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The impact of the Covid-19 pandemic on postnatal depression: analysis of three population-based national maternity surveys in England (2014–2020)

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Summary

Background Few studies have evaluated postnatal depression before and during the Covid-19 pandemic using comparable data across time. We used data from three national maternity surveys in England to compare prevalence and risk factors for postnatal depression before and during the pandemic.

Methods Analysis was conducted using population-based surveys carried out in 2014 (n = 4571), 2018 (n = 4509), and 2020 (n = 4611). Weighted prevalence estimates for postnatal depression (EPDS score ≥13) were compared across surveys. Modified Poisson regression was used to estimate adjusted risk ratios (aRR) for the association between sociodemographic, pregnancy- and birth-related, and biopsychosocial factors, and postnatal depression.

Findings Prevalence of postnatal depression increased from 10.3% in 2014 to 16.0% in 2018 (difference = +5.7% (95% CI: 4.0–7.4); RR = 1.55 (95% CI: 1.36–1.77)) and to 23.9% in 2020 (difference = +7.9% (95% CI: 5.9–9.9); RR = 1.49 (95% CI: 1.34–1.66)). Having a long-term mental health problem (aRR range = 1.48–2.02), antenatal anxiety (aRR range = 1.73–2.12) and antenatal depression (aRR range = 1.44–2.24) were associated with increased risk of postnatal depression, whereas satisfaction with birth (aRR range = 0.89–0.92) and social support (aRR range = 0.73–0.78) were associated with decreased risk before and during the pandemic.

Interpretation This analysis indicates that Covid-19 had an important negative impact on postnatal women's mental health and may have accelerated an existing trend of increasing prevalence of postnatal depression. Risk factors for postnatal depression were consistent before and during the pandemic. Timely identification, intervention and follow-up are key to supporting women at risk, and it is essential that mechanisms to support women are strengthened during times of heightened risk such as the pandemic.

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Keywords: Postnatal depression; Perinatal mental health; Maternal mental health; Pregnancy and childbirth; Maternity survey; COVID-19 pandemic; Prevalence; Risk factors

Introduction

The widespread disruption caused by the Covid-19 pandemic presented unique challenges for pregnant and postnatal women at what can already be a vulnerable time. Uncertainty around the impact of Covid-19 on the baby and around vaccine safety in pregnancy caused worry and stress among women who were pregnant or had recently given birth.[1,2] Additionally, from the onset of the pandemic in England in late February 2020, maternity services were interrupted, birth partners were excluded from appointments and even the birth itself, mothers and babies were separated in hospital, and

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Research in context

Evidence before this study

We searched PubMed, Google Scholar, and Cochrane databases, with no date or language restrictions, to identify evidence for the impact of Covid-19 on postnatal depression. The search included terms relating to "perinatal mental health", "prevalence rates", and the "Covid-19 pandemic". Several systematic reviews and meta-analyses have reported prevalence of postnatal depression during the pandemic, with pooled estimates ranging from 17% to 34%. Most, but not all, of these reviews have indicated significantly higher rates of postnatal depression during the pandemic compared to pre-pandemic rates. However, high heterogeneity across studies conducted before and during the pandemic makes it difficult to compare prevalence estimates reliably and to evaluate the impact of Covid-19 on postnatal depression. Furthermore, studies conducted during the pandemic are limited in number and by size, non-population-based samples, and lack of comparable pre-pandemic data.

Added value of this study

This is the first UK-based study to evaluate the impact of the Covid-19 pandemic on prevalence of postnatal depression using comparable data from before and during the pandemic. We analysed data from three large population-based maternity surveys in England conducted between 2014 and 2020. There was evidence of an upward trend in the prevalence of postnatal depression prior to the pandemic (from 10% in 2014 to 16% in 2018) and a further large increase in prevalence during the pandemic (from 16% to 24%). Risk factors for postnatal depression before and during the pandemic were long-term and antenatal mental health problems, whereas satisfaction with birth and social support were protective.

Implications of all the available evidence

The existing evidence indicates that Covid-19 had an important negative impact on postnatal women's mental health. Prevalence estimates of postnatal depression for women who gave birth during the pandemic are alarmingly high, even six months after childbirth. Policy makers and health-care leaders must urgently investigate robust strategies for early identification, intervention and follow-up of women at risk of and experiencing postnatal mental health problems. It is essential that mechanisms to identify and support women remain in place, and ideally are strengthened, during times of heightened risk such as the pandemic.

perinatal support both from health care professionals and personal networks was drastically reduced.[3–6] Taken together, these factors are likely to have increased the risk to women's mental health and wellbeing during pregnancy and after giving birth. This is especially important given that it is well known that poor perinatal mental health can adversely affect longer-term physical and mental health outcomes for the mother, partner and baby and also place a burden on the wider family and society.[7,8]

There is increasing evidence to show the negative impact of giving birth during the Covid-19 pandemic on women's mental health. Several systematic reviews and meta-analyses have reported prevalence of postnatal depression during the pandemic, with pooled estimates ranging from 17% to 34%.[9–16] Most of these reviews have indicated higher rates of postnatal depression during the pandemic,[9–14] compared to pre-pandemic rates (global pooled prevalence 17–18%),[17,18] although not all have reported statistically significant differences.[15,16] The studies included in reviews conducted before and during the pandemic are highly variable in terms of target population, sampling methods, and mental health measures, and this heterogeneity makes it difficult to pool and compare prevalence estimates reliably, and therefore to evaluate the impact of Covid-19 on postnatal depression. Limited studies have assessed the impact of the Covid-19 pandemic on postnatal depression using comparable data across time and, to date, no such studies have been conducted in the UK.

The current study addresses this evidence gap by using data from large population-based national maternity surveys in England, which have been conducted at regular intervals by the National Perinatal Epidemiology Unit (NPEU). The surveys employ consistent methods and measures allowing reliable assessment of changes over time. We used data from the three most recent surveys in 2014, 2018 (pre-pandemic) and 2020 (during the pandemic) to: 1) compare prevalence of postnatal depression before and during the pandemic; and 2) assess the association between different risk factors and postnatal depression before and during the pandemic.

