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Research paper

The impact of the Covid-19 pandemic on postnatal anxiety and posttraumatic stress: Analysis of two population-based national maternity surveys in England

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ABSTRACT

Background: Few studies have evaluated postnatal anxiety and posttraumatic stress (PTS) before and during the Covid-19 pandemic using comparable data across time. We used data from two national maternity surveys in England to explore the impact of the pandemic on prevalence and risk factors for postnatal anxiety and PTS.
Methods: Analysis was conducted using population-based surveys carried out in 2018 ($n = 4509$) and 2020 ($n = 4611$). Weighted prevalence estimates for postnatal anxiety and PTS were compared across surveys. Adjusted risk ratios (aRR) were estimated for the association between risk factors and postnatal anxiety and PTS.
Findings: Prevalence of postnatal anxiety increased from 13.7 % in 2018 to 15.1 % in 2020 (+1.4 %(95%CI:-0.4–3.1)). Prevalence of postnatal PTS increased from 9.7 % in 2018 to 11.5 % in 2020 (+1.8 %(95% CI:0.3–3.4)), due to an increase in PTS related to birth trauma from 2.5 % to 4.3 % (+1.8 %(95%CI:0.9–2.6); there was no increase in PTS related to non-birth trauma. Younger age (aRR = 1.31–1.51), being born in the UK (aRR = 1.29–1.59), long-term physical or mental health problem(s) (aRR = 1.27–1.94), and antenatal anxiety (aRR = 1.97–2.22) were associated with increased risk of postnatal anxiety and PTS before and during the pandemic, whereas higher satisfaction with birth (aRR = 0.92–0.94) and social support (aRR = 0.81–0.82) were associated with decreased risk.
Interpretation: Prevalence of postnatal PTS was significantly higher during the pandemic, compared to before the pandemic, due to an increase in PTS related to birth trauma. Prevalence of postnatal anxiety was not significantly higher during the pandemic. Risk factors for postnatal anxiety and PTS were similar before and during the pandemic.

1. Background

The Covid-19 outbreak was one of the biggest global crises in generations causing fear and panic worldwide. For perinatal populations, it was especially alarming because the World Health Organization designated pregnant women as a vulnerable group and there was uncertainty over the risk to unborn and newborn babies. The limited information available about Covid-19, particularly during 2020, and the lack of guidance around pregnancy and childbirth are likely to have heightened fear among pregnant and postnatal women (Jackson et al., 2023). In addition, the introduction of stringent measures to control the virus, including social distancing, restrictions on travel and enforced lockdowns caused widespread disruption to maternity services (Jardine et al., 2021). Antenatal and postnatal check-up appointments were frequently cancelled, curtailed or changed to remote consultations. Women who were able to access appointments were often required to

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attend without their birth partners, and some women were unaccompanied during labour or the birth itself (Aydin et al., 2022). Postnatally, women faced constraints on visitor policies and a lack of staff to help care for their baby (Sanders and Blaylock, 2021). Therefore, many women who gave birth during the pandemic encountered unique challenges and additional stress, coupled with a vast reduction in the support that was available, both from healthcare professionals and personal networks (McLeish et al., 2022).

A growing number of studies have explored the impact of the Covid-19 pandemic on perinatal mental health and overall the evidence points to higher rates of mental health problems during the pandemic compared to pre-pandemic rates (Chmielewska et al., 2021; Hessami et al., 2022; Iyengar et al., 2021). The majority of existing studies conducted during the pandemic focused on pregnant women, and studies which included postnatal women focused primarily on postnatal depression (Iyengar et al., 2021). The relatively few studies on postnatal anxiety or posttraumatic stress (PTS) have reported varying prevalence estimates, which may be attributable to sample variations or differing assessment methods (Basu et al., 2021; Liu et al., 2021: Ostacoli et al., 2020; Shorey et al., 2021; Zhang et al., 2022).

Several studies have explored factors associated with perinatal mental health problems for women who gave birth during the pandemic (Basu et al., 2021; Harrison et al., 2023; Iyengar et al., 2021; Liu et al., 2021; Motrico et al., 2023; Ostacoli et al., 2020; Zhang et al., 2022). The limited evidence from the UK suggests that chronic illness, unplanned pregnancy, smoking, and lower perceived support increased the risk of postnatal anxiety (Ceulemans et al., 2021). There have been no UK studies looking at risk factors for postnatal PTS for women who gave birth in the Covid-19 era, but studies from the USA and Europe indicate that pandemic-related maternity healthcare changes, concerns and distress along with younger age, lower education, relationship status, multiparity, and mental health history were important in the development of postnatal PTS (Liu et al., 2021; Motrico et al., 2023).

In addition to the paucity of research on postnatal anxiety and PTS during the pandemic, few studies have evaluated directly the impact of the pandemic on these mental health outcomes due to the lack of comparable pre-pandemic data. The current study uses data from two large population-based national maternity surveys in England, which were conducted in 2018 (pre-pandemic) and 2020 (during the pandemic) to evaluate the impact of the pandemic on postnatal anxiety and PTS. The study objective was to compare prevalence of and factors associated with postnatal anxiety and postnatal PTS six months after childbirth for women who gave birth before and during the Covid-19 pandemic.

2. Methods

2.1. Design and sample

The 2018 and 2020 national maternity surveys were cross-sectional surveys of postnatal women. Random population-based samples of 16,000 women in the 2018 survey and 16,050 women in the 2020 survey were identified by the Office for National Statistics (ONS) using birth registration records. Women were aged 16 years or older, had given birth to their baby in England during a two-week period in October 2017 (in the 2018 survey) or in May 2020 (in the 2020 survey), and were living in England at the time they registered the birth. In both surveys, women were invited to take part six months after the birth. Women were contacted via post and three different modes of response were available: on paper, online or by telephone. Up to two reminders were sent to non-respondents.

The usable response rate was 29 % in both the 2018 ($n = 4509$) and 2020 ($n = 4611$) surveys, consistent with response rates in similar surveys (Harrison et al., 2020a). ONS provided anonymised sociodemographic data for all of the women sampled, enabling comparison of selected characteristics of respondents and non-respondents. Across both surveys, women who responded were more likely to be older (>25 years), have registered the birth in married names, be living in more socioeconomically advantaged areas based on the index of multiple deprivation (IMD), have been born in the UK, and be first-time mothers (Harrison et al., 2020a). Therefore, non-response weights based on these sociodemographic factors were derived for each survey and the weights were applied to the current analyses to reduce the effect of non-response bias. Further details of the 2018 and 2020 surveys and the calculation of the survey weights are published elsewhere (Harrison et al., 2020b; Harrison et al., 2021).

2.2. Outcomes

The questionnaires included detailed sections about perinatal mental health. Anxiety symptoms were assessed with the two-item Generalised Anxiety Disorder Scale (GAD-2) and PTS symptoms were assessed with the Primary Care PTSD Screen for DSM (PC-PTSD-IV and PC-PTSD-5). As the outcomes were based on self-report scales rather than diagnostic interviews, we use 'anxiety' to denote anxiety symptoms and 'PTS' to denote PTS symptoms throughout the manuscript.

The GAD-2 is a sub-scale of the GAD-7, which is a commonly used self-assessment tool for anxiety. Respondents are asked to rate the frequency of anxiety symptoms they have experienced within the previous two weeks. The anxiety symptoms asked in the GAD-2 are feeling nervous, anxious or on edge, and not being able to stop or control worrying. Each item is scored on a four-point Likert scale (0–3) and the GAD-2 gives a total score ranging from 0 to 6. A score of 3 or more has been identified as an acceptable cut-off for detecting clinically significant anxiety symptoms in the general population (Plummer et al., 2016). Using a cut-off of 3 or more, the GAD-2 has weighted sensitivity of 0.69 and specificity of 0.91 for a diagnosis of generalised anxiety disorder in pregnant women (Nath et al., 2018).

The PC-PTSD-5 is a brief measure designed for use in primary care settings where physician time and resources are limited (Prins et al., 2016). It includes five items, each mapping onto one of the symptom factors proposed to underlie the construct of PTSD: 1) re-experiencing a traumatic event; 2) avoidance; 3) hyperarousal; 4) emotional numbing; and 5) guilt and/or a distorted sense of blame. Respondents are asked about symptoms experienced in the past month that are related to a traumatic event that occurred anytime in their lifetime. The five items are scored dichotomously as either 0 (no) or 1 (yes) and a score of 3 or more gives a 'positive' result. At a cut-off score of 3 or more, the PC-PTSD-5 has sensitivity of 0.93 and specificity of 0.85 (Prins et al., 2016). In the 2018 survey, the previous version of the PC-PTSD screen was used (PC-PTSD-IV), which is very similar to the PC-PTSD-5 but includes four symptom factors (omitting guilt and/or a distorted sense of blame). A cut-off point of 3 or more is also optimal on the PC-PTSD-IV at which the sensitivity is 0.78 and specificity is 0.78 (Prins et al., 2004). As the measure was used to assess PTS symptoms and not to diagnose posttraumatic stress disorder, we refer to PTS throughout the paper.

In both surveys, women were asked to indicate whether any PTS symptoms they reported were related to their labour or childbirth. This enabled us to assess and differentiate between PTS related to birth trauma and PTS related to non-birth trauma.

