Effects of the SARS-CoV-2 pandemic on perinatal activity in the Yorkshire and Humber region during 2020: an interrupted time-series analysis

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# Abstract

**Objective:** To assess the impact of public health measures taken during the coronavirus pandemic on perinatal health indicators.  
**Design:** Interrupted time series analysis comparing periods of the pandemic with the previous 5 years.  
**Setting:** Yorkshire & Humber region, England (2015-2020).  
**Main outcome measures:** Relative risk (RR) of stillbirth, extreme preterm (EPT, 27 weeks’ gestational age) delivery, hypoxic ischaemic encephalopathy (HIE) and meconium aspiration syndrome (MAS), antenatal transfer for threatened EPT delivery, and postnatal transfer for EPT birth, HIE or MAS.  
**Results:** Stillbirths fell from 3.7/1000 deliveries pre-pandemic to 2.9/1000 afterwards; EPT births decreased from 2.5/1000 to 1.8/1000 live births. Following adjustment, during the first lockdown there were decreased antenatal transfers (relative risk 0.74, 95% confidence interval (CI) 0.57 to 0.94) with non-statistically significant increased stillbirth (RR 1.08, 95%CI 0.78 to 1.51) and decreased EPT admissions (RR 0.88, 95%CI 0.60 to 1.29). Over the entire coronavirus period, antenatal transfer (RR 0.64, 95%CI 0.55 to 0.76) and EPT birth (RR 0.73, 95%CI 0.56 to 0.94) decreased; stillbirths showed non-statistically significant increases overall (RR 1.21, 95%CI 0.98 to 1.49) but with increasing trend through the pandemic (RR 1.11, 95%CI 1.00 to 1.22). No changes were seen for HIE, MAS, postnatal transfers or in subgroup analyses by ethnicity.  
**Conclusions:** Lower rates of antenatal transfer and extreme preterm birth were identified, alongside an apparent increase in stillbirth over time. The findings provide evidence that effects on perinatal activity related to the pandemic changed over time.  
**Funding:** This study was unfunded.

**Key words:** Extreme preterm, Perinatal, Neonatal, Epidemiology, SARS-CoV-2, coronavirus

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# Background

The appearance of SARS-CoV-2 (severe acute respiratory syndrome coronoavirus 2 virus) led to extensive public health measures being taken around the world. Although SARS-CoV-2 did not appear to affect neonates or young children seriously,[1] the societal impact of measures taken to contain spread led to substantial changes in behaviour, with increased home-working, manual workers in non-essential jobs furloughed, and widespread fear about attending hospitals.

Early reports suggested there were decreased numbers of extremely preterm (EPT) babies live born,[2] with a possible increase in stillbirths.[3] Subsequent studies added weight to these suggestions, with a systematic review finding increased stillbirths (predominantly in low and middle income countries) and a tendency towards decreased preterm birth (particularly in high income countries).[4] Most studies included compared the first few months following the implementation of public health measures to similar time periods in previous years; few published studies include longer time periods or take into account potential variation over time unrelated to the pandemic.[5]

We sought to explore the impact of the pandemic and related public health measures on timing and place of birth by examining perinatal health indicators in a region of England taking into consideration underlying time trends. We examined antenatal transfer for EPT delivery and, as stillbirths may occur at term gestations, the term neonatal morbidities of meconium aspiration syndrome (MAS) and hypoxic ischaemic encephalopathy (HIE) as well as EPT birth and stillbirth. We also examined postnatal transfers for these conditions.

# Methods

## Data collection

Data were collected on a weekly basis using statistical weeks (starting on Mondays) for the years 2015 to 2020; the first week began 29th December 2014 and the last week the 28th December 2020. The years 2015 and 2020 had 53 weeks, all others had 52 weeks.