Methods

Design and sample

The 2014, 2018 and 2020 national maternity surveys were cross-sectional surveys of postnatal women. Random population-based samples of 10,000 women in 2014, 16,000 women in 2018, and 16,050 women in 2020 were identified by the Office for National Statistics (ONS) using birth registration records. The women were aged 16 years or older, were living in England at the time the birth was registered, and had given birth to their baby in England during a two-week period in January 2014 (in the 2014 survey), October 2017 (in the 2018 survey) or May 2020 (in the 2020 survey). The women who took part in the different surveys therefore gave birth during different seasons: during winter in the 2014 survey, during autumn in the 2018 survey, and

during spring in the 2020 survey. The interval between the 2014 and 2018 surveys was 3 years 9 months, and the interval between the 2018 and 2020 surveys was 2 years 7 months. Women were invited to take part three months after they had given birth in the 2014 survey and six months after they had given birth in the 2018 and 2020 surveys. Women were contacted via post and three different modes of response were available: on paper, online or by telephone. Up to three reminders were sent to non-respondents.

The useable response rate to the surveys was 47% in 2014 (n = 4571) and 29% in both 2018 (n = 4509) and 2020 (n = 4611). Anonymised sociodemographic information was provided for all women (respondents and non-respondents) by ONS. In all surveys, comparison of respondents and non-respondents showed that the women who responded were more likely to be older (>25 years), married when the birth was registered, living in more socio-economically advantaged areas based on the index of multiple deprivation (IMD), a measure used to classify the relative deprivation in small areas in England, born in the UK, and first-time mothers (2018 and 2020 surveys only).[19] These variables were fitted in a binary logistic regression model with response/non-response as the outcome, and the resulting coefficients (adjusted odds ratios) were used to derive non-response survey weights for each survey. The survey weights were applied to the current analyses to reduce the effect of non-response bias. Further details of the 2014, 2018 and 2020 national maternity surveys, including the calculation of survey weights, are published elsewhere.[20–22]

Two pilot national maternity surveys were conducted in 2016 (n = 560) and 2017 (n = 1041). The surveys employed similar methods and measures to the 2014, 2018 and 2020 surveys, however, in both pilot surveys, women were recruited either three or six months after they had given birth. The women in the 2016 pilot survey gave birth in April 2016 or July 2016 and the women in the 2017 pilot survey gave birth in December 2016 or March 2017.

Choice of primary measure

The questionnaire employed in each survey included sections about perinatal mental health and used the Edinburgh Postnatal Depression Scale (EPDS) to assess symptoms of postnatal depression. The EPDS is the most widely used standardised self-report instrument for postnatal depression, which includes 10 items asking women to rate the intensity of depressive symptoms they have experienced within the previous seven days.[23] Each item is scored on a four-point Likert scale (0–3) and total scores of between 0 and 30 are calculated by summing the items. A cut-off for 'probable depression' has been suggested at 13 and above and, using this cut-off, the EPDS has sensitivity of 0.86 and specificity of 0.78.[23,24] The EPDS has been translated into multiple languages and is freely available.

Explanatory risk factors

The explanatory risk factors were all selected *a priori* as they have been associated with postnatal mental health problems in previous studies published in this field. The sociodemographic factors were: age (<25 years, 25–29 years, 30–34 years, 35 years and older); registration status (whether the birth was registered in parents' married names, joint (unmarried) names of parents living at the same address, joint (unmarried) names of parents living at different addresses, or the 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 socio-economically advantaged] to 5 [most socio-economically advantaged]); ethnicity (White, Black, Asian, Mixed or Other minority ethnicity); and country of birth (UK, outside UK). The pregnancy- and birth-related factors were: pregnancy planning (planned, unplanned); 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 2014 and 2020 surveys or on 6 of the 10 items on the BSS-R in the 2018 survey).[25] The biopsychosocial factors were: long-term physical health problem(s) (yes, no); long-term mental health problem(s) (yes, no); antenatal anxiety (yes, no); and antenatal depression (yes, no). Data on smoking during pregnancy (yes, no) and social support (Likert-type scale [score from 0 (least support) to 6 (most support)]) were collected in the 2018 and 2020 surveys only, and these factors were included in the regression models in a sensitivity analysis.

Statistical analysis

The datasets for the three surveys were combined initially and weighted prevalence estimates of postnatal depression (percentage of women scoring 13 and above on the EPDS) were calculated and compared for the women who took part in the 2014, 2018 and 2020 surveys. Weighted prevalence estimates from the two pilot surveys in 2016 and 2017 were also calculated to provide additional data points in the analysis of postnatal depression prevalence over time. Weighted prevalence estimates of postnatal depression for women with different sociodemographic, pregnancy- and birth-related, and biopsychosocial factors were calculated and are presented graphically across the 2014, 2018 and 2020 surveys using bar charts.

In order to provide an estimate for the effect of the timing of the survey, and more specifically the effect of birth during the pandemic, on postnatal depression,

univariable modified Poisson regression was used to estimate the unadjusted risk ratio (RR) with 95% confidence intervals (CIs) for the association between survey year and postnatal depression. The reference category for survey year was the preceding survey, therefore the prevalence of postnatal depression in the 2018 survey was compared to the 2014 survey, and the prevalence of postnatal depression in the 2020 survey was compared to the 2018 survey. The absolute percentage differences in the weighted prevalence between the 2014 and 2018 surveys and between the 2018 and 2020 surveys are also reported, together with the 95% CIs for the differences.

Due to statistically significant ($P < 0.05$) interaction effects between survey year and a number of the other explanatory factors (Supplementary Table S1), the datasets for the three surveys were analysed separately for the rest of the univariable and multivariable modified Poisson regression analyses. Explanatory factors that were statistically associated ($P < 0.1$) with postnatal depression in the univariable models were entered into multivariable models, and factors that were statistically associated ($P < 0.05$) with postnatal depression in the multivariable models, after adjusting for all other factors, were retained in the final models. Modified Poisson regression was selected in order to report relative risks and because the outcome of postnatal depression was not rare (prevalence >10%).[26]

All analyses were conducted in Stata version 17.6 using survey-weighted commands to allow for non-response.[27] There were between 1.5 and 3.5% missing data for postnatal depression and between 0.0 and 6.2% missing data for the explanatory factors across the surveys. As the amount of item non-response was low in comparison with unit non-response, a complete case analysis with survey weights was employed, and between 87.1 and 93.2% of all cases were included in the final regression models.