2.3. Explanatory risk factors

The questionnaires included questions on a number of risk factors, which have been associated with postnatal mental health problems in previous studies, and additional data were provided by ONS. Sociodemographic factors were: age (<25 years, 25–29 years, 30–34 years, 35 years and older); birth registration status (registered in married names, registered in joint names living at the same address, registered in joint names living at different addresses or registered in mother's sole name); age at completion of full-time education (16 years or younger, 17–18 years, 19 years or older); IMD (quintiles 1 [least

socioeconomically advantaged] to 5 [most socioeconomically advantaged); ethnicity (Asian, Black, Mixed, White, or Other); and country of birth (UK, outside UK). Pregnancy- and birth-related factors were: planning of pregnancy (planned, unplanned); smoking during pregnancy (smoking, not smoking); parity (primiparous, multiparous); multiplicity (single birth, multiple birth); mode of birth (vaginal, instrumental, planned caesarean section, unplanned caesarean section); gestational age at birth (preterm [<37 weeks], term [37 weeks or later]); birthweight (low birthweight [<2500 g], normal birthweight [2500 g or over]); neonatal admission (yes, no); birth experience (better than or as expected, worse than expected); and satisfaction with birth (score from 0 [least satisfied] to 12 [most satisfied] on the 6-item Birth Satisfaction Scale Revised Indicator (BSS-RI) in the 2020 survey or on 6 of the 10 items on the BSS-R in the 2018 survey) (Martin et al., 2017). Biopsychosocial factors were: long-term physical health problem(s) (yes, no); long-term mental health problem(s) (yes, no); antenatal anxiety (yes, no); antenatal depression (yes, no); and social support (score from 0 [low social support] to 6 [high social support]).

2.4. Statistical analysis

The 2018 and 2020 survey datasets were combined for all analyses. Weighted prevalence estimates for postnatal anxiety and PTS were calculated in addition to separate estimates for PTS related to birth trauma and non-birth trauma. The estimates were compared across the two surveys using absolute differences and unadjusted risk ratios (uRR) with 95 % confidence intervals (CIs) to assess the impact of giving birth during the pandemic on these mental health outcomes. Weighted prevalence estimates for postnatal anxiety and PTS for women with different sociodemographic, pregnancy- and birth-related, and biopsychosocial factors were compared graphically across the 2018 and 2020 surveys using bar charts.

As the primary study outcomes (postnatal anxiety and PTS) were not rare (prevalence >10 %), Modified Poisson regression analyses were used to estimate unadjusted and adjusted risk ratios (uRR and aRR) for the association between explanatory risk factors and mental health outcomes. Although the outcomes of PTS related to birth trauma and non-birth trauma were less prevalent (<10 %), Modified Poisson regression was also used to estimate the association between the explanatory risk factors and these outcomes to ensure consistency. Firstly, univariable analyses were conducted to assess the association between each factor and each of the mental health outcomes. Secondly, the factors that were statistically associated ($p < 0.1$) with each of the outcomes in the univariable analyses were entered into the multivariable analyses for those outcomes. Those variables that were not significant at $p < 0.05$ were removed sequentially from the multivariable model with those least significant being removed first. This process continued until only factors significantly associated with each of the outcomes remained in the models in addition to survey year, which was included irrespective of the *p*-value. Lastly, interaction terms between survey year and each of the factors in turn were included in the final models to compare the aRRs in the 2018 and 2020 surveys. All analyses were conducted using Stata version 17.6.

3. Results

3.1. Baseline characteristics

Table 1 shows the weighted distributions of sociodemographic characteristics for women who took part in the 2018 and 2020 surveys. The characteristics were broadly similar across survey years and any small variations reflect changes over time in the structure of the population of women giving birth in England. The only notable difference is that the weighted proportion of women of Black ethnicity was higher in the 2020 survey, whereas the weighted proportion of women of Other ethnicity was higher in the 2018 survey.

Table 1
Baseline characteristics of respondents to the 2018 and 2020 surveys.

	2018 (N = 4509)		2020 (N = 4611)		p-value
	n	%	n	%	
Age					0.5429
<20 years	59	2.5	44	2.8	
20–24 years	359	13.8	355	12.5	
25–29 years	1055	27.0	1117	26.5	
30–34 years	1713	33.4	1785	33.8	
35+ years	1323	23.3	1310	24.5	
Registration status					0.7666
Married	2865	52.8	2886	51.7	
Joint registration (same address)	1322	31.6	1392	32.7	
Joint registration (different address)	216	10.8	220	10.5	
Sole registration	106	4.8	113	5.2	
Age left full-time education[a]					0.1426
<17 years	493	14.8	514	14.0	
17–18 years	1045	26.1	1226	28.4	
19+ years	2922	59.1	2823	57.7	
IMD					0.5757
1 (least socioeconomically advantaged)	706	27.0	698	25.6	
2	869	22.2	876	21.9	
3	945	18.4	957	19.3	
4	1006	17.1	1070	17.9	
5 (most socioeconomically advantaged)	983	15.2	1010	15.4	
Ethnicity[a]					0.0014
Asian	308	10.0	380	10.1	
Black	102	4.0	126	5.4	
Mixed	101	2.6	104	2.7	
White	3779	81.2	3911	81.0	
Other	67	2.1	27	0.8	
Country of birth					0.1218
UK	3483	71.0	3674	69.1	
Outside UK	1026	29.0	937	30.9	

[a] Education: 1.5 % missing data in 2018 and 2020.
Ethnicity: 4.3 % missing data in 2018 and 1.7 % missing data in 2020.

3.2. Prevalence of postnatal anxiety and PTS in the 2018 and 2020 surveys

Prevalence of postnatal anxiety and PTS was higher in 2020 compared to 2018 (Table 2). The percentage of women who scored above the cut-off on the GAD-2 increased from 13.7 % in 2018 to 15.1 % in 2020 (difference: +1.4 % (95%CI:-0.4–3.1), $p = 0.127$). The percentage of women who scored above the cut-off on the PC-PTSD increased from 9.7 % in 2018 to 11.5 % in 2020 (difference: +1.8 % (95%CI:0.3–3.4), $p = 0.024$). Therefore, there was an increase in prevalence of both postnatal mental health outcomes for women who gave birth during the pandemic, compared to women who gave birth before the pandemic, but the increase was statistically significant for postnatal PTS only ($p < 0.05$). Table 2 also shows the prevalence of PTS related to birth trauma and non-birth trauma. The prevalence of PTS related to birth trauma was 2.5 % in 2018 and 4.3 % in 2020, which is a statistically significant increase (+1.8 % (95%CI:0.9–2.6), $p < 0.001$). The prevalence of PTS related to non-birth trauma did not change between 2018 (7.0 %) and 2020 (7.0 %) (+ < 0.1 % (95%CI:-1.1–1.4), $p = 0.836$). Therefore, the increase in overall prevalence of PTS is explained by the increase in PTS related to birth trauma.

The prevalence of postnatal anxiety and PTS by survey year and selected sociodemographic, pregnancy- and birth-related, and biopsychosocial factors is shown in Fig. 1 (anxiety) and Fig. 2 (PTS). These descriptive figures show higher prevalence of postnatal anxiety and PTS before and during the pandemic for women who were younger, with sole or joint (but unmarried) registration status, who were born in the UK, who self-identified as Mixed, White or Other ethnicity, who left full-time education at a younger age (before 19 years), and who were living in less socioeconomically advantaged areas. In addition, the figures show

Table 2
Prevalence and absolute difference (with 95 % CIs) for postnatal anxiety and PTS in the 2018 and 2020 surveys.

	2018		2020		Difference	p-value
	n/N	%	n/N	%	(95 % CI)	
Anxiety (GAD-2 score ≥ 3)	521/4339	13.7	654/4550	15.1	+1.4 % (−0.4, 3.1)	0.127
PTS (PC-PTSD score ≥ 3)	374/4369	9.7	473/4505	11.5	+1.8 % (0.3, 3.4)	0.024
PTS related to birth trauma[a]	101/4369	2.5	193/4505	4.3	+1.8 % (0.9, 2.6)	<0.001
PTS related to non-birth trauma[a]	265/4369	7.0	269/4505	7.0	<0.1 % (−1.1, 1.4)	0.836

n/N = unweighted, % = weighted.
[a] Sum of PTS related to birth and non-birth trauma does not equal overall PTS because 8 women in the 2018 survey and 11 women in the 2020 survey did not indicate whether their symptoms were related to their labour and/or childbirth.

higher prevalence of postnatal anxiety and PTS before and during the pandemic for women who had an unplanned pregnancy, smoked during pregnancy, were less satisfied with childbirth, had a long-term physical or mental health problem, had antenatal anxiety or depression, and had lower social support. Prevalence of postnatal PTS was also higher before and during the pandemic for women who gave birth to a pre-term or low birthweight baby and for women whose baby was admitted to a neonatal unit.

3.3. Factors associated with postnatal anxiety

Table 3 shows the univariable and multivariable associations between each of the explanatory factors and postnatal anxiety. In the multivariable regression analysis, factors associated with increased risk of postnatal anxiety after adjusting for all other factors were younger age, registering the birth of the baby in unmarried names despite living at the same address as the second registered parent, being born in the UK, long-term physical health problem(s), long-term mental health problem(s), and antenatal anxiety (Fig. 3). Higher satisfaction with birth and higher social support were associated with decreased risk of postnatal anxiety (Fig. 3). There was no evidence of association between survey year and postnatal anxiety in the univariable or multivariable analyses. Testing for interactions between survey year and each of the above factors in turn indicated that there was a significant interaction effect between survey year and social support only. Prior to the pandemic, higher social support was more strongly associated with a decreased risk of postnatal anxiety. The strength of the association between each of the other factors and postnatal anxiety did not vary significantly according to survey year.

3.4. Factors associated with postnatal PTS

Table 4 shows the univariable and multivariable associations between each of the explanatory factors and postnatal PTS. In the multivariable regression analysis, the factors associated with increased risk of postnatal PTS after adjusting for all other factors were younger age, being born in the UK, having an unplanned pregnancy, long-term physical health problem(s), long-term mental health problem(s), antenatal anxiety, and antenatal depression. Higher satisfaction with birth and higher social support were associated with decreased risk of postnatal PTS (Fig. 4). There was evidence of association between survey year and postnatal PTS in the univariable analysis but not in the multivariable analysis after adjusting for all other factors. The aRR for the association between survey year and PTS attenuated to 1.01 (95%CI: 0.87–1.16) when adjusting for antenatal anxiety alone. Testing for interactions between survey year and each of the above factors in turn indicated that there were no significant interaction effects. Therefore, the strength of the association between each of the factors and postnatal PTS did not vary significantly according to survey year.

