IV: 1) re-experiencing; 2) emotional numbing; 3) avoidance; and 4) hyperarousal. The four items are scored dichotomously as either 0 (no) or 1 (yes) and a score of 3 or 4 gives a 'positive' result. At a cut-off score of  $\geq 3$ , the PC-PTSD-IV has sensitivity of 0.78 and specificity of 0.78 compared to structured clinical interview (Prins et al., 2004). The PC-PTSD-IV has been found to be a feasible tool for perinatal populations (Wenz-Gross et al., 2016). For the purpose of the current study, an additional question was included asking women whether any PTS symptoms were related to labour and/or childbirth: 'do your answers relate to your experience of labour and/or childbirth?' In the current study, PTS refers to a positive result on the PC-PTSD-IV.

### 3.3. Factors

Data on the available factors found to be associated with postpartum PTS in previous studies were either collected from the questionnaires or provided by ONS. The sociodemographic factors included: age group (16-24 years, 25-29 years, 30-34 years, 35+ years); country of birth (UK, outside UK); ethnicity (White British, Other); level of area deprivation measured by the index of multiple deprivation (IMD) (grouped into quintiles); age when leaving education ( $\leq 16$  years, 17-18 years,  $\geq 19$  years); and living with partner (yes, no). The pregnancy-related factors included: parity (primiparous, multiparous); multiplicity (singleton, multiple birth); pregnancy planning (planned, unplanned); reaction to pregnancy (positive, neutral/mixed, negative); anxiety during pregnancy (yes, no); depression during pregnancy (yes, no); whether a health professional was available during pregnancy to discuss sensitive issues (yes, no); any long-term health problems which affected pregnancy (e.g. epilepsy, diabetes) (yes, no); and any pregnancy-specific health problems (e.g. high blood pressure, low-lying placenta) (yes, no). Finally, the childbirth-related factors included: gestation at birth (pre-term ( $< 37$  weeks), term ( $\geq 37$  weeks)); mode of birth (vaginal birth, assisted vaginal birth, planned caesarean section, unplanned caesarean section); satisfaction with birth (0-40 on the birth satisfaction scale-revised (BSS-R (Hollins-Martin and Martin, 2014))); how the birth met with expectations (better than expected, more or less as expected, worse than expected); and whether the baby was admitted to neonatal intensive care (NICU) (yes, no). Further details on the assessment of these factors are available in the published report (Harrison et al., 2020).

### 3.4. Statistical analysis

Non-identifiable data on the characteristics of respondents and non-respondents were provided by ONS. These data included age, marital status at birth registration, country of birth, IMD, region of residence, and parity. These variables were fitted in a binary logistic regression model with response/non-response as the outcome, and the resulting adjusted odds ratios were used to derive survey weights. The survey weights were applied to the data to reduce the effect of non-response bias.

Descriptive statistics were used to describe the characteristics of survey respondents and to evaluate prevalence of PTS-C and PTS-O,

together with 95% confidence intervals (CI). Prevalence of each of the symptoms reported by the women with PTS-C and PTS-O was also estimated with 95% CI. Logistic regression was used to estimate the association between different sociodemographic, pregnancy- and childbirth-related factors and PTS-C or PTS-O. Each factor was fitted in a univariable binary logistic regression model with either no PTS/PTS-C or no PTS/PTS-O as the outcome. The factors that were significant at univariable level ( $p < 0.1$ ) were fitted in a binary multivariable logistic regression model. The factors that were significant at multivariable level ( $p < 0.05$ ), after mutually adjusting for all other factors, were retained in the model. The crude odds ratios (OR) were calculated for the univariable analyses and the adjusted odds ratios (AOR) were calculated for the multivariable analyses. All analyses were conducted in STATA version 15.

#### 4. Results

##### 4.1. Respondent characteristics

Questionnaires were returned by 4,509 women, a response rate of 29.0% (24.8% postal, 4.2% online, and 0.1% by telephone). The majority of the women who responded were aged between 25 and 39 years (median age=32 years; interquartile range=29–36 years). More than half of the women were first-time mothers (54.5%). Almost two-thirds of the women registered their baby in married names (63.5%) or in joint (unmarried) names living at the same address (29.3%). Only a small number of women registered their baby in their sole name (2.4%). Over three quarters of the women who responded to the survey were born in the UK (77.2%). Three quarters of the women who disclosed their ethnicity self-identified as being from White British backgrounds (75.7%). Forty-four percent of respondents were in the top two quintiles (most advantaged) on the IMD. Most women indicated that they were living with their spouse or partner at the time they took part in the survey (89.7%) and two-thirds of respondents had continued full-time education until 19 years of age or older (65.5%).