Role of the funding source

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Results

Baseline characteristics

Table 1 shows the weighted distributions of sociodemographic characteristics for women who took part in the 2014, 2018 and 2020 surveys. There are some small variations across the surveys reflecting changes over time in the structure of the population of women giving birth in England.[28]

Prevalence of postnatal depression in the 2014, 2018 and 2020 surveys

The prevalence of postnatal depression increased across successive surveys (Fig. 1). The percentage of women who scored above the cut-off on the EPDS for probable depression was 10.3% in 2014, compared to 16.0% in 2018, and 23.9% in 2020 (large square markers). The increases in prevalence between the 2014 and 2018 surveys (difference = +5.7% (95% CI: 4.0–7.4); RR = 1.55 (95% CI: 1.36–1.77)) and between the 2018 and 2020 surveys (difference = +7.9% (95% CI: 5.9–9.9); RR = 1.49 (95% CI: 1.34–1.66)) were statistically significant ($P < 0.001$). The increases in prevalence between 2014 and 2018 and between 2018 and 2020 were similar despite the differing time intervals between the surveys. Fig. 1 also shows the prevalence of postnatal depression in the two smaller pilot surveys, carried out in 2016 and 2017 (small square markers). The different data series show prevalence for women who were recruited three months (dotted line) or six months (continuous line) after they had given birth. Both pilot surveys included women recruited either three or six months after they had given birth, hence the two prevalence estimates for each year. The 95% CIs for these two prevalence estimates overlap in both pilot surveys.

The prevalence of postnatal depression by survey year and selected sociodemographic factors is shown in Fig. 2 and the prevalence of postnatal depression by survey year and selected pregnancy- and birth-related and biopsychosocial factors is shown in Fig. 3.

Factors associated with postnatal depression

Table 2 shows the unadjusted and adjusted RR (with 95% CIs) for the association between different sociodemographic, pregnancy- and birth-related, and biopsychosocial factors and postnatal depression across the three surveys. In univariable analyses, there was evidence of an association between age, registration status, education, IMD, pregnancy planning, birth experience, satisfaction with birth, long-term physical and mental health problems, antenatal anxiety and depression, and postnatal depression across all surveys. The pattern was similar across all three surveys, as shown by similar unadjusted RRs. There was some evidence of an association between other explanatory factors and postnatal depression, for example, ethnicity, country of birth, parity and neonatal admission, but associations were not consistent across surveys.

In the multivariable analyses, having a long-term mental health problem (aRR range = 1.48–2.02), antenatal anxiety (aRR range = 1.73–2.12) and antenatal depression (aRR range = 1.44–2.24) were all associated with increased risk of postnatal depression. Satisfaction

	2014 (n = 4568)		2018 (n = 4509)		2020 (n = 4611)	
	n	%	n	%	n	%
Age						
<20 years	101	3.7	59	2.5	44	2.8
20–24 years	538	17.3	359	13.8	355	12.5
25–29 years	1228	28.3	1055	27.0	1117	26.5
30–34 years	1587	30.1	1713	33.4	1785	33.8
35+ years	1114	20.6	1323	23.3	1310	24.5
Missing	1	<0.1	0	0	0	0
Registration status						
Married	2744	52.0	2865	52.8	2886	51.7
Joint registration (same address)	1394	31.1	1322	31.6	1392	32.7
Joint registration (different address)	291	11.7	216	10.8	220	10.5
Sole registration	139	5.0	106	4.8	113	5.2
Missing	2	<0.1	0	0	0	0
Age left full-time education						
<17 years	756	19.1	493	14.8	514	14.0
17–18 years	1209	28.5	1045	26.1	1226	28.4
19+ years	2506	52.5	2922	59.1	2823	57.7
Missing	97	2.8	49	1.5	48	1.5
IMD						
1 (least socio-economically advantaged)	893	27.6	706	27.0	698	25.6
2	977	22.8	869	22.2	876	21.9
3	934	18.7	945	18.4	957	19.3
4	865	15.9	1006	17.1	1070	17.9
5 (most socio-economically advantaged)	899	15.0	983	15.2	1010	15.4
Missing	1	<0.1	0	0	0	0
Ethnicity						
Asian	442	12.1	308	10.0	380	10.1
Black	158	5.1	102	4.0	126	5.4
Mixed	87	2.3	101	2.6	104	2.7
White	3708	80.0	3779	81.2	3911	81.0
Other	23	0.6	67	2.1	27	0.8
Missing	150	3.8	152	4.3	63	1.7
Country of birth						
UK	3485	72.5	3483	71.0	3674	69.1
Outside UK	1083	27.5	1026	29.0	937	30.9
Missing	1	<0.1	0	0	0	0

Table 1: **Baseline characteristics of respondents to the 2014, 2018 and 2020 surveys.**

with birth (higher scores on the BSS-RI scale) was associated with decreased risk of postnatal depression (aRR range = 0.89–0.92) across all surveys, both before and during the pandemic (Fig. 4). With each one point increase on the BSS-RI scale, the risk of postnatal depression decreased by between 8% and 11%. These factors all had a consistent effect across surveys, while the effect of other factors varied across surveys. For example, sole registration or joint registration (but different addresses) was associated with increased risk of postnatal depression in both 2014 (aRR = 1.34, 1.00–1.79) and 2018 (aRR = 1.44, 1.11–1.88); having an unplanned pregnancy was associated with increased risk of postnatal depression in both 2014 (aRR = 1.36, 1.10–1.69) and 2020 (aRR = 1.18, 1.03–1.35); and having a long-term physical health problem was associated with increased risk of postnatal depression in both 2018 (aRR = 1.34, 1.03–1.75) and 2020 (aRR = 1.24, 1.05–1.47). The effect sizes for most of these risk factors tended to decrease in successive surveys although there was considerable overlap in the 95% CIs (Fig. 4). Black, Asian, Mixed or Other minority ethnicity (aRR = 1.51, 1.16–1.97) was associated with increased risk of postnatal depression in 2014 only; younger age (<25 years (aRR = 1.37, 1.06–1.78) or 25–29 years (aRR = 1.25, 1.01–1.56)) and multiparity (aRR = 1.32, 1.20–1.43) were associated with increased risk of postnatal depression in 2018 only; and fewer years education (leaving education