3.5. Factors associated with postnatal PTS related to birth or non-birth trauma

Table 5 shows the univariable and multivariable associations between each of the explanatory factors and PTS related to birth trauma or non-birth trauma. In the multivariable regression analyses, factors associated with increased risk of PTS related to birth trauma after adjusting for all other factors were younger age, registering the birth of the baby in unmarried names despite living at the same address as the second registered parent, having a multiple birth, neonatal admission, the birth experience being worse than expected, long-term physical health problem(s), long-term mental health problem(s), and antenatal anxiety. Higher birth satisfaction was associated with decreased risk of PTS related to birth trauma. In addition, after adjusting for all other factors in the multivariable analysis, survey year or giving birth during the pandemic was associated with increased risk of postnatal PTS related to birth trauma, compared to giving birth before the pandemic.

Factors associated with increased risk of PTS related to non-birth trauma after adjusting for all other factors were younger age, being born in the UK, having an unplanned pregnancy, smoking during pregnancy, long-term mental health problem(s), antenatal anxiety, and antenatal depression. Higher social support was associated with decreased risk of PTS related to non-birth trauma. There was no evidence of association between survey year and postnatal PTS related to non-birth trauma in the univariable or multivariable analyses. Therefore, several of the risk and protective factors were common to postnatal PTS regardless of whether the trauma related to childbirth, yet there were also unique factors which were specific to PTS related to birth or non-birth trauma.

Testing for interaction effects between survey year and each of the factors in turn indicated that there was only a statistically significant interaction effect between survey year and registration status for PTS related to birth trauma ($p < 0.05$); registering the baby in unmarried names was more strongly associated with PTS related to birth trauma before the pandemic. No other interaction effects were statistically significant ($p > 0.1$). Therefore, the strength of the association between each of the factors and postnatal PTS related to birth trauma or non-birth trauma did not vary significantly according to survey year.

4. Discussion

4.1. Summary of main findings

The current findings are based on data from the 2018 and 2020 national maternity surveys in England and indicate that prevalence of two common postnatal mental health problems, anxiety and PTS, was slightly higher among women who gave birth during the Covid-19 pandemic in 2020, compared to pre-pandemic rates in 2018. In the 2020 survey, 15.1 % of women reported postnatal anxiety six months after childbirth, an increase of 1.4 %, and 11.5 % of women reported postnatal PTS, an increase of 1.9 %. Although the increases in prevalence were relatively small, any worsening of maternal mental health is concerning. Separating women with PTS related to birth trauma from



Fig. 1. Proportion of women scoring above the cut-off on the GAD-2 by survey year and other sociodemographic, pregnancy- and birth-related, and bio-psychosocial factors.

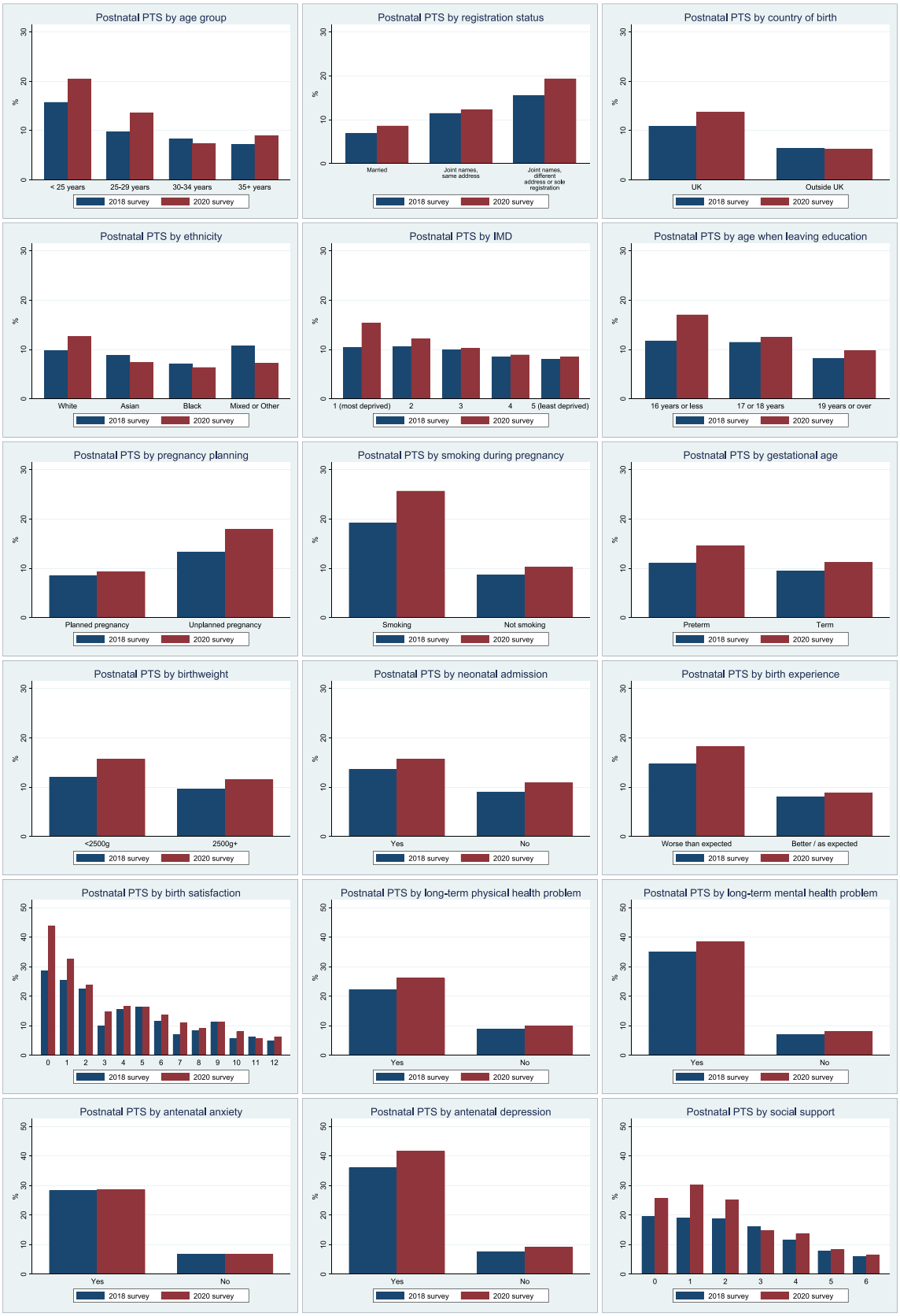


Fig. 2. Proportion of women scoring above the cut-off on the PC-PTSD by survey year and other sociodemographic, pregnancy- and birth-related, and bio-psychosocial factors.

Table 3
Unadjusted and adjusted RRs (and 95%CI) for association between sociodemographic, pregnancy and birth, and biopsychosocial risk factors and postnatal anxiety.

			Postnatal anxiety			
			Unadjusted		Adjusted	
		%[a]	RR[b] (95%CI)	p-value[c]	aRR[d] (95%CI)	p-value[e]
Pandemic						
Survey year	2018	13.7	1		1	
	2020	15.1	1.10 (0.97, 1.24)	0.127	0.99 (0.88, 1.12)	0.897
Sociodemographic						
Age	<25 years	21.2	1.79 (1.50, 2.14)[f]	<0.001	1.31 (1.08, 1.58)[g]	0.006
	25-29 years	16.5	1.40 (1.20, 1.63)[f]	<0.001	1.27 (1.09, 1.47)[g]	0.002
	30-34 years	11.8	1		1	
	35+ years	11.1	0.94 (0.80, 1.10)	0.431	0.94 (0.80, 1.10)	0.432
Registration status	Married	11.2	1		1	
	Living at same address	16.9	1.51 (1.33, 1.71)[f]	<0.001	1.17 (1.03, 1.34)[g]	0.016
	Living at different address/sole registration	19.7	1.75 (1.46, 2.11)[f]	<0.001	1.07 (0.87, 1.31)	0.515
Age left education	<17 years	17.2	1.33 (1.12, 1.59)[f]	0.001		NS
	17-18 years	16.1	1.25 (1.09, 1.44)[f]	0.002		
	19+ years	12.9	1			
IMD	1 (most socio-economically disadvantaged)	16.8	1.33 (1.11, 1.60)[f]	0.002		NS
	2	15.6	1.23 (1.03, 1.48)[f]	0.022		
	3	13.3	1.05 (0.87, 1.25)	0.615		
	4	12.0	0.95 (0.79, 1,14)	0.569		
	5 (least socio-economically disadvantaged)	12.7	1			
Ethnicity	Asian	12.3	0.82 (0.64, 1.06)	0.139		NS
	Black	8.7	0.58 (0.36, 0.95)[f]	0.031		
	Mixed	15.3	1.02 (0.70, 1.51)	0.903		
	White	14.9	1			
	Other	11.5	0.77 (0.39, 1.53)	0.459		
Country of birth	UK	16.2	1		1	
	Outside UK	10.1	0.62 (0.53, 0.74)[f]	<0.001	0.78 (0.65, 0.93)[g]	0.005
Pregnancy and birth						
Pregnancy planning	Planned	12.7	1			NS
	Unplanned	19.4	1.52 (1.33, 1.74)[f]	<0.001		
Smoking during pregnancy	Yes	23.1	1.71 (1.42, 2.05)[f]	<0.001		NS
	No	13.5	1			
Parity	Primiparous	14.4	1.00 (0.89, 1.13)	0.962		–
	Multiparous	14.4	1			
Multiplicity	Single birth	14.5	1			–
	Multiple birth	11.6	0.80 (0.48, 1.36)	0.415		
Mode of birth	Vaginal	14.1	1			–
	Instrumental	14.8	1.05 (0.88, 1.25)	0.603		
	Planned caesarean	15.5	1.10 (0.93, 1.30)	0.279		
	Unplanned caesarean	14.5	1.03 (0.86, 1.23)	0.763		
Gestational age at birth	Preterm (< 37 weeks)	15.4	1.09 (0.87, 1.35)	0.470		–
	Term (37+ weeks)	14.2	1			
Birthweight	Low BW (<2500 g)	14.5	0.99 (0.78, 1.26)	0.953		–
	Normal BW (2500 g+)	14.6	1			
Neonatal admission	Yes	16.3	1.15 (0.96, 1.39)	0.124		–
	No	14.1	1			
Birth experience	Better than / as expected	12.8	1			NS
	Worse than expected	18.5	1.45 (1.28, 1.64)[f]	<0.001		
Birth satisfaction[h]	Median (IQR)	8 (6–10)	0.89 (0.88, 0.91)[f]	<0.001	0.94 (0.92, 0.96)[g]	<0.001
Biopsychosocial						
Physical health problem	Yes	27.1	2.03 (1.72, 2.40)[f]	<0.001	1.27 (1.07, 1.50)[g]	0.005
	No	13.4	1		1	
Mental health problem	Yes	44.4	4.03 (3.59, 4.52)[f]	<0.001	1.94 (1.68, 2.24)[g]	<0.001
	No	11.0	1		1	
Antenatal anxiety	Yes	36.6	3.81 (3.40, 4.27)[f]	<0.001	2.22 (1.92, 2.57)[g]	<0.001
	No	9.6	1		1	
Antenatal depression	Yes	42.2	3.46 (3.03, 3.96)[f]	<0.001		NS
	No	12.2	1			
Social support[h]	Median (IQR)	5 (4–6)	0.77 (0.75, 0.79)[f]	<0.001	0.81 (0.79, 0.84)[g]	<0.001