### Obstetric data

Stillbirth data are routinely collected by hospitals in the United Kingdom (UK) for inclusion in the national audit MBRRACE-UK (Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK), but delayed returns mean that data are not immediately available. Instead, the 13 National Health Service Trusts (including 16 acute hospitals) in the Yorkshire & Humber region providing maternity services were contacted individually and asked to provide aggregated data on the total number of stillbirths, live births and of women delivering in their Trust, broken down by ethnicity using Office for National Statistics (ONS) categorisations. Weekly data were required for 2020. For historical data (2015 to 2019), some hospitals were unable to provide weekly data hence we accepted monthly or quarterly data; these were averaged over the intervening time periods to provide weekly estimates.

### Transport and neonatal data

All hospitals in Yorkshire & Humber collect neonatal data for clinical care purposes using the BadgerNet system with real-time reporting available on a network-wide basis. Data were obtained for admissions of EPT (<27 weeks of gestational age (GA)) infants and for babies ≥36 weeks’ GA with HIE (defined as treatment with active hypothermia within 48 hours of birth) or MAS (defined as receiving inhaled nitric oxide (iNO) treatment within 5 days of birth).

The Embrace Transport Service, which coordinates all antenatal and performs all postnatal transfers maintains a database of activity. We obtained data for transfers of women with threatened EPT delivery with singleton pregnancies of <27 weeks’ GA or multiple pregnancies of <28 weeks’ GA, in line with national recommendations.

Neonatal but not transport data were also available using the same ethnicity categorisations as the obstetric data.

## Exposure

The primary exposure for this study was time, divided into the following periods:

1. pre-pandemic period (all weeks prior to the implementation of public health measures in England, from the beginning of the study until the week of March 16th 2020);
2. the initial period of public health measures, or “first lockdown”, from 23rd March to 14th June 2020;
3. the time between national lockdowns, when fewer restrictions were in place, from 15th June until the beginning of the second lockdown;
4. from the start of the second lockdown, for which the first complete week commenced 9th November 2020, until the end of the year.

## Outcomes

We studied the rates of antenatal transfer (per 1000 women delivering), stillbirth (per 1000 births), and EPT, HIE and MAS transfers and admissions to neonatal intensive care (all per 1000 live births).

## Ethnicity

Ethnicities were re-categorised from standard ONS classification as shown in Table [1](#tab:ethnic-cats).

## Statistical methods

Data were analysed using an interrupted time-series methodology.[6,7] Indicators were first plotted over time, highlighting periods of particular interest (first lockdown, period between lockdowns, second lockdown). We calculated rate ratios (RR) using Poisson models with a linear indicator for time and periodic Fourier terms to account for seasonal variation, and were offset according to the relevant baseline population. We examined the first lockdown in isolation as well as the entire pandemic period (23rd March 2020 until the end of the year) in relation to the pre-pandemic period. We then included indicator variables for different periods of the pandemic, using the prepandemic period as baseline, and assessed whether there was a trend over time. Finally, we repeated analyses for different ethnic groups (Asian, Black, Mixed, Other, White). As the majority ethnicity in the region is White and numbers were low for other ethnic groups individually, we performed analyses for all non-White ethnicities combined.

Missing data were imputed using the Kalman smoothing algorithm from the R package ‘imputeTS’.[8] All analyses were performed using R version 4.04.[9]

## Sensitivity analyses

All analyses were repeated using the available data only. Main analyses were also repeated using negative binomial regression models.

## Ethics

No patient identifiable information was used in this study, with all data aggregated across the region, hence formal ethical approval was not required. The project was approved in advance by the Yorkshire & Humber Neonatal Operational Delivery Network Executive Management Group meeting (01st September 2020), and by the Yorkshire & Humber maternity network (via the weekly Heads of Maternity meeting, 09th October 2020).

# Results

Complete obstetric data were obtained for 2017, 2018 and 2019; one Trust only moved to an electronic data collection system in April 2016 and could not provide data prior to this, another changed systems during 2015 and could not retrieve data from the old system, and another experienced downtime during which no records were computerised. Antenatal and postnatal transfer data were complete other than information relating to postnatal transfer of extremely preterm babies in 2015.

