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Differences in the pregnancy gestation period and mean birth weights in infants born to Indian, Pakistani, Bangladeshi and white British mothers in Luton, UK: a retrospective analysis of routinely collected data

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ABSTRACT

Objective To compare mean birth weights and gestational age at delivery of infants born to Indian, Pakistani, Bangladeshi and white British mothers in Luton, UK.

Design Retrospective analysis using routinely recorded secondary data in Ciconia Maternity information System, between 2008 and 2013.

Setting Luton, UK.

Participants Mothers whose ethnicity was recorded as white British, Bangladeshi, Pakistani or Indian and living in Luton, aged over 16, who had a live singleton birth over 24 weeks of gestation were included in the analysis (n=14 871).

Outcome measures Primary outcome measures were mean birth weight and gestational age at delivery.

Results After controlling for maternal age, smoking, diabetes, gestation age, parity and maternal height and body mass index at booking, a significant difference in infants' mean birth weight was found between white British and Indian, Pakistani and Bangladeshi infants, $F(3, 12\,287)=300.32$, $p<0.0001$. The partial Eta-squared for maternal ethnicity was $\eta^2=0.067$. The adjusted mean birth weight for white British infants was found to be 3377.89 g (95% CI 3365.34 to 3390.44); Indian infants, 3033.09 g (95% CI 3038.63 to 3103.55); Pakistani infants, 3129.49 g (95% CI 3114.5 to 3144.48); and Bangladeshi infants, 3064.21 g (95% CI 3041.36 to 3087.06). There was a significant association in preterm delivery found in primipara Indian mothers, compared with Indian mothers (Wald=8.192, df 1, $p<0.005$).

Conclusions Results show important differences in adjusted mean birth weight between Indian, Pakistani, Bangladeshi and white British women. Moreover, an association was found between primipara Indian mothers and preterm delivery, when compared with Pakistani, Bangladeshi and white British women.

Strengths and limitations of the study

- This study uses retrospective routinely collected data over 6 years providing a large sample size, (n=14 871), providing more generalisable results.
- This paper adds to the sparse existing evidence that examines heterogeneity in birth weight and gestation age at delivery between women from South Asia in the UK.
- This study was unable to accurately identify socioeconomic measures and subsequently control for, and analyse these, understanding that socioeconomic factors may have contributed to the study results.

INTRODUCTION

Low birth weight (LBW) is a significant contributory factor for increased risk of infant mortality and morbidity[1] and has health consequences extending into adulthood.[2]It is also a recognised proxy for maternal health.[3 4] LBW is defined as birth weight of less than 2500 g at birth.[5 6] The rather arbitrary figure of 2500 g was determined by WHO, as birth weight less than this shows a substantially increased mortality rate.[7] Birth weight of 1500 g is classified as very low birth weight (VLBW) and has an exponentially higher mortality rate.[8] VLBW/LBW may be a consequence of a number of mediating factors including preterm birth (PTB),[9] small for gestational age[6 10] and intrauterine growth restriction (IUGR), whereby the normal development of the fetus is hampered.[11]

Existing evidence shows that South Asian women typically give birth to infants of lower birth weights than white British (WB) women[12 13] with babies on average being 230–350 g lighter.[14–16] Typically, statistics in the UK use aggregated data from Indian, Pakistani and Bangladeshi infants/mothers, as 'South Asian',[4 17–19] obscuring nuances between each ethnic group,[20] or have been reported as 'South Asian' when only one specific ethnic group is reported (eg, Pakistani).[16 19] Research documents a host of maternal, infant and social factors contributing to LBW, for example, gestational age at delivery,[21] poor maternal nutrition,[22] smoking,[23] maternal underweight,[24] socioeconomic status[5] and maternal depression.[25] Studies have also assessed differences in maternal country of birth on birth weights[14 26] and between generations.[4 14 27]

Lighter birthweight infants in South Asian infants are well documented.[12 14 19] Margetts and colleagues[4] defined South Asian mothers originating from the Indian subcontinent using either maternal place of birth, for example, India, Pakistan or Bangladesh (as first generation), or UK born (as second generation). They reported differences in the mean birth weights of first-generation Indian (3077 g), Bangladeshi (3161 g) and Pakistani (3235 g) infants. The same trend was observed in the Millennium Cohort Study (MCS) whereby Indian mothers have the lightest infants and Pakistani mothers had the heaviest.[12] Conversely, Leon and Moser[14] found that Bangladeshi infants were the lightest, while consistent with the other studies, Pakistani infants were heaviest among the infants born to South Asian mothers.

