The Impact of Ethnicity and Migration on Pregnancy and Birth Outcomes: A Secondary Analysis of the Born in Bradford Cohort.

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Abstract

International evidence suggests differences in perinatal outcomes between migrant women and their native-born peers, however the intergeneration impact of family migration and interplay with maternal ethnicity remains unclear. The study investigates the relationships between maternal ethnicity, migration status and perinatal outcomes using secondary analysis of data obtained by an established birth cohort study in the North of England using regression models.

Pakistani migrants had higher odds of low birthweight and lower odds of macrosomia compared to white British natives. Pakistani migrants of all generations had higher odds of gestational diabetes, with odds among first-generation migrants almost double that of second-generation migrants. First-generation Pakistani migrants also had lower odds of preterm birth and APGAR score<7 at 1 minute in comparison with other groups.

Lower incidence of premature birth in first generation migrant Pakistani women is of importance. Higher odds of low birthweight and lower odds of macrosomia among Pakistani migrants compared to White British women, merits further investigation. It is noteworthy that this is despite higher odds of gestational diabetes overall in this population and generational differences in among Pakistani migrants requiring further attention, with a full consideration of confounding environmental and biological factors, with a view to addressing identified inequalities.

Key words: Perinatal; Pregnancy; Ethnicity; Migration; Born in Bradford;

Introduction

The World Health Organisation (WHO) in it's 2018 report on the health of refugees and migrants in the WHO European Region highlights significant differences in pregnancy-related indicators among refugees and migrants

compared to native populations[1]. While the nature and magnitude of these differences varies between host countries, a WHO review found that refugee and migrant women were at increased risk of adverse events including induced and spontaneous abortions, caesarean sections, birth complications and instrumental deliveries across the WHO European Region[2]. Further country specific evidence has shown specific examples of adverse outcomes, including a 18 fold increased risk of neonatal death among African refugee and migrant mothers in Sweden[3] and increased risk of preterm birth in Italy[4] and Portugal[5]. While these studies provide important context, the majority are of a significant age (10-15 years), meaning that the need for updated evidence in this field is of paramount importance.

In the UK, analysis of health outcomes related to migration is often based on self-reported ethnicity due to a lack of data relating to migration in health datasets. According to mortality rates in the 2011 census, a slight advantage in terms of life expectancy at birth among first generation migrants was observed,[6] however further research has highlighted that ethnic minority groups have lower disability free life expectancy compared to the white British population.[7] Improving recording of ethnicity and migration history in health records is of paramount importance in studying the patterns of health and disease in these populations.[8]

Bradford is an ethnically diverse and relatively economically deprived city in the north of England. The population of the city was influenced by large numbers of Pakistani migrants arriving in the 1950's, having been actively recruited to take up employment in the city's wool mills. Most migrants initially were working aged men; subsequently family reconstitution migration has meant that Bradford is now home to a three-generational population of Pakistani origin.[9]

It has been established that an association exists between perinatal outcomes and maternal ethnicity; women of South Asian origin have been found to be more at risk of delivering babies who are of a low birthweight and less at risk of macrosomia, despite higher prevalence of gestational diabetes. It is also important to consider that the concept of ethnicity is a social construct that

attempts to convey a sense of shared cultural characteristics which may include elements such as language, religion, dietary practices, norms and customs, in addition to shared nationality or family heritage. While the use of ethnic groupings is useful in identifying and addressing inequalities, it does not account for variation in environment and experience within an ethnic group[10]. The relationship between maternal ethnicity and migration status is less clear in the existing literature. A narrative review of available evidence relating to perinatal outcomes in migrant women highlighted the need for research that attempts to explore the interplay between ethnicity and migration to examine whether migration status influences the established additional risks associated with ethnicity.[11]

Given the international importance of improving maternity outcomes and reducing inequalities, as highlighted as a key component of achieving the United Nations Sustainable Development Goals[12], it is imperative that factors contributing to adverse perinatal events are identified and contextualised to inform preventative strategies. While international evidence of poorer outcome for refugee and migrant women exists, this tends to focus on recent and/or forced migration, and therefore does not account for intergenerational influences, nor does it assess whether belonging to a largely settled and established migrant community impacts outcomes.