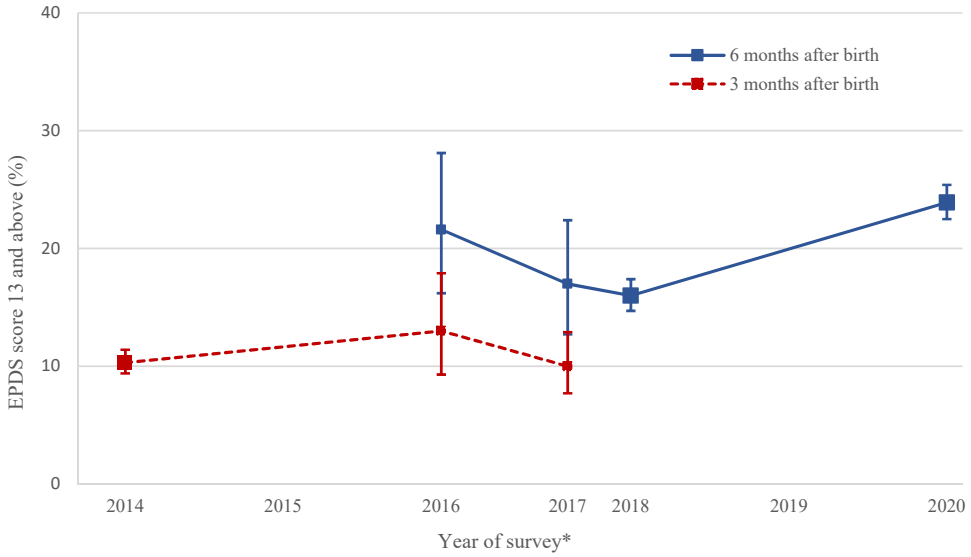


Fig. 1: **Prevalence of postnatal depression (EPDS ≥13) across the surveys.**

aged 17–18 years (aRR = 1.15, 1.01–1.32)) was associated with increased risk of postnatal depression in 2020 only.

Data on smoking during pregnancy and social support were collected in the 2018 and 2020 surveys only. These factors were included in the 2018 and 2020 regression models in a sensitivity analysis (Supplementary Table S2). After adjusting for all other factors, smoking during pregnancy was associated with increased risk of postnatal depression in 2018 only (aRR = 1.43, 1.13–1.80). Social support (higher scores on the social support scale) was associated with decreased risk of postnatal depression in both 2018 (aRR = 0.73, 0.70–0.77) and 2020 (aRR = 0.78, 0.76–0.81) (Fig. 4). With each one point increase on the social support scale, the risk of postnatal depression decreased by between 22% and 27%. When smoking during pregnancy and social support were included in the 2018 model, sole registration or joint registration (but different addresses) was no longer associated with postnatal depression. When social support was included in the 2020 model, having an unplanned pregnancy and having a long-term physical health problem were no longer associated with postnatal depression.

Discussion

Summary of main findings

The current findings from population-based national maternity surveys in England indicate that almost one in four women who gave birth in May 2020, during the Covid-19 pandemic in the UK, reported symptoms indicating probable clinical depression six months after giving birth. The prevalence of postnatal depression was markedly higher among women who gave birth during the Covid-19 pandemic (23.9% in 2020), compared to pre-pandemic rates (16.0% in 2018 and 10.3% in 2014). The prevalence of postnatal depression had previously increased between 2014 and 2018, with a similar magnitude to that between 2018 and 2020 although over a longer time interval (3 years 9 months (2014–2018) compared to 2 years 7 months (2018–2020)). Therefore, the findings suggest that Covid-19 and giving birth during the height of the first national lockdown in the UK (when all residents were ordered to stay at home and were permitted to leave for essential purposes only) had a negative impact on mental health and may have accelerated a trend of increasing prevalence of postnatal depression. To our knowledge, this is the first population-based study in the UK to report comparable prevalence estimates of postnatal depression from before and during the pandemic.

The findings from this study are consistent with a growing body of evidence which shows that Covid-19 had a negative impact on perinatal mental health. Several systematic reviews and meta-analyses have reported pooled prevalence estimates between 17% (95% CI: 10–24%) and 34% (95% CI: 21–46%) for postnatal depression during the pandemic,[9–16] and our prevalence estimate in the 2020 survey is in line with these figures. The majority of reviews conducted during the pandemic indicate significantly higher prevalence of postnatal depression compared to pre-pandemic rates of 17–18%[17,18] which is also consistent with our findings. To date, relatively few studies on postnatal depression during the pandemic have been conducted in the UK. One small study found that 43% of mothers who were recruited during the first UK lockdown reported a score of ≥13 on the EPDS.[29] This figure is higher than in our