Margetts *et al*[4] restricted their analyses to births after 37 weeks, which eliminated trends accounted for by gestational age, in addition to aggregating maternal ethnicity to assess for differences between maternal generations (ie, born in the Indian subcontinent classified as first generation or UK classified as second generation). While MCS showed that Pakistani mothers had a lower rate of preterm delivery, the study showed that Indian mothers had a higher rate.[12] Moreover, national figures for 2012 showed that Bangladeshi mothers had higher rate of infant mortality; conversely, Pakistani and Indian mothers had higher preterm delivery rates,[28] while Pakistani mothers had a higher preterm delivery mortality rate, when compared with British women.[29] Together, this demonstrates discreet differences between birth patterns of women of South Asian ethnicity in the UK.

LBW is a complex research area that has been hampered by inconsistent research methods and outcome measures such as mean birth weight[4 14] or weight frequencies[3 30 31] or aggregated ethnicities,[4] thereby making comparison between studies difficult. It is important to tease out the nuances of low birth weight trends between Indian, Pakistani and Bangladeshi mothers in order to uncover modifiable factors before specific tailored interventions are developed[32] and by identifying differences in birth weight and gestational age at delivery between Indian, Pakistani and Bangladeshi and WB women in Luton, England. This paper makes a contribution to this research area.

METHODS

Routinely collected retrospective data from Ciconia Maternity information System (CMiS) from the Luton and Dunstable University Hospital were used. The CMiS database is a clinical information system used in some maternity departments in the UK to record all births (ie, hospital and home). Purposive sampling of women aged over 16 and all birth outcomes (ie, live and perinatal mortality), who gave birth between January 2008 and December 2013, residing in specified postcode areas were included.

Variables

Outcome variables of mean birth weight and preterm gestation age were used. Known confounders were maternal age (16–20, 21–25, 26–30, 31–35, 36–40, >40), smoking (binary variable smoker/non-smoker), parity, diabetes (binary variable), gestation age (binary variable <24 weeks of gestation excluded, 24–37 weeks of gestation and after 37 weeks of gestation) and maternal height and body mass index (BMI) at booking were included and controlled.[31 33–36] Maternal hypertension is associated with increased risks of adversity in pregnancy for mother and fetus, including placental problems and IUGR.[37] However, the CMiS data (for WB, Indian, Pakistani and Bangladeshi records) only had 12 data entries recorded for maternal hypertension; the reasons for the lack of data are unknown, and therefore to avoid error, the variable was excluded from this analysis.

Recording ethnicity in the National Health Service (NHS) is a mandatory requirement, and staff is required to ask women for their self-ascribed ethnicity, according to the 2001 census categories[38] Ethnicity is a self-defined construct, which incorporates culture, religion, shared language and ancestry.[39] Consequently, within this study, maternal country of birth, length of residency or generational status was not ascertained, but the broader self-classification of ethnicity as recorded in NHS is used for analysis. Cases with missing data were excluded.

Statistical analysis

Analyses were conducted using IBM Statistics Package for the Social Sciences V21. The raw data contained data on all ethnicities (n=21 264); however, for the purposes of this paper, data were selected for only WB, Pakistani, Indian and Bangladeshi outcomes, and statistics were conducted on live singleton infants only who were delivered after 24 weeks (reported as adjusted means) (n=14 871).

Frequency counts and percentages were calculated. Analysis of variance (ANOVA) was used to determine whether there were any significant differences in birth weight between the four ethnic groups and each confounder variable (ie, maternal age, smoking status, diabetes, gestation age at delivery, parity and maternal height and BMI). Means, SE and 95% CI were calculated for each ethnic group. An analysis of covariance (ANCOVA) was conducted to ascertain birthweight difference between ethnic groups and to control for confounding variables with birth weight as the outcome variable. Bonferonni post hoc analysis was used to determine where significant differences were, if any. Pearson χ^2 test for association and adjusted standardised residual were used to test for associations between maternal ethnicity and gestation age at delivery. However, to account for the effect of parity on gestation age at delivery, a filter variable was created to use only primipara (others were treated as missing), for the calculation of preterm delivery. Multiple regressions were used to determine variance explained of smoking on birth weight, and logistic regression was used to determine whether ethnicity increased the OR for PTB.

Routinely collected secondary data were provided to the research team in a non-identifiable form. Ethics approval was therefore not required from National Research Ethics Service (NRES) but was obtained from the University of Bedfordshire Research Ethics Committee (March 2014). Scrutiny from the hospital's information governance manager ensured adherence to patient confidentiality and data protection before de-identified routinely collected data were provided.

