RESEARCH REPORT

Persistence of lower birth weight in second generation South Asian babies born in the United Kingdom

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Objective: To assess differences in birth weight between all first and second generation South Asian babies born in Southampton, and trends since 1957.
Design: Retrospective, cohort study.
Setting: Birth records for babies born in Southampton from 1957 to 1996 were searched to identify all babies born of South Asian origin (including from the Indian subcontinent, East Africa, and elsewhere).
Main outcome measures: All information recorded in the birth record about the mother and baby was extracted.
Results: 2395 full term (>37 weeks; mean birth weight 3110; 95%CI 3092 to 3129) singleton births were identified. Detailed analysis was restricted to mothers either born in the Indian subcontinent (India, Pakistan, or Bangladesh (1435)) or United Kingdom (283). Mean birth weight and % low birth weight (<2500 g) were 3133 g (95%CI 3108 to 3157) and 7.5%, for first generation babies and 3046 g (2992 to 3099) and 11.7% for second generation babies. There was no trend over time to increased average birth weight in either first or second generation babies. Adjusting for other factors that were statistically significantly related to birth weight (gender, gestational age, mother's age, maternal weight at 15 weeks, parity, and mother's ethnic group) did not alter the trends.
Conclusions: For that group in the UK who derive from the Indian subcontinent, average birth weight is significantly less than the national average. There has not been any increase in the average birth weight over the past 40 years, and the birth weight of babies of women who were born in the UK are no greater. The persistence of lower than desirable birth weight may result long term in higher than average rates of diabetes and heart disease in these groups.

The weight at birth for babies in developing countries tends to be lower than that for the general population in developed countries. For babies born in the UK to mothers from the Indian subcontinent, weight at birth is greater than for babies born in India (by about 300 g), but lower than for the general population in the UK (by about 300 g).[1 2] Within India, socioeconomic circumstances have an effect on birth outcome such that babies born to better off mothers are of comparable weight to the general population in the UK.[3–5] Although few data are available, it is likely that environmental stresses, such as infection or poor nutrition, before and during pregnancy are important factors that contribute to lower birth weight in the Indian subcontinent.[6]

Birth weight has been used as a general proxy for wellbeing, as there is a continuous positive (linear) relation between birth weight and improved markers of health in both the short and long term. [7] With the exception of fetal macrosomia, across the normal range of birth weight babies that are born heavier and longer, tend to have fewer health problems in early life and are at lower risk of hypertension, coronary heart disease, and type II diabetes during adult life.[8]

If the quality of the environment is important for fetal development, it would be expected that when families move from a location of lower than average birth weight to one of higher than average birth weight, there will be a shift to higher birth weight in time. This would mean that with time, or after one or two generations, the birth weight of the migrating population would approximate that of the host population. There are two studies in which birth weight has been compared between first and second generation babies for migrants from South Asia to the UK.[9 10] In a smaller study, the birth weight of second generation babies was found to be significantly greater than for the first generation.[9] By contrast, in a larger study, no difference could be identified.[10] There are no studies in which trends over time have been reported. This study aimed to assess the trends in birth outcome over time in first and second generation babies of South Asian origin, born in Southampton, UK, since 1957. The initial hypothesis was that with time birth weight would increase and that babies born to second generation mothers would be bigger than babies born to first generation mothers approximating the birth weight of the general population trends.

METHODS

We have carried out a search for information in the birth record for all those of South Asian origin who gave birth in Southampton from 1957 to 1996. All the data for the mother and baby in the birth record were extracted and computer coded. The birth records for babies born in Southampton from 1957 to 1996 were checked to identify all babies of South Asian origin. The medical records of patients from the maternity unit of the Southampton General Hospital (now the Princess Anne Hospital) are sent to the District Inactive Library (DIL) after three years. After a further three years the records were stored on microfilms (or microfiche) or more recently the records have been entered on a computerised database. Birth records for the 1990s that have not been microfilmed or entered into the database are kept in their clinic folders and stored in boxes at the DIL. All information recorded in the birth record for the mother and baby were extracted and computer coded.

