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Impact of pandemic service changes on ethnic inequalities in maternal and perinatal outcomes in England: a population-based study

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ABSTRACT

Objective In the UK and worldwide, there are substantial ethnic inequalities in maternal and perinatal care and outcomes. We aim to assess the impact of the unprecedented change in care provision during the COVID-19 pandemic on inequalities in adverse maternity outcomes.

Design Retrospective cohort study using structured electronic health record data.

Setting English hospital trusts providing maternity care.

Participants Women giving birth and babies born in the National Health Service (NHS) in England between 1 April 2018 and 31 March 2021, in three time groups: prepandemic, the first pandemic wave (26 March 2020 to 30 June 2020) and second pandemic wave (1 July 2020 to 31 March 2021). Self-reported ethnicity was grouped into White, South-Asian, Black, Mixed and Other.

Main outcome measures Composite and component measures of maternal (emergency caesarean section, obstetric anal sphincter injury, hysterectomy, sepsis, anaesthetic complications and prolonged hospital stay) and perinatal (stillbirth, neonatal death, preterm birth, brain injury, small for gestational age and prolonged hospital stay). Poisson regression was used to compare relative risks between different ethnic groups.

Findings 1.54 million maternal and 1.43 million neonatal records were included. The overall incidence of adverse outcomes per 1000 births initially decreased maternal: from 308.0 (95% CI 307.0 to 309.0) to 291.0 (95% CI 311.4 to 314.9) (p<0.001); perinatal: from 133.0 (95% CI 132.3 to 133.7) to 111.9 (95% CI 110.1 to 113.7) (p<0.001)), but then increased in the second pandemic period (maternal: 313.2 (95% CI 311.4 to 314.9) (p<0.001); perinatal 118.9 (95% CI 117.7 to 120.0) (p<0.001)). The risk of adverse outcomes was higher in women and babies from all ethnic minority groups compared with White women in both pandemic periods. Black and South-Asian women and babies were approximately 25% more likely to sustain adverse outcomes. While similar overall changes in adverse outcomes were seen in all groups, existing inequalities were sustained throughout the pandemic periods.

Interpretation Existing inequalities in adverse maternal and perinatal/neonatal outcomes were maintained, not tempered, during the pandemic, despite substantial changes to maternity services and care. Further research on possible interventions to reduce inequality is needed.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study uses electronic health records representing over 85% of all births in England during the COVID pandemic to understand whether changes in policy impacted existing health inequalities. A key strength is the large and representative data set.

⇒ Limitations include missing data, which may affect both exposures and outcomes. We have used methods to try and mitigate against incompleteness.

⇒ In this study, maternal and neonatal records are not linked, limiting risk adjustment for perinatal outcomes to perinatal factors.

⇒ Finally, this study uses composite maternal and perinatal outcomes to examine differences, which can mask smaller differences in component outcomes. To mitigate this, we report the rates of component outcomes.

INTRODUCTION

Profound inequalities in maternity care and outcomes were observed in England, as in other countries, even prior to the COVID-19 pandemic. In the triennium 2017–2019, Black women were four times, Asian women almost two times and women from mixed ethnicity two times more likely to die during pregnancy, birth and the postpartum period than white women.[1] In 2019, rates of stillbirth were approximately twice as high for babies of Black ethnicity as for babies of White ethnicity.[2] Women of ethnic minority groups have been disproportionally affected by COVID-19 infection.[3] There have been well-documented indirect maternal health effects of the COVID-19 pandemic, due to changes to care, social isolation and public health measures including the impact of lockdowns.[4]

During the pandemic period, there were substantial shifts in the way maternity care is delivered in the National Health Service (NHS) in England, which were heterogeneous between NHS hospital organisations (NHS Trusts).[5] Some of these changes continue to persist such as increased use of remote appointments. The impact of these changes on existing inequalities in maternity outcomes is unknown: they may have mitigated, or increased, existing inequalities. Identifying any changes is important to inform the future development of the health system including implementation or not of 'lessons learnt' that may potentially impact on health inequalities in maternity outcomes in the future.

This study evaluates the indirect impact of the COVID-19 pandemic on ethnic inequalities in outcomes for women giving birth in England and their babies using data collected during their maternity care.

METHODS

Study design

This is a retrospective cohort study using electronic health record data.

Population

The population of interest is women who gave birth in the English NHS between 1 April 2018 and 31 March 2021 and their babies.