RESULTS

Our results focus on mothers of WB, Indian, Pakistani and Bangladeshi ethnicity. There were a total 15 211 births for the years 2008–2013, of which 14 871 were recorded in CMiS as live singleton deliveries, which were delivered after 24 weeks of gestation. The frequencies and percentages of women recorded as being smokers, diagnosed with diabetes (type 1, type 2 and gestational diabetes), maternal BMI at booking and gestational age at delivery are shown by ethnic group (table 1), as recognised confounders to infant weight. A series of ANOVAS found significant differences between birth weight and each ethnicity for each confounding variable and these shown in table 1. There were 69 missing entries for diabetes (0.5%) and 29 cases of smoking data missing (0.2%) and 8 missing entries for BMI (0.05%). The cohort mean birth weight is 3214 g.

An ANCOVA was used to determine the effect of maternal ethnicity on birth weight and adjusting confounders to birth weight. Birth weight is reported as unadjusted and adjusted mean(s) and shown for each maternal ethnicity (table 2). The adjusted mean birth weight results found that Bangladeshi mothers had the lightest mean birth weights (3068.01 g) compared with WB mothers who delivered infants with a mean birth weight of 3375.66 g, showing a difference of 307.65 g. The adjusted results showed a significant difference in mean infant birth weight by maternal ethnicity; F(3,

Table 1 Cohort frequencies and percentages of live singleton deliveries, age, smokers, diabetes, BMI and gestation for 2008–2013

		White British	Indian	Pakistani	Bangladeshi	Total
Live singletons N (%)		6862 (46.1)	1710 (24.8)	5025 (33.8)	2013 (13.5)	14 871
p		<0.001	0.370	<0.001	<0.001	
Maternal age N (%)	16–20	1006 (14.6)	15 (1.5)	217 (4.3)	91 (4.5)	1329 (8.9)
	21–25	1710 (24.8)	200 (20.5)	1486 (29.3)	581 (28.5)	3977 (26.5)
	26–30	2010 (29.1)	407 (41.7)	1859 (36.6)	801 (39.3)	5077 (33.9)
	31–35	1487 (21.5)	261 (26.8)	1099 (21.6	431 (21.2)	3278 (21.9)
	36–40	599 (8.7)	79 (8.1)	378 (7.4)	123 (6)	1179 (7.9)
	40+	97 (1.4)	13 (1.3)	38 (0.7)	9 (0.4)	157 (1)
p		<0.001	<0.001	<0.001	<0.001	
Smokers N (%)		1490 (21.6)	19 (2)	73 (1.4)	18 (0.9)	1600 (10.7)
p		0.001	0.002	0.031	0.016	
Diabetic		54 (0.8)	14 (1.4)	117 (2.3)	18 (0.9)	253 (1.7)
p		0.11	0.08	0.54	0.39	
BMI N (%)	19–24.9	2518 (36.5)	424 (43.5)	1624 (32)	757 (37.2)	5323 (35.5)
	25–29.5	1710 (24.6	262 (26.9)	1297 (25.6)	546 (26.8)	3815 (25.5)
	30–39.9	1146 (16.6)	79 (8.1)	794 (15.6)	226 (11.1)	2245 (15)
	40–50	182 (2.6)	8 (0.8)	80 (1.6)	24 (1.2)	294 (2)
p		<0.001	0.07	<0.001	<0.001	
Gestation (in weeks) N (%)	24–37	451 (6.5)	74 (7.6)	308 (6.1)	124 (6.1)	957 (6.4)
	37+	6447 (93.5)	899 (92.4)	4757 (93.9)	1908 (93.6)	14 011 (93.6)
p		<0.001	<0.001	<0.001	<0.001	

BMI, body mass index.

Table 2 Unadjusted and adjusted mean birth weight for 2008–2013 by maternal ethnicity

Maternal ethnicity	N	Unadjusted mean	SE	Adjusted mean*	SE	95% CI Lower bound	95% CI Upper bound
White British	5853	3352.51	5.13	3375.66	6.43	3363.07	3388.26
Indian	840	3045.53	4.64	3073.08	16.56	3040.62	3105.55
Pakistani	4013	3164.89	4.71	3130.71	7.65	3115.72	3145.71
Bangladeshi	1689	3080.75	5.14	3068.01	11.7	3045.09	3090.93

*Adjusted for maternal age, smoking status, diabetes, gestation age at delivery and maternal height, body mass index and parity.

14781)=310.23, p<0.001. The partial Eta-squared for maternal ethnicity was η^2=0.067.