- not entered in the multivariable analysis as not significant ($p > 0.1$) in univariable analysis.
NS entered into the multivariable analysis but not significant ($p > 0.05$) after adjusting for other factors and therefore removed from final model.

[a] Prevalence of postnatal anxiety.
[b] Risk ratio unadjusted (univariable association only).
[c] *p*-value for RR (each category).
[d] Risk ratio adjusted for survey year, age, registration status, country of birth, birth satisfaction, long-term physical health problem, long-term mental health problem, antenatal anxiety, and social support.
[e] p-value for aRR (each category).

[f] Significant at $p < 0.1$.
[g] Significant at $p < 0.05$.
[h] Entered into the model as a continuous variable – median shown is for all women who took part in the surveys.

those with PTS related to non-birth trauma showed that the increase in overall prevalence of PTS in 2020 was fully explained by an increase in the prevalence of PTS related to birth trauma.

The increase in prevalence of postnatal anxiety from before to during the pandemic was not statistically significant and the increase in prevalence of postnatal PTS (related to birth and non-birth trauma combined) was only statistically significant prior to adjusting for other factors. After adjusting for other factors, giving birth during the pandemic was not associated with either postnatal anxiety or PTS. However, it is still possible that giving birth during the pandemic affected postnatal mental health through its impact on other risk and protective factors. For example, we know that the prevalence of antenatal mental health problems increased considerably during the pandemic and that satisfaction with childbirth and access to social support both declined (Harrison et al., 2021). These factors are important in determining postnatal mental health and may explain the increase in anxiety and PTS seen prior to adjustment.

The risk factors that were associated with postnatal anxiety and PTS after adjusting for other factors were younger age (below 30 years old), being born in the UK, having long-term physical or mental health problems, and experiencing antenatal anxiety or depression. In addition, registering the birth of the baby in unmarried names despite living at the same address as the second registered parent was a risk factor for postnatal anxiety and having an unplanned pregnancy was a risk factor for postnatal PTS. Higher satisfaction with childbirth and higher social support were protective against both postnatal anxiety and PTS. Many of these factors are well-known predictors of poor postnatal mental health outcomes (Howard et al., 2014). The risk and protective factors did not change materially according to the year that women gave birth and the strength of the association between risk and protective factors and postnatal mental health outcomes was similar for women who gave birth before and during the pandemic. Therefore, there was no evidence to suggest that the women who were at risk of postnatal anxiety or PTS before the pandemic differed to the women who were at risk during the pandemic, based on risk factors we assessed in the current study.

There was also no evidence to suggest that women at risk of PTS related to birth or non-birth trauma before the Covid-19 outbreak differed to the women who were at risk during the pandemic, although giving birth during the pandemic did in itself increase the risk of PTS related to birth trauma. In addition, the factors associated with PTS related to birth trauma differed compared to those related to non-birth trauma and this was particularly evident when considering factors relating directly to the birth. For example, having a multiple birth, experiencing the birth as worse than was expected, lower satisfaction with birth, and having the baby admitted to a neonatal unit were unique risk factors for PTS related to birth trauma. Conversely, some of the more general factors, such as being born in the UK, smoking during pregnancy, and lower social support were unique risk factors for PTS

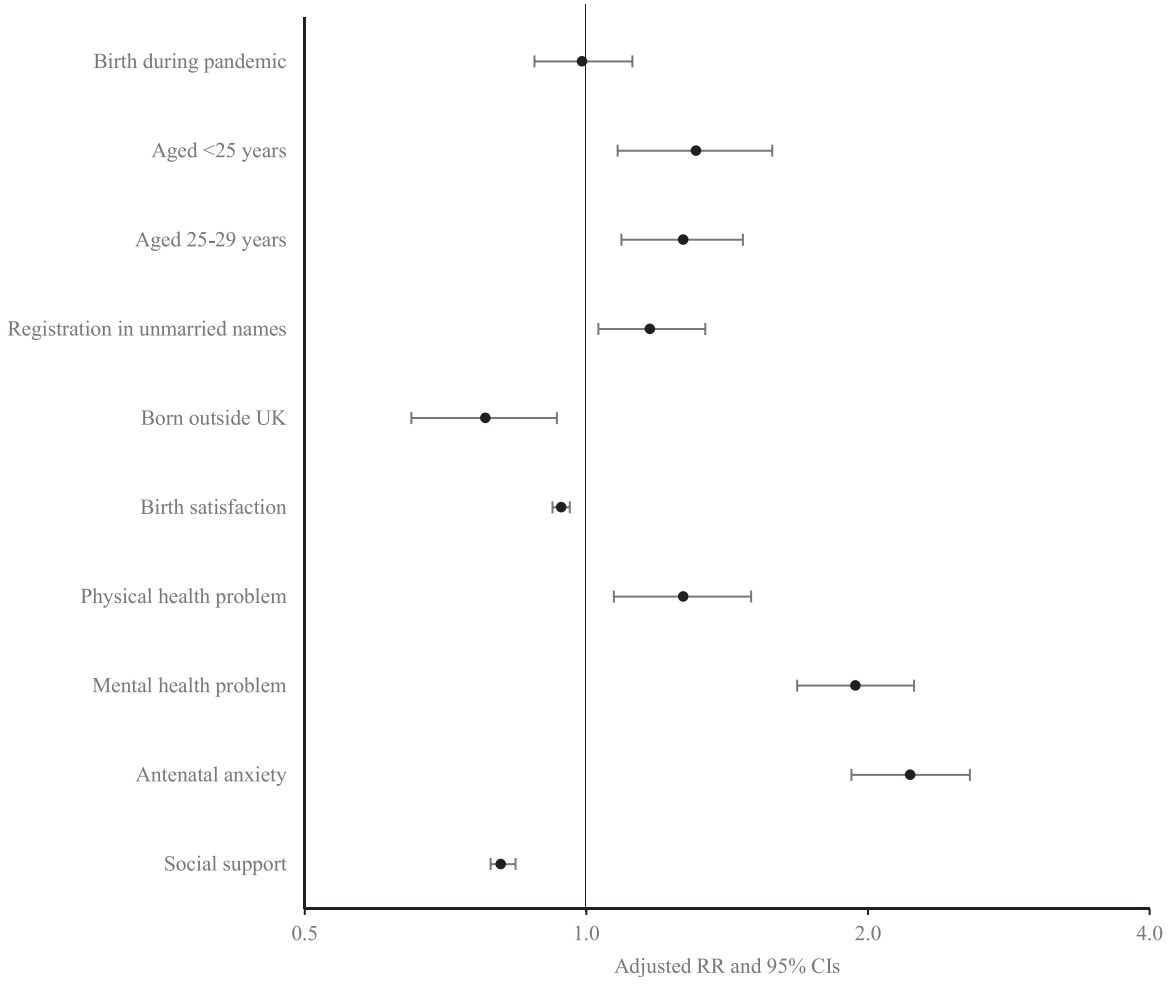


Fig. 3. Forest plot showing adjusted RRs for the factors included in the final regression model for postnatal anxiety.

Table 4
Unadjusted and adjusted RRs (and 95%CI) for association between sociodemographic, pregnancy and birth, and biopsychosocial risk factors and postnatal PTS.

