


BMJ Open Understanding ethnic inequalities in stillbirth rates: a UK population-based cohort study

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ABSTRACT

Objectives To investigate inequalities in stillbirth rates by ethnicity to facilitate development of initiatives to target those at highest risk.

Design Population-based perinatal mortality surveillance linked to national birth and death registration (Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK).

Setting UK.

Participants 4 391 569 singleton births at $\geq 24^{+0}$ weeks gestation between 2014 and 2019.

Main outcome measures Stillbirth rate difference per 1000 total births by ethnicity.

Results Adjusted absolute differences in stillbirth rates were higher for babies of black African (3.83, 95% CI 3.35 to 4.32), black Caribbean (3.60, 95% CI 2.65 to 4.55) and Pakistani (2.99, 95% CI 2.58 to 3.40) ethnicities compared with white ethnicities. Higher proportions of babies of Bangladeshi (42%), black African (39%), other black (39%) and black Caribbean (37%) ethnicities were from most deprived areas, which were associated with an additional risk of 1.50 stillbirths per 1000 births (95% CI 1.32 to 1.67). Exploring primary cause of death, higher stillbirth rates due to congenital anomalies were observed in babies of Pakistani, Bangladeshi and black African ethnicities (range 0.63–1.05 per 1000 births) and more placental causes in black ethnicities (range 1.97 to 2.24 per 1000 births). For the whole population, over 40% of stillbirths were of unknown cause; however, this was particularly high for babies of other Asian (60%), Bangladeshi (58%) and Indian (52%) ethnicities.

Conclusions Stillbirth rates declined in the UK, but substantial excess risk of stillbirth persists among babies of black and Asian ethnicities. The combined disadvantage for black, Pakistani and Bangladeshi ethnicities who are more likely to live in most deprived areas is associated with considerably higher rates. Key causes of death were congenital anomalies and placental causes. Improved strategies for investigation of stillbirth causes are needed to reduce unexplained deaths so that interventions can be targeted to reduce stillbirths.

INTRODUCTION

The worldwide COVID-19 pandemic has highlighted the unacceptable health inequalities experienced by individuals from different

Strengths and limitations of this study

- National data with complete ascertainment of all stillbirths over a 6-year period from 2014 to 2019.
- Inclusion of over 4 million births and over 16 000 stillbirths, which allows exploration of ethnicity with greater granularity.
- Information on cause of death allows further understanding of inequalities in stillbirth rates.
- Despite reporting adjusted estimates, we cannot rule out residual confounding by potentially important modifiable risk factors not measured for all births.
- Ethnicity from birth notifications is in principle self-defined, but in reality may sometimes be assigned by health professionals and therefore subject to misclassification.

ethnic groups, and the issue is receiving the global attention it has long deserved. In the UK, reports of ethnic inequalities in maternal mortality¹ have highlighted this issue and sparked the Fivexmore campaign to change black women's maternal health outcomes (<https://www.fivexmore.com>). Stillbirths are a major health burden with large disparity between and, importantly, within countries.^{2–4} Ethnic inequalities in stillbirth rates have been noted in a number of high-income countries including Australia,⁵ New Zealand,⁶ North America⁷ and Europe^{8,9} with rates often over double for migrant mothers or minority ethnic groups compared with those of white ethnicity. Recent national stillbirth data for the UK¹⁰ and England and Wales¹¹ similarly report stillbirth rates to be around twice as high in babies of black ethnicity and 60% higher in babies of Asian ethnicity compared with babies of white ethnicity.