South Asian people were defined as that group who were resident in Britain and who originally came from the Indian subcontinent, or were the descendants of people originally from the Indian subcontinent (Bangladesh, India, and

Table 1 Mean birth weight by descriptive characteristics of mother, includes all mothers in study

	Number	Mean	95% confidence interval
All mothers	2395	3110	3092 to 3129
Mother's place of birth*			
India	800	3077 [a,b]	3046 to 3108
Pakistan	389	3235 [a,b,c,d]	3187 to 3283
Bangladesh	247	3161 [b]	3101 to 3220
East Africa	194	3035 [c,e]	2978 to 3093
Fiji	27	3242 [e]	3026 to 3458
Other outside UK†	17	3230	3035 to 3424
UK	283	3043 [d]	2989 to 3096
Religion‡			
Sikh	1216	3061 [a]	3036 to 3086
Hindu	313	3078 [b]	3024 to 3124
Muslim	853	3195 [a,b]	3165 to 3229
Gestational age§			
37–38 [1]	157	2838	2769 to 2908
38–39 [2]	364	2897	2853 to 2942
39–40 [3]	530	3085	3051 to 3119
40–41 [4]	930	3181	3152 to 3210
41–42 [5]	289	3287	3236 to 3338
42–43 [6]	109	3257	3154 to 3359
43+ [7]	16	3162	2936 to 3389

*438 mothers no known place of birth; †includes Malaysia, Singapore, Mauritius, Sri Lanka, South America; ‡13 women with other religions, 8 missing; Post hoc analysis of variance; LSD- groups with the same superscript letters are statistically significantly different from each other p<0.05; §number in [ ] used for summarising significant multiple comparisons; 1 v. 3,4,5,6,7; 2 v. 3,4,5,6,7; 3 v. 1,2,4,5,6; 4 v. 1,2,3,5; 5 v. 1,2,3,4; 6 v. 1,2,3; 7 v. 1,2.

Pakistan). South Asian names were identified from the birth records using the approach of Henley [11] and with guidance from the local community. By using both first and second names it is possible to correctly classify 98.5% of the South Asian people, compared with a reference judgement.[12] The later records contained information on the mothers' place of birth, which reduced uncertainties about ethnicity. The records of any students, or the wives of students, from South Asia were not included because it was considered unlikely that they would be resident in the UK in the long term. All measurements were converted to metric units. From the 1970s onwards, the dates of the last menstrual period (LMP) and the expected date of delivery were recorded. The length of gestation was calculated as the difference between the date of the LMP and the actual date of delivery. In cases where the date of the LMP was not known, the midwife or the doctor made an estimate of the duration of gestation based upon the height of the uterine fundus. In later records ultrasound scans were used to estimate fetal size and therefore its "age". An estimate of maternal weight at 15 weeks gestation was derived by linear regression analysis, using weights taken before 13 weeks, between 13 to 15 weeks, and between 17 to 20 weeks.

To determine the completeness with which people from South Asia had been identified, a check was carried out against the information collected during the 1991 census for Southampton. The Southampton and South West Hampshire Local Research Ethics Committee gave approval for the study to be carried out.

RESULTS

The analyses in this paper have been restricted to singleton births delivered at term (greater than 37 weeks gestation). The total number of singleton births was 2683 and 46 twin births were excluded. Of the singleton births, there were 210 pre-term births; 77 babies without data on gestational age or birth weight, and three babies without a recorded gender, all of whom were excluded. The number of births available for subsequent analysis was 2395.

Table 1 presents the overall mean birth weight for all subjects in the study, as well as mean levels broken down by place of birth, religion, and gestational age. Birth weight tended to be greater in babies born to mothers from Pakistan and Fiji. The lightest babies were likely to be born from mothers from East Africa or the UK. Babies of Muslim mothers tended to be heavier than babies of either Sikh or Hindu mothers. There was an increase in birth weight with gestational age, even though all of the babies included in the study were born at a gestation longer than 37 weeks.