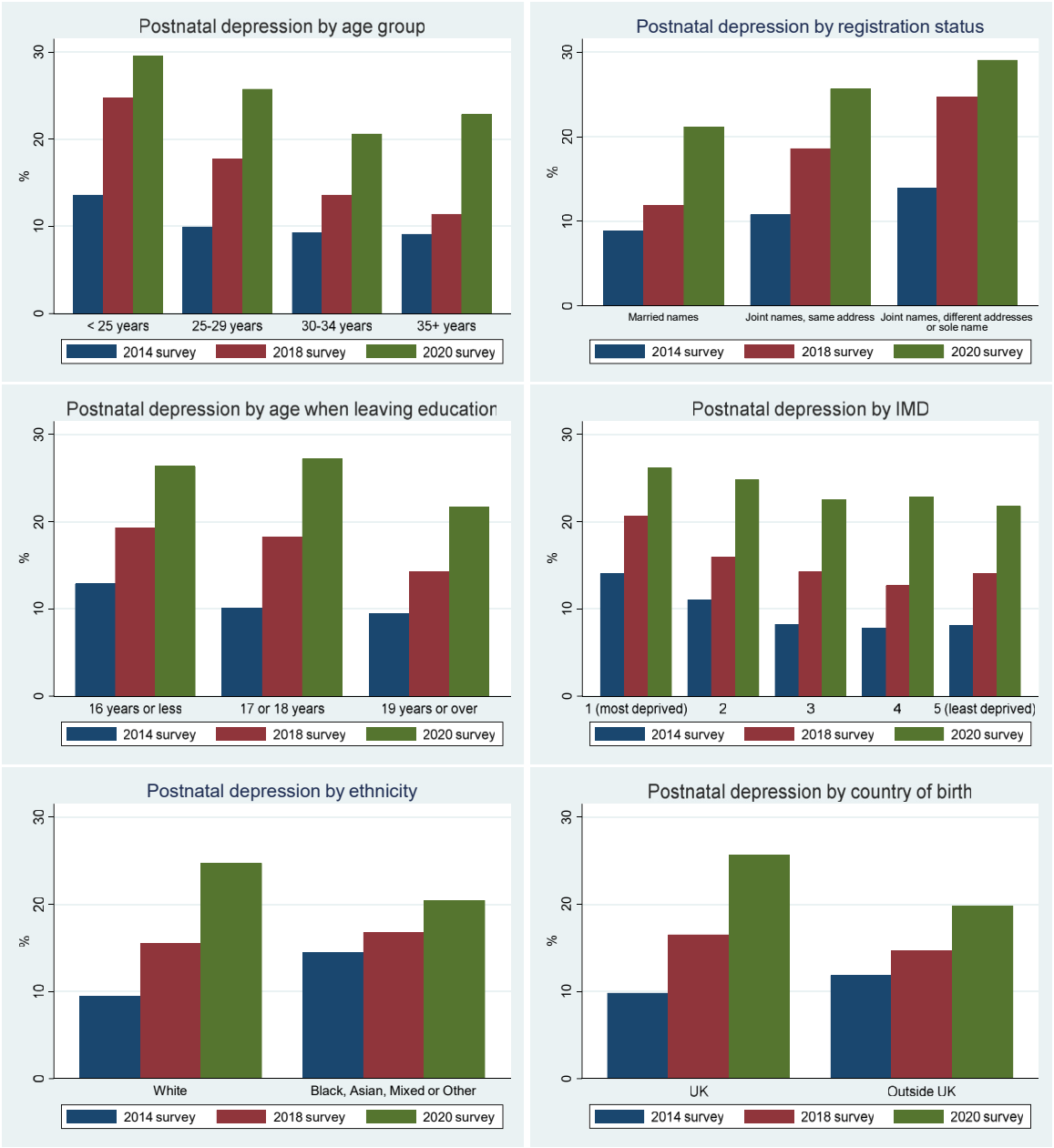


Fig. 2: **Proportion of women scoring above the cut-off on the EPDS by survey year and other explanatory sociodemographic factors.**

2020 survey, but data were collected by convenience sampling and early in the postnatal period (babies aged 0–12 weeks), whereas the women in our 2020 survey had given birth at least six months previously.

The current analysis found that women with long-term mental health problems and women experiencing anxiety or depression during their pregnancy were at increased risk of postnatal depression both before and during the pandemic (across all three surveys). Satisfaction with the birth was found to be protective against postnatal depression before and during the pandemic (also across all three surveys). These are all well-known psychosocial risk and protective factors for perinatal mental health.[30] Women who had an unplanned pregnancy and those with long-term physical health problems were also at increased risk of postnatal depression before (either in the 2014 or 2018 survey) and during the pandemic. These factors have also been associated with postnatal depression in previous studies.[31] However, when social support and smoking



Fig. 3: **Proportion of women scoring above the cut-off on the EPDS by survey year and other explanatory pregnancy- and birth-related and biopsychosocial factors.**

