The Impact of Wider Determinant Factors on Birth Outcomes in Birmingham and Solihull

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Infant health in Birmingham and Solihull

Birmingham and Solihull (BSol) face significant challenges related to pregnancy outcomes. Rates for infant mortality and low birth weight are higher in BSol than the national average. The infant mortality rate in BSol during 2020-2022 was 7.0 per 1000 live births compared to the England average of 4.0 per 1000 live births [1]. Similarly, BSol suffers above-average rates of low birth weight and premature births with significant inequality in these outcomes [1].

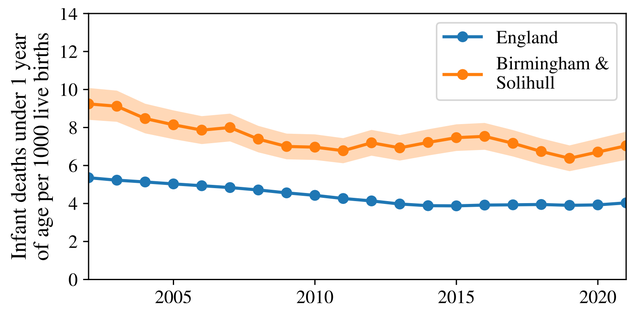

Figure 1. Infant deaths under 1 year of age per 1000 live births in Birmingham and Solihull and England for three-year intervals [1].

As shown in Fig. 1, the infant mortality rate has fallen over the last 20 years in BSol and across England. However, the BSol rate remains 74% higher than the national average.

Methods

We use pseudonymised data provided by the Birmingham and Solihull United Maternity and Newborn Partnership (BUMP) via BadgerNet. This data includes all births from four maternity units: Birmingham Women's and Children's Hospital, Good Hope Maternity Unit, Heartlands Maternity, and Solihull Maternity Unit from October 2020 to March 2023 with a total of 41,231 births. After removing Non registerable births, multiple births beyond twins, and eliminating cases with unknown Index of Multiple Deprivation (IMD), 39,973 (96.9%) unique births were remaining in the dataset.

We investigated the occurrence of two intermediate outcomes: premature birth and low birth weight (LBW), and two final outcomes: stillbirth and neonatal death. For brevity, only the results for intermediate outcomes will be presented here. A full analysis will be provided in our forthcoming paper [2].

First, we calculated the unadjusted attributable fraction of LBW and premature births attributed to the mother's ethnicity and IMD. We did not calculate the attributable fraction for stillbirth due to the small number of outcomes. Subsequently, we conducted a logistic regression analysis on all three outcomes to examine the relative risk associated with a comprehensive set of determinants of health, considering variables beyond ethnicity and IMD. This allowed us to explore the multifaceted relationships between various factors and birth outcomes while adjusting for confounding variables.

BUMP/BadgerNet Data

BadgerNet is a maternity patient administration system currently used at Birmingham Women's & Children's Hospital and University Hospital Birmingham. It provides intelligent solutions to clinicians, families and all those who care and support them through pregnancy, neonatal and paediatric care.

All information entered for patients is viewable, allowing for improved data quality and ease of entry while still participating in networked-based care across a region. The data is extracted from the data tables which are held locally within our data warehouses across two providers [3].

Population Analysis

52% of the women were White ethnicity, of which 77% were "White British". The second largest group were Asian ethnicity women who had around 33% of all births in the data, of which 63% were Pakistani. The third largest ethnicity cohort was White-Other (6%) followed by Indian and Black African (both 5%).

54.5% of the women lived in one of the 20% of the most deprived areas of England. However, as shown in Fig. 2, this deprivation is not experienced equally across different ethnic groups. The White ethnicity cohort was the least likely to live in the most deprived areas, with 42.8% of White ethnicity women living in the most deprived areas. Meanwhile, Black ethnicity women were the most likely with 72.5% living in the most deprived areas. Asian and Middle Eastern ethnicity women had similar rates with 66.8% and 68.5% respectively living in the most deprived areas. For women of Mixed or Other ethnic origin, 58.6% and 59.5% respectively lived in the most deprived areas.