The rest of the analyses presented in this paper will be restricted to mothers either born in the Indian subcontinent (first generation, 1435) or the UK (second generation, 283).

Table 2 presents mean data on booking age, parity, maternal height and weight, as well as birth weight and head circumference broken down by whether the baby was born to a first or second generation mother. First generation mothers were statistically significantly older at age of booking and had more children than second generation mothers. There was no statistically significant difference in maternal height between generations, but first generation mothers tended to be heavier at booking than second generation mothers. Unadjusted birth weights were greater in babies born to first, rather than second, generation mothers; however, the difference between generations was only present between girl babies (who were also lighter than boy babies of either generation). Of babies born to first generation mothers from the Indian subcontinent, 7.5% were classified as low birth weight (less than

Table 2 Difference between first and second generation mothers; for those born Indian subcontinent (first generation) or UK (second generation)

	First generation (n=1435)		Second generation (n=283)		Between generation comparison	
	Mean	95% confidence intervals	Mean	95% confidence intervals	*t* Statistic	p Value
Average age at booking	26.4	26.2 to 26.7	22.9	22.5 to 23.4	11.0	<0.01
Parity	2.88	2.78 to 2.98	2.02	1.88 to 2.16	6.7	<0.01
Gestational age	39.7	39.6 to 39.8	39.5	39.4 to 39.7	2.2	0.03
Maternal height	156.1	155.8 to 156.4	155.6	155.1 to 156.1	2.1	0.03
Maternal weight at booking	59.8	59.3 to 60.3	57.9	57.1 to 58.7	3.5	<0.01
Birth weight						
Unadjusted	3133	3108 to 3157	3046	2992 to 3099	2.7	0.01
Boys	3195	3161 to 3229	3138	3062 to 3215	1.0	0.31
Girls	3071	3038 to 3105	2950	2877 to 3022	2.9	0.01
Adjusted	3120	3080 to 3160	3119	2958 to 3280	0.5	0.5
Head circumference						
Unadjusted	33.86	33.8 to 33.9	33.45	33.3 to 33.6	4.5	<0.01
Adjusted	33.73	33.6 to 33.9	33.92	33.4 to 34.4	0.3	0.60

Table 3 Adjusted trends in birth weight (mean and 95% CI) by generation, based on full term births and only for mothers born in the Indian subcontinent (first generation) or the UK (second generation)

	First generation			Second generation		
	Number	Adjusted mean*	95% Confidence intervals	Number	Adjusted mean*	95% Confidence intervals
<1965	35	3192	3046 to 3339			
1966–1970	143	3072	2997 to 3148			
1971–1975	49	3133	3011 to 3256	5	2771	2416 to 3127
1976–1980	102	2974	2887 to 3060	7	2910	2606 to 3213
1981–1985	311	3126	3077 to 3175	43	3015	2887 to 3143
1986–1990	370	3145	3100 to 3190	98	3083	3003 to 3163
1991 and above	283	3220	3168 to 3273	124	3042	2968 to 3117

*Adjusted for: sex of baby; mother's ethnic group and place of birth; gestation recalculated (weeks); mother's age at booking; parity; weight at booking adjusted to 15 weeks.

2500 g) compared with 11.7% in babies born to second generation mothers. After adjusting for gender, mother's ethnic group, age, religion, parity, and weight at booking; the statistically significant difference between generations disappeared. Adjusted head circumference did not differ between generations.

Table 3 presents adjusted birth weights for babies born to first and second generation babies broken down by five year periods. The first time period in which second generation mothers gave birth to babies was 1971–75. The number of births is small for 1971–75 and 1976–80 and therefore mean estimates may be unreliable (wide confidence intervals). After adjusting for other factors, babies born to second generation mothers were statistically significantly lighter than babies born to first generation mothers for babies born since 1991 (3042 g compared with 3220 g), but for no other years. For babies born to either first or second generation mothers, after adjusting for factors known to influence birth weight, there was no clear trend for increasing birth weight over time, although babies born to first generation mothers since 1991 were on average the heaviest, before and after adjusting for other factors. Although women born in Pakistan gave birth to heavier babies than women born in India, in neither group was there a trend for increasing birth weight over time (data not presented).