Data set

Data were extracted from Hospital Episode Statistics Admitted Patient Care (HES APC). HES is an administrative database that includes all hospital activity paid for by the NHS in England (covering an estimated 98%–99% of all hospital activity), processed to create a structured data set.[6] Each HES APC episode includes patient demographic information (eg, sex, age and ethnicity) and clinical details (International Classification of Diseases, 10th revision (ICD-10)[7] and Office for Population Censuses and Surveys classification, fourth revision (OPCS-4)[8] codes for diagnoses and procedures). Access to pseudonymised HES data was provided via the NHS Digital Access Request Service (DARS) which approved the research protocol.

HES APC includes births that occur in NHS hospital trusts. Trusts are administrative organisations within the NHS which consist of between one and three hospitals providing maternity care, together with their community services including births in midwife-led maternity units. In 2020, over 99% of births in England occurred in the NHS.[9]

Definition of cohort

Two cohorts were derived for the analysis: one for mothers, and one for babies, with both covering the same time period. Maternal records were identified as 'birth episodes' by the presence of one or more of (1) ICD-10 codes Z37 (the baby's outcome at birth), (2) OPCS-4 codes R17-R25 (delivery procedures) or (3) a valid record

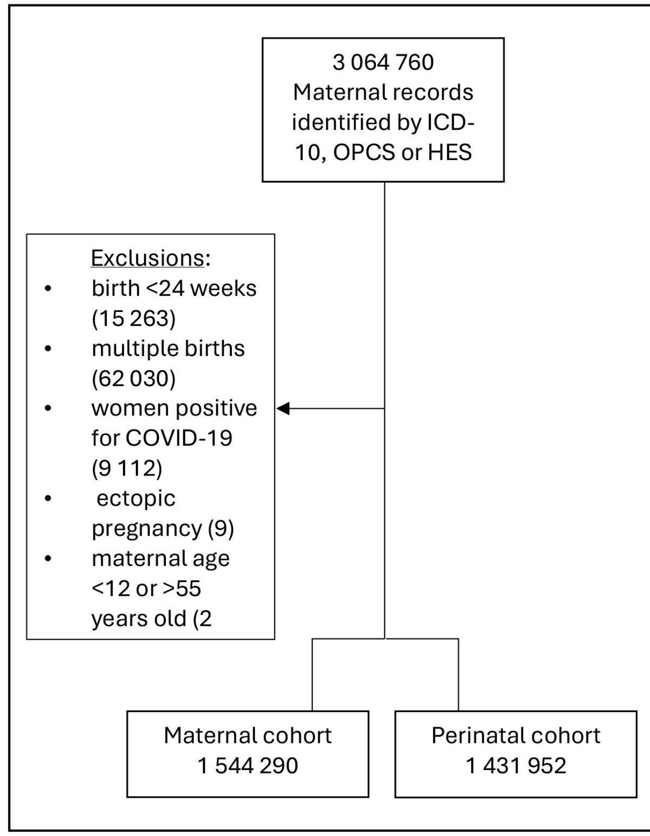

Figure 1 Flow chart: derivation of maternal and perinatal cohorts.

of the method of delivery in the 'baby tail' (delmeth).[10] Birth records for babies were identified by the presence of either the ICD-10 codes for birth Z37-Z38, or HES fields relating to episode type, method of admission, age at start of episode and level of neonatal care.[10] Maternal and babies records were not linked. Records from the two cohorts were analysed separately.

Births were included in the cohort if the outcome was either live birth or stillbirth, and excluded if the outcome was an ectopic pregnancy, miscarriage or termination of pregnancy. Births were excluded from the cohort if they had a recorded gestational age of less than 24 completed weeks. In the UK, registerable births are all births which occur at or after 24 completed weeks of gestation, or live births which occur prior to this gestation, and births prior to 24 completed weeks where the baby has no signs of life are legally regarded as a miscarriage, therefore including births under 24 weeks can slightly bias the rate of stillbirth overall (as only live births are included). Birth episodes with an associated ICD-10 code of COVID-19 (U70.1–U70.2) were excluded because we were interested in the indirect effect of COVID-19. The neonatal cohort was restricted to singleton births. Maternal records were included in the study if the mother had a recorded age of between 12 and 55 years.

Figure 1 describes the cohort extraction. Maternal and neonatal characteristics used in the study were extracted from HES using either ICD-10, or OPCS-4, or HES codes.