In the pre-pandemic period there was a mean of 1161.4 (standard deviation (SD) 56.9) women giving birth to a mean 1192.8 (SD 58.8) babies (1187.4 (SD 58.3) live borns) per week. This decreased during the pandemic, with the lowest numbers seen during the period of the second lockdown (Table [2](#tab:mean-sd)). Means for all outcomes were lower during the pandemic period, other than the mean number of HIE admissions during the period between lockdowns which was similar to before the pandemic. There was evidence of a decrease over time in the number of women delivering with a strong seasonal component as well as in the number of babies delivered and live born (Figure).

The mean proportion of women delivering who self-identified as White decreased over time (Table [3](#tab:ethnic-props)). This was primarily related to an increase in women classified as Other although the proportion of women who were classified as Asian also increased in the pandemic.

Stillbirths fell from 3.7/1000 deliveries pre-pandemic to 2.9/1000 afterwards; EPT births decreased from 2.5/1000 to 1.8/1000 live births. Following adjustment, during the first lockdown there were decreased antenatal transfers (RR 0.74, 95% CI 0.57 to 0.94) with non-statistically significant increased stillbirth (RR 1.08, 95% CI 0.78 to 1.51) and decreased EPT admissions (RR 0.88, 95% CI 0.60 to 1.28). Over the entire coronavirus period, antenatal transfer (RR 0.64, 95% CI 0.55 to 0.76) and EPT birth (RR 0.73, 95% CI 0.56 to 0.94) decreased; stillbirths showed non-statistically significant increases overall (RR 1.21, 95% CI 0.98 to 1.49) but with increasing trend through the pandemic (RR 1.11, 95% CI 1.00 to 1.22). No changes were seen for HIE, MAS or postnatal transfers. Full results are in Table [4](#tab:complete-results).

## Analyses by ethnicity

No meaningful differences were seen among Asian or Black women. EPT admissions decreased for those classified as White across the different periods of the pandemic (RR 0.80, 95% CI 0.67 to 0.95 ) although the change for the whole period combined was not significant (RR 0.73, 95% CI 0.52 to 1.02 ). Among those in the Other category, across the whole of the pandemic both EPT admissions (RR 0.56, 95% CI 0.35 to 0.90 ) and admissions for HIE (RR 0.37, 95% CI 0.18 to 0.78 ) decreased. Full details are in Supplementary Tables S[1](#tab:complete-results-asian) to S6.

## Sensitivity analyses

Analyses of complete data were consistent with the main results (Supplementary Tables S7 and S8). Models using negative binomial regression (Supplementary Table S9) were also very similar.

# Discussion

In this population-based analysis comparing indicators of perinatal activity during the pandemic with the preceding five years, we identified decreased rates of antenatal transfers for women with threatened EPT delivery alongside decreased rates of admission to neonatal intensive care for babies born EPT. We did not identify any changes in the rates of babies with HIE or MAS, or with postnatal transfers, nor were any changes seen in rates of stillbirth although there was a suggestion these increased across the study period.

## Strengths and limitations

We employed an interrupted time-series regression methodology;[6,7] this has been infrequently used in previous studies examining the impact of the coronavirus pandemic on perinatal outcomes [5] but is necessary to ensure underlying trends are appropriately accounted for.[6] We also used population level data from a defined geographical area that were obtained from all NHS Trusts providing maternity care within the region. There were potentially some limitations. Data were collected retrospectively and some Trusts could only provide historical data at monthly or quarterly intervals, hence these data were averaged over the intervening time. This may have reduced week-to-week variability amongst the historic data. We do not believe this had a major influence on the results: most hospitals provided weekly data, and marked weekly variability remained, as seen in the Figure[. Furthermore, the pandemic periods we studied were all eight weeks or longer, with comparisons made against the trend of data from the entire historic period rather than just a comparable week in preceding years. There were also a small amount of missing data: this amounted to fewer than 5% overall and was accounted for using imputation. Additionally, complete data analysis gave consistent results. A further point is that we did not directly model a lag period.[10] This is consistent with previous literature and is based on the assumption that public health measures taken during the pandemic had an immediate effect – or, at least, that effects occurred within the weekly intervals used in this study. An alternative hypothesis is that public health measures had a delayed impact, for example with decreased provision of antenatal care being associated with higher rates of stillbirth happening later in pregnancy, hence why increased stillbirths were not identified in England during the first lockdown.[11] Our results potentially support this, as the RR for stillbirth was higher at later points during the study period and coincided with a decreased rate of antenatal transfer during the second lockdown.](#fig:total-women)