Research into ethnic inequalities in stillbirth rates is limited, and little is known about differences in the causes of stillbirth between ethnic groups. Studies including stillbirth cause are lacking detailed information on

Table 1 Number of births (total, live births and stillbirths) and stillbirth rates per 1000 total births by sociodemographic characteristics for births in the UK: 2014–2019

		Total births	Live births	Stillbirths	Stillbirth rate (95% CI)
Year	2014	749 288	746 322	2966	3.96 (3.81 to 4.11)
	2015	754 545	751 732	2813	3.73 (3.59 to 3.87)
	2016	752 232	749 328	2904	3.86 (3.72 to 4.01)
	2017	733 283	730 623	2660	3.63 (3.49 to 3.77)
	2018	710 197	707 768	2429	3.42 (3.28 to 3.56)
	2019	692 024	689 783	2241	3.24 (3.10 to 3.38)
Baby's ethnicity	White	3 116 448	3 105 855	10 593	3.40 (3.33 to 3.47)
	Asian	426 050	423 640	2410	5.66 (5.42 to 5.90)
	Indian	124 065	123 449	616	4.97 (4.58 to 5.38)
	Pakistani	166 443	165 350	1093	6.57 (6.17 to 6.99)
	Bangladeshi	57 517	57 199	335	5.82 (5.21 to 6.51)
	Other Asian	78 025	77 642	366	4.69 (4.23 to 5.20)
	Black	185 861	184 452	1409	7.58 (7.19 to 7.99)
	Black Caribbean	31 780	31 544	236	7.43 (6.54 to 8.43)
	Black African	132 005	130 997	1008	7.64 (7.17 to 8.13)
	Black other	22 076	21 911	165	7.47 (6.42 to 8.70)
	Mixed	231 818	230 945	873	3.77 (3.52 to 4.03)
	Other	115 879	115 439	440	3.80 (3.45 to 4.17)
Country	England	3 765 551	3 751 863	13 688	3.64 (3.57 to 3.70)
	Wales	188 002	187 241	761	4.05 (3.75 to 4.36)
	Scotland	300 309	299 237	1072	3.57 (3.36 to 3.80)
	Northern Ireland	137 707	137 215	492	3.57 (3.26 to 3.91)
Deprivation	Least deprived quintile	882 217	879 838	2379	2.70 (2.58 to 2.81)
	Second quintile	872 282	869 595	2687	3.08 (2.96 to 3.21)
	Third quintile	873 814	870 669	3145	3.60 (3.47 to 3.73)
	Fourth quintile	877 204	873 630	3574	4.07 (3.94 to 4.22)
	Most deprived quintile	873 171	868 981	4190	4.80 (4.64 to 4.96)
Maternal age	<20 years	140 920	140 242	678	4.81 (4.46 to 5.19)
	20–24 years	644 229	641 519	2710	4.21 (4.05 to 4.37)
	25–29 years	1 205 330	1 201 156	4174	3.46 (3.35 to 3.58)
	30–34 years	1 360 207	1 355 712	4495	3.31 (3.20 to 3.41)
	35–39 years	761 204	758 207	2997	3.94 (3.79 to 4.09)
	40+ years	176 447	175 490	957	5.42 (5.09 to 5.79)

cause of death.^{7 11} Minority ethnic groups in the UK are typically more socioeconomically disadvantaged and likely to have poorer health outcomes than the white population^{11 12} and may have different age profiles because of migration patterns or cultural differences in timing of motherhood. It is therefore important to consider the impact these factors have on the association between ethnicity and stillbirth.^{13 14}

Stillbirth rates are higher in the UK than many other comparable high-income countries, and are decreasing more slowly.^{2 15} Despite targets set by the governments across the UK to reduce stillbirths by between 35% and 50%^{16–18} alongside a number of initiatives aimed at improving maternity services and care^{19–23} improvements remain gradual. A greater impact on stillbirth rates may

be achieved through better understanding of the multiple disadvantages that lead to higher risks of stillbirth^{2 24} and the differences in the causes of death between ethnicities, so that initiatives can be targeted towards those most in need and reduce evident inequalities in stillbirth rates. Here, we explore recent trends in UK stillbirth rates by ethnicity, the extent to which associations between ethnicity and stillbirth are mediated by socioeconomic deprivation and maternal age, and whether cause of death varies between ethnic groups.