Compared to non-respondents, the women who responded to the survey were more likely to be older, married when they registered the birth of their baby, born in the UK, living in more advantaged areas, and first-time mothers. Therefore, the sample of women was not representative of the target population on these key demographics. Survey weights were applied to the data to reduce the effects of non-response bias (i.e. women with characteristics associated with non-response (e.g. younger age, living in less advantaged areas) were given more weight in the analysis). This led to a slight increase in the prevalence estimates of PTS, indicating a higher prevalence of PTS in the women who were from underrepresented groups in the survey.

##### 4.2. Prevalence of PTS-C and PTS-O

**Table 1** shows the frequency and prevalence of women scoring above the cut-off ( $\geq 3$ ) for PTS-C and PTS-O and below the cut-off ( $< 3$ : no PTS)

**Table 1**  
Scores on the PC-PTSD-IV for women with no PTS, PTS-C, PTS-O and PTS-total

PC-PTSD-IV score	No PTS		PTS-C		PTS-O		PTS-Total	
	n <sup>1</sup>	% <sup>2</sup>	n <sup>1</sup>	% <sup>2</sup>	n <sup>1</sup>	% <sup>2</sup>	n <sup>1</sup>	% <sup>2</sup>
0	3222	70.2	-	-	-	-	-	-
1	504	12.3	-	-	-	-	-	-
2	338	8.0	-	-	-	-	-	-
(Total below cut-off 0-2)	(4064)	(90.5)						
3	-	-	59	1.3	148	3.7	209 <sup>3</sup>	5.1
4	-	-	42	1.2	117	3.1	165 <sup>3</sup>	4.4
(Total above cut-off 3-4)			(101)	(2.5)	(265)	(6.8)	(374 <sup>3</sup> )	(9.5)

<sup>1</sup> Unweighted totals

<sup>2</sup> Weighted prevalence

<sup>3</sup> 71 women did not complete the PC-PTSD-IV and 8 women scoring about the cut-off did not indicate whether their PTS was due to childbirth

on the PC-PTSD-IV. The overall prevalence of PTS-C and PTS-O combined is also shown (PTS-Total). The prevalence of PTS-C was 2.5% (95%CI: 2.0, 3.1) and the prevalence of PTS-O was 6.8% (95%CI: 6.0, 7.8). Therefore, in total, almost one in ten women, who completed the PC-PTSD-IV, scored above the cut-off reporting three or more symptoms of PTS (9.5%, 95%CI: 8.5, 10.6). One in five women reported one or two symptoms of PTS but scored below the cut-off on the PC-PTSD-IV (20.3%); the majority of women who completed the PC-PTSD-IV reported no symptoms of PTS six months after childbirth (70.2%).

##### 4.3. Clinical characteristics of women with PTS-C and PTS-O

**Table 2** shows the prevalence of specific symptoms reported by the women with PTS-C or PTS-O. The symptom reported most frequently by the women with PTS-C was re-experiencing; hyperarousal was reported least frequently. The symptom reported most frequently by the women with PTS-O was avoidance; hyperarousal again was reported least frequently. The prevalence for emotional numbing, avoidance and hyperarousal symptoms was comparable for the women with PTS-C and PTS-O but the women with PTS-C were significantly more likely to report re-experiencing symptoms compared to the women with PTS-O (Chi-Square=7.69,  $p < 0.01$ ).