The Born in Bradford cohort offers a unique opportunity to examine these factors, having collected data relating to the personal and family history of migration of all participants. Assessing pregnancy and birth outcomes, particularly with the inclusion of more objective variables such as migration status, length of stay in the host country (or length of migration) and country of origin, in addition to self-reported ethnicity, could provide substantive information on health inequalities and the extent to which these may change over time The objectives of this study are therefore to:

- Investigate the impact of maternal migration status on perinatal outcomes
- Explore the influence of family migration history on differences in perinatal outcomes
- Assess the extent to which self-reported ethnic group contributes to differences in perinatal outcomes

Methods

Born in Bradford cohort

Born in Bradford (BiB) is a prospective cohort study that recruited participants during pregnancy. The cohort was established in the Northern English city of Bradford in response to the observation of very high rates of infant mortality in the city. Women were invited to participate in the study when attending a universally offered oral glucose tolerance test appointment at 26–28 weeks' gestation or when attending other antenatal appointments. Informed consent was obtained, and women were asked to complete a baseline questionnaire providing data on maternal characteristics, including their personal and family migration background. Recruitment took place between March 2007 and December 2010, and over 80% of women eligible in this period agreed to take part, which represents approximately 64% of the births occurring in Bradford during this period. Data from the baseline questionnaire has been linked with routine maternity data which enables the examination of perinatal outcomes by maternal characteristics. Details of the cohort profile are published elsewhere.[13]

Outcome variables

The neonatal outcome variables studied were low birthweight (below 2500 g), macrosomia (birth weight over 4000 g), preterm birth (<37 completed weeks gestation), outcome of birth (live birth or stillbirth) and Apgar score at 1 min and 5 min (analysed as two groups: <7 and 7–10). Low birthweight and macrosomic

infants were compared with infants born weighing 2500–4000 g, and those born preterm to those born ≥37 completed weeks' gestation. Birthweight and gestational age at delivery were also considered as continuous variables. Maternal outcome variables studied were diagnosis of pre-eclampsia (diagnosis in this cohort was made when proteinuria is >0.3 mg and blood pressure is ≥140/90mmHg on more than one occasion), diagnosis of gestational diabetes (defined as a 2-hour post-glucose load plasma glucose level of 7.8 mmol/L or a fasting plasma glucose level of 6.1 mmol/L),[14] and mode of birth (vaginal or caesarean section). Distinction between elective and emergency caesarean sections was not available. The outcome variables were collected in the process of routine maternity care and were made available for this analysis via data linkage to questionnaire data.

Migration status

Migration status groups were calculated using questionnaire responses to questions about the mother's own country of birth and that of her parents and grandparents. First generation migrants are therefore those women who were themselves born outside of the UK; second generation migrants those women who were themselves born in the UK but have at least one parent who was born abroad. Due to small numbers, those with a higher order migrant background (i.e. grandparents born abroad) were combined with second-generation migrants. To account for the impact of ethnicity in differences between groups, each migrant group was stratified based on self-reported ethnicity, White British, Pakistani or Other Ethnicity. While it is acknowledged that 'Pakistani' may not commonly be regarded as an ethnicity, rather a nationality, and 'White British' an ethnic group and nationality combined, these categorisations were self-reported by the individuals participating in the study when asked to define their ethnic group. These groupings therefore reflect the source data and are analysed with the complexities of defining a socially constructed concept such as ethnicity in mind.

Statistical analysis

Characteristics of the sample and perinatal outcomes in all other groups were

compared with those for white British native women who were considered as the reference group. Characteristics of the sample were described, presenting categorical variables as percentages and continuous variables as means and standard deviations (SD). Differences between groups were explored using $\chi 2$ for categorical data and Student's t-test for continuous data.