METHODS

Data on all singleton live births and stillbirths from 24 weeks gestation to mothers resident in England, Wales,

Table 2 Adjusted disparities in rates of stillbirth for ethnic groups, deprivation quintile and maternal age for births in the UK: 2014–2019

	Base models	Multivariable model
	Rate difference (95% CI)	Rate difference (95% CI)
Baby's ethnicity		
White	0	0
Indian	1.66 (1.25 to 2.06)	1.71 (1.30 to 2.11)
Pakistani	3.26 (2.85 to 3.67)	2.99 (2.58 to 3.40)
Bangladeshi	2.51 (1.86 to 3.16)	2.18 (1.54 to 2.83)
Other Asian	1.41 (0.92 to 1.90)	1.27 (0.79 to 1.76)
Black Caribbean	4.14 (3.19 to 5.08)	3.60 (2.65 to 4.55)
Black African	4.32 (3.84 to 4.80)	3.83 (3.35 to 4.32)
Other black	4.18 (3.04 to 5.31)	3.76 (2.62 to 4.89)
Mixed	0.45 (0.19 to 0.71)	0.27 (0.02 to 0.53)
Other	0.45 (0.09 to 0.82)	0.25 (−0.10 to 0.60)
Deprivation		
Most deprived versus least deprived quintile	2.08 (1.91 to 2.24)	1.50 (1.32 to 1.67)
Age		
<20 years	1.47 (1.09 to 1.85)	1.41 (1.01 to 1.80)
20–24 years	0.88 (0.69 to 1.07)	0.78 (0.58 to 0.97)
25–29 years	0.15 (0.00 to 0.30)	0.05 (−0.09 to 0.19)
30–34 years	0	0
35–39 years	0.65 (0.47 to 0.82)	0.57 (0.40 to 0.75)
40+ years	2.12 (1.76 to 2.49)	1.88 (1.51 to 2.25)

*Separate models for ethnicity, deprivation and maternal age, each model adjusted for country of residence and year of birth.

†Multivariable model including ethnicity, deprivation and maternal age (also adjusted for country of residence and year of birth).

Scotland and Northern Ireland between 1 January 2014 and 31 December 2019 were obtained from the Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK (MBRRACE-UK) perinatal mortality surveillance programme¹⁰ linked to birth notification and registration data. In January 2013, the Healthcare Quality Improvement Partnership commissioned the MBRRACE-UK collaboration to collect UK perinatal mortality surveillance data. MBRRACE-UK links detailed information on all deaths reported by UK hospitals with data on all births from the Patient Demographic Service (formerly the NN4B birth notification system) and birth and death registration data from the Office for National Statistics for England and Wales, National Records Scotland and Information Services Division for Scotland and the Northern Ireland Maternity System for Northern Ireland. MBRRACE-UK use stillbirth registrations from statutory notifications to ensure complete ascertainment of stillbirths.

Information about the baby's ethnicity is obtained via linkage with birth notification data for all births. We

categorise baby's ethnicity as: white, Indian, Pakistani, Bangladeshi, other Asian, black Caribbean, black African and other black, mixed ethnicities, and other (including Chinese). Minor variations in ethnicity classification between the four UK countries prevented reporting rates for more specific ethnicity groupings for babies of mixed ethnicity at the UK level as well as for minority white ethnic groups. Where routine ethnicity data were missing for a stillborn baby, we used ethnicity as recorded in MBRRACE-UK surveillance data.

We used the Children in low-income families local measure²⁵ as an estimate of socioeconomic deprivation. This is an area based measure of the proportion of children living in families that are either in receipt of out-of-work benefits or in receipt of tax credits with a reported income that is less than 60% of the national median income. We allocated this to mother's postcode of residence at the time of birth through data linkage at the small area level. We ranked all areas in the UK by deprivation score, dividing them into five groups with approximately equal numbers of births in each quintile. Birth notification data were also used to provide information about maternal age, which was grouped into 5 year age bands (<20 years, 20–24, 25–29, 30–34, 35–39 and 40+ years).

Stillbirths were classified based on timing of death as intrapartum if the baby was known to be alive at the onset of the care episode which led to birth, and antepartum if the baby was not alive at onset of care or if the timing of death was unknown (n=559). Cause of death was classified by local MBRRACE-UK reporters at each hospital using the Cause of Death and Associated Conditions (CODAC) classification system²⁶ into the following first level categories: Infection, Intrapartum, Congenital Anomaly, Fetal, Cord Related, Placental Related, Maternal, or Unknown.