	2014				2018				2020			
	%[a]	RR[b] (95% CI)	aRR[c] (95% CI)	P value[d]	%[a]	RR[b] (95% CI)	aRR[c] (95% CI)	P value[d]	%[a]	RR[b] (95% CI)	aRR[c] (95% CI)	P value[d]
Sociodemographic												
Age				NS								NS
<25 years	13.6	1.46 (1.11, 1.93)[e]			24.7	1.82 (1.42, 2.31)[e]	1.37 (1.06, 1.78)[f]	0.017	29.5	1.43 (1.17, 1.75)[e]		
25–29 years	10.0	1.07 (0.83, 1.39)			17.7	1.30 (1.05, 1.62)[e]	1.25 (1.01, 1.56)[f]	0.043	25.8	1.25 (1.07, 1.45)[e]		
30–34 years	9.3	1			13.6	1	1		20.6	1		
35+ years	9.1	0.98 (0.76, 1.27)			11.4	0.84 (0.67, 1.05)	0.96 (0.78, 1.20)	0.772	22.8	1.11 (0.95, 1.29)		
Registration status												NS
Married	8.9	1	1		11.9	1	1		21.2	1		
Living at same address	10.8	1.21 (0.98, 1.50)[e]	1.22 (0.98, 1.53)[f]	0.071	18.6	1.56 (1.31, 1.87)[e]	1.18 (0.98, 1.43)	0.080	25.7	1.21 (1.07, 1.38)[e]		
Living at different address/sole registration	13.9	1.57 (1.18, 2.09)[e]	1.34 (1.00, 1.79)[f]	0.049	24.8	2.08 (1.63, 2.66)[e]	1.44 (1.11, 1.88)[f]	0.006	29.1	1.37 (1.12, 1.68)[e]		
Age left education				NS				NS				
<17 years	12.9	1.36 (1.06, 1.75)[e]			19.3	1.36 (1.06, 1.74)[e]			26.4	1.21 (1.01, 1.46)[e]	1.02 (0.85, 1.22)	0.847
17–18 years	10.1	1.07 (0.84, 1.36)			18.3	1.29 (1.06, 1.56)[e]			27.2	1.25 (1.09, 1.44)[e]	1.15 (1.01, 1.32)[f]	0.006
19+ years	9.5	1			14.2	1			21.7	1	1	
IMD				NS				NS				NS
1 (least socio-economically advantaged)	14.1	1.73 (1.29, 2.32)[e]			20.6	1.46 (1.15, 1.87)[e]			26.2	1.20 (0.99, 1.45)[e]		
2	11.1	1.36 (1.01, 1.83)[e]			16.0	1.13 (0.88, 1.46)			24.8	1.14 (0.95, 1.37)		
3	8.3	1.01 (0.73, 1.40)			14.3	1.01 (0.79, 1,30)			22.5	1.03 (0.86, 1.23)		
4	7.8	0.96 (0.68, 1.33)			12.7	0.90 (0.70, 1.15)			22.9	1.05 (0.88, 1.25)		
5 (most socio-economically advantaged)	8.1	1			14.1	1			21.8	1		
Ethnicity								NE				NS
White	9.4	1	1		15.5	1			24.7	1		
Black, Asian, Mixed or Other minority ethnicity	14.4	1.53 (1.21, 1.94)[e]	1.51 (1.16,1.97)[f]	0.002	16.8	1.08 (0.84, 1.38)			20.5	0.83 (0.68, 1.00)[e]		
Country of birth				NE				NE				NS
UK	9.8	1			16.5	1			25.7	1		
Outside UK	11.8	1.20 (0.95, 1.51)			14.7	0.89 (0.72, 1.10)			19.9	0.77 (0.66, 0.91)[e]		
Pregnancy and birth												
Pregnancy planning								NS				
Planned	8.5	1	1		13.8	1			21.5	1	1	
Unplanned	15.2	1.79 (1.46, 2.19)[e]	1.36 (1.10, 1.69)[f]	0.004	22.6	1.64 (1.37, 1.97)[e]			30.9	1.44 (1.25, 1.65)[e]	1.18 (1.03, 1.35)[f]	0.016
Parity				NE								NE
Primiparous	10.0	0.93 (0.76, 1.14)			14.0	0.80 (0.68, 0.95)[e]	0.68 (0.57, 0.80)[f]	<0.001	24.0	1.01 (0.89, 1.14)		
Multiparous	10.7	1			17.5	1	1		23.8	1		
Multiplicity				NE				NE				NE
Single birth	10.4	1			15.9	1			24.1	1		
Multiple birth	9.2	0.89 (0.43, 1.84)			16.8	1.05 (0.64, 1.74)			13.6	0.57 (0.28, 1.14)		
Mode of birth				NE				NE				NE
Vaginal	10.7	1			16.4	1			23.1	1		
Instrumental	10.4	0.97 (0.73, 1.28)			15.3	0.93 (0.71, 1.23)			24.7	1.07 (0.88, 1.30)		
Planned caesarean[g]	8.1	0.75 (0.52, 1.08)			16.6	1.01 (0.79, 1.30)			24.7	1.07 (0.91, 1.27)		
Unplanned caesarean[g]	10.5	0.98 (0.72, 1.34)			14.5	0.89 (0.68, 1.15)			26.5	1.15 (0.97, 1.37)		

(Table 2 continues on next page)

	2014				2018				2020			
	%[a]	RR[b] (95% CI)	aRR[c] (95% CI)	P value[d]	%[a]	RR[b] (95% CI)	aRR[c] (95% CI)	P value[d]	%[a]	RR[b] (95% CI)	aRR[c] (95% CI)	P value[d]
(Continued from previous page)												
Gestational age at birth				NE				NE				NE
Preterm (<37 weeks)	12.5	1.25 (0.87, 1.79)			16.4	1.03 (0.76, 1.40)			26.0	1.10 (0.86, 1.40)		
Term (37+ weeks)	10.0	1			15.9	1			23.8	1		
Birthweight				NE				NE				NE
Low BW (<2500 g)	10.6	1.04 (0.72, 1.51)			14.6	0.93 (0.67, 1.28)			25.3	1.05 (0.80, 1.37)		
Normal BW (2500 g[h])	10.2	1			15.7	1			24.2	1		
Neonatal admission				NE				NS				NE
Yes	9.1	0.85 (0.61, 1.18)			20.9	1.37 (1.09, 1.70)[e]			27.5	1.17 (0.96, 1.42)		
No	10.7	1			15.3	1			23.5	1		
Birth experience				NS				NS				NS
Better than/as expected	9.4	1			14.3	1			20.7	1		
Worse than expected	13.0	1.38 (1.12, 1.69)[e]			20.6	1.44 (1.20, 1.72)[e]			32.1	1.55 (1.37, 1.75)[e]		
Birth satisfaction[i]												
Median (IQR)	7 (5–9)	0.86 (0.84, 0.89)[e]	0.89 (0.87, 0.92)[f]	<0.001	6 (4–9)	0.89 (0.87, 0.92)[e]	0.92 (0.90, 0.94)[f]	<0.001	7 (4–9)	0.89 (0.88, 0.91)[e]	0.92 (0.90, 0.93)[f]	<0.001
Biopsychosocial												
Physical health problem				NS								
Yes	23.0	2.33 (1.61, 3.39)[e]			32.5	2.20 (1.75, 2.76)[e]	1.34 (1.03, 1.75)[f]	0.027	39.2	1.75 (1.48, 2.05)[e]	1.24 (1.05, 1.47)[f]	0.012
No	9.9	1			14.8	1	1		22.5	1	1	
Mental health problem												
Yes	47.5	5.21 (4.15, 6.54)[e]	2.02 (1.49, 2.73)[f]	<0.001	53.2	4.37 (3.74, 5.10)[e]	1.94 (1.52, 2.49)[f]	<0.001	54.3	2.69 (2.39, 3.03)[e]	1.48 (1.28, 1.74)[f]	<0.001
No	9.1	1	1		12.2	1	1		20.2	1	1	
Antenatal anxiety												
Yes	29.2	3.98 (3.29, 4.82)[e]	2.03 (1.50, 2.73)[f]	<0.001	44.2	3.83 (3.27, 4.48)[e]	2.12 (1.68, 2.67)[f]	<0.001	45.8	2.58 (2.30, 2.90)[e]	1.73 (1.51, 1.98)[f]	<0.001
No	7.3	1	1		11.5	1	1		17.8	1	1	
Antenatal depression												
Yes	40.3	5.17 (4.27, 6.26)[e]	2.24 (1.61, 3.11)[f]	<0.001	55.6	4.28 (3.63, 5.03)[e]	1.44 (1.10, 1.88)[f]	0.007	60.5	2.89 (2.55, 2.29)[e]	1.50 (1.28, 1.76)[f]	<0.001
No	7.8	1	1		13.0	1	1		20.9	1	1	