Logistic regression analyses were used to compare the rate of each of the binary outcome variables by migration status, with white British women considered as the reference group and differences between groups estimated using odds ratios (ORs). The adjusted regression model included maternal characteristics which may influence the outcome variables. These were informed by the literature and refined by the assessment of multicollinearity. Index of multiple deprivation (IMD) score, maternal age, and parity were therefore included as covariates in the adjusted analysis. Crude and adjusted ORs (OR and aOR) are therefore presented with 95% confidence intervals (CI). IMD is the official measure of relative deprivation for small areas in England and combines information from seven domains of deprivation (income, employment, education, health, crime, housing and environment) to give a deprivation score. IMD score is therefore assigned to participants based on their self-reported home address.

In the multivariate logistic regression model for this study, there is no clear logical or theoretical basis for assuming any variable to be prior to any other, either in terms of its relevance to the research goal of explaining phenomena or in terms of a hypothetical causal structure of the data. For this reason, a simultaneous model of including independent variables in the multivariate logistic regression model was most appropriate.

Where significant associations between first generation migrant status and outcome variables were observed, multiple linear regression was employed to explore the extent to which maternal length of stay in the UK was associated with changes in outcomes. Statistical analysis was undertaken using SPSS V.24.

Results

Characteristics of the sample

For descriptive analysis, differences between groups were explored using $\chi 2$ for categorical data and Student's t-test for continuous data. There were a significantly higher proportion of adolescent mothers in all native groups compared to migrant groups, except for second-generation white migrants (majority Irish immigrants). Approximately, 23.5 % of first-generation Pakistani migrants had parity of three or more compared to 17.1% among second generation Pakistani migrants and 7.2% of white British natives. Migrant women of both Pakistani and other ethnicities were significantly more likely to be married compared to native women in the same ethnic groups. Both mothers and fathers in migrant groups were more likely to have educational qualifications equivalent to A level or higher; first generation Pakistani migrants were twice as likely than any other group to have never been employed and the highest levels of unemployment among fathers were in the native Pakistani men and native men of other ethnicities. Characteristics of the sample are shown in Table 1.

Exploratory analysis of differences in perinatal outcomes between migrant groups is shown in Table 2. The results suggest a higher prevalence of gestational diabetes among migrant groups with the highest rate being among first generation Pakistani migrants. There was also a higher incidence of low birthweight and a lower rate of macrosomia among these groups. The rate of low birthweight was highest among second-generation migrants of Pakistani or other ethnicities.

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Table 1 Characteristics of the sample

Self-reported questionnaire responses			Native			First generation migrants		Second or third generation migrants				
			White British	Pakistani	Other Ethnicity	Pakistani	Other Ethnicity	White British	Pakistani	Other Ethnicity	Total	p=
Language used to administer questionnaire	English	n	4238	10	130	1098	1007	2130	175	482	9270	<0.001
		%	99.7%	100.0%	97.7%	36.7%	89.8%	97.9%	100.0%	99.6%	81.8%	
	Mirpuri/Punjabi	n	1	0	0	511	33	8	0	0	553	
		%	0.0%	0.0%	0.0%	17.1%	2.9%	0.4%	0.0%	0.0%	4.9%	
	Other	n	0	0	0	1	8	0	0	0	9	
		%	0.0%	0.0%	0.0%	0.0%	0.7%	0.0%	0.0%	0.0%	0.1%	
	Urdu	n	0	0	1	1367	72	30	0	1	1471	
		%	0.0%	0.0%	0.8%	45.7%	6.4%	1.4%	0.0%	0.2%	13.0%	
Mother's age at delivery grouped	<20	n	475	3	37	44	33	80	26	22	720	<0.001
		%	11.2%	30.0%	27.8%	1.5%	2.9%	3.7%	14.9%	4.5%	6.4%	
	20-34	n	3230	7	93	2548	937	1857	118	388	9178	
		%	76.0%	70.0%	69.9%	85.2%	83.5%	85.3%	67.4%	80.2%	80.9%	
	35+	n	544	0	3	397	152	239	31	74	1440	
		%	12.8%	0.0%	2.3%	13.3%	13.5%	11.0%	17.7%	15.3%	12.7%	
Marital Status	Married and living with partner	n	1349	4	18	2860	862	1944	60	374	7471	<0.001
		%	31.7%	40.0%	13.5%	95.7%	76.8%	89.3%	34.3%	77.3%	65.9%	
	Not living with partner	n	1212	2	85	121	107	211	42	69	1849	
		%	28.5%	20.0%	63.9%	4.0%	9.5%	9.7%	24.0%	14.3%	16.3%	
	Not married and living with partner	n	1680	4	30	3	150	16	73	40	1996	
		%	39.5%	40.0%	22.6%	0.1%	13.4%	0.7%	41.7%	8.3%	17.6%	
Parity	0	n	1926	4	76	799	488	776	89	207	4365	<0.001
		%	48.2%	44.4%	61.3%	28.3%	47.8%	38.1%	54.3%	46.0%	41.1%	
	1	n	1262	4	26	753	309	529	40	135	3058	
		%	31.6%	44.4%	21.0%	26.7%	30.3%	25.9%	24.4%	30.0%	28.8%	
	2	n	525	1	12	608	148	385	20	60	1759	