Statistical analysis

We calculated the observed stillbirth rate (per 1000 total births) by ethnicity, deprivation quintile, maternal age, country of residence at time of birth and year of birth. Binomial regression models with identity link were fitted to explore the absolute difference in stillbirth rates separately for ethnicity, deprivation quintile (fitted as a continuous variable after assessment of linearity) and maternal age, with variance adjusted for clustering within small area (lower super output area or data zone). These models were adjusted for country of residence (England, Scotland, Wales and Northern Ireland) to allow for differences in policy between the devolved nations that may influence stillbirth rates, and year of birth, to allow for differences in stillbirth rates over time. Multivariable models were then fitted including all factors to take into account confounding of maternal age and deprivation on estimates of ethnic differences in stillbirth rates. Interactions were fitted between ethnicity and deprivation quintile to explore whether the effect of deprivation varied by ethnicity. Trends in ethnic inequalities over time were explored by fitting interactions with year of birth.

Sensitivity analyses

Multivariable models reported here are on a complete case basis, but repeating analyses including individuals with missing data for covariates using an additional category for those with missing data did not materially affect the results. Causes of death were examined before and after exclusion of stillbirths where the primary cause of death was congenital anomalies, because of the association with access and choices surrounding termination of pregnancy for fetal anomaly.

The excess stillbirth rate associated with ethnicity was calculated by applying the stillbirth rate observed for babies of white ethnicity to the number of births for each other ethnic group and comparing this number to the observed number of stillbirths for that ethnic group.

All analyses were conducted in STATA/IC V.16.0.

Patient and public involvement

The ongoing MBRRACE-UK collaboration includes patient and public involvement (PPI) representatives and bereaved parents. The MBRRACE-UK collaboration has also established a third sector stakeholder group comprising representatives from all relevant national mother and baby charities. The PPI stakeholder group is consulted about the programme at an annual meeting held face to face in the past and remotely during the global pandemic. We consult them by email between the annual meetings.

RESULTS

Between January 2014 and December 2019, there were 4 391 569 singleton births at or above 24 weeks gestation to mothers resident in the UK, of which 16 013 ended in stillbirth (3.65 per 1000 total births, 95% CI 3.58 to 3.71). Of these, 14 633 were antepartum (3.33 per 1000, 95% CI 3.27 to 3.39) and 1380 intrapartum (0.31 per 1000, 95% CI 0.29 to 0.34). Information about ethnicity was available for 93% of all births and 98% of stillbirths; of the 4 076 056 births with information on ethnicity, 76% were classified as white, 10% Asian (including Indian, Pakistani, Bangladeshi and other Asian groups), 5% black (including black Caribbean, black African and other black groups), 6% mixed and 3% other ethnicities (see [table 1](#)).

[Table 1](#) shows the number and rate of stillbirths by ethnicity, socioeconomic deprivation, maternal age, year and country of residence. Stillbirth rates were substantially higher in babies of black (7.58 per 1000, 95% CI 7.19 to 7.99) and Asian (5.66 per 1000, 95% CI 5.42 to 5.90) ethnicities compared with babies of white (3.40 per 1000, 95% CI 3.33 to 3.47), mixed (3.77, 95% CI 3.52 to 4.03) and Chinese or other (3.80, 95% CI 3.45 to 4.17) ethnicities. Aggregating the Asian ethnicities masked higher stillbirth rates of 6.57 per 1000 (95% CI 6.17 to 6.99) for babies of Pakistani ethnicity and 5.82 per 1000 (95% CI 5.21 to 6.51) for babies of Bangladeshi ethnicity compared with babies of Indian ethnicity (4.97 per 1000, 95% CI 4.58 to 5.38). Stillbirth rates were universally high

for babies of black ethnicity, with rates of over 7 per 1000 births ([table 1](#)). Stillbirth rates increased with socioeconomic deprivation, from 2.70 per 1000 (95% CI 2.58 to 2.81) in the least deprived quintile, to 4.80 per 1000 (95% CI 4.64 to 4.96) in the most deprived quintile. Stillbirth rates were highest in the youngest (<20 years) and oldest (>40 years) mothers ([table 1](#)). There was an 18% decrease in stillbirth rates over 6 years ([table 1](#)).