##### Factors associated with PTS-C and PTS-O

Regression analyses were carried out for PTS-C (excluding PTS-O) and for PTS-O (excluding PTS-C). **Table 3** shows the prevalence of PTS-C or PTS-O for women according to different sociodemographic, pregnancy- and childbirth-related factors and the OR with 95% CI for the univariable association between each of the factors and PTS-C or PTS-O. Some factors were significantly associated with PTS-C only (higher level of deprivation, multiple birth, not having a health care professional to talk to about sensitive issues during pregnancy, having an instrumental or caesarean birth, experiencing childbirth as worse than expected, the baby being admitted to NICU); some factors were significantly associated with PTS-O only (younger age, non-White-British ethnicity, leaving education before 19 years of age); some factors were significantly associated with both PTS-C and PTS-O (living without a partner, a neutral or mixed reaction to pregnancy, anxiety during pregnancy, depression during pregnancy, having a pregnancy

**Table 2**  
Symptoms reported by women with PTS-C or PTS-O

Symptoms	PTS-C (N=101)			PTS-O (N=265)		
	n <sup>1</sup>	% <sup>2</sup>	95%CI	n <sup>1</sup>	% <sup>2</sup>	95%CI
Re-experiencing	100	99.1	(93.8, 99.9)	242	91.4	(86.9, 94.5)
Emotional numbing	78	79.7	(69.9, 87.0)	222	84.8	(79.3, 89.0)
Avoidance	96	96.9	(91.8, 98.9)	255	96.9	(93.3, 98.6)
Hyperarousal	71	74.5	(63.8, 82.8)	193	74.8	(68.3, 80.4)

<sup>1</sup> Unweighted totals

<sup>2</sup> Weighted prevalence

**Table 3**

Prevalence and crude odds ratios with 95% CI for PTS-C and PTS-O (compared to no PTS; <3 on PC-PTSD-IV) for women with different sociodemographic, pregnancy- and childbirth-related factors

	PTS-C (N=101)				PTS-O (N=265)			
	N	%	OR	95% CI	N	%	OR	95% CI
<b>Sociodemographic factors</b>								
<b>Age group</b>								
≤24 years	362	3.8	1.74	(0.84, 3.30)	401	12.4	2.26*	(1.52, 3.36)
25-29 years	980	3.3	1.51	(0.86, 2.62)	1009	6.7	1.16	(0.79, 1.69)
30-34 years <sup>#</sup>	1598	2.2	1		1653	5.9	1	
35+ years	1225	1.9	0.84	(0.48, 1.47)	1266	5.2	0.88	(0.61, 1.25)
<b>Country of birth</b>								
UK	3219	3.1	1		3357	8.0	1	
Outside UK	946	1.5	0.45*	(0.26, 0.80)	972	4.5	0.54*	(0.37, 0.80)
<b>Ethnicity</b>								
White-British	3060	2.7	1		3191	7.7	1	
Other	973	2.2	0.80	(0.46, 1.38)	1004	5.5	0.69*	(0.48, 0.99)
<b>IMD quintile</b>								
1	636	2.9	1.67	(0.80, 3.48)	667	7.5	1.22	(0.79, 1.90)
2	791	2.8	1.59	(0.76, 3.32)	828	7.5	1.22	(0.79, 1.88)
3	878	3.3	1.89*	(0.96, 3.69)	904	7.0	1.13	(0.73, 1.74)
4	941	2.3	1.31	(0.65, 2.62)	974	6.2	0.99	(0.65, 1.52)
5	919	1.8	1		956	6.3	1	
<b>Age when leaving education</b>								
16 years or less	443	3.5	1.40	(0.74, 2.65)	468	8.4	1.56*	(1.04, 2.33)
17-18 years	952	2.3	0.93	(0.52, 1.66)	1014	9.3	1.74*	(1.26, 2.41)
19 years or over	2733	2.5	1		2809	5.6	1	
<b>Living with partner</b>								
Yes	400	2.3	1		3900	6.2	1	
No	3765	4.3	1.90*	(1.05, 3.44)	429	10.9	1.88*	(1.30, 2.70)
<b>Pregnancy-related factors</b>								
<b>Parity</b>								
Primiparous	2164	3.0	1.25	(0.79, 1.97)	2228	6.8	0.93	(0.70, 1.24)
Multiparous	2001	2.4	1		2101	7.2	1	
<b>Multiplicity</b>								
Singleton	4066	2.6	1		4227	7.0	1	
Multiple birth	99	6.5	2.67*	(0.85, 8.35)	102	8.5	1.24	(0.55, 2.81)
<b>Pregnancy planning</b>								
Planned	3386	2.4	1		3493	6.0		
Unplanned	739	3.5	1.51	(0.87, 2.60)	795	10.0	1.73*	(1.27, 2.37)
<b>Reaction to pregnancy</b>								
Positive	3352	2.1	1		3469	5.9	1	
Neutral / mixed	651	4.9	2.36*	(1.38, 4.03)	693	11.4	2.06*	(1.48, 2.87)
Negative	51	1.6	0.75	(0.10, 5.55)	54	8.4	1.46	(0.51, 4.22)
<b>Anxiety during pregnancy</b>								
No	3698	1.9	1		3799	4.8	1	
Yes	467	8.2	4.53*	(2.83, 7.27)	530	21.7	5.47*	(4.03, 7.43)
<b>Depression during pregnancy</b>								
No	3985	2.3	1		4095	5.3	1	
Yes	180	9.0	4.23*	(2.14, 8.37)	234	30.4	7.76*	(5.40, 11.14)
<b>Health professional to talk to during pregnancy</b>								
Yes	3580	2.2	1		3725	6.8	1	
No	556	4.7	2.19*	(1.29, 3.71)	573	7.4	1.10	(0.75, 1.60)
<b>Pregnancy affected by long-term health problems</b>								
No	3783	2.4	1		3904	6.0	1	
Yes	362	5.6	2.42*	(1.29, 4.51)	400	15.7	2.89*	(2.03, 4.13)
<b>Pregnancy-specific health problems</b>								
No	3003	1.7	1		3112	5.9		
Yes	1142	5.4	3.30*	(2.08, 5.23)	1197	10.4	1.85*	(1.38, 2.48)
<b>Childbirth-related factors</b>								
<b>Gestation at birth</b>								
Pre-term	295	3.7	1.48	(0.79, 2.77)	299	7.4	1.06	(0.61, 1.86)
Term	3812	2.5	1		3970	7.0	1	
<b>Mode of birth</b>								
Vaginal	2344	1.8	1		2464	7.2	1	
Assisted vaginal birth	602	4.2	2.44*	(1.25, 4.76)	611	6.5	0.89	(0.56, 1.42)
Planned caesarean section	586	3.1	1.75*	(0.93, 3.29)	616	8.4	1.19	(0.81, 1.74)
Unplanned caesarean section	617	4.8	2.81*	(1.55, 5.09)	622	5.4	0.74	(0.47, 1.16)
<b>Satisfaction with birth<sup>#</sup></b>								
Low (score ≤ 20)	833	7.4	0.88*	(0.84, 0.91)	846	10.2	0.96*	(0.94, 0.98)
High (score > 20)	2870	1.6	1		3003	6.4	1	
<b>How birth met expectations</b>								
Better than expected	1598	1.2	1		1681	6.4	1	
More or less as expected	1406	1.4	1.15	(0.57, 2.34)	1477	6.8	1.07	(0.77, 1.50)
Worse than expected	1127	6.9	6.19*	(3.44, 11.15)	1136	8.4	1.35	(0.94, 1.93)
<b>Admission to neonatal intensive care</b>								
No	3659	2.3	1		3811	6.8	1	
Yes	488	5.6	2.53*	(1.51, 4.22)	496	7.9	1.17	(0.76, 1.80)