		%	13.1%	11.1%	9.7%	21.5%	14.5%	18.9%	12.2%	13.3%	16.5%	
	3+	n	286	0	10	664	76	349	15	48	1448	
		%	7.2%	0.0%	8.1%	23.5%	7.4%	17.1%	9.1%	10.7%	13.6%	
Mother's highest qualifications	<5 GCSE's* or equivalent	n	851	4	37	988	152	344	34	37	2447	<0.001
		%	20.0%	40.0%	27.8%	33.2%	13.6%	15.8%	19.4%	7.7%	21.6%	
	5 GCSE's* or equivalent	n	1471	4	57	891	170	717	50	124	3484	
		%	34.6%	40.0%	42.9%	29.9%	15.2%	33.0%	28.6%	25.7%	30.8%	
	A-level** or higher	n	1518	2	30	1008	632	978	72	276	4516	
		%	35.8%	20.0%	22.6%	33.8%	56.6%	45.0%	41.1%	57.3%	39.9%	
	Other/unknown	n	406	0	9	91	162	135	19	45	867	
		%	9.6%	0.0%	6.8%	3.1%	14.5%	6.2%	10.9%	9.3%	7.7%	
Father's highest qualifications	<5 GCSE's or equivalent	n	737	3	28	469	126	295	26	58	1742	<0.001
		%	17.4%	30.0%	21.1%	15.7%	11.3%	13.6%	14.9%	12.0%	15.4%	
	5 GCSE's or equivalent	n	1123	3	27	697	136	608	36	85	2715	
		%	26.4%	30.0%	20.3%	23.4%	12.2%	28.1%	20.6%	17.6%	24.0%	
	A-level or higher	n	1131	2	24	1132	601	830	56	229	4005	
		%	26.6%	20.0%	18.0%	38.0%	54.0%	38.3%	32.0%	47.4%	35.4%	
	Other/unknown	n	1255	2	54	683	249	433	57	111	2844	
		%	29.6%	20.0%	40.6%	22.9%	22.4%	20.0%	32.6%	23.0%	25.2%	
Mother's employment	Currently employed	n	2704	3	57	340	590	871	107	304	4976	<0.001
		%	63.6%	30.0%	42.9%	11.4%	52.6%	40.0%	61.1%	62.8%	43.9%	
	Never employed	n	369	3	24	1992	257	399	19	46	3109	
		%	8.7%	30.0%	18.0%	66.6%	22.9%	18.3%	10.9%	9.5%	27.4%	
	Previously employed	n	1174	4	52	649	272	904	49	133	3237	
		%	27.6%	40.0%	39.1%	21.7%	24.2%	41.5%	28.0%	27.5%	28.6%	
Father's employment	Unemployed	n	483	3	30	258	163	181	21	36	1175	<0.001
		%	12.1%	33.3%	25.9%	9.0%	14.9%	8.6%	12.5%	7.6%	10.8%	
	Employee	n	3116	4	76	2077	799	1469	129	362	8032	
		%	77.7%	44.4%	65.5%	72.2%	73.1%	70.0%	76.8%	76.7%	74.1%	
	Self-employed	n	409	2	10	542	131	449	18	74	1635	
		%	10.2%	22.2%	8.6%	18.8%	12.0%	21.4%	10.7%	15.7%	15.1%	