We were unable to disaggregate the gestational age of stillbirths as we did not have access to individual level data. The interplay between EPT birth and stillbirth at these gestations could not therefore be examined directly, nor could we examine balances between late pregnancy losses, delayed presentation (resulting in HIE or MAS) and delivery of a healthy baby at term. We were also limited in our examination of ethnicity to categories defined in official statistics. These do not capture the fact that over 20% of the region’s foreign-born inhabitants are from Eastern Europe,[12] thus may have different outcomes from other women classified as White who were born and raised in England.

## Interpretation

The finding of decreased EPT admissions is consistent with other studies [4] as well as with anecdotal reports suggesting there were decreased EPT births during the pandemic, and may be related to biological mechanism such as decreased physical stress for pregnant women or decreased exposure to viral infections. That antenatal transfers for threatened EPT delivery also decreased is coherent: decreases in EPT births are most likely due to decreased spontaneous deliveries, thus likely preceded by fewer women with threatened EPT labour – hence fewer women requiring transfer. Indeed, this is the first study that we know of examining both antenatal and postnatal transfers within a defined geographical region. The findings, particularly for antenatal transfer, are likely to be similar for other parts of the UK with similar transfer policies, and suggest the pandemic had an important impact on where women delivered that may not be sustained in the future. As noted above and demonstrated in the Figure, the stillbirth rate appeared to increase through the study period, corresponding with decreasing antenatal transfers. This might be related to women having less contact with antenatal services than previously, thus being less aware of when to attend hospital.

Ethnicity is frequently identified as important in analyses relating to the pandemic.[13] We did not find evidence of a difference between ethnic groups, but numbers per week were low and, as a majority of women were classified as White, there was probably insufficient power to detect differential effects across groups. The one notable result was the finding of decreased HIE admissions among non-Whites, primarily due to a markedly lower rate in the Other category. This category included women for whom ethnicity was unknown, and increased substantially during the pandemic, hence the result may simply be due to misclassification.

## Generalisability

Yorkshire & Humber includes approximately 10% of England’s population (between 5 and 5.5 million inhabitants) with major urban conglomerations as well as more rural areas. Around 10% of the population were foreign-born in 2017,[12] and 20% of births are to Black and Minority Ethnic mothers.[14] There are some differences from elsewhere, notably poorer child health indicators than the average for England.[14] Despite this, the region is probably representative of England in terms of population attitudes and behaviours.

Although not all studies have found differences in perinatal outcomes,[15,16] consistency with some studies suggests our results are true. Moreover, it is likely that other factors explain differences in findings: the outcomes studied are relatively uncommon, hence requiring studies with large baseline populations, yet behavioural effects from public health measures are likely to be more localised and to vary between geographical regions.[17] Our data are interesting because we included the whole of 2020 as well as considering different periods of the pandemic. Other studies published recently have also included longer time periods [18–20] although the way epochs are defined varies. The fact we identified substantial differences between epochs is notable, and highlights that impacts from pandemic public health measures are complex, potentially with both short and longer term repercussions.

## Conclusion

In a population-based interrupted time-series analysis, following implementation of public health measures for the coronavirus pandemic in Yorkshire & the Humber, we identified lower rates of antenatal transfer and EPT birth, with an apparent increase in stillbirth over time. No differences were identified in the rates of HIE, MAS or postnatal transfer, nor were important differences identified in non-White ethnic groups. Our findings also provide evidence that effects on perinatal activity changed over the course of the pandemic.

# Data availability statement

Data are available upon reasonable request from the corresponding author.

# **Funding**

This study was unfunded.

# **Author contributions**

ASM and CH conceived the study. ASM and ESD were involved in developing the methodology. ASM, CH, CB and HF were involved in data collection; ASM and CB were responsible for data curation, and ASM conducted the data analysis, drafted the initial manuscript and coordinated revisions. All authors were involved in reviewing and approving the final manuscript.