<sup>1</sup>Unweighted totals<sup>2</sup>Weighted prevalence\* Statistically significant ( $p < 0.1$ )

# 30-34 years was selected as the reference category for age because it was the largest group

affected by long-term health problems, pregnancy-specific health problems, lower satisfaction with birth); and finally, some factors were not significantly associated with PTS-C or PTS-O (parity, gestation at birth). There was considerable overlap in the pregnancy-related factors that were associated with PTS-C and PTS-O at univariable level, yet less overlap with the sociodemographic and childbirth-related factors.

Table 4 shows the sociodemographic, pregnancy- and childbirth-related factors which were retained in the multivariable regression models for PTS-C and PTS-O. The unique factors that were significantly associated with PTS-C after adjusting for all factors were: higher level of deprivation, not having a health professional to talk to about sensitive issues during pregnancy, and the baby being admitted to NICU. The unique factors that were significantly associated with PTS-O after adjusting for all factors were: age  $\leq 24$  years, depression during pregnancy, and having a pregnancy affected by long-term health problems. The factors that were significantly associated with both outcomes were: living without a partner, anxiety during pregnancy, pregnancy-specific health problems, and lower satisfaction with birth. Therefore, there was overlap with some factors, yet other factors were specific to either

PTS-C or PTS-O. However, it is important to note that there were low numbers of women in some of the subgroups in these separate analyses, hence the analyses may have been underpowered to identify all risk factors for each of the outcomes.