* General Certificate of Secondary Education, typically awarded at age 16
** Advanced Level qualifications, typically awarded at age 18

Table 2. Descriptive analysis of differences in perinatal outcomes by migration status

Migration Status		Native			First generation migrants		Second or third generation migrants				
Self- Reported Ethnicity		White British	Pakistani	Other Ethnicity	Pakistani	Other Ethnicity	White British	Pakistani	Other Ethnicity	Total	p=
	N	3879	8	121	2662	995	163	1877	412	10117	
Low birthweight <2500g	N	262	2	9	284	70	6	253	57	943	<0.001
	%	6.3	20.0	6.9	9.6	6.6	3.6	11.9	12.2	8.5	
Macrosomia	N	483	0	14	126	84	18	88	13	826	<0.001
	%	11.7	0.0	10.8	4.3	7.9	10.7	4.1	2.8	7.5	
Preterm <37 completed weeks	N	275	2	11	163	66	7	149	34	707	0.119
	%	6.6	20.0	8.5	5.5	6.2	4.1	7.0	7.2	6.4	
APGAR score <7 at 1 minute	N	527	0	20	287	125	18	242	55	1274	0.009
	%	13.0	0.0	15.9	9.9	11.9	10.7	11.6	11.9	11.7	
APGAR score <7 at 5 minutes	N	87	0	3	59	27	3	48	12	239	0.971
	%	2.1	0.0	2.4	2.0	2.6	1.8	2.3	2.6	2.2	
Stillbirth	N	17	0	1	20	5	0	16	1	60	0.514
	%	0.4	0.0	0.8	0.7	0.5	0.0	0.8	0.2	0.5	
Pre-eclampsia	N	103	0	0	68	28	6	66	9	280	0.283
	%	2.6	0.0	0.0	2.4	2.7	3.7	3.3	2.0	2.6	
Gestational diabetes	N	203	1	4	383	104	10	178	33	916	<0.001
	%	4.9	10.0	3.1	13.0	9.8	5.9	8.4	7.1	8.3	

Perinatal outcomes by Ethnicity and Migration Status

Table 3 presents a comparison of perinatal outcomes by ethnicity and migration status. Native women of Pakistani ethnicity are excluded from this analysis due to small numbers. First and second-generation migrant Pakistani women and second-generation migrant women of other ethnicities had higher odds of delivering low birthweight babies in the adjusted analysis while lower odds of macrosomia were also observed among these groups. First generation Pakistani migrants had increased odds of stillbirth, but it did not reach statistical significance. However decreased odds of preterm delivery, APGAR score below 7 at 1 minute and caesarean section were observed in this group of migrant women compare to native mothers.

Given the differing observations relating to preterm delivery and birthweight categories between migrant groups, multiple linear regression analyses were conducted to examine the relationship between both birthweight and gestational age at delivery and length of stay in the UK for first generation migrants.

The multiple linear regression calculated to predict birthweight based on length of stay in the UK and adjusted for maternal age, maternal BMI, Index of Multiple Deprivation score, parity and gestational age at delivery found a significant regression equation ($F(6,3625)=418.1$, $p<0.001$), with an R^2 of 0.409 and effect size $f^2=0.692$. Predicted birthweight increased 4.4 grams for each additional year of residence in the UK amongst first generation migrants. The multiple linear regression calculated to predict gestational age at delivery based on length of stay in the UK and adjusted for maternal age, maternal BMI, Index of Multiple Deprivation score and parity found a significant regression equation ($F(5,3626)=8.67$, $p<0.001$), with an R^2 of 0.012 and effect size $f^2=0.012$. Predicted gestational age at delivery decreased by 0.014 days for each additional year of residence in the UK amongst first generation migrants.