To determine whether it was possible to identify a unit change in birth weight by year of birth, a multiple regression analysis was used, with adjustment for other factors. It was not possible to demonstrate an effect of year of birth on birth weight. Within the total population, there was a difference in birth weight for the different ethnic groups, but for none of these groups was there a consistent pattern of change in birth weight with time. Adjusting for ethnic group did not change the overall pattern.

Similar explorations were carried out to determine any changes with time for head circumference, placental weight, and the ratio of placental weight to birth weight. There was no identifiable change with time for any of the variables (data not presented).

DISCUSSION

The main finding from this study is that, after adjusting for factors known to influence birth weight, there has not been any clear increase in birth weight for either first or second generation babies born in Southampton over the past 40 years. There was no difference in birth weight for babies born to second generation mothers compared with babies born to first generation mothers who were born in the Indian subcontinent. Furthermore, in neither group was there a trend with time to suggest any increase in birth weight. Although women from Pakistan gave birth to heavier babies than women from India, in neither groups was there a trend for increasing birth weight over time.

Key points

- There has been no secular trend over the past 40 years to increased birth weights for babies born in Southampton, UK, to mothers from the Indian subcontinent.
- Birth weights of babies of mothers from the Indian subcontinent are still well below the UK general population average.
- Second generation babies are no bigger than first generation babies.

We have used the data contained in the 1991 census to determine that the data presented here represent a fairly complete record of all South Asian babies born in Southampton. Using the age specific census estimates, we conclude that the observed number of births was very close to that expected, suggesting that the sample in this study is a reasonable reflection of the population. The clinic data used in the study were collected routinely and therefore it is likely that some errors will have occurred. The data were thoroughly checked to eliminate obvious coding errors, but it is not possible when using retrospective material to check the accuracy of the data. We have had to assume that any errors that have occurred are randomly distributed, and that errors were not systematically related to year of study such that an underlying trend was obscured by error. The staff in the clinics where the maternal anthropometry was carried out were not the same as those who made the measurements in the newborn babies, making it unlikely that any errors would be correlated. Any uncertainty around the dates of the LMP, and hence in the estimation of gestational age, might have occurred in the earlier records before ultrasound scanning became a routine procedure, but is unlikely to have been consistent in nature. It was assumed that any estimate of gestational age of more than 44 weeks was probably attributable to an incorrect LMP, and therefore these cases were excluded from the main analysis.

There are two other studies that have looked at intergenerational effects on birth weight, for people from the Indian subcontinent, in the UK. One study, based upon 111 second generation births, showed an increase in birth weight from first to second generation babies.[9] By contrast, another study based upon 778 second generation births, showed no intergenerational increase in birth weight.[10] Our results, based on 283 second generation births, conform with the findings in the latter study and we were not able to demonstrate any change in birth weight across the generations. Furthermore, we were not able to identify any pattern of change towards increased birth weight in time for the population as a whole or any subgroup within the population. It is possible that either selection and information bias may be present in all three studies, but we are not able to explain how any bias that might have

Policy implications box

Our data would suggest that it would not be appropriate to adopt a complacent approach that assumes simply that the problem will resolve itself in time as social circumstances improve. The persistence of low birth weight within this group of the population requires a focused approach for further research, to determine the specific biological factors that lead to constrained fetal growth. Identifying specific factors that may be amenable to intervention, and that hasten the process of achieving a more desirable, or optimal, birth weight should be an important component of the research agenda.

occurred is likely to lead to the patterns present in our study. We estimate that random error could account for a variation in birth weight of about 100 g in our sample. Thus, given the size of our study we would expect to be able to detect differences between year groups of about 100 g. Therefore, it seems unlikely that if a true increase in birth weight exists, either over time or between generations, it has been masked by error.

The birth weight of South Asian babies born in Southampton, is not different to that for South Asian babies born elsewhere in the UK.[2 13] The birth weight for infants born in the UK