			Postnatal PTS			
			Unadjusted		Adjusted	
		%[a]	RR[b] (95%CI)	p-value[c]	aRR[d] (95%CI)	p-value[e]
Pandemic						
Survey year	2018	9.7	1		1	
	2020	11.5	1.19 (1.02, 1.38)[f]	0.023	1.03 (0.89, 1.19)	0.696
Sociodemographic						
Age	<25 years	18.1	2.30 (1.87, 2.83)[f]	<0.001	1.51 (1.23, 1.86)[g]	<0.001
	25-29 years	11.7	1.49 (1.24, 1.80)[f]	<0.001	1.23 (1.02, 1.47)[g]	0.031
	30-34 years	7.9	1		1	
	35+ years	8.2	1.04 (0.86, 1.26)	0.704	1.00 (0.83, 1.21)	0.981
Registration status	Married	7.7	1			NS
	Living at same address	11.9	1.54 (1.32, 1.79)[f]	<0.001		
	Living at different address/sole registration	17.5	2.27 (1.84, 2.79)[f]	<0.001		
Age left education	<17 years	14.4	1.59 (1.30, 1.96)[f]	<0.001		NS
	17–18 years	12.0	1.33 (1.12, 1.57)[f]	0.001		
	19+ years	9.0	1			
IMD	1 (most socio-economically disadvantaged)	12.9	1.57 (1.25, 1.96)[f]	<0.001		NS
	2	11.4	1.38 (1.10, 1.73)[f]	0.005		
	3	10.1	1.23 (0.98, 1.54)[f]	0.078		
	4	8.7	1.06 (0.85, 1.32)	0.626		
	5 (least socio-economically disadvantaged)	8.3	1			
Ethnicity	Asian	8.1	0.72 (0.52, 0.99)[f]	0.049		NS
	Black	6.7	0.59 (0.34, 1.03)[f]	0.064		
	Mixed	11.0	0.98 (0.57, 1.63)	0.934		
	White	11.3	1			
	Other	5.7	0.51 (0.22, 1.16)	0.107		
Country of birth	UK	12.4	1		1	
	Outside UK	6.3	0.51 (0.41, 0.63)[f]	<0.001	0.63 (0.50, 0.78)[g]	<0.001
Pregnancy and birth						
Pregnancy planning	Planned	9.0	1		1	
	Unplanned	15.7	1.75 (1.50, 2.05)[f]	<0.001	1.20 (1.02, 1.40)[g]	0.025
Smoking during pregnancy	Yes	22.2	2.33 (1.92, 2.83)[f]	<0.001		NS
	No	9.5	1			
Parity	Primiparous	11.0	1.07 (0.92, 1.24)	0.377		–
	Multiparous	10.3	1			
Multiplicity	Single birth	10.6	1			–
	Multiple birth	11.9	1.12 (0.71, 1.78)	0.627		
Mode of birth	Vaginal	10.0	1			NS
	Instrumental	11.5	1.15 (0.93, 1.43)	0.201		
	Planned caesarean	11.1	1.10 (0.90, 1.36)	0.447		
	Unplanned caesarean	12.1	1.21 (0.99, 1.48)[f]	0.068		
Gestational age at birth	Preterm (< 37 weeks)	12.9	1.24 (0.96, 1.59)[f]	0.093		NS
	Term (37+ weeks)	10.4	1			
Birthweight	Low BW (<2500 g)	13.9	1.31 (1.02, 1.68)[f]	0.033		NS
	Normal BW (2500 g+)	10.6	1			
Neonatal admission	Yes	14.5	1.44 (1.18, 1.75)[f]	<0.001		NS
	No	10.1	1			
Birth experience	Better than / as expected	8.4	1			NS
	Worse than expected	16.7	1.97 (1.70, 2.28)[f]	<0.001		
Birth satisfaction[h]	Median (IQR)	8 (6–10)	0.87 (0.85, 0.89)[f]	<0.001	0.92 (0.90, 0.94)[g]	<0.001
Biopsychosocial						
Physical health problem	Yes	24.5	2.59 (2.16, 3.11)[f]	<0.001	1.50 (1.24, 1.82)[g]	<0.001
	No	9.5	1		1	
Mental health problem	Yes	37.0	4.84 (4.21, 5.56)[f]	<0.001	1.80 (1.48, 2.19)[g]	<0.001
	No	7.6	1		1	
Antenatal anxiety	Yes	28.5	4.21 (3.66, 4.85)[f]	<0.001	1.97 (1.65, 2.36)[g]	<0.001
	No	6.8	1		1	
Antenatal depression	Yes	39.0	4.64 (3.99, 5.40)[f]	<0.001	1.49 (1.21, 1.83)[g]	<0.001
	No	8.4	1		1	
Social support[h]	Median (IQR)	5 (4–6)	0.77 (0.74, 0.80)[f]	<0.001	0.82 (0.78, 0.85)[g]	<0.001

- not entered in the multivariable analysis as not significant ($p > 0.1$) in univariable analysis. NS entered into the multivariable analysis but not significant ($p > 0.05$) after adjusting for other factors and therefore removed from final model.

[a] Prevalence of postnatal PTS.

[b] Risk ratio unadjusted (univariable association only).

[c] *p*-value for RR (each category).

[d] Risk ratio adjusted for survey year, age, country of birth, pregnancy planning, birth satisfaction, long-term physical health problem, long-term mental health problem, antenatal anxiety, antenatal depression, and social support.

[e] p-value for aRR (each category).

[f] Significant at $p < 0.1$.

[g] Significant at $p < 0.05$.

[h] Entered into the model as a continuous variable – median shown is for all women who took part in the surveys - not entered in the multivariable analysis as not significant ($p > 0.1$) in univariable analysis.

related to non-birth trauma. Younger age, long-term mental health problem(s) and antenatal anxiety were common to PTS regardless of whether or not the trauma related to the birth.

4.2. Comparison with other studies

The existing literature suggests a greater impact of the Covid-19 pandemic on prevalence of postnatal anxiety than was found in the current study. In a recent international study including the UK, prevalence of anxiety was 27 % among 3939 women who were up to six months postpartum and the study found higher levels of symptoms during compared to before the pandemic (Mateus et al., 2022). Similarly, another UK study found 61 % of women up to 12 weeks postpartum reported clinically relevant anxiety (Fallon et al., 2021). Furthermore, the Covid-19 Mental Disorders Collaborators reported that, throughout 2020, the pandemic led to a 25.6 % increase in cases of anxiety disorders among the general population globally (Daly et al., 2022). Given the existing evidence from perinatal and general populations, the relatively small and statistically non-significant increase in the prevalence of postnatal anxiety reported in the current study is perhaps lower than would be expected. The prevalence of PTS in the current study is more consistent with existing literature, yet still at the lower end of the range of other estimates reported.

Many of the risk factors for postnatal anxiety and postnatal PTS identified in the current study are consistent with the pre-pandemic literature (Howard et al., 2014). There is also overlap between the findings of the current study and other studies conducted during the pandemic. In an international study including data from the UK, having a chronic physical or mental illness, unplanned pregnancy, smoking, and lower perceived support emerged as risk factors for poor perinatal mental health outcomes (Ceulemans et al., 2021). Social support was also identified as an important protective factor amidst the pandemic in a review of 81 international studies (Iyengar et al., 2021). More recently, a large Spanish study of pregnant and postpartum women found that being younger, suffering from pandemic concerns and distress, changes due to the pandemic, and previous mental health problems were risk factors associated with PTS symptoms in perinatal women (Motrico et al., 2023). The current study therefore provides further support for the importance of several of these risk and protective factors.