Table 3. Perinatal outcomes by Ethnicity and Migration Status

		Native		First generation migrants		Second or higher order generation migrants		
		White British** (n=3879)	Other Ethnicity (n=121)	Pakistani (n=2662)	Other Ethnicity (n=995)	Pakistani (1877)	Other Ethnicity (412)	White British (n=163)
Low birthweight <2500g	aOR*	1.00	0.99	**1.63**	0.93	**2.01**	**1.90**	0.55
	LCI	1.00	0.48	**1.35**	0.70	**1.66**	**1.39**	0.24
	UCI	1.00	2.05	**1.97**	1.24	**2.42**	**2.60**	1.25
Macrosomia	aOR*	1.00	0.93	**0.30**	**0.64**	**0.30**	**0.18**	0.81
	LCI	1.00	0.51	**0.24**	**0.50**	**0.24**	**0.10**	0.48
	UCI	1.00	1.71	**0.37**	**0.83**	**0.39**	**0.34**	1.37
Preterm <37 completed weeks	aOR*	1.00	1.21	**0.80**	0.80	1.03	1.05	0.60
	LCI	1.00	0.62	**0.64**	0.60	0.83	0.72	0.28
	UCI	1.00	2.34	**0.98**	1.07	1.28	1.52	1.29
APGAR score <7 at 1 minute	aOR*	1.00	1.23	**0.80**	0.85	0.90	0.87	0.76
	LCI	1.00	0.74	**0.68**	0.68	0.76	0.64	0.46
	UCI	1.00	2.03	**0.94**	1.05	1.07	1.17	1.27
APGAR score <7 at 5 minutes	aOR*	1.00	1.16	1.08	1.08	1.15	1.18	0.83
	LCI	1.00	0.36	0.76	0.69	0.79	0.64	0.26
	UCI	1.00	3.74	1.54	1.70	1.65	2.18	2.64
Stillborn	aOR*	1.00	1.68	2.01	1.29	1.95	0.59	0.00
	LCI	1.00	0.22	1.00	0.46	0.95	0.08	0.00
	UCI	1.00	12.92	4.01	3.61	4.01	4.47	
Pre-eclampsia	aOR*	1.00	0.00	1.14	0.97	**1.40**	0.74	1.42
	LCI	1.00	0.00	0.82	0.63	**1.00**	0.37	0.61
	UCI	1.00		1.59	1.51	**1.94**	1.49	3.29
Gestational diabetes	aOR*	1.00	0.75	**2.68**	**1.89**	**1.79**	1.32	1.04
	LCI	1.00	0.23	**2.20**	**1.46**	**1.43**	0.89	0.52
	UCI	1.00	2.40	**3.27**	**2.45**	**2.23**	1.96	2.09

** Reference group
*Adjusted odds ratio - Adjustment for Mother's age at delivery, Mother's booking BMI (derived), IMD 2010 score, Registerable parity, Gestation to last completed week.
LCI = Lower confidence interval
UCI = Upper confidence interval

Discussion

Main findings

The results show some important differences in outcomes both by ethnicity and migration status. The results of this study support the previous literature

suggesting higher odds of low birthweight and gestational diabetes in Pakistani women and lower odds of macrosomia.[11,15] However, the results show that first generation Pakistani migrants had decreased odds of preterm delivery and APGAR score below 7 at 1 minute which were not apparent in other groups.

Examination of gestational age at delivery and birthweight for first generation migrants using multivariate linear regression suggested a statistically significant association between both variables and length of stay in the UK. This said, the effect size related to gestational age was small, equating to 0.014 days gestation for each additional year of residence suggests this is not a clinically important finding. The effect size related to birthweight was larger, equating to a increase of 4.4g for each year of residence. While this finding, in itself, is not sufficient to draw clear conclusions, it does suggest length of stay may be an important consideration for differences in birthweight.