Definition of time periods

Time was defined in three epochs: the prepandemic period from the 1 April 2018 to 25 March 2020; first pandemic period from 26 March 2020 to 30 June 2020 coinciding with the first national lockdown in the UK; and second pandemic period from 1 July 2020 to 31 March 2021.[11] We used 2 years of pre-pandemic data to account for seasonal and annual variation in unmeasured risk factors.

Choice of outcomes

We used maternal and perinatal composite indicators to evaluate trends in outcomes and inequalities. Composite indicators are those in which several individual component outcomes are combined to produce a single outcome.[12] Women or babies experiencing any of the component outcomes were considered to have experienced the composite indicator.

Component outcomes were chosen following a literature review of studies using routinely available hospital data.[13–18] We selected outcomes that could be identified in HES by using ICD-10 and OPCS-4 codes or HES fields. For quality control of outcomes, we selected only those that had been compared with evidence from published population-based epidemiological studies in England.[15–17] The final list of component outcomes was reviewed and approved by a Women's Reference Group.

The maternal composite adverse outcome indicator comprised any of:

1. Emergency caesarean section.
2. Obstetric anal sphincter injuries (OASI), defined as a diagnosis or repair of third-degree or fourth-degree tear.
3. Hysterectomy.
4. Sepsis during labour and delivery, or in the puerperium.
5. Major complications of anaesthesia during labour and delivery (pulmonary, cardiac, central nervous system, and unspecified complications of anaesthesia).
6. Prolonged stay in hospital (> 3 days).

The perinatal composite adverse outcome indicator comprised any of:

1. Stillbirth.
2. Preterm birth (less than 37 completed weeks).
3. Small for gestational age defined as birthweight <10th centile using the WHO-UK90 paediatric growth charts.[19]
4. Hypoxic Ischaemic Encephalopathy (HIE).
5. Prolonged stay in hospital (> 3 days).
6. Neonatal death.

A full description of the codes that were used to identify each outcome is shown in online supplemental table S1. Of note, the standard length of stay in the UK is 2 days or less regardless of mode of birth.[16]

Maternal age was grouped into four categories: <20, 20–34, 35–44 and 45 years or older. Parity was defined using records of previous births through a 'look-back' approach in HES, and handled in three categories: primiparous, multiparous without previous caesarean delivery and multiparous with previous caesarean delivery.[20 21] We divided the HES ethnicity information into five groups as defined by the Office for National Statistics in the UK: 'White', 'Mixed', 'Asian', 'Black' and 'Other'. 'Asian' category included Indian, Bangladeshi and Pakistani ethnicity, Chinese ethnicity was included in the 'Other' category.[22] Ethnicity was based on self-declared ethnicity for the mother or the baby, respectively. Gestational age was grouped into three categories: <37, 37–41 and over 41 weeks. Socioeconomic deprivation was defined by the Index of Multiple Deprivation 2019 (IMD),[23] an overall measure of multiple deprivation derived from information about income, education, employment, crime and the living environment, and grouped into quintiles.

Patient and public involvement

A Women's Reference Group of 23 women from diverse ethnic and socioeconomic backgrounds who gave birth between March 2020 and March 2021 was recruited from across England. This group supported development and execution of the project, including the selection of quantitative outcomes. Details of their involvement can be found in online supplemental table S6.

Statistical analysis

We inspected the distribution of continuous variables such as age using scatter plots to look for substantial deviations from normality and found none. We compared the characteristics of women and babies in the cohort in the three periods of study by using χ^2 test for categorical variables and one-way analysis of variance for continuous variables. Rates of maternal and perinatal outcomes and composite indicators were calculated in the pre-pandemic, first and second pandemic period.

Relative risks (RR) of maternal and perinatal composite indicators were estimated with 95% CI using modified Poisson regression analysis.[24 25] The model was adjusted for maternal and perinatal risk factors for adverse outcomes: for the maternal indicator, maternal age, obstetric history and socioeconomic deprivation; and for the perinatal indicator, socioeconomic deprivation. Unadjusted and adjusted RR were calculated for the composite indicators overall and for each individual component indicator. Models were fitted with robust standard variance to account for clustering within healthcare organisations and, for models within the maternal cohort, for subsequent births to the same mother. Within the neonatal cohort, due to lack of mother–baby linkage, we could not allow for sibling clustering.[25]

Within regression models, missing values of maternal age, gestational age and birth weight were accounted for using multiple imputation. Chained equations including all available covariates were used to generate 20 data sets; estimates from these data sets were pooled using Rubin's rules.[26]

Four sensitivity analyses were performed. In the first, we examined whether associations differed within more