NE 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. [a]Prevalence of postnatal depression. [b]Risk ratio unadjusted (univariable association only). [c]Risk ratio adjusted. [d]P value for aRR (each category). [e]Significant at P < 0.1. [f]Significant at P < 0.05. [g]170 out of 1187 (14.3%) women did not indicate whether their caesarean section was planned or unplanned in the 2014 survey. [h]Country of birth for at least 1% of the participants: Germany, India, Pakistan, Poland and Romania. [i]Entered into the model as a continuous variable—median shown is for all women who took part in the surveys.

Table 2: **Unadjusted and adjusted RRs (and 95% CI) for the association between sociodemographic, pregnancy- and birth-related, and biopsychosocial risk factors and postnatal depression in the 2014, 2018 and 2020 surveys.**

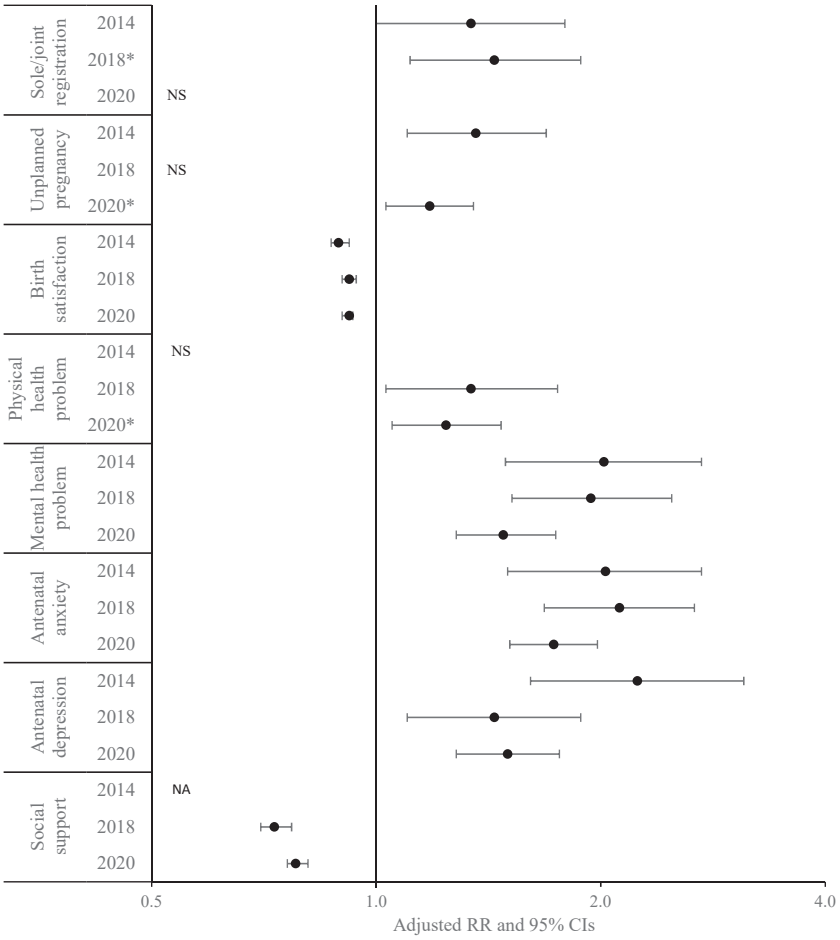


Fig. 4: **Forest plot to show the aRR and 95% CIs for risk factors that were associated with postnatal depression across at least two surveys.**

during pregnancy were included in the current analysis of the 2018 and 2020 surveys, the effect of pregnancy planning on postnatal depression was lessened and there was only an effect of long-term physical health problems on postnatal depression in the 2018 survey. Therefore, the findings suggest that social support may help to mitigate the effects of some of the other risk factors.

In a multinational study including the UK, Ceulemans et al. (2021) found that having a chronic physical or mental illness, unplanned pregnancy, smoking, and lower perceived support emerged as risk factors for poor mental health outcomes for pregnant and breastfeeding women.[32] Therefore, the current findings support the existing evidence for some of the risk factors identified in previous studies conducted during the pandemic.[30] The current analysis found less consistency in the effects of the other sociodemographic and pregnancy- and birth-related risk factors on postnatal depression. Whereas younger age, sole or joint (but unmarried) registration status, and Black, Asian, Mixed or Other minority ethnicity were associated with increased risk of postnatal depression in women who gave birth before the pandemic (either in the 2014 or 2018 survey), only fewer years of education was associated with increased risk of postnatal depression in women who gave birth during the pandemic. The only risk factor which had a different effect in the 2020 survey compared with both pre-pandemic surveys was leaving full-time education aged 17–18 years, compared to leaving at 19 years or older.

Interpretation and implications of findings

Our results suggest that almost one in four women who gave birth during the Covid-19 pandemic experienced postnatal depression six months after childbirth, representing a significant burden among postnatal women. The marked increase in the prevalence of postnatal depression between 2018 and 2020 is concerning. The stress, uncertainty, disruption and

reduced access to services and support caused by Covid-19, particularly during the early stages of the pandemic, are likely to have contributed to this increase. Evidence from studies of the general population also indicates that Covid-19 had a negative impact on mental health. The Covid-19 Mental Disorders Collaborators reported that, throughout 2020, the pandemic led to a 27.6% increase in cases of major depressive disorders globally.[33] Data from the nationally representative UK Household Longitudinal Study also found that mental health problems increased markedly by over 50% in 2020 compared to 2017–2019.[34] Therefore, although the prevalence of postnatal depression may have already been increasing prior to Covid-19, the pandemic is likely to have further negatively impacted postnatal women's mental health and accelerated an existing trend.