Absolute differences in stillbirth rates between ethnicities, adjusted for year of birth and country of residence, before and after additional adjustment for deprivation and maternal age are shown in [table 2](#). The absolute difference in stillbirth rates was slightly attenuated after adjustment for deprivation and maternal age; here, we discuss the adjusted rates. Adjusted stillbirth rates were 3.6 per 1000 higher or more for babies of black ethnicities compared with babies of white ethnicity, equating to a doubling of risk ([table 2](#)). For babies of Asian ethnicity, the absolute rate difference compared with babies of white ethnicity was highest for babies of Pakistani, (2.99 per 1000, 95% CI 2.58 to 3.40) and Bangladeshi ethnicities (2.18 per 1000, 95% CI 1.54 to 2.83). This relates to a 61%–88% increased risk compared with babies of white ethnicity. For babies of Indian and other Asian ethnicities, the adjusted absolute differences were less, but still significantly higher than babies of white ethnicity ([table 2](#)). After adjustment, babies born to mothers living in the most deprived quintile had an increased absolute rate difference of 1.5 stillbirths per 1000 total births compared with the least deprived quintile (1.50, 95% CI 1.32 to 1.67).

[Figure 1](#) shows the proportion of total births (live and stillbirths) within each deprivation quintile for each ethnicity (for underlying numbers see online supplemental table S1). The colour of the bars depicts the stillbirth rate for babies within each ethnic group and deprivation quintile. This highlights that a much higher proportion of babies of Bangladeshi (41.7%), black African (39.2%), other black (38.8%) and black Caribbean (37.3%) ethnicities are born to mothers living in the most deprived quintile. It also highlights the increased stillbirth rates experienced by babies of black African, other black and black Caribbean ethnicities across deprivation quintile, and similarly for babies of Bangladeshi and Pakistani ethnicities. The combined impact of living in the most deprived quintile for a baby of black African ethnicity leads to an increase in stillbirth rate of 5.70 per 1000 (95% CI 5.20 to 6.21) compared with babies of white ethnicity born to mothers living in the least deprived quintile. Despite the far higher proportion of babies of Bangladeshi, black African, other black and black Caribbean ethnicities living in most deprived areas, ethnic inequalities were similar across socioeconomic deprivation quintiles (p-value for interaction=0.31). There was no evidence of ethnic inequalities in stillbirth rates changing significantly between 2014 and 2019, shown by a non-significant interaction between ethnicity and year in the adjusted model (p=0.22).