While the odds of gestational diabetes in both first- and second-generation Pakistani women in the present study were significantly higher compared to white British native women there were also differences between these two groups. Odds of gestational diabetes in first generation Pakistani migrants were 2.68 [CI 2.20 - 3.27] compared to 1.79 [CI 1.43 - 2.23] for second generation Pakistani migrants, meaning the odds for first generation migrants were almost double those for second generation migrants in the same ethnic group.

Previous studies examining the relationship between ethnicity and preterm birth have reported mixed results regarding Pakistani populations,[16-18] suggesting that factors other than ethnicity may be stronger predictors of preterm birth risk. A previous retrospective study examining the relationships between ethnicity, maternal country of birth and preterm birth in over 4.5 million births in England and Wales found an increased risk of preterm birth in Pakistani mothers; however, this risk was lower in mothers born outside the UK compared to UK born Pakistanis.[19] This lower rate of preterm birth in mothers who were born outside the UK is in line with our study findings and raises the importance of considering intergenerational and migration status differences in the analysis of such population-based studies. Family structure and support through lower

incidence of single parents, smoking and adolescent pregnancies and higher level of education observed mostly in the first-generation Pakistani families in a previous study may have also played a role in the observed positive outcomes[20]. Additionally, studies have shown that vaginal microecological dysbiosis-related diseases are the most common causes of preterm birth, such as bacterial vaginosis (BV), vulvovaginal candidiasis (VVC), group B streptococcal (GBS) infections and other infectious diseases[21]. Therefore, the impact of healthy lifestyles in terms lower incidence of smoking, adolescent pregnancies, maternal family structures (e.g. having higher rates of marriage and stable relationships in mothers and vaginal infection rates in relation to differences in lower incidence of preterm birth in Pakistani women merits further investigation.

Associations between ethnicity, hyperglycaemia and perinatal outcomes have previously been investigated in the Born in Bradford cohort.[22] In addition to examining birthweight this study also examined infant adiposity measured using skinfold thickness and cord blood leptin levels. The study found that while babies born to South Asian women were lighter, on average they had a higher body fat percentage when adjusted for birthweight compared to white British infants. These findings suggest that any attempts to address disparities in low birthweight babies must be mindful of the tendency for greater adiposity in South Asian infants and that the classification of low birthweight thresholds may need to be revisited to take account of ethnic variations in the determinants of adverse outcomes. These findings are expanded upon by the current study by examining migration status of women of Pakistani origin as a strata within women of South Asian ethnicity. While our findings add weight to the need to consider ethnicity specific thresholds, they also highlight that there are nuances within ethnic groupings which warrant further exploration. This is supported by clear evidence of correlation between incidence of low birthweight and poverty related measures such as nutrition, health care and housing that transcend international boundaries[23]. In the present study, Index of Multiple Deprivation, and geographic small area-based measure, was used to consider this factor in the model, meaning that individual differences between families living within the

same area are not captured. This again highlights the need for improved clarity and detail in routine data collection in the UK.

Ethnicity-specific birthweight distributions have previously been investigated with significant results. A study assessing birthweight distribution of babies with European, Chinese and South Asian heritage reported that on average infants born at 40 weeks gestation of European descent weighed 254.6g more than those of South Asian origin.[24] The use of the proposed ethnicity-specific vs. general population based birthweight distributions in a further study found the former to be significantly better at identifying infants at increased risk of short-term neonatal morbidity (Apgar score <7 at 5 minutes, admission to the neonatal intensive care unit, ventilation, extended length of stay in hospital, hypothermia, hypoglycaemia, and infection).[25] Previous work in this programme of research has found lower rates of physical activity in Asian women.[26] Due to the known benefit of physical activity perinatally in reducing the risk of gestational diabetes[27] these findings provide an evidence base for targeted implementation research.