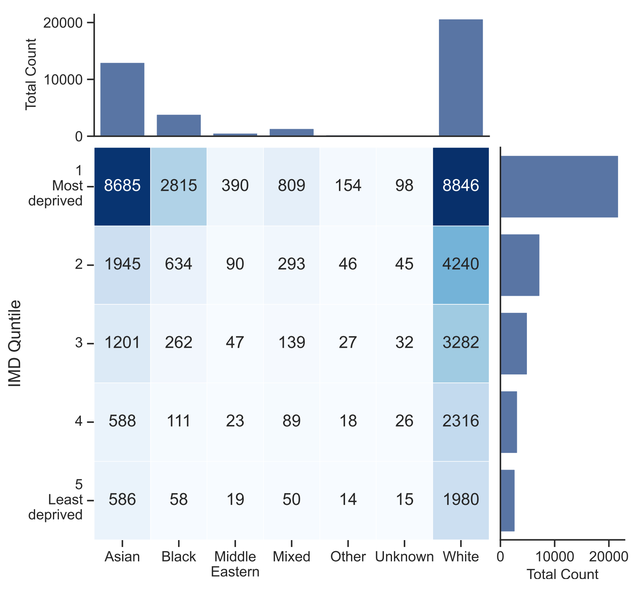

Figure 2. Distribution of Birmingham and Solihull mothers across ethnicity and IMD.

The average age of all mothers was 30. Teenage mothers (12-17 years) accounted for 259 ($0.65 \pm 0.08\%$) of live births. This is consistent with the national average [1]. Again, this percentage was significantly higher in the most deprived quintile ($0.88 \pm 0.12\%$) than in the least deprived quintile ($0.07 \pm 0.09\%$).

In total, $8.1 \pm 0.3\%$ of mothers were smoking at the time of delivery. However, there were significant differences across ethnicity and deprivation levels. Almost five times as many mothers in the most deprived quintile were smoking at delivery than the least deprived quintile ($10.3 \pm 0.4\%$ compared to $2.1 \pm 0.5\%$). Additionally, White ethnicity mothers and those of a Mixed ethnic background were significantly more likely to smoke at $13.1 \pm 0.3\%$ and $12.1 \pm 1.6\%$ respectively.

Overall, $78.7 \pm 0.4\%$ of mothers initiated breastfeeding. This went down to $76.5 \pm 0.5\%$ in the most deprived quintile compared to $84.9 \pm 1.4\%$ in the least deprived areas. Those with an unknown ethnicity were the least likely to breastfeed at initiation at $62.5 \pm 6.5\%$ followed by White ethnicity mothers at 72.6 ± 0.6. Mothers with a Middle Eastern, Black or Other ethnic background were the most likely to breastfeed at $91.6 \pm 2.2\%$, $89.7 \pm 0.6\%$ and $92.3 \pm 3.3\%$ respectively.

A further breakdown of the risk factors across IMD and ethnicity will be provided in our forthcoming paper [2].

Results

We calculated the unadjusted percentage of low-weight and premature births attributable to the mother's ethnicity and index of deprivation, i.e. how many fewer negative outcomes would have occurred if the mothers had the same level of risk as White mothers in the least deprived area (IMD quintile 3+).

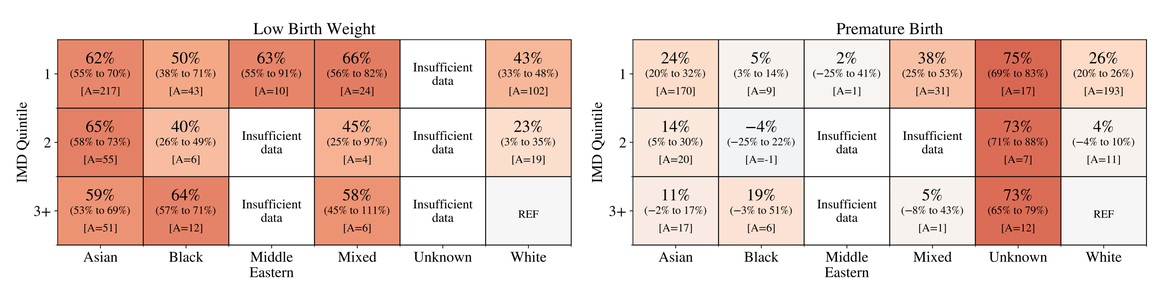

Figure 3. Percentage of low birth weight (Top) and premature births (Bottom) across ethnicity and IMD that would not have occurred if the mother had the same level of risk as White ethnicity mothers in the least deprived area (IMD quintile 3+). A is the number of outcomes in the data set that would have been avoided. 95% CI calculated using bootstrapping. Code for calculating and plotting attributable fraction available on GitHub: EquiPy.

Fig. 3 shows that almost all groups, for which we have sufficient data, experienced a higher rate of premature and low weight birth than the reference group. Furthermore, IMD also played a significant role for the White, Asian, and Mixed ethnicity cohorts. Overall, we estimate that in this period, 494 (16.7%) premature births and 549 (47.6%) LBWs would not have occurred in the absence of ethnic and socioeconomic inequalities. This would equate to 191 fewer premature births and 212 fewer LBWs each year in BSol.