## 5. Discussion

### 5.1. Prevalence of PTS-C and PTS-O

This population-based survey is the first to examine differences in the prevalence of postpartum PTS specifically in relation to childbirth (PTS-C) or in relation to other current or past traumatic events (PTS-O). The study found that almost one in ten women reported PTS (regardless of cause) six months after childbirth. A quarter of these women identified childbirth as the stressor criterion, hence the majority (three-quarters) of women with PTS attributed their symptoms to events other than childbirth. The findings provide new insight on prevalence rates for postpartum PTS due to the distinction between different stressors. Such a distinction may be important in terms of clinical characteristics,

**Table 4**

Crude and adjusted OR with 95% CI and p-values for PTS-C and PTS-O (compared to no PTS (<3 on PC-PTSD-IV) according to sociodemographic, pregnancy- and childbirth-related factors

	PTS-C				PTS-O			
	OR	AOR	95% CI	P value	OR	AOR	95% CI	P value
<b>Sociodemographic factors</b>								
<b>Age group</b>								
$\leq 24$ years	1.74	NE			2.26	1.64*	(1.03, 2.63)	0.038
25-29 years	1.51	NE			1.16	1.20	(0.79, 1.82)	0.401
30-34 years	1				1	1		
35+ years	0.84	NE			0.88	0.95	(0.64, 1.40)	0.789
<b>IMD quintile</b>								
1	1.67	2.03	(0.88, 4.68)	0.098	1.22	NE		
2	1.59	2.38*	(1.06, 5.38)	0.036	1.22	NE		
3	1.89	3.28*	(1.55, 6.93)	0.002	1.13	NE		
4	1.31	2.06	(0.96, 4.43)	0.064	0.99	NE		
5	1	1			1			
<b>Living with partner</b>								
Yes	1	1			1			
No	1.90	2.74*	(1.40, 5.39)	0.003	1.88	1.65*	(1.08, 2.52)	0.022
<b>Pregnancy-related factors</b>								
<b>Anxiety during pregnancy</b>								
No	1	1			1	1		
Yes	4.53	3.50*	(2.08, 5.87)	<0.001	5.47	2.76*	(1.88, 4.03)	<0.001
<b>Depression during pregnancy</b>								
No	1				1	1		
Yes	4.23	2.45	(0.94, 6.37)	0.067	7.76	3.35*	(2.13, 5.28)	<0.001
<b>Health professional to talk to during pregnancy</b>								
Yes	1	1						
No	2.19	2.10*	(1.19, 3.72)	0.011	1.10	NE		
<b>Pregnancy affected by long-term health problems</b>								
No	1							
Yes	2.42	1.72	(0.80, 3.73)	0.166	2.89	2.02*	(1.30, 3.15)	0.002
<b>Pregnancy-specific health problems</b>								
Yes	1	1						
No	3.30	2.95*	(1.74, 5.00)	<0.001	1.85	1.57*	(1.12, 2.21)	0.009
<b>Childbirth-related factors</b>								
<b>Satisfaction with birth</b> #								
Low (score $\leq 20$ )	0.88	0.89*	(0.85, 0.92)	<0.001	0.96	0.97*	(0.95, 0.99)	0.012
High (score $> 20$ )	1	1			1	1		
<b>Admission to neonatal intensive care</b>								
No	1	1			1			
Yes	2.53	2.07*	(1.19, 3.63)	0.01	1.17	NE		

NE Not entered into the multivariable logistic regression

\* Significant after adjusting for other factors in multivariable regression

# Entered into the logistic regression analysis as a continuous variable

identification and intervention.

The prevalence of PTS-C was 2.5%, which is reasonably consistent with recent systematic review and meta-analysis estimates of between 3–4% (Yildiz et al., 2017; Grekin and O'Hara, 2014). However, many more women reported PTS-O suggesting that studies which focus exclusively on PTS-C might underestimate the extent of postpartum PTS. The prevalence of PTS-O was 6.8%, which is slightly higher than previous review estimates (Grekin and O'Hara, 2014). It is also marginally higher than the prevalence of PTS reported by women in the most recent UK Adult Psychiatric Morbidity Survey (5.1%) (McManus et al., 2016) although combined with PTS-C, the overall prevalence of PTS was similar to national estimates of PTS in US women (Kilpatrick et al., 2013).