The covariates of BMI (F(1, 12384)=242.43, p<0.005, partial η^2=0.019), maternal smoking (F(1, 12384)=212.78, p<0.005, partial η^2=0.017), maternal height (F(1, 12384)=14.57, p<0.001, partial η^2=0.001) and parity (F(1, 12384)=33.07, p<0.005, partial η^2=0.003) had a significant effect on birth weight, while the covariates of maternal diabetes and age were not significant in this analysis.

Bonferroni post hoc analysis revealed that adjusted mean birth weight was statistically significantly lower in Indian (M=3073.08, SE=17.83), Pakistani (M=3130.71, SE=10.74) and Bangladeshi (M=3068.01, SE=13.62) compared with WB infants (M=3375.66, SE=6.43), a mean difference of −302.58 g (95% CI 255.53 to 349.62), p<0.005, (Indian); −307.65 g (95% CI 271.72 to 343.59), p<0.005 (Bangladeshi); and −244.95 (95% CI 217.84 to 272.06), p<0.005 (Pakistani). Moreover, differences in adjusted mean birth weight were found between Indian and Pakistani infants (−57.63 g (95% CI −105.85 to −9.41), p<0.01) and Pakistani and Bangladeshi infants (62.7 g (95% CI 26.44 to 98.96), p<0.005), but no significance was found between the adjusted mean birth weight of Indian and Bangladeshi infants.

As smoking is a recognised contributor for LBW, multiple regressions were conducted to determine the variance of smoking on birth weight. The assumptions for multiple regressions were checked and satisfied. The R^2 for the model was 0.046. Smoking was found to statistically predict lower birth weight F(2, 15174)=365.85, p<0.001 (see table 3).

Next, multiple regression was conducted to establish variance of PTB on birth weight, by ethnicity. R^2 varied according to ethnicity between 0.222 and 0.288; the cohort model was 0.26, R^2 for Bangladeshi infants was 0.236, R^2 for Pakistani infants was 0.234, R^2 for WB infants 0.288 and R^2 for Indian infants was 0.222.

Table 3 Summary of multiple regressions

Variable	B	SE_B	β
Smoking status	−242.25	16.23	−0.125
Ethnicity	−50.52	1.93	−0.219

B, unstandardised regression coefficient; SE_B, SE error of the coefficient; β, standardised coefficient.

ANOVA was significant in all ethnic groups. ANOVA for WB infants was F(1, 7015)=2831.84, p<0.001; Indian infants, F(1, 989)=282.25, p<0.001; Pakistani infants, F(1, 1539)=1844.75, p<0.001; and Bangladeshi infants, F(1, 2055)=634.52, p<0.001.

A binary logistic regression procedure was used to examine the relationship between ethnicity and PTB. An overall significant relationship was observed (χ^2 (7.85)=df 3, p<0.05). Using the WB category as a comparison, it was found that the Indian ethnic group was significantly over-represented in terms of PTB (*W*=8.192, df 1, p<0.005). The Exp(B)/OR value was 1.621 (95% CI 1.165 to 2.258).

DISCUSSION

The aim of this paper was to identify differences in birth weight and gestation age at delivery between Indian, Pakistani and Bangladeshi and WB women. Differences between the mean birth weights of Indian, Pakistani, Bangladeshi and WB infants were found, in addition to an association between preterm delivery in primipara Indian mothers. The results showed that there was a difference of 307.65 g between WB and Bangladeshi infants. This is consistent with previous results showing that South Asian infants are 230–250 g lighter.[14–16] Moreover, a small difference ranging from 57.63 to 62.7 g was also identified between Indian, Bangladeshi and Pakistani infants, although this marginal difference is likely not be clinically useful.

The results showed that Indian infants had the lightest unadjusted mean birth weights, followed by Bangladeshi, Pakistani and WB infants, respectively. However, after controlling for known confounders, Bangladeshi infants were found to have the lightest mean birth weight. Not unexpectedly, maternal smoking, maternal height, BMI and parity showed a significant independent contribution to the outcome of infant birth weight. Furthermore, an association was found between primipara Indian mothers and preterm delivery, within this cohort.

Leon and Moser[14] also found that Bangladeshi infants were the lightest, compared with Indian, Pakistani or WB infants. On the other hand, MCS[12] calculated birth weight gestation age at delivery using self-reported data and found that the unadjusted mean birth weight was lightest in Indian infants, followed by Bangladeshi, Pakistani and WB, respectively. Furthermore, the adjusted mean calculations showed a number of different findings according to the variables controlled; maternal and infant factors (ie, gestation age, parity, maternal height and weight and antenatal complications) found that Pakistani infants were lightest, whereas controlling for behavioural factors (ie, antenatal care, smoking and drinking) and socioeconomic factors (ie, household income, education status, occupation status, single parentage and housing tenure) showed that Indian infants were lightest. Margetts *et al*[4] results also showed that infants delivered to mothers born in India had lighter infants, while Pakistani-born mothers had heavier infants; however, their results were only adjusted for generation status, and therefore, the mean weight reported in the paper is unadjusted.