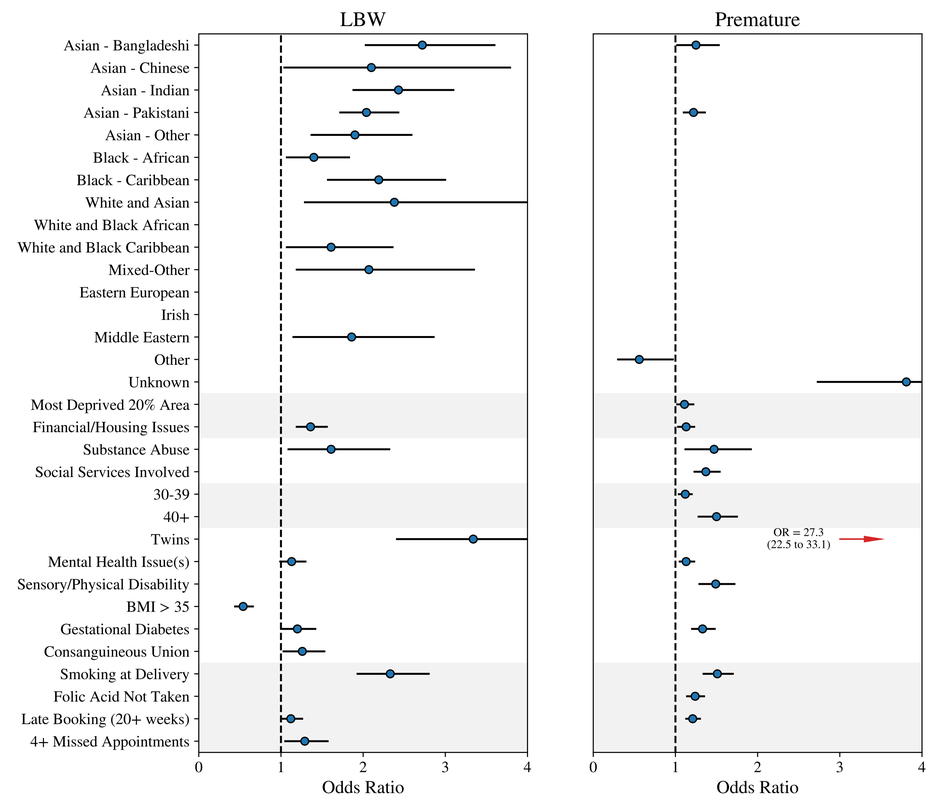

Figure 4. Odds ratios for i) low birth weight (LBW), ii) premature birth and iii) stillbirth compared to the reference group (White mothers living in an area with IMD of 3 or more without known risk factors). The reference group is indicated by the dashed line. All presented values have $p \leq 0.1$, indicating a probability greater than 90% that the difference is not due to random chance.

The contributions of each characteristic to the odd of premature birth and LBW are shown in Fig. 4. We see that most global majority ethnicities had a significantly increased risk of LBW compared to White ethnicity mothers, while fewer groups were found to have significantly higher rates of premature. Mothers with an unknown ethnicity had, by far, the greatest risk. Additionally, those living in the most deprived areas experienced higher rates of all three outcomes, while those with financial/housing problems had higher rates of LBW and premature birth.

Having twins was the most significant of all investigated risk factors for LBW and premature birth. We also found that substance abuse, mental health issues, gestational diabetes, and late antenatal booking were also associated with increased odds of both LBW and premature birth. Meanwhile, smoking at delivery was the most significant behavioural risk factor for both outcomes.

Conclusions

Mothers from the global majority also experienced significantly higher rates of LBW. Mothers with an unknown ethnicity had almost four times the odds of premature birth. The missing data may reflect a lack of engagement with healthcare services. A range of other socioeconomic factors were found to significantly increase the odds of both outcomes.

While multiple pregnancy was the single biggest risk factor for LBW and premature birth, there were many other social and care factors found to significantly increase a mother's risk. These findings highlight the need for targeted interventions to support populations at higher risk and further research to understand the factors behind the elevated risks.

References

[1] Office for Health Improvement and Disparities. Public health profiles. 2023. `https://fingertips.phe.org.uk`, 2023. © Crown copyright 2023. Accessed: 2023-04-20.

[2] David Ellis et. al. Wider Determinants of Maternity Outcomes in Birmingham & Solihull. in preparation.

[3] UHB and BWC BadgeNet Maternity PAS Systems extracted by Ranjana Basra, 2023.

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