Table 1 Characteristics of cohort by pandemic period* (no (%))

Maternal				Perinatal			
Variable	**Prepandemic**	**First pandemic**	**Second pandemic**	**Variable**	**Prepandemic**	**First pandemic**	**Second pandemic**
Maternal age (years)				Birth weight (median (IQR))	3370 (3030–3700)	3380 (3040–3710)	3380 (3045–3710)
<20	28 900 (2.9)	3655 (2.6)	9597 (2.4)				
20–35	745 538 (73.8)	104 958 (73.4)	287 845 (73.7)	Missing	86 834 (9.1)	8954 (7.0)	26 521 (7.5)
35–45	232 947 (23.0)	33 872 (23.7)	92 100 (23.6)				
>45	3194 (0.3)	509 (0.3)	1143 (0.3)				
Missing	29 (0.0)	2 (0.0)	1 (0.0)				
Gestational age (weeks)				Gestational age (weeks)			
<37	54 793 (5.4)	6608 (4.6)	17 610 (4.5)	<37	56 045 (5.9)	6664 (5.2)	18 099 (5.1)
37–41	731 751 (72.4)	100 368 (70.2)	272 293 (69.7)	37–41	753 181 (79.3)	101 314 (79.0)	279 256 (78.7)
>41	15 631 (1.6)	2181 (1.5)	5839 (1.5)	>41	18 638 (2.0)	2415 (1.9)	6329 (1.8)
	208 433 (20.6)	33 839 (23.7)	94 944 (24.3)	Missing	121 225 (12.8)	17 835 (13.9)	50 951 (14.4)
Ethnicity				Ethnicity			
White	777 261 (76.9)	98 299 (68.7)	271 001 (69.4)	White	700 119 (73.8)	87 386 (68.2)	243 566 (68.7)
South Asian	116 110 (11.5)	15 756 (11.0)	43 129 (11.0)	South Asian	113 513 (12.0)	15 634 (12.2)	43 993 (12.4)
Black	48 654 (4.8)	6465 (4.5)	17 032 (4.4)	Black	46 437 (4.9)	6087 (4.7)	16 592 (4.7)
Mixed	20 784 (2.1)	2653 (1.9)	7785 (2.0)	Mixed	60 485 (6.4)	7978 (6.2)	22 319 (6.3)
Other	47 058 (4.6)	6312 (4.4)	16 562 (4.2)	Other	28 039 (2.9)	3534 (2.8)	9434 (2.6)
Missing	741 (0.1)	13 511 (9.5)	35 177 (9.0)	Missing	496 (0.0)	7609 (5.9)	18 731 (5.3)
Obstetric history							
Primiparous	486 776 (48.2)	73 125 (51.1)	206 112 (52.8)				
Multiparous (no CS)†	407 978 (40.4)	53 760 (37.6)	140 413 (35.9)				
Multiparous (CS)‡	115 854 (11.4)	16 111 (11.3)	44 161 (11.3)				
Socioeconomic deprivation§				Socioeconomic deprivation**			
1=least deprived	148 064 (14.6)	21 093 (14.7)	59 622 (15.3)	1=least deprived	121 259 (12.8)	16 665 (13.0)	46 837 (13.2)
2	159 372 (15.8)	22 864 (16.0)	63 410 (16.2)	2	125 131 (13.2)	17 467 (13.6)	48 788 (13.8)
3	212 868 (21.1)	29 975 (21.0)	81 277 (20.8)	3	172 446 (18.1)	23 573 (18.4)	65 452 (18.4)
4	214 742 (21.3)	30 232 (21.1)	81 824 (20.9)	4	173 511 (18.3)	24 008 (18.7)	65 887 (18.6)
5=most deprived	234 858 (23.2)	32 395 (22.7)	87 483 (22.4)	5=most deprived	196 672 (20.7)	26 890 (21.0)	74 366 (21.0)
Missing	40 704 (4.0)	6 437 (4.5)	17 070 (4.4)	Missing	160 070 (16.9)	19 625 (15.3)	53 305 (15.0)

All p values<0.001.
*Pandemic period: prepandemic period from 1 April 2018 to 25 March 2020; first pandemic period 26 March 2020 to 30 June 2020 and second pandemic period from 1 July 2020 to 31 March 2021.
†Multiparous with no previous caesarean delivery.
‡Multiparous with previous caesarean delivery.
§Defined by the Index of Multiple Deprivation 2019 (IMD).
CS, caesarean.