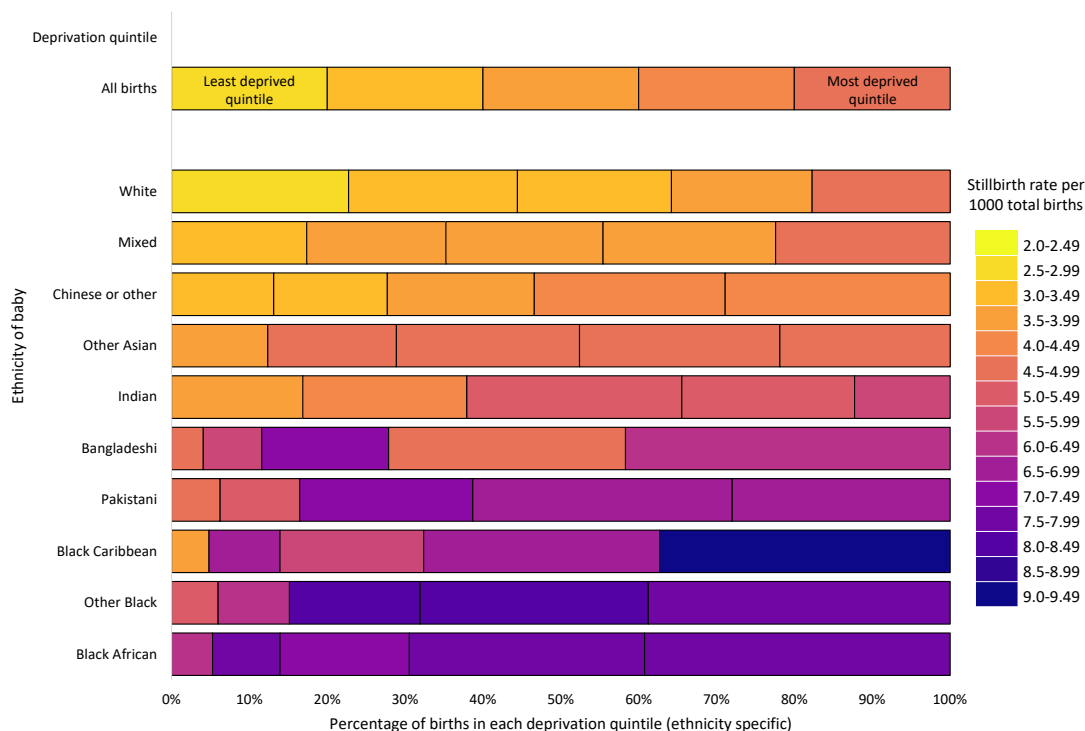


Figure 1 Stillbirth rates by ethnicity and deprivation quintile, with bar sizes reflecting the percentage of babies for each ethnicity born in each deprivation quintile, and colours showing the stillbirth rate within these groups.

By applying the rate of stillbirth for babies of white ethnicity to all other ethnic groups, we estimated that 1869 stillbirths could potentially have been prevented over the 6 years from 2014 to 2019 if ethnic inequalities did not exist, a 12% reduction in stillbirths. The largest reduction in the number of stillbirths would be in the Pakistani (527 stillbirths) and black African (559 stillbirths) groups.

Figure 2 shows the cause of stillbirth by baby's ethnicity. Stillbirth rates for most causes showed similar patterns to overall differences by ethnicity (figure 2). Stillbirth rates with no known cause were much higher in babies of black African (2.99 per 1000, 95% CI 2.30 to 3.49) than babies of white ethnicity (1.29 per 1000, 95% CI 1.25 to 1.33), but also higher in babies of Asian ethnicities (ranging

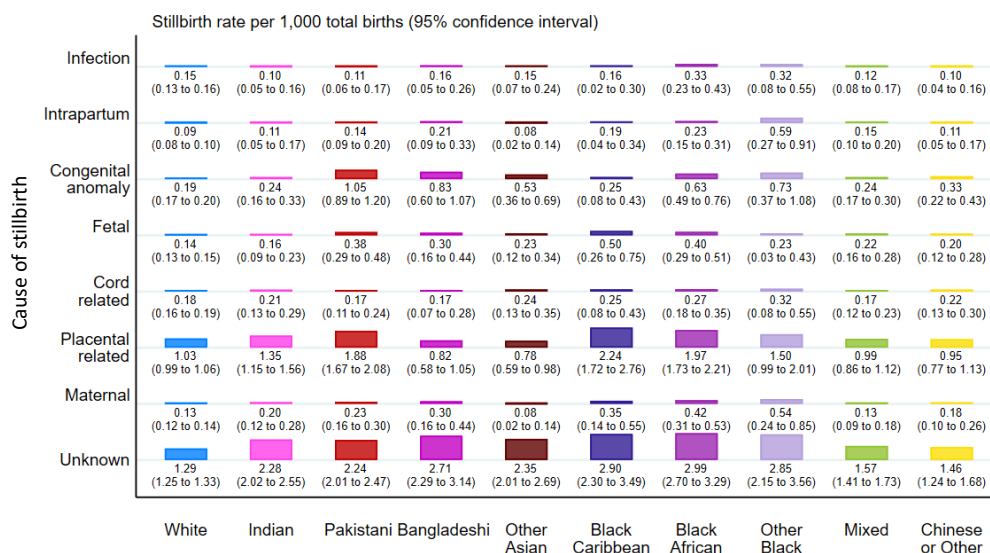


Figure 2 Cause of death for stillbirths (rate per 1000 total births) by baby's ethnicity for births in the UK: 2014–2019.