# **Competing interests**

The authors have no competing interests to declare.

# **Acknowledgements**

We would like to thank the following for their help with data collection: Sara Hollins and Kaylee Pitts (Bradford Teaching Hospitals NHS Foundation Trust); Susan Gibson and Misbah Mahmood (Leeds Teaching Hospitals NHS Foundation Trust); Janet Cairns and Elizabeth Davis (Hull University Teaching Hospitals NHS Trust); Lianne Likaj and Natalie Khoaz (Sheffield Teaching Hospitals NHS Foundation Trust); Sarah Simpson (Airedale NHS Foundation Trust); Victoria Carlisle (Barnsley Hospital NHS Foundation Trust); Saima Hussain (The Health Informatics Service) and Karen Spencer (Calderdale and Huddersfield NHS Foundation Trust); Lois Mellor (Doncaster & Bassetlaw Teaching Hospitals NHS Foundation Trust); Jane Warner and Carrie-Louise Dixon (Northern Lincolnshire & Goole NHS Foundation Trust); Anne-Marie Henshaw and John Taylor (Mid Yorkshire Hospitals NHS Trust); Sarah Petty and Jamie Dodd (The Rotherham NHS Foundation Trust); Magdalena Boruczkowska (York Teaching Hospital NHS Foundation Trust); Alison Pedlingham and Andy Brown (Harrogate and District NHS Foundation Trust); Lindsey Lithall (Embrace Transport Service, Sheffield Childrens’ Hospital NHS Foundation Trust).

## What is already known on this subject

* Previous studies suggest there were decreased extremely preterm births during the first few months following the institution of pandemic public health measures in 2020.
* Differences in the impact of the pandemic have been noted according to ethnicity.
* The impact of the pandemic on antenatal or neonatal transfer and on morbidities in term-born infants is currently unclear.

## What this study adds

* During the pandemic, decreased rates of extremely preterm admission were accompanied by decreased rates of antenatal transfer for threatened preterm labour.
* There were no differences in rates of hypoxic-ischaemic encephalopathy, meconium aspiration syndrome or in postnatal emergency transfers.
* No differences were identified by ethnicity, but there was an increase in the proportions of missing data during the pandemic.

## **How this study might affect research, practice or policy**

* Public health measures are likely to have immediate and delayed effects; these should both be considered when developing policy to deal with unforeseen events.
* In times of increased health service pressures, maintenance of high quality data collection is critical for understanding differential effects on populations (e.g. by ethnicity).
* Future studies should investigate how perinatal activity changed over the course of the pandemic, including consideration of delayed impacts from public health interventions.

# References

1 Gale C, Quigley MA, Placzek A *et al.* Characteristics and outcomes of neonatal SARS-CoV-2 infection in the UK: A prospective national cohort study using active surveillance. *The Lancet Child & Adolescent Health* 2021;**5**:113–21. doi:[10.1016/S2352-4642(20)30342-4](https://doi.org/10.1016/S2352-4642(20)30342-4)

2 Hedermann G, Hedley PL, Baekvad-Hansen M *et al.* Danish premature birth rates during the COVID-19 lockdown. *Archives of Disease in Childhood Fetal and Neonatal Edition* 2021;**106**:93–5. doi:[10.1136/archdischild-2020-319990](https://doi.org/10.1136/archdischild-2020-319990)

3 Khalil A, Dadelszen P von, Draycott T *et al.* Change in the incidence of stillbirth and preterm delivery during the COVID-19 pandemic. *JAMA* 2020;**324**:705–6. doi:[10.1001/jama.2020.12746](https://doi.org/10.1001/jama.2020.12746)

4 Chmielewska B, Barratt I, Townsend R *et al.* Effects of the COVID-19 pandemic on maternal and perinatal outcomes: A systematic review and meta-analysis. 2021. doi:[10.1016/S2214-109X(21)00079-6](https://doi.org/10.1016/S2214-109X(21)00079-6)