granular ethnic groups: 'Asian' was divided into 'Indian' and 'Any other Asian' and 'Black' into 'Caribbean' and 'African or any other Black'. In the second, we performed a complete case analysis, which included all records with complete information about all covariates within the model; this was to evaluate whether the use of imputed values changed the direction of any estimated relationships. In the third, we repeated the maternal analysis without adjustment for socioeconomic deprivation, to evaluate whether the known association between ethnic and socioeconomic inequalities confounded our results. In the fourth and final sensitivity analyses, we repeated the analysis for the maternal composite indicator in an expanded cohort including women who tested positive for COVID-19, to check that their exclusion did not bias our results (as women from ethnic minority groups are both more likely to test positive for COVID-19 and to experience adverse outcomes).

All analyses were conducted using Stata 16 (StataCorp, College Station, TX).

RESULTS

1 544 290 women with singleton pregnancy and 1 431 952 babies were included in the study (figure 1). Table 1 shows the characteristics of included women and babies across the three study periods. The proportion of primiparous women increased over time, from 48.2% to 52.8%, while the proportion of multiparous women with no previous caesarean birth decreased, from 40.4% to 35.9% (p<0.001) (table 1). Only small changes occurred in the other maternal characteristics. Similarly, neonatal characteristics showed little variation across the study periods except for the proportion of babies born preterm, which decreased from 6.8% to 5.9% between the pre-pandemic and second pandemic period (p<0.001) (table 1).

Overall, the incidence rate per 1000 births of both maternal and perinatal composite indicator decreased in the first pandemic period (maternal: from 308.0 (95% CI 307.0 to 309.0) to 291.0 (95% CI 311.4 to 314.9) (p<0.001); perinatal: from 133.0 (95% CI 132.3 to 133.7) to 111.9 (95% CI 110.1 to 113.7) (p<0.001)). In the second pandemic period, rates of both indicators increased (maternal: 313.2 (95% CI 311.4 to 314.9) (p<0.001); perinatal 118.9 (95% CI 117.7 to 120.0) (p<0.001)), with the rate of the maternal adverse outcome exceeding that prior to the pandemic (table 2). Rates of the individual components included in the maternal and perinatal composite indicator are shown in table 2. Some component indicators showed different trends from the overall composite indicator: there was a sustained rise in the proportion of women who had an emergency caesarean birth between periods from 165.2 (95% CI 164.4 to 166.0) per 1000 prepandemic to 186.2 (95% CI 184.9 to 187.6) per 1000 in the second pandemic period (p<0.001), and a fall in the rate of babies born small for gestational age in the later pandemic, from 75.4 (95% CI 74.8 to 76.0) prepandemic to 70.1 (95% CI 69.2 to 71.1) in the second pandemic period (p<0.001).

Table 2 Maternal and perinatal composite indicator* incidence rate per 1000 births by pandemic period (incidence rate (95% CI))

	Prepandemic	First pandemic period	Second pandemic period
Maternal composite indicator	308.0 (307.0 to 309.0)	291.0 (288.2 to 293.8)	313.2 (311.4 to 314.9)
Maternal outcomes			
Emergency caesarean section	165.2 (164.4 to 166.0)	174.4 (172.2 to 176.5)	186.2 (184.9 to 187.6)
OASI	20.8 (20.5 to 21.2)	21.2 (20.5 to 22.0)	20.1 (19.6 to 20.5)
Hysterectomy	0.17 (0.14 to 0.20)	0.09 (0.04 to 0.15)	0.15 (0.11 to 0.19)
Sepsis	13.1 (12.8 to 13.2)	11.2 (10.6 to 11.7)	13.5 (13.1 to 13.8)
Major complications of anaesthesia	0.11 (0.09 to 0.13)	0.10 (0.04 to 0.15)	0.12 (0.07 to 0.15)
Prolonged stay in hospital (>3 days)	200.3 (199.4 to 201.2)	161.3 (159.2 to 163.3)	182.7 (181.3 to 184.0)
Perinatal composite indicator	133.0 (132.3 to 133.7)	111.9 (110.1 to 113.7)	118.9 (117.7 to 120.0)
Perinatal outcomes			
Stillbirth	3.29 (3.17 to 3.40)	3.56 (3.23 to 3.89)	3.32 (3.13 to 3.51)
Preterm birth	62.8 (62.3 to 63.3)	56.1 (54.8 to 57.4)	55.4 (54.6 to 56.1)
Small for gestational age	75.4 (74.8 to 76.0)	76.5 (74.9 to 78.2)	70.1 (69.2 to 71.1)
HIE	1.43 (1.36 to 1.51)	1.40 (1.20 to 1.60)	1.41 (1.30 to 1.53)
Neonatal death	1.09 (1.02 to 1.16)	1.10 (0.92 to 1.30)	1.09 (0.98 to 1.20)
Prolonged stay in hospital (>3 days)	94.7 (94.1 to 95.4)	78.2 (76.7 to 79.7)	85.9 (84.9 to 86.8)