Taken together, this is suggestive that birth weight might be sensitive to different combinations of mediators, which may vary according to maternal ethnicity, an important point for specific antenatal interventions.[32] Moreover, a further explanation of the results found in this study is that that birth weight is sensitive to environmental influences and the national level figures used in Leon and Moser's analysis will average out regional variations, as evidenced in the current paper, which focuses on mean birth weights specifically in Luton.[14 40] Furthermore, these results fail to support the current explanation that South Asian infants are lighter as a consequence of their parents being of a smaller stature,[19 41 42] since BMI at booking and maternal height was controlled and adjusted mean birth weight was still found to be significantly lighter in all South Asian ethnicities, compared with WB.

While Patel and colleagues used a large South Asian sample size (n=16 192) and found an increased OR for South Asian mothers having a preterm birth in their study,[18] they aggregated Pakistani, Bangladeshi and Indian mothers, which obscured any subgroup trends. However, our study assessed preterm delivery in primipara Pakistani, Bangladeshi Indian and WB mothers and found a significant association between preterm delivery and Indian mothers, although it is recognised that socioeconomic factors were not controlled in this cohort.

MCS also showed that Indian mothers had a higher rate of preterm birth compared with Pakistani and Bangladeshi mothers; however, similar to the present study, the analyses was restricted to a binary outcome of births 24–37 weeks of gestation and after 37 weeks of gestation (hence excluding previable births). Therefore, this results in the loss of some information; exclusion of previable births (ie, <24 weeks of gestation) means that it is impossible to compare the frequency of early pregnancy loss by maternal ethnicity.[12] Higher rates of early loss may well be evident in Pakistani mothers, due to a higher prevalence of congenital anomalies, some of which may be lethal, but this as yet needs to be elucidated.[43]

Taken together, these results highlight a number of key findings. First, that there are important differences between Pakistani, Bangladeshi and Indian infant birth weights, whereby treating them in research terms as a homogenous group categorised as 'South Asian' obscures distal determinants. Researchers should move away from using the category of 'South Asian' and be more specific about ethnicity when reporting populations under study. Second, when comparing the findings with previous studies,[4 12 18 44] this study shows that the confounding variables controlled for also influences the results of which maternal ethnicity has the lightest mean birth weight, suggestive that a closer examination of maternal and behavioural mediators is warranted. It is possible that contributors for LBW in one population are less pronounced in another, and these factors need to be better understood. Furthermore, while there are known trends such as LBW in South Asian mothers,[27 28] there are also clear ethnic and regional variations, suggestive of mediating social and environmental factors, which warrant further investigation.

This study has a number of strengths: the large sample sizes of the Indian, Pakistani and Bangladeshi mothers, compared with MCS,[12] whereby the authors oversampled from black, Asian and minority ethnic populations, actually had smaller sample sizes from Indian (n=433), Pakistani (n=687) and Bangladeshi mothers (n=215) than the present study, whose subgroup sample size is substantially larger, providing more generalisable results. In addition, it accesses 5 years' worth of data, which provides a more reliable picture and addresses any cohort anomalies that may occur in shorter duration datasets.

This study is not without limitations. Hypertension in pregnancy is known to contribute to growth restriction, placental problems and increase maternal mortality risk. However, in this cohort, the data reported only 12 cases; therefore, while this was excluded from analysis, it may have had a clinical impact not accounted for. Furthermore, while the sample sizes for Indian, Pakistani and Bangladeshi mothers were larger than MCS, our Indian sample size was still relatively small. In addition, there were no socioeconomic measures available to the research team to allow controlling of socioeconomic factors known to mediate preterm birth in this study. It would be beneficial for future research to investigate further trends in preterm birth and Pakistani, Bangladeshi and Indian infants, while controlling for socioeconomic factors, especially as there are known differences in the socioeconomic status between Indian, Pakistani and Bangladeshi ethnic groups in England.[45]

In conclusion, this study presents important differences in mean birth weights between Indian, Pakistani and Bangladeshi infants. Furthermore, an association between primipara Indian mothers and preterm birth was found. LBW and PTB both contribute significantly to mortality and morbidity outcomes; therefore, understanding the reasons for this disparity is essential for levelling up service provision and policy planning.[20 21 46 47]

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