The strongest risk factors for postnatal anxiety and PTS in the current

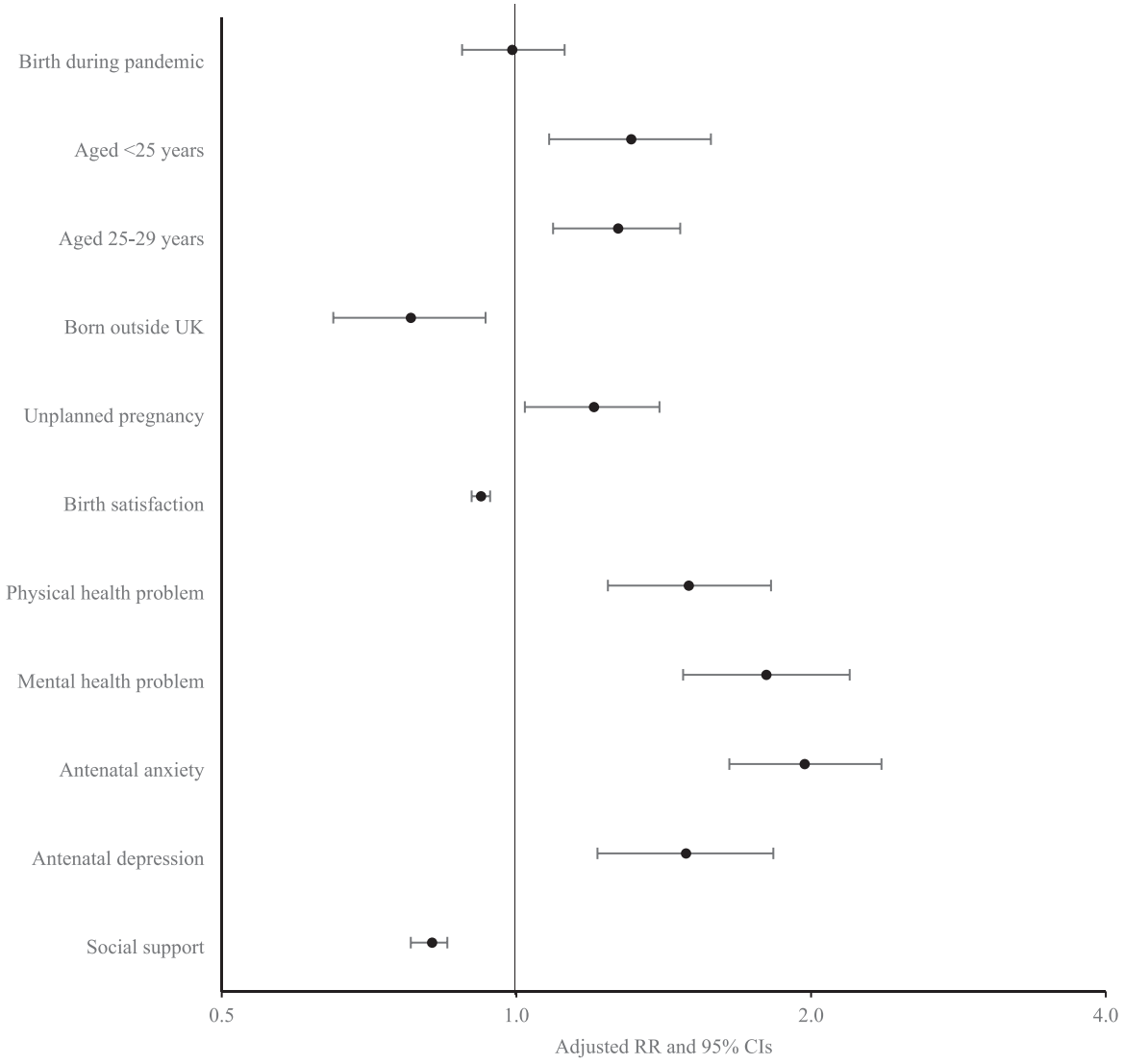


Fig. 4. Forest plot showing adjusted RRs for the factors included in the final regression model for postnatal PTS.

Table 5
Unadjusted and adjusted RRs (and 95%CI) for association between sociodemographic, pregnancy and birth, and biopsychosocial risk factors and postnatal PTS relating to birth and non-birth trauma.

		Postnatal PTS related to birth trauma					Postnatal PTS related to non-birth trauma				
			Unadjusted		Adjusted			Unadjusted		Adjusted	
		%[a]	RR[b] (95% CI)	p-value[c]	aRR[d] (95%CI)	p-value[e]	%[a]	RR[b] (95% CI)	p-value[c]	aRR[d] (95%CI)	p-value[e]
Pandemic											
Survey year	2018		1		1			1		1	
	2020		1.74 (1.32, 2.29)[f]	<0.001	1.45 (1.10, 1.92)[g]	0.009		1.02 (0.84, 1.23)	0.836	0.92 (0.77, 1.11)	0.398
Sociodemographic											
Age	<25 years	3.8	1.59 (1.04, 2.42)[f]	0.031	0.92 (0.60, 1.43)	0.718	13.8	2.74 (2.13, 3.53)[f]	<0.001	1.78 (1.38, 2.30)[g]	<0.001
	25-29 years	4.6	1.91 (1.39, 2.62)[f]	<0.001	1.46 (1.07, 1.98)[g]	0.016	6.6	1.32 (1.03, 1.68)[f]	0.027	1.15 (0.90, 1.47)	0.261
	30–34 years	2.4	1		1		5.0	1		1	
	35+ years	2.9	1.21 (0.87, 1.69)	0.258	1.04 (0.75, 1.44)	0.828	4.7	0.93 (0.73, 1.19)	0.572	0.97 (0.76, 1.24)	0.822
Registration status	Married	2.4	1		1		4.9	1			NS
	Joint registration (same address)	3.8	1.59 (1.23, 2.07)[f]	<0.001	1.39 (1.07, 1.81)[g]	0.014	7.5	1.55 (1.27, 1.89)[f]	<0.001		
	Joint registration (different address) or sole registration	5.2	2.16 (1.47, 3.18)[f]	<0.001	1.42 (0.93, 2.15)	0.104	11.5	2.37 (1.83, 3.08)[f]	<0.001		
Age left education	<17 years	3.6	1.14 (0.77, 1.69)	0.508		–	10.2	1.20 (1.47, 2.46)[f]	<0.001		NS
	17–18 years	3.6	1.16 (0.86, 1.56)	0.340			8.1	1.51 (1.22, 1.87)[f]	<0.001		
	19+ years	3.1	1				5.3	1			
IMD	1 (least socioeconomically advantaged)	3.8	1.39 (0.93, 2.05)	0.105		–	8.4	1.61 (1.21, 2.14)[f]	0.001		NS
	2	3.3	1.23 (0.83, 1.81)	0.305			7.3	1.39 (1.04, 1.86)[f]	0.025		
	3	3.5	1.30 (0.87, 1.91)	0.179			6.2	1.17 (0.87, 1.58)	0.285		
	4	2.9	1.06 (0.73, 1.54)	0.767			5.4	1.04 (0.78, 1.38)	0.814		
	5 (most socioeconomically advantaged)	2.7	1				5.3	1			
Ethnicity	Asian	2.1	0.59 (0.33, 1.05)[f]	0.075		NS	5.0	0.69 (0.46, 1.05)[f]	0.080		NS
	Black	2.8	0.77 (0.31, 1.93)	0.580			3.6	0.50 (0.25, 1.00)[f]	0.049		
	Mixed	1.6	0.45 (0.17, 1.23)	0.120			9.1	1.27 (0.71, 2.28)	0.426		
	White	3.6	1				7.2	1			
	Other	0.8	0.21 (0.03, 1.53)	0.125			4.7	0.66 (0.27, 1.63)	0.365		
Country of birth	UK	3.9	1			NS	8.0	1		1	
	Outside UK	2.0	0.52 (0.36, 0.76)[f]	<0.001			3.8	0.47 (0.36, 0.62)[f]	<0.001	0.68 (0.52. 0.90)[g]	0.006
Pregnancy and birth											
Pregnancy planning	Planned	3.0	1			NS	5.4	1		1	

(continued on next page)

Table 5 (*continued*)

		Postnatal PTS related to birth trauma					Postnatal PTS related to non-birth trauma				
			Unadjusted		Adjusted			Unadjusted		Adjusted	
		%[a]	RR[b] (95% CI)	p-value[c]	aRR[d] (95%CI)	p-value[e]	%[a]	RR[b] (95% CI)	p-value[c]	aRR[d] (95%CI)	p-value[e]
	Unplanned	4.1	1.36 (1.00, 1.85)[f]	0.049			10.9	2.02 (1.66, 2.45)[f]	<0.001	1.24 (1.01, 1.52)[g]	0.037
Smoking during pregnancy	Yes	5.4	1.74 (1.15, 2.63)[f]	0.009		NS	15.5	2.61 (2.05, 3.33)[f]	<0.001	1.32 (1.02, 1.70)[g]	0.034
	No	3.1	1				5.9	1		1	
Parity	Primiparous	4.0	1.43 (1.10, 1.86)[f]	0.008		NS	6.6	0.97 (0.80, 1.17)	0.744		–
	Multiparous	2.8	1				6.9	1			
Multiplicity	Single birth	3.2	1		1		6.8	1			–
	Multiple birth	6.0	1.85 (0.94, 3.64)[f]	0.076	2.46 (1.30, 4.66)[g]	0.006	5.5	0.80 (0.41, 1.58)	0.525		
Mode of birth	Vaginal	2.3	1			NS	7.4	1		1	
	Instrumental	5.0	2.23 (1.57, 3.17)[f]	<0.001			5.8	0.79 (0.58, 1.08)	0.143	0.85 (0.63, 1.14)	0.268
	Planned caesarean	3.2	1.43 (0.98, 2.10)[f]	0.067			7.0	0.95 (0.74, 1.23)	0.706	1.08 (0.84, 1.38)	0.569
	Unplanned caesarean	6.6	2.93 (2.10, 4.08)[f]	<0.001			4.9	0.66 (0.49, 0.89)[f]	0.007	0.65 (0.49, 0.88)[g]	0.004
Gestational age at birth	Preterm (< 37 weeks)	6.2	2.03 (1.43, 2.87)[f]	<0.001		NS	6.1	0.89 (0.61, 1.31)	0.559		–
	Term (37+ weeks)	3.1	1				6.8	1			
Birthweight	Low BW (<2500 g)	5.6	1.74 (1.18, 2.56)[f]	0.005		NS	7.4	1.08 (0.76, 1.53)	0.673		–
	Normal BW (2500 g+)	3.2	1				6.8	1			
Neonatal admission	Yes	7.2	2.55 (1.90, 3.42)[f]	<0.001	1.47 (1.10, 1.97)[g]	0.009	6.5	0.96 (0.71, 1.30)	0.796		–
	No	2.8	1				6.7	1			
Birth experience	Better than / as expected	8.3	1		1.94 (1.34, 2.81)[g]	<0.001	6.5	1			–
	Worse than expected	1.5	5.49 (4.17, 7.23)[f]	<0.001			7.6	1.18 (0.96, 1.45)	0.115		
Birth satisfaction[h]	Median (IQR)	8 (6–10)	0.74 (0.71, 0.77)[f]	<0.001	0.83 (0.78, 0.87)[g]	<0.001	8 (6–10)	0.94 (0.92, 0.97)[f]	<0.001		NS
Biopsychosocial											
Physical health problem	Yes	10.7	3.91 (2.84, 5.38)[f]	<0.001	2.40 (1.75, 3.31)[g]	<0.001	12.8	2.05 (1.59, 2.64)[f]	<0.001		NS
	No	2.7	1		1		6.3	1			
Mental health problem	Yes	11.4	4.71 (3.59, 6.17)[f]	<0.001	1.62 (1.17, 2.25)[g]	0.004	24.3	5.05 (4.19, 6.08)[f]	<0.001	2.06 (1.61, 2.64)[g]	<0.001
	No	2.4	1		1		4.8	1		1	
Anxiety during pregnancy	Yes	9.5	4.79 (3.70, 6.20)[f]	<0.001	2.30 (1.69, 3.12)[g]	<0.001	17.5	3.93 (3.27, 4.73)[f]	<0.001	1.88 (1.50, 2.35)[g]	<0.001
	No	2.0	1		1		4.5	1		1	
Depression during pregnancy	Yes	10.6	3.85 (2.80, 5.28)[f]	<0.001		NS	26.9	5.18 (4.26, 6.31)[f]	<0.001	1.73 (1.35, 2.22)[g]	<0.001
	No	2.7	1				5.2	1		1	
Social support[h]	Median (IQR)	5 (4–6)	0.81 (0.76, 0.87)[f]	<0.001		NS	5 (4–6)	0.76 (0.72, 0.80)[f]	<0.001	0.79 (0.75, 0.84)[g]	<0.001

- not entered in the multivariable analysis as not significant ($p > 0.1$) in univariable analysis. NS entered into the multivariable analysis but not significant ($p > 0.05$) after adjusting for other factors and therefore removed from final model.