All p values (using Poisson model to estimate incident rate) <0.001.
*Women or babies experiencing any of the component maternal/perinatal outcomes were considered to have experienced the composite indicator.
HIE, Hypoxic Ischaemic Encephalopathy; OASI, obstetric anal sphincter injuries.

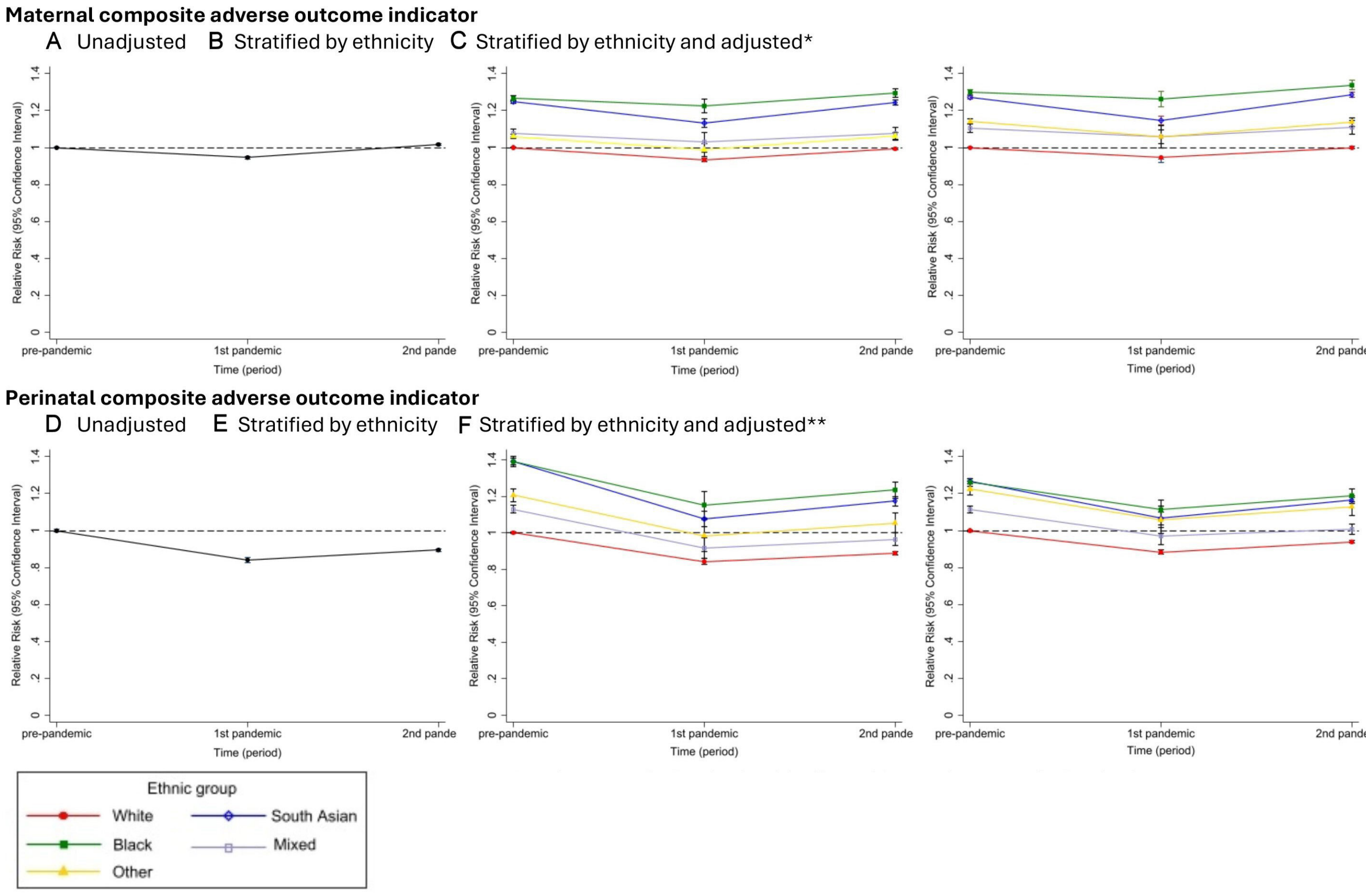

Figure 2 Relative risk and 95% CI for composite adverse outcome indicator by pandemic period. *Adjusted for maternal age, obstetric history, and socioeconomic deprivation. **Adjusted for socioeconomic deprivation.