5 Ochoa LB, Brockway M, Stock SJ *et al.* COVID-19 and maternal and perinatal outcomes. *The Lancet Global Health* 2021;**9**:e1063–4. doi:[10.1016/S2214-109X(21)00295-3](https://doi.org/10.1016/S2214-109X(21)00295-3)

6 Lopez Bernal J, Cummins S, Gasparrini A. Interrupted time series regression for the evaluation of public health interventions: A tutorial. *International Journal of Epidemiology* 2016;**46**:348–55. doi:[10.1093/ije/dyw098](https://doi.org/10.1093/ije/dyw098)

7 Bhaskaran K, Gasparrini A, Hajat S *et al.* Time series regression studies in environmental epidemiology. *International Journal of Epidemiology* 2013;**42**:1187–95. doi:[10.1093/ije/dyt092](https://doi.org/10.1093/ije/dyt092)

8 Moritz S, Bartz-Beielstein T. imputeTS: Time series missing value imputation in R. *The R Journal* 2017;**9**:207–18. doi:[10.32614/RJ-2017-009](https://doi.org/10.32614/RJ-2017-009)

9 R Core Team, R Foundation for Statistical Computing. R: A language and environment for statistical computing. 2021.

10 Gasparrini A. Distributed lag linear and non-linear models in R: The package ‘dlnm’. *Journal of Statistical Software* 2011;**43**:1–20.

11 Stowe J, Smith H, Thurland K *et al.* Stillbirths during the COVID-19 pandemic in England, April-June 2020. *Jama* 2021;**325**:86–7. doi:[10.1001/jama.2020.21369](https://doi.org/10.1001/jama.2020.21369)

12 The Migration Observatory, COMPAS (Centre on Migration, Policy and Society), University of Oxford. Migration Observatory regional profile: Yorkshire and the Humber. Online:: The Migration Observatory, COMPAS (Centre on Migration, Policy; Society), University of Oxford 2018.

13 Sze S, Pan D, Nevill CR *et al.* Ethnicity and clinical outcomes in COVID-19: A systematic review and meta-analysis. *EClinicalMedicine* 2020;**29**:100630. doi:[10.1016/j.eclinm.2020.100630](https://doi.org/10.1016/j.eclinm.2020.100630)

14 Public Health England. Child and maternal health overview: Yorkshire & Humber. 2021.

15 Pasternak B, Neovius M, Soderling J *et al.* Preterm birth and stillbirth during the COVID-19 pandemic in Sweden: A nationwide cohort study. *Annals of Internal Medicine* Published Online First: 2021. doi:[10.7326/M20-6367](https://doi.org/10.7326/M20-6367)

16 Arnaez J, Ochoa-Sangrador C, Caserio S *et al.* Lack of changes in preterm delivery and stillbirths during COVID-19 lockdown in a European region. *European Journal of Pediatrics* 2021;**180**:1997–2002. doi:[10.1007/s00431-021-03984-6](https://doi.org/10.1007/s00431-021-03984-6)

17 Cheung P-Y, Alshaikh B, Yang C. COVID-19 pandemic: Different associative relationships of city lockdown with preterm births in three cities – an ecological study. *Frontiers in Pediatrics* 2021;**9**:644771. doi:[10.3389/fped.2021.644771](https://doi.org/10.3389/fped.2021.644771)

18 Einarsdottir K, Swift EM, Zoega H. Changes in obstetric interventions and preterm birth during COVID-19: A nationwide study from Iceland. *Acta Obstetricia et Gynecologica Scandinavica* 2021;**100**:1924–30. doi:[10.1111/aogs.14231](https://doi.org/10.1111/aogs.14231)

19 Shah PS, Ye XY, Yang J *et al.* Preterm birth and stillbirth rates during the COVID-19 pandemic: A population-based cohort study. *CMAJ : Canadian Medical Association Journal = Journal de l’Association Medicale Canadienne* 2021;**193**:E1164–72. doi:[10.1503/cmaj.210081](https://doi.org/10.1503/cmaj.210081)