[a] Prevalence of postnatal PTS.

[b] Risk ratio unadjusted (univariable association only).

[c] *p*-value for RR (each category).
[d] Risk ratio adjusted for survey year, age, registration status, multiplicity, neonatal admission, birth experience, birth satisfaction, long-term physical health problem, long-term mental health problem, and antenatal anxiety (PTS related to birth trauma); Risk ratio adjusted for survey year, age, country of birth, pregnancy planning, smoking during pregnancy, mode of birth, long-term mental health problem, antenatal anxiety, antenatal depression, and social support (PTS related to non-birth trauma).
[e] p-value for aRR (each category).
[f] Significant at $p < 0.1$.
[g] Significant at $p < 0.05$.
[h] Entered into the model as a continuous variable – median shown is for all women who took part in the surveys - not entered in the multivariable analysis as not significant ($p > 0.1$) in univariable analysis.

study were pre-existing mental health problems, either long-term or with onset antenatally. A study from the USA also found that women with pre-existing mental health diagnoses were 1.6 to 3.7 times more likely to have clinically significant levels of depression, generalised anxiety, and PTSD and, although women largely endorsed current symptoms corresponding with their existing diagnoses, the findings also indicated that women were more likely to report symptoms of additional mental health conditions (Liu et al., 2021). Similarly, in the current study, we found that antenatal anxiety and depression were risk factors for postnatal PTS. Therefore, postnatal women with pre-existing mental health problems may be vulnerable to exacerbation of existing symptoms and development of new symptoms.

Our findings indicated that women who gave birth during the pandemic were at increased risk of PTS related to birth trauma six months after giving birth, even after adjusting for all other factors, whereas there was no increase in the risk of PTS related to non-birth trauma. This is perhaps unsurprising given the circumstances surrounding many women's childbirth experiences during the pandemic. A recent qualitative study using free text data from the 2020 national maternity survey highlighted the impact on women of the changes to care around labour and birth (McLeish et al., 2022). Themes of fear and abandonment emerged from the data and many women found the absence of birth partners during labour, birth and in the early postnatal days to be traumatic and upsetting.

4.3. Interpretation and implications

There are several explanations for why our prevalence estimates of postnatal anxiety and PTS during the pandemic may be lower than estimates from some other studies. The differences observed may be attributable to sample variations across studies; it is notable that the current study recruited a random representative sample of women, whereas other studies have often relied on convenience sampling through social media advertisements, which may be more prone to self-selection bias. The differences may also be attributable to varying assessment measures and time points during the perinatal period or the Covid-19 pandemic. The current study surveyed women who gave birth in May 2020, which was relatively early in the course of the pandemic and prior to the peak of the case rate of Covid-19 in the UK; it is possible, therefore, that prevalence of mental health problems, including anxiety and PTS, increased as the pandemic progressed. Conversely, anxiety and PTS symptoms may have been at their highest during critical phases, such as the beginning of the Covid-19 outbreak, during pregnancy and childbirth, or immediately after birth. As the women who took part in the 2020 survey were surveyed six months after they had given birth and more than six months after the onset of the pandemic in England, levels of perinatal mental health symptoms may have subsided from earlier in the outbreak. Additional data from the 2020 survey shows that self-reported anxiety (from a health checklist) was highest one month after birth and declined by six months (Harrison et al., 2021). Review findings have also demonstrated a spike in perinatal anxiety at the outbreak of the pandemic and an eventual decrease in symptoms as more information became available (Iyengar et al., 2021). Furthermore, a meta-analysis of longitudinal cohort studies of the general population indicated that there was an acute increase in mental health symptoms at the pandemic onset, but symptoms declined significantly over time and were indistinguishable from pre-pandemic symptom profiles within a few months of the outbreak (Daly et al., 2022). Alternatively, it may be that symptoms of anxiety and PTS did not lessen, but rather persisted and shifted into a depressive illness (Howard et al., 2014). Our recent study on the impact of the pandemic on postnatal depression showed a large increase in prevalence six months after childbirth from before to during the pandemic (Harrison et al., 2023). Similarly, a study of perinatal women in the USA concluded that depression rates appeared to be more elevated during the pandemic compared to anxiety or PTS (Liu et al., 2021).

The relatively low prevalence of postnatal anxiety in the current study could also be explained by the use of the GAD-2 measure. Evidence for the use of the GAD-2 as a suitable perinatal screening tool is limited (Sinesi et al., 2019) and a recent study found the GAD-2 to be the least sensitive measure when compared to other self-report measures of postnatal anxiety (Fellmeth et al., 2022). Furthermore, the GAD-2 assesses generalised anxiety and a measure more specific to pregnancy and childbirth related stress and anxiety may have detected a greater impact of the pandemic on perinatal women (Sinesi et al., 2019).

The main risk and protective factors for postnatal anxiety and PTS remained the same for women who gave birth before and during the pandemic. Therefore, the findings suggest that the same women who were at the greatest risk prior to the pandemic were also at the greatest risk during the pandemic, which provides important information for service planning and resource targeting in the event of another pandemic. In the UK, the National Institute for Health and Care Excellence (NICE) guidelines recommend that all women are asked about their mental health six weeks after giving birth. Timely assessment, detection, intervention and follow-up are key to supporting women at risk, and it is essential that these mechanisms to identify and support women remain in place, and ideally are strengthened and repeated, during times of heightened risk such as the pandemic.

4.4. Strengths and limitations

The strengths of this study include the large population-based samples of women in the 2018 and 2020 surveys and the application of survey weights to increase the representativeness of the respondents and validity of the prevalence estimates. In addition, the availability of comparable data from two consecutive surveys conducted before and during the pandemic allows us to evaluate the impact of the pandemic on postnatal women's mental health. A further strength is the inclusion of standardised measures of mental health outcomes, each of which have validated cut-off points allowing comparison with other studies in the field. Ideally, mental health is assessed via structured clinical interview; the lack of such an assessment is a limitation of the study, yet such resource intensive and non-anonymised assessments are unfeasible in large observational research studies, and the use of valid and widely recognised self-report measures is the next best alternative. It should be noted, however, that we did not measure anxiety disorders or post-traumatic stress disorder, but rather symptoms of anxiety and PTS. An additional strength of the study is the distinction between PTS related to birth and non-birth trauma, which are often undistinguished in the literature. This study was limited by the risk factors that could be

explored in relation to the mental health outcomes, relying on those that were included in the questionnaires employed in the two surveys.

5. Conclusion

Our findings add to the growing literature on perinatal mental health during the pandemic. Analysis of data from two large population-based maternity surveys in England shows that almost one in six women who gave birth during the Covid-19 pandemic experienced postnatal anxiety and one in nine women experienced postnatal PTS six months after childbirth. Prevalence of postnatal anxiety and PTS was higher during the pandemic compared to pre-pandemic levels, yet the increase was not statistically significant for either mental health outcome after adjusting for other factors. Separating PTS into birth trauma and non-birth trauma indicated that the increase in postnatal PTS could be explained by an increase in birth trauma. Younger age, being born in the UK, long-term and antenatal mental health problems were risk factors for both postnatal anxiety and PTS, whereas satisfaction with childbirth and social support were protective. These risk and protective factors remained the same for women who gave birth before and during the pandemic.

Ethical approval and consent to participate

Ethnical approval was obtained for each survey separately: the 2018 survey was approved by the London Bloomsbury NRES Committee (18/LO/0271); and the 2020 survey was approved by the North West - Greater Manchester East NRES Committee (20/NW/0426). The Ethics Committees approved the surveys without the requirement for informed consent. Return of partially or fully completed questionnaires was considered to imply agreement to participate in the study and consent to use the data.

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Contributors

SH, MQ and FA developed the idea for the study. SH conducted the analysis with input from MQ, FA, GF 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.

Data sharing statement

Data are archived by the NPEU. Requests for any data access can be made to the Director of the NPEU. Any requests will be subject to further regulatory approval should access be required for any purposes other than those outlined in the study protocol.

CRediT authorship contribution statement

S. Harrison: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. **M.A. Quigley:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – review & editing. **G. Fellmeth:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – review & editing. **A. Stein:** Writing – review & editing. **S. Ayers:** Formal analysis, Writing – review & editing. **F. Alderdice:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Aydin, E., Glasgow, K.A., Weiss, S.M., Khan, Z., Austin, T., Johnson, M.H., Barlow, J., Lloyd-Fox, S., 2022. Giving birth in a pandemic: women's birth experiences in England during COVID-19. BMC Pregnancy Childbirth 22 (1), 304. https://doi.org/10.1186/s12884-022-04637-8.

Basu, A., Kim, H.H., Basaldua, R., Choi, K.W., Charron, L., Kelsall, N., Hernandez-Diaz, S., Wyszynski, D.F., Koenen, K.C., 2021. A cross-national study of factors associated with women's perinatal mental health and wellbeing during the COVID-19 pandemic. PloS One 16 (4), e0249780. https://doi.org/10.1371/journal.pone.0249780.