Incidence rates of the maternal and perinatal composite indicators, and their components, stratified by ethnicity are shown in online supplemental table S2. The incidence rates of all adverse outcomes were higher in women and babies from ethnic minority groups compared with women and babies from White ethnicity in each pandemic period. While rates for most of the maternal and perinatal individual components for all ethnic groups followed similar trends to the composite indicators, rates of major complications from anaesthesia in the second pandemic period were even higher than rates in the prepandemic period for all women from ethnic minority groups and especially for women in the Black ethnic group. Similarly, the rate of neonatal deaths increased in the second pandemic period to higher levels compared with the prepandemic period for babies in the Black ethnic group, from 1.9 (95% CI 1.5 to 2.3) prepandemic to 2.3 (95% CI 1.5 to 3.0) in the second pandemic period (p<0.001).

In the first pandemic period, the risk of both maternal and perinatal adverse outcomes fell (maternal RR 0.94 (95% CI 0.93 to 0.95, p<0.001); perinatal RR 0.84 (95% CI 0.82 to 0.85, p<0.001), figure 1). In the second pandemic period, while the risk of maternal adverse outcomes returned to the prepandemic level (RR 1.01 (95% CI 1.01 to 1.02, p<0.001)) the risk of adverse outcomes for babies did not, remaining lower than it had been prepandemic (RR 0.89 (95% CI 0.88 to 0.90, p<0.001)) (figure 2A,D). The risk of developing maternal adverse outcomes was higher in all minority ethnic groups throughout the three periods of study compared with White ethnic groups in the prepandemic period (figure 2B), even when the model was adjusted for maternal characteristics (figure 2C). The same trend was observed for babies experiencing adverse perinatal outcomes. Babies from minority ethnic groups were at higher risk of adverse outcomes compared with babies of white ethnicity (figure 2E) even when adjusting for other risk factors (figure 2F). Across all three periods of study, the risk of both maternal and perinatal adverse outcomes was considerably higher in the South Asian and Black ethnic groups.

When ethnicity was handled at a more granular level, there remained evidence of an increased risk of developing maternal and perinatal adverse outcomes in all minority ethnic groups compared with White ethnicity in the prepandemic period (online supplemental figure S1). The results of a complete case analysis (online supplemental table S3), modified analysis adjusting for additional maternal risk factors (online supplemental table S4) and analysis including mothers with COVID-19 infection at the time of birth (online supplemental table S5) were not materially different to the primary analysis.

DISCUSSION

Summary of results

In this analysis of 1.54 million women and 1.43 million babies born in England from April 2018 to March 2021, we demonstrate that while there was a fall in maternal and perinatal adverse outcomes in the initial pandemic period (26 March 2020–30 June 2020), this was not sustained, and in the subsequent period to March 2021, there was a small rise in adverse outcomes with maternal adverse outcomes becoming slightly more frequent than before the pandemic. Existing inequalities in adverse maternal and perinatal outcomes were maintained, but not tempered, during the pandemic. These results were robust to sensitivity analyses under a range of assumptions.

Strengths and limitations

This study uses routinely collected data to evaluate maternal and perinatal outcomes by ethnic group. The central strengths and limitations of this study are tied to the data set used: the study is large, including over 85% of all births in England during the time period;[27] and due to record availability, we are able to compare with a 2 year reference period, accounting for seasonal variation in outcomes. The main reasons for exclusion from this cohort are related to data quality, and are typically on the hospital level rather than the individual level, reducing the likelihood of bias in our results. The study is therefore likely to be able to detect small differences in outcomes between groups.

There have previously been concerns about the quality of recording of ethnicity in electronic health records. Recent validation comparing ethnicity records in HES to the gold-standard of self-reported ethnicity in the census revealed good levels of agreement between ethnicity when reported in groups (White, South Asian, Black, Mixed and Other); this was slightly less good when reported by ethnicity (eg, Bangladeshi, Pakistani).[22] We have accordingly used the former groupings in our study. Furthermore, in a sensitivity analysis using the more granular classification of ethnicity, no meaningful differences were seen in our results.