20 Maslin K, McKeon-Carter R, Hosking J *et al.* Preterm births in South-West England before and during the COVID-19 pandemic: An audit of retrospective data. *European Journal of Pediatrics* Published Online First: 2021. doi:[10.1007/s00431-021-04265-y](https://doi.org/10.1007/s00431-021-04265-y)

# Tables

**Table 1:** **Ethnic categories**

|  |  |
| --- | --- |
| **Category** | **ONS classifications** |
| Asian | Indian, Pakistani, Bangladeshi, Other Asian, Chinese |
| Black | Black Caribbean, Black African, Black other |
| Mixed | Mixed White-Black Caribbean, Mixed White-Black African, Mixed White-Asian, Mixed Other |
| Other | Any other, Not known |
| White | White British, White Irish, White other |

**Table 2: Descriptive data (means (SD)) for perinatal activity indicators in Yorkshire & Humber, 2015-2020**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Pre-pandemic** | **Lockdown 1** | **Between lockdown 1 and 2** | **Lockdown 2** | **Entire pandemic period** |
|  | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) |
| Number of women | 1161.4 (56.9) | 1074.3 (33.2) | 1103.2 (30.4) | 1006.2 (60.9) | 1075.8 (52.7) |
| Number of deliveries | 1192.8 (58.8) | 1090.7 (35.0) | 1117.0 (32.6) | 1016.7 (60.0) | 1089.8 (54.4) |
| Number of live births | 1187.4 (58.3) | 1086.6 (34.7) | 1112.8 (31.9) | 1011.8 (59.4) | 1085.4 (54.2) |
| Number of stillbirths | 4.9 (2.1) | 3.6 (2.5) | 3.7 (1.7) | 3.5 (2.2) | 3.6 (2.0) |
| Number of antenatal transfers | 8.1 (3.1) | 6.2 (2.8) | 5.9 (2.7) | 3.0 (2.3) | 5.4 (2.9) |
| EPT admissions | 3.1 (2.0) | 2.8 (1.8) | 1.9 (1.5) | 2.6 (2.2) | 2.3 (1.7) |
| HIE admissions | 1.6 (1.3) | 1.4 (0.9) | 1.6 (1.2) | 1.1 (1.1) | 1.4 (1.1) |
| MAS admissions | 0.7 (0.9) | 0.6 (0.8) | 1.0 (0.9) | 0.5 (0.9) | 0.8 (0.9) |
| EPT transfers | 1.0 (0.9) | 1.3 (1.1) | 0.6 (0.7) | 0.9 (1.1) | 0.9 (0.9) |
| HIE transfers | 0.6 (0.8) | 0.6 (0.7) | 0.7 (0.7) | 0.2 (0.5) | 0.6 (0.7) |
| MAS transfers | 0.6 (0.9) | 0.6 (0.7) | 0.7 (0.9) | 0.2 (0.7) | 0.6 (0.8) |

\Antenatal transfers: number of women transferred at <27 weeks’ gestational age (GA), or <28 weeks if multiple pregnancy; EPT: extreme preterm (<27 weeks of GA); HIE: hypoxic ischaemic encephalopathy (defined as babies 36+ weeks’ GA who received active cooling within 48 hours of delivery); MAS: meconium aspiration syndrome (defined as babies 36+ weeks’ GA who received inhaled nitric oxide within 5 days of delivery)

**Table 3: Mean (SD) proportions of women of different ethnicities delivering in Yorkshire & Humber, 2015-2020**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Pre-pandemic** | **Lockdown 1** | **Between lockdown 1 and 2** | **Lockdown 2** |
|  |  | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) |
| White | | 74.5 (1.9) | 72.3 (1.0) | 72.6 (1.6) | 71.6 (1.6) |
| Non-White | | 23.2 (2.4) | 27.6 (1.0) | 27.2 (1.6) | 27.5 (1.4) |
|  | Asian | 11.5 (1.6) | 12.3 (0.8) | 11.8 (0.8) | 12.1 (0.7) |
|  | Black | 2.6 (0.4) | 2.9 (0.4) | 2.7 (0.5) | 2.6 (0.4) |
|  | Mixed | 2.9 (0.4) | 2.9 (0.4) | 2.9 (0.6) | 2.7 (0.4) |
|  | Other | 6.2 (1.3) | 74.5 (1.9) | 9.9 (1.1) | 10.1 (0.9) |

Prepandemic: 29th December 2014 to 22nd March 2020; Lockdown 1: 23rd March 2020 to 14th June 2020; Between lockdown 1 and 2: 15th June 2020 to 08th November 2020; Lockdown 2: 09th November 2020 to 03rd January 2021; SD: standard deviation.