The women in the current study completed the PTS measure at least six months following childbirth (range=26–49 weeks), and some longitudinal studies have indicated that rates of postpartum PTS reduce later in the postpartum period (Ayers and Pickering, 2001). By six months postpartum, some women may have experienced traumatic reactions following childbirth or related to postpartum events, which have subsequently remitted, with or without intervention. In addition, women whose baby had died were excluded from the sample, which also might have led to slightly lower rates of PTS. For these reasons, it is possible that the current findings are a conservative estimate of the prevalence of PTS in the postpartum period or that they are highlighting the more severe or treatment-resistant cases.

### **5.2. Clinical characteristics of PTS-C and PTS-O**

Findings from the current study suggest that the clinical characteristics of PTS-C and PTS-O may differ slightly, with significantly more women with PTS-C reporting re-experiencing symptoms. Research on the clinical characteristics of PTS-C has fairly consistently identified two clusters of symptoms: childbirth-related symptoms of re-experiencing and avoidance; and general symptoms of hyperarousal and negative cognitions and mood (Ayers et al., 2018) although not all studies have found this (Olde et al., 2006). The increase in re-experiencing symptoms could be due to a number of factors. Childbirth is a highly physiological, sensory event which might result in stronger sensory trauma memories being created. In addition, re-experiencing symptoms may be triggered by physiological pain or post-birth symptoms, or indeed by the baby, who may act as a reminder. If women with PTS-C differ in clinical characteristics, this has implications for assessment and treatment (Ayers et al., 2007; Furuta et al., 2018). However, this finding needs to be replicated and examined in more detail before definite conclusions can be drawn.

### **5.3. Factors associated with PTS-C and PTS-O**

The current study found both common and unique factors to be associated with PTS-C and PTS-O. The association between socio-demographic characteristics and postpartum PTS has been inconsistent in the literature although the importance of support (or lack of) is recognised (Grekin and O'Hara, 2014; Ayers et al., 2016). In line with this, the only sociodemographic factor found to be associated with both PTS-C and PTS-O in the current study was living without or separately from a partner. The pregnancy-related factors common to PTS-C and PTS-O were anxiety during pregnancy and pregnancy-specific health problems; previous studies have also found that pregnancy affected by complications or poor physical or mental health was associated with greater risk of PTS (Ayers et al., 2016). Such pregnancy-related factors can easily be identified prior to childbirth with appropriate assessment and communication between women and healthcare professionals. Further research is warranted to explore the benefit of using pregnancy-related factors to identify women who may be vulnerable to PTS-C or PTS-O, which may include the delivery of timely care and support to help prevent or alleviate subsequent traumatic responses.

Lower satisfaction with birth was also associated with both PTS-C and PTS-O, whereas mode of birth was not associated with either outcome. This finding is consistent with multiple studies that have shown subjective birth experience is more strongly associated with adverse mental health outcomes than obstetric outcomes (Dikmen-Yildiz et al., 2017). As with the pregnancy-related factors, satisfaction with childbirth is potentially modifiable. The risk of adverse reactions may be ameliorated with better support (Ford and Ayers, 2011; Patterson et al., 2019) and communication during labour and childbirth and also through timely intervention (for example, debriefing, counselling or trauma-focused psychological therapy) in the early postpartum period (Furuta et al., 2018).

The unique factors found to be associated with PTS-C were higher level of deprivation, not having a health professional to talk to about sensitive issues during pregnancy, and the baby being admitted to NICU. Threat during birth to the life of mother or baby or subsequent NICU admission are highly stressful experiences, which are more likely to trigger PTS-C (Roque et al., 2017). Perhaps unsurprisingly, other childbirth-related factors, such as mode of birth and experience of birth, were also more strongly associated with PTS-C than with PTS-O but the effects were not statistically significant after adjusting for other factors. The unique factors found to be associated with PTS-O were younger age, depression during pregnancy and having a pregnancy affected by long-term health problems.