Ceulemans, M., Foulon, V., Ngo, E., Panchaud, A., Winterfeld, U., Pomar, L., Lambelet, V., Cleary, B., O'Shaughnessy, F., Passier, A., Richardson, J.L., Hompes, T., Nordeng, H., 2021. Mental health status of pregnant and breastfeeding women during the COVID-19 pandemic-a multinational cross-sectional study. Acta Obstet. Gynecol. Scand. 100 (7), 1219–1229. https://doi.org/10.1111/aogs.14092.

Chmielewska, B., Barratt, I., Townsend, R., Kalafat, E., van der Meulen, J., Gurol-Urganci, I., O'Brien, P., Morris, E., Draycott, T., Thangaratinam, S., Le Doare, K., Ladhani, S., von Dadelszen, P., Magee, L., Khalil, A., 2021. Effects of the COVID-19 pandemic on maternal and perinatal outcomes: a systematic review and meta-analysis. Lancet Glob. Health 9 (6), e759–e772. https://doi.org/10.1016/S2214-109X(21)00079-6.

Daly, M., Sutin, A.R., Robinson, E., 2022. Longitudinal changes in mental health and the COVID-19 pandemic: evidence from the UK household longitudinal study. Psychol. Med. 52 (13), 2549–2558. https://doi.org/10.1017/S0033291720004432.

Fallon, V., Davies, S.M., Silverio, S.A., Jackson, L., De Pascalis, L., Harrold, J.A., 2021. Psychosocial experiences of postnatal women during the COVID-19 pandemic. A UK-wide study of prevalence rates and risk factors for clinically relevant depression and anxiety. J. Psychiatr. Res. 136, 157–166. https://doi.org/10.1016/j.jpsychires.2021.01.048.

Fellmeth, G., Harrison, S., Quigley, M.A., Alderdice, F., 2022. A comparison of three measures to identify postnatal anxiety: analysis of the 2020 National Maternity Survey in England. Int. J. Environ. Res. Public Health 19 (11), 6578. https://doi.org/10.3390/ijerph19116578.

Harrison, S., Alderdice, F., Henderson, J., Redshaw, M., Quigley, M.A., 2020a. Trends in response rates and respondent characteristics in five National Maternity Surveys in England during 1995-2018. Arch Pub Health. 78, 46. https://doi.org/10.1186/s13690-020-00427-w.

Harrison, S., Alderdice, F., Henderson, J., & Quigley, M. A. (2020b). You and your Baby: A National Survey of Health and Care. Oxford: National Perinatal Epidemiology Unit, University of Oxford, ISBN: 978–0–9956854-5-1.

Harrison, S., Alderdice, F., McLeish, J., Quigley, M.A., 2021. You & your Baby: A National Survey of Health and Care during the 2020 Covid-19 Pandemic. Nuffield Department of Population Health. University of Oxford (Report No.: 978-1-8383678-4–8).

Harrison, S., Quigley, M.A., Fellmeth, G., Stein, A., Alderdice, F., 2023. The impact of the Covid-19 pandemic on postnatal depression: analysis of three population-based national maternity surveys in England (2014-2020). The Lancet Regional Health - Europe 30, 100654. https://doi.org/10.1016/j.lanepe.2023.100654.

Hessami, K., Romanelli, C., Chiurazzi, M., Cozzolino, M., 2022. COVID-19 pandemic and maternal mental health: a systematic review and meta-analysis. J. Matern. Fetal Neonatal Med. 35 (20), 4014–4021. https://doi.org/10.1080/14767058.2020.1843155.

Howard, L.M., Molyneaux, E., Dennis, C.L., Rochat, T., Stein, A., Milgrom, J., 2014. Non-psychotic mental disorders in the perinatal period. Lancet 384 (9956), 1775–1788. https://doi.org/10.1016/S0140-6736(14)61276-9.

Iyengar, U., Jaiprakash, B., Haitsuka, H., Kim, S., 2021. One year into the pandemic: a systematic review of perinatal mental health outcomes during COVID-19. Front. Psych. 12, 674194 https://doi.org/10.3389/fpsyt.2021.674194.

Jackson, C., Brawner, J., Ball, M., Crossley, K., Dickerson, J., Dharni, N., Rodriguez, D.G., Turner, E., Sheard, L., Smith, H., 2023. Being pregnant and becoming a parent during the COVID-19 pandemic: a longitudinal qualitative study with women in the

born in Bradford COVID-19 research study. BMC Pregnancy Childbirth 23 (1), 494. https://doi.org/10.1186/s12884-023-05774-4.

Jardine, J., Relph, S., Magee, L.A., von Dadelszen, P., Morris, E., Ross-Davie, M., Draycott, T., Khalil, A., 2021. Maternity services in the UK during the coronavirus disease 2019 pandemic: a national survey of modifications to standard care. BJOG 128 (5), 880–889. https://doi.org/10.1111/1471-0528.16547.

Liu, C.H., Erdei, C., Mittal, L., 2021. Risk factors for depression, anxiety, and PTSD symptoms in perinatal women during the COVID-19 pandemic. Psychiatry Res. 295, 113552 https://doi.org/10.1016/j.psychres.2020.113552.

Martin, C.R., Hollins Martin, C., Redshaw, M., 2017. The birth satisfaction scale-revised Indicator (BSS-RI). BMC Pregnancy Childbirth 17 (1), 277. https://doi.org/10.1186/s12884-017-1459-5.

Mateus, V., Cruz, S., Costa, R., Mesquita, A., Christoforou, A., Wilson, C.A., Vousoura, E., Dikmen-Yildiz, P., Bina, R., Dominguez-Salas, S., Contreras-García, Y., Motrico, E., Osório, A., 2022. Rates of depressive and anxiety symptoms in the perinatal period during the COVID-19 pandemic: comparisons between countries and with pre-pandemic data. J. Affect. Disord. 316, 245–253. https://doi.org/10.1016/j.jad.2022.08.017.

McLeish, J., Harrison, S., Quigley, M., Alderdice, F., 2022. Learning from a crisis: a qualitative study of the impact on mothers' emotional wellbeing of changes to maternity care during the COVID-19 pandemic in England, using the National Maternity Survey 2020. BMC Pregnancy Childbirth 22 (1), 868. https://doi.org/10.1186/s12884-022-05208-7.

Motrico, E., Galán-Luque, T., Rodríguez-Domínguez, C., Gómez-Gómez, I., Domínguez-Salas, S., 2023. Factors associated with post-traumatic stress symptoms in pregnant and postpartum women. J. Womens Health 32 (5), 583–591. https://doi.org/10.1089/jwh.2022.0400.

Nath, S., Ryan, E.G., Trevillion, K., Bick, D., Demilew, J., Milgrom, J., Pickles, A., Howard, L.M., 2018. Prevalence and identification of anxiety disorders in pregnancy: the diagnostic accuracy of the two-item generalised anxiety disorder scale (GAD-2). BMJ Open 8 (9), e023766. https://doi.org/10.1136/bmjopen-2018-023766.

Ostacoli, L., Cosma, S., Bevilacqua, F., Berchialla, P., Bovetti, M., Carosso, A.R., Malandrone, F., Carletto, S., Benedetto, C., 2020. Psychosocial factors associated with postpartum psychological distress during the Covid-19 pandemic: a cross-sectional study. BMC Pregnancy Childbirth 20 (1), 703. https://doi.org/10.1186/s12884-020-03399-5.

Plummer, F., Manea, L., Trepel, D., McMillan, D., 2016. Screening for anxiety disorders with the GAD-7 and GAD-2: a systematic review and diagnostic metaanalysis. Gen. Hosp. Psychiatry 39, 24–31. https://doi.org/10.1016/j.genhosppsych.2015.11.005.

Prins, A., Ouimette, P.C., Kimerling, R., Cameron, R.P., Hugelshofer, D.S., Shaw-Hegwer, J., Thrailkill, A., Gusman, F.D., Sheikh, J., 2004. The primary care PTSD screen (PC-PTSD): development and operating characteristics. Prim. Care Psychiatry 9, 9–14.

Prins, A., Bovin, M.J., Smolenski, D.J., Marx, B.P., Kimerling, R., Jenkins-Guarnieri, M. A., Kaloupek, D.G., Schnurr, P.P., Kaiser, A.P., Leyva, Y.E., Tiet, Q.Q., 2016. The primary care PTSD screen for DSM-5 (PC-PTSD-5): development and evaluation within a veteran primary care sample. J. Gen. Intern. Med. 31 (10), 1206–1211. https://doi.org/10.1007/s11606-016-3703-5.

Sanders, J., Blaylock, R., 2021. "anxious and traumatised": Users' experiences of maternity care in the UK during the COVID-19 pandemic. Midwifery 102, 103069. https://doi.org/10.1016/j.midw.2021.103069.

Shorey, S.Y., Ng, E.D., Chee, C.Y.I., 2021. Anxiety and depressive symptoms of women in the perinatal period during the COVID-19 pandemic: a systematic review and meta-analysis. Scand. J. Public Health 49 (7), 730–740. https://doi.org/10.1177/14034948211011793.

Sinesi, A., Maxwell, M., O'Carroll, R., Cheyne, H., 2019. Anxiety scales used in pregnancy: systematic review. BJPsych Open 5 (1), e5. https://doi.org/10.1192/bjo.2018.75.

Zhang, C.X.W., Okeke, J.C., Levitan, R.D., Murphy, K.E., Foshay, K., Lye, S.J., Knight, J. A., Matthews, S.G., 2022. Evaluating depression and anxiety throughout pregnancy and after birth: impact of the COVID-19 pandemic. Am J Obstet Gynecol MFM. 4 (3), 100605 https://doi.org/10.1016/j.ajogmf.2022.100605.