**Table 4: Rate ratios, adjusted for trend over time and seasonal variation, for perinatal activity indicators during the periods of the coronavirus pandemic compared to the previous 5 years.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Lockdown 1** | **Between lockdown 1 and 2** | **Lockdown 2** | ***p*-value (trend)** | **Entire pandemic period** | |
|  | RR (95% CI) | RR (95% CI) | RR (95% CI) |  | RR (95% CI) | *p*-value |
| Stillbirths | 1.08 (0.78 – 1.51) | 1.26 (0.97 – 1.65) | 1.29 (0.87 – 1.93) | 0.050 | 1.21 (0.98 – 1.49) | 0.075 |
| Antenatal transfers | 0.74 (0.57 – 0.94) | 0.70 (0.57 – 0.86) | 0.37 (0.24 – 0.56) | <0.001 | 0.64 (0.55 – 0.76) | <0.001 |
| EPT admissions | 0.88 (0.60 – 1.28) | 0.60 (0.42 – 0.85) | 0.81 (0.51 – 1.28) | 0.015 | 0.73 (0.56 – 0.94) | 0.013 |
| HIE admissions | 0.85 (0.50 – 1.45) | 0.81 (0.54 – 1.22) | 0.68 (0.34 – 1.38) | 0.159 | 0.80 (0.57 – 1.11) | 0.181 |
| MAS admissions | 0.79 (0.35 – 1.80) | 1.41 (0.81 – 2.45) | 1.00 (0.35 – 2.85) | 0.434 | 1.15 (0.71 – 1.84) | 0.572 |
| EPT transfers | 1.37 (0.77 – 2.44) | 0.61 (0.32 – 1.15) | 0.86 (0.39 – 1.93) | 0.324 | 0.90 (0.59 – 1.37) | 0.616 |
| HIE transfers | 1.04 (0.45 – 2.40) | 0.94 (0.50 – 1.78) | 0.36 (0.09 – 1.51) | 0.302 | 0.84 (0.50 – 1.44) | 0.534 |
| MAS transfers | 0.92 (0.40 – 2.12) | 1.28 (0.67 – 2.44) | 0.62 (0.14 – 2.62) | 0.926 | 1.05 (0.61 – 1.79) | 0.867 |

Lockdown 1: 23rd March 2020 to 14th June 2020; Between lockdown 1 and 2: 15th June 2020 to 08th November 2020; Lockdown 2: 09th November 2020 to 03rd January 2021; Entire pandemic period: 23rd March 2020 to 03rd January 2021;RR: Rate ratio; 95% CI: 95% confidence interval; EPT: extreme preterm (27 weeks of gestational age (GA)); HIE: hypoxic ischaemic encephalopathy (defined as babies 36+ weeks’ GA who received active cooling within 48 hours of delivery); MAS: meconium aspiration syndrome (defined as babies 36+ weeks’ GA who received inhaled nitric oxide within 5 days of delivery)

# Figures

**Figure: Time series for perinatal indicators from the Yorkshire & Humber region, 2015-2020.** Solid black lines indicate the trend over time, taking into consideration seasonal variation; dashed black lines indicate trends additionally taking into account the different periods of the pandemic which are separated by vertical dotted lines. Pre-pandemic: 29th December 2014 to 22nd March 2020; L1: lockdown 1, from 23rd March 2020 to 14th June 2020; I: between lockdowns 1 and 2, from 15th June 2020 to 08th November 2020; L2: lockdown 2, from 09th November 2020 to 03rd January 2021.