The observed higher odds of stillbirth among first-generation Pakistani migrants and the higher odds of preeclampsia in the Pakistani second-generation migrants were of a borderline statistical significance, which could be indicative of the need for a larger sample size for these outcomes. Similar patterns by ethnicity have been seen previously,[28] however the higher risk of pre-eclampsia in second-generation Pakistani mothers' merits further attention to investigate the potential interplay between ethnicity, acculturation and environmental influences on birth outcomes.

The increasing trend for risk of stillbirth is in line with previous reports in which Pakistani ethnicity has been identified as a significant risk factor for stillbirth alongside factors such as maternal obesity, smoking, pre-existing diabetes, socioeconomic inequalities and foetal growth restriction[29]. Gardosi et.al.[30] identified unrecognised foetal growth restriction as the single largest risk factor and, along with our findings, this provides a solid evidence base for the need for targeted preventive strategies. Stillbirth may also be associated with higher

prevalence of congenital abnormalities particularly considering that consanguineous marriages are also more common in this group.[31] Previous study of the Born in Bradford cohort showed the risk of congenital abnormalities in infants of Pakistani origin was almost twice that of white British infants and that 37% of babies born in Pakistani families had parents in first-cousin unions.[31] The current study potentially adds a further level of detail to these associations by highlighting the increased odds of stillbirth in first generation Pakistani migrants, however further investigation into these associations is needed.

There is a significant lack of evidence in the existing literature regarding the relationship between migration status of UK residents, country of origin, or migration journey experiences with perinatal health, and the focus is largely on refugees and asylum seekers' pregnancy and birth outcomes. It is possible that this highlights problems in grouping of 'migrants' vs. 'non-migrants' without consideration of the reasons for migration or differences between migrant categories. Economic and family restoration migrants are likely to have very different characteristics compared to refugees and asylum seekers, for example, meaning the grouping of migrants as a homogenous group may be problematic. A recent systematic review evaluating maternal and perinatal outcomes of asylum seekers and undocumented migrants in Europe found evidence of increased risk of adverse outcomes in these groups, largely attributed to lack of access to health care and quality of services.[32] This said the study only reviewed eleven eligible papers, highlighting the dearth of research in this area. Data regarding the reason for migration and migration journey was not available in the Born in Bradford cohort; however, this is an important consideration for further research.

Strengths and limitations

The size and diversity of the Born in Bradford cohort is a significant strength of this study, particularly the availability of detailed information regarding migration histories and country of origin. This analysis utilises this data in a way that is

unique and adds important nuance to established patterns of ethnic inequalities by adding migration history and intergenerational variations as a contextual measure. Due to significant shortcomings in the collection of routine data relating to ethnicity and migration history in the UK, all variables related to these characteristics in this study were self-reported. For this reason, it is possible that errors of recollection or knowledge of family history could have impacted groupings. There were also no data available regarding reasons for migration or travel histories before reaching the UK (for example, time spent in other countries or traumatic experiences through migration journey while in transit). These details could provide further insight into the mechanisms at play resulting in differential outcomes. Similarly, no standardised measure of individual socio-economic status was available to this study. The use of a small geographical area measure as a proxy is legitimate; this may however lead to individual differences being missed.

Analyses for some outcomes were also limited by small numbers, particularly in relation to rare outcomes such as stillbirth, meaning robust conclusions are difficult to draw.

Conclusion

At the time of writing, this is the first UK based study to examine the interplay between ethnicity and migration status in reference to perinatal health and has uncovered some important differences, particularly between groups of women with shared ethnicity but different migration status. Positive results such as lower incidence of premature birth or lower incidence of macrosomia amongst Pakistani women compared to White British women is noteworthy however higher incidence of complications such as gestational diabetes, pre-eclampsia and low birthweight among these women requires further attention. Of particular note, is the finding that odds of gestational diabetes among first generation Pakistani migrants were almost double that of second-generation migrants despite shared country of origin. Work to develop appropriate interventions with a full consideration of confounding environmental and biological factors to address the identified inequalities is urgently needed.

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