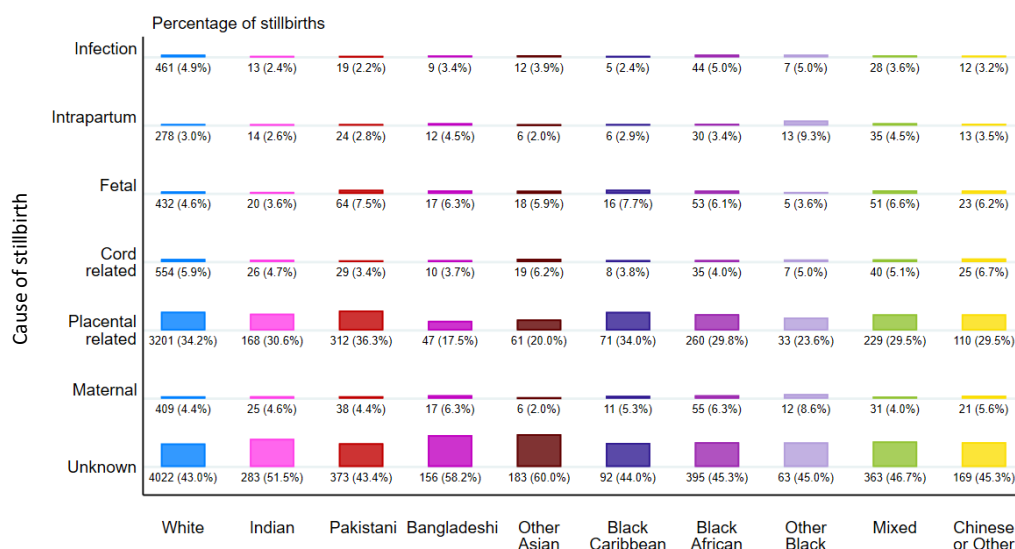


Figure 3 Cause of death for stillbirths as a percent of stillbirths (excluding those caused by congenital anomalies) by baby's ethnicity for births in the UK: 2014–2019.

from 2.24 per 1000 to 2.56 per 1000). Stillbirth rates (per 1000 total births) where the primary cause was a congenital anomaly were substantially higher for babies of Pakistani, Bangladeshi, black African and other black ethnicities. Rates of congenital anomalies for babies of Indian ethnicity (0.24 per 1000, 95% CI 0.16 to 0.33) were similar to babies of white ethnicity. Babies of black ethnicities had around double the rate of stillbirths associated with placental causes compared with babies of white ethnicity (figure 2).

Since the percentage of stillbirths due to congenital anomalies is likely to be influenced by both access and choices around prenatal screening and termination of pregnancy, we reviewed the percentage of deaths attributed to each cause excluding congenital anomalies (figure 3). In total, over 40% of stillbirths were recorded as unknown cause. The proportion of stillbirths of unknown cause was higher in babies of Bangladeshi (58.2%), Indian (51.5%) and other Asian (60.0%) ethnicities compared with all other ethnicities, where the proportion recorded as unknown cause was 43% to 47%. Conversely, a lower proportion of deaths attributed to placental causes was observed for these groups (figure 3).

DISCUSSION

Stillbirth rates for singleton births in the UK have decreased by 18% between 2014 and 2019, but ethnic inequalities persist. Crude stillbirth rates are highest in babies of black African, black Caribbean and Pakistani ethnicities and adjusting for deprivation and maternal age only marginally attenuated this increased risk. The increased risks associated with deprivation were consistent for all ethnic groups. However, higher proportions

of babies of black Caribbean, black African, Bangladeshi and Pakistani ethnicities were born to mothers living in the most deprived areas placing them at additional risk. Rates of stillbirth attributed to unknown causes were high, with particularly high rates for babies of black ethnicities, and accounted for high proportions of stillbirths for babies of Asian ethnicities. Key causes of stillbirth were placental-related causes and congenital anomalies, which had higher rates in babies of black ethnicities.