Although the analyses of factors associated with PTS-C and PTS-O are based on small numbers of women in some of the subgroups, the unique factors might be due to women with PTS-C having pregnancy-specific experiences, such as lack of healthcare professional support or NICU admission, which increase their vulnerability or place them at greater risk of developing PTS-C; in contrast, women with PTS-O may have past experiences, which mean they enter pregnancy with greater vulnerability, for example with depression or other long-term health problems, and potentially at a younger age. Therefore, it might be that the current findings are identifying risk factors for PTS-C and consequences of PTS-O. These preliminary observations suggest potential differences between PTS-C and PTS-O and highlight why it is important to explore both in more detail in even larger population-based studies.

### **5.4. Strengths and limitations**

The strength of this study is that it is the first to explore prevalence, clinical characteristics, and factors associated with PTS in postpartum women which is related either to childbirth or to other past or current events. Furthermore, previous studies estimating PTS prevalence have typically included small samples of women whereas the population-based sample in the current study was large and drawn at random from all women giving birth in England. In addition, information was available on non-respondents to explore sample bias and to apply survey weights to help mitigate against the low overall response rate.

Despite the application of survey weights, the response rate to the maternity survey is a potential limitation, which may have impacted on the observed prevalence of PTS, particularly if experiencing PTS increased the likelihood of non-response. It is noteworthy that our sample gave accurate prevalence estimates of key maternity indicators, including low birthweight, preterm birth and caesarean section despite the response rate (Harrison et al., in press). Furthermore, the observed associations between different factors and PTS are less likely to be impacted by low response rates (Galea and Tracy, 2007).

This study was cross-sectional in design and relied on women to recall their perinatal experiences at least six months after childbirth. Recall of subjective events is subject to state bias, whereby women who are experiencing PTS or other mental health problems might be more likely to recall and report experiences more negatively. Furthermore, this study was secondary analysis of data from a national maternity survey and some factors previously found to be associated with PTS were not assessed as part of the survey, for example, adverse childhood events

and intimate partner violence. The factors explored in the current study were those available in the maternity survey that were deemed to be important based on the existing literature.

An additional limitation of the study is that the prevalence estimates of PTS are based on self-reported symptoms rather than diagnostic interview, whereby a comprehensive differential diagnosis could be completed. However, interview methodology would be unfeasible in large population-based studies and so self-report tools are needed; the majority of studies included in the aforementioned reviews have also relied on self-reported data on symptomatology. In addition, PTS symptoms expressed at a subclinical level have been suggested to be related to the same problems as a full PTS diagnosis, such as comorbid mental health problems and clinically meaningful levels of functional impairment (Stein et al., 1997). The use of a single binary question to distinguish between PTS-C and PTS-O could be improved to allow respondents to indicate symptoms associated with both labour/childbirth and other stressors, and also to collect information about the nature and timing of the specific stressors when PTS-O is indicated.

Finally, the PC-PTSD-IV is based on the DSM-IV diagnostic criteria as opposed to the updated DSM-5 criteria. DSM-5 has a different definition of what constitutes a stressor event, it removed emotional numbing, and added symptoms of negative cognitions and mood (American Psychiatric Association, 2013). However, studies comparing the DSM-IV and DSM-5 criteria for PTS have found relatively minimal effects on prevalence estimates (Kilpatrick et al., 2013; Calhoun, et al., 2012) and the report of three symptom clusters would correspond to a positive screen on both the PC-PTSD-IV (based on DSM-IV) and the PC-PTSD-5 (based on DSM-5) (Prins et al., 2016).

This study highlights a need to review current thinking and practice around identification and management of PTS-C and PTS-O before and after childbirth. Future prospective studies are required to further explore PTS in the postpartum period arising due to different stressors and to examine the extent to which PTS-C is a unique type of PTS requiring tailored management protocols. Research should also explore comorbidity and multimorbidity in this population.

**Ethical approval and consent to participate:** The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving human subjects/patients were approved by London Bloomsbury NRES Committee (reference: 18/LO/0271). Return of the questionnaire was taken as implicit consent from all participants.

## Data Availability

Data are archived by the NPEU at the University of Oxford. Requests for any data access can be made to the Director of the NPEU. Any requests will be considered by the NPEU data access committee following the NPEU data sharing policy and will be subject to further regulatory approval should access be required for any purposes other than those outlined in the NMS study protocol.

## Author contributions

SH, FA and SA developed the idea for the study. SH conducted the analysis with input from MQ, FA and SA. SH produced the first draft of the manuscript. All authors helped interpret the results, reviewed the draft versions of the manuscript and approved the final version.

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## Declaration of Competing Interest

None.

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