Studies using routinely collected data are subject to limitations in data recording and availability, which may affect both exposures and outcomes. While HES has been used for both maternity and neonatal research in the past,[6 14] limitations apply to the cohort, including in the recording of parity. We have used methods to try and mitigate against incompleteness, including a 'look-back' approach.[20] While we have used multiple imputation as our primary method of handling missing data, we cannot be sure that missing data are missing at random. Multiple non-random reasons, including hospital-based (hospital IT system and coding practices) and individual (speed of events limiting documentation, giving birth in another hospital and thus missing history-taking including comorbidities), can be postulated to exist. However, in a complete case analysis, where the assumptions of missing data patterns are less strong, our findings were very similar.

In our study, maternal and neonatal records are not linked, and thus these cohorts have been treated independently of one another. This has limited the risk adjustment for perinatal outcomes to only those factors reported in both records, which may mean that these results are not sufficiently adjusted for maternal medical conditions. However, the central purpose of our analysis is to examine changes over time, and the proportion of women with pre-existing medical conditions is unlikely to have changed substantially over the time we studied.

Finally, this study uses composite maternal and perinatal outcomes to examine differences between groups. The use of composite outcomes can have unwanted effects: masking results for individual outcomes which contradict the overall pattern of association; or including outcomes which are not relevant or not well measured in the data source.[28 29] In our study, we examined the distribution of each individual component indicator per period to elucidate differences between the component outcomes, in order to ensure greater clarity.

Interpretation

Other population-level studies have reported a fall in adverse maternal and perinatal outcomes, particularly preterm birth, during the initial wave of the COVID-19 pandemic in England.[27 30] Reductions were observed in spontaneous preterm birth. Hypotheses for the underlying mechanisms included reduced exposure to infection, changes in patterns of physical exertion and working, improvement in environmental factors and air pollution and changes in access to healthcare reducing the opportunity to identify triggers for iatrogenic preterm birth. It is also possible that these findings have little to do with the pandemic, instead reflecting an improvement in healthcare services more broadly; similar results were seen in Nordic countries despite the variation in lockdown measures.[31] A novel finding in our data set is the fall in the proportion of babies born small-for-gestational age in the second pandemic wave, which may be associated with increased gestational weight gain or other changes in health and social behaviours; further investigation is indicated to identify if this observation continued over time.

The maintenance of existing inequalities in maternity care is disappointing and occurred despite increasing focus on these during the pandemic and reflects similar findings in a crude analysis of outcomes of white compared with minority ethnic women in 2020.[30] In the summer of 2020, there was a national call to action on inequalities in maternity care following initial reports that women from Black and South Asian ethnic groups were at increased risk of admission to hospital with COVID-19 infection.[3 32] This mirrored a similar international focus on maternity inequalities. In England, the government's chief midwifery officer asked units to specifically focus on care improvement for women from minority ethnic groups, and there was widespread attention in the press. It is not possible in our study to unpick whether this focus on women from ethnic minority groups had little impact, or whether it acted to mitigate what would otherwise have been an increase in inequality driven by an increase in the differences between more and less affluent groups during the pandemic.[33] These findings may further reflect that changes in maternity care have limited capacity to influence ethnic inequalities in maternity outcomes, which are strongly influenced by health and well-being prior to pregnancy which are impacted by existing health, socioeconomic and structural inequality.

Our findings suggest that no specific intervention during the pandemic was sufficient to narrow inequalities, and that further, novel action is needed to reduce inequalities in maternity care which have persisted during the pandemic. These findings apply to England but similar patterns may be hypothesised to occur in other high-income countries with underlying inequalities in maternity outcomes by ethnic group. At present, there are few interventions with an evidence-base for reducing ethnic inequalities in maternity outcomes. A recent study has demonstrated that the use of a new risk calculator can reduce ethnic inequalities in perinatal mortality.[34] Further research should focus on further development and rigorous evaluation of interventions and care practices with explicit ethnic stratification which may reduce inequality.

Conclusions

Despite increased attention on ethnic inequalities in maternity care, inequality in adverse maternal and perinatal outcomes was maintained during the first year of the COVID-19 pandemic, even though there was an overall improvement in adverse maternal and perinatal outcomes. This suggests that attention alone is insufficient to reduce ethnic inequalities in maternity outcomes. Further ethnic-focused research is urgently needed to develop and evaluate interventions focused on reducing inequalities in maternity care.

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