A major strength of our study is the use of high-quality population surveillance data for mortality over a 6-year period, with complete ascertainment of stillbirths from 24 weeks gestation including termination of pregnancies. This ensures generalisability to the UK population as well as providing detailed information on cause of death and facilitating exclusion of termination of pregnancies from stillbirth estimates. Few high-income countries have similar active national programme of stillbirth surveillance.⁶ Our large sample size allowed exploration of ethnicity with more granularity as recommended by Khunti *et al*²⁷ to avoid combining groups with different cultural, religious, social and economic experiences. This highlighted differences in stillbirth rates between babies of Indian, Pakistani and Bangladeshi ethnicities not seen in previous studies^{28 29} which looked at aggregated data. However, surveillance data have limitations associated with routine data. Routine ethnicity classification is in principle self-defined, but in reality may be assigned by the health professional completing the notification³⁰ with potential for misclassification. Misclassification has been found to be a particular issue for more granular mixed and other ethnic groups³¹; here, we report on granular Asian and black ethnic groups where misclassification is

less of a problem, and aggregated mixed or other ethnic groups.

Measurement of deprivation is limited to area level data on income deprivation. In addition, there is a lack of information in the birth notification data regarding mother's country of birth, gravidity and previous stillbirths as well as other potentially modifiable risk factors such as antenatal attendance and smoking during pregnancy. Therefore, residual confounding cannot be ruled out. MBRRACE-UK are currently undertaking a confidential enquiry to review the quality of care provision for black mothers who experience a stillbirth or neonatal death which will facilitate greater understanding than can be attained through routine data surveillance alone.

Our finding of increased stillbirth rates in babies of black and Asian ethnicities is consistent with other UK^{28 29 32} and international studies⁷ but few studies have explored differences in cause of death by ethnicity, and recent Office for National Statistics (ONS) estimates for England and Wales give infant mortality rates by ethnicity and limited cause of death, but not for stillbirth.¹¹ Our finding of inequalities in stillbirth rates caused by congenital anomalies could be influenced by access and choices surrounding termination of pregnancies, with Pakistani mothers in particular less likely to choose to terminate their pregnancy when an anomaly is identified, while termination rates are also lower in more deprived areas.³³ There may be differences in provision and/or uptake of antenatal screening for Pakistani women,³⁴ a population where consanguinity is also more prevalent.³⁵

Further emphasis on the need for collecting detailed information on cause of death in national surveillance programmes will aid our understanding of the high rates of stillbirth experienced by babies of black and Asian ethnicities and improve our ability to monitor and reduce stillbirth inequalities.³⁶ Efforts to increase uptake of post mortem³⁷ and other investigations after stillbirth could reduce the high numbers of stillbirths of unknown cause seen in our study and in other high-income countries.³⁶ The International Stillbirth Alliance is in the process of developing and evaluating a hybrid classification system building on the strengths of existing classification systems³⁸ such as CODAC and incorporating the principles of the WHO International Statistical Classification of Diseases and Related Health Problems application to deaths during the perinatal period (ICD-PM) classification. This should address the limitations of current classification systems such as the lack of sufficient detail on placental pathology resulting in large proportions of unexplained stillbirth.³⁹ These strategies will facilitate the design of services to address the specific needs of the populations they serve and reduce unacceptable ethnic inequalities.

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Contributors The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. JJK is the Principal Investigator holding the grant to deliver the Maternal, Newborn and Infant Clinical Outcome Review programme by the MBRRACE-UK collaboration. ESD leads the perinatal arm of the MBRRACE-UK programme. ESD, ACF, BM and LKS are members of the MBRRACE-UK collaboration. Contributions are as follows: funding: ESD, JJK, BM, LKS; supervision: ESD, BM LKS; conceptualisation and study design: JD-B, ESD, JJK, BM, RJM, LKS; data curation: IG, BM, RJM; methodology: BM, RJM, LKS; statistical analysis, visualisation and original draft: RJM, LKS. All authors were involved with reviewing, critically appraising and editing the manuscript. All authors have approved the final version. RJM is guarantor.

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