Our findings suggest that pre-existing long-term or antenatal mental health problems place women at increased risk of postnatal depression. For some women, poor mental health in the postnatal period is a continuation of symptoms that already manifested before or during pregnancy, therefore highlighting the value of early detection and appropriate management. Focusing on psychotherapeutic techniques which aim to enhance positive affects and psychological well-being may promote resilience and prevent continuation or exacerbation of mental health problems during the perinatal period.[35,36] Our findings also suggest that symptoms of postnatal depression are evident many months after giving birth, which again emphasises the potential benefit of timely assessment and intervention, and also the importance of routine follow-up and ongoing support. There is good evidence that when postnatal depression persists, the risks increase markedly both for longer-term maternal depression and for childhood difficulties, including the development of depression at 18 years of age.[37] Although postnatal depression usually has its onset within the first few months following childbirth and may persist, it can also have its onset later into the postnatal period. Therefore, it is important to raise awareness among new parents about the potential onset, course and duration of this illness.

Our findings suggest that satisfaction with childbirth is protective against postnatal depression. It is noteworthy that the current study did not find evidence of association between mode of birth and postnatal depression, which provides further support for the significance of women's subjective experiences and levels of satisfaction in predicting subsequent mental health outcomes, as opposed to their actual clinical circumstances.[38] Greater awareness among health professionals of the importance of women's experiences of childbirth, beyond having a safe and uncomplicated delivery, should encourage better communication, support, and review. Our findings also suggest that social support is protective against postnatal depression and may even mitigate the effects of some of the other risk factors, such as having an unplanned pregnancy, being a sole parent or living separately from the baby's other parent, and having a long-term physical health problem. The importance of social support to women during the perinatal period cannot be underestimated,[39] and this was highlighted by reports of the negative impact of reduced accessibility to support networks due to Covid-19 restrictions and social distancing measures.[40] For women who have inadequate support networks or who would benefit from additional provision, peer interventions may also offer a valuable source of support and should be valued, nurtured and encouraged by practitioners.[41]

The strongest risk and protective factors for postnatal depression identified in the current study were the same before and during the pandemic. There was some evidence that the strength of the association between these risk and protective factors and postnatal depression decreased over time, yet there was considerable overlap in the confidence intervals for the estimates. Therefore, the findings suggest that the same women who were at the greatest risk of postnatal depression 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.

Strengths and limitations

The strengths of this study include the large population-based samples of women in the 2014, 2018 and 2020 surveys and the application of survey weights to increase the representativeness of the samples and the validity of the prevalence estimates. The availability of comparative data from three consecutive surveys with similar sampling frames before and during the Covid-19 pandemic allows us to estimate the impact of the pandemic on postnatal depression. A further strength is the inclusion of a standardised measure of depression, which has a validated cut-off point allowing comparison with other studies in the field. Ideally, postnatal depression is assessed via structured clinical interview but such resource intensive and non-anonymised assessments are unfeasible in large observational research studies, and so the use of a valid and widely recognised self-measurement tool is recommended.

Limitations include the differences in timing of the measurement in the surveys: the 2014 survey recruited women three months after childbirth, whereas the 2018 and 2020 surveys recruited women six months after childbirth. However, there is little conclusive evidence about the trajectory of postnatal depression; some studies suggest rates decline throughout the postnatal period,[42,43] others suggest they stay the same or even increase.[44] The findings from our pilot surveys in 2016 and 2017 indicated similar rates three and six months

after birth, hence despite the difference in the timing of the measurements, the observed increase between the 2014 and 2018 surveys is likely to be reliable. The season of administration also differed across the surveys and it is possible that seasonality can affect postnatal depression.[45] However, the 2018 and 2020 surveys were carried out in the autumn and spring respectively, and there is little evidence of large differences in postnatal depression between these seasons. The cross-sectional design of the surveys makes establishing causality difficult; it is possible that satisfaction with birth, mental health before and during pregnancy, and availability of support might be assessed more negatively through a lens of postnatal depression. The cross-sectional design also required women to recall their mental health and perinatal experiences from many months earlier, hence their reports are prone to recall bias.

The response rate to the surveys ranged from 29% to 47% and there were sociodemographic differences between the respondents and non-respondents. Although survey weights were applied to the data to reduce the effects of non-response bias, such statistical techniques are limited by the weighting variables that are available and cannot fully mitigate non-response bias. Finally, the risk factors included in the analysis were limited to those that were assessed in the surveys. Data on smoking and social support were not collected in 2014 and so these factors could not be explored across all surveys. Additional factors that have been identified as being associated with postnatal depression in the literature, such as family history of depression and intimate partner violence, were not included in any of the surveys. Future research should include these and other known factors as it is important to understand how they contribute to the risk of postnatal depression in normal times and in times of crisis. Future research should also examine the mental health of women's partners in this context and the mental health of women and their partners in the post-Covid era.

Conclusion

Analysis of data from repeated large population-based maternity surveys in England shows that almost one in four women who gave birth during the Covid-19 pandemic experienced postnatal depression six months after childbirth. Prevalence of postnatal depression was significantly higher during the pandemic compared to pre-pandemic levels, suggesting that Covid-19 had an important negative impact on postnatal women's mental health. Prevalence rates had already increased prior to the pandemic (between 2014 and 2018), and it is possible that Covid-19 could have accelerated an existing trend. Long-term and antenatal mental health problems were risk factors for postnatal depression, 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. The NICE guidelines recommend that all women are asked about their mental health six weeks after giving birth.[46] Timely assessment, detection, intervention and follow-up are key to supporting women at risk and women experiencing symptoms, and it is essential that these mechanisms to identify and support women remain in place, or ideally are strengthened and repeated, during times of heightened risk such as the pandemic. The relative lack of information about the mental health of women's partners in this context also needs to be redressed.

Contributors

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

Ethical approval and consent to participate

Ethnical approval was obtained for each survey separately: the 2014 survey was approved by the Yorkshire and The Humber—Humber Bridge NRES committee (14/YH/0065); 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.

Declaration of interests

None.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lanepe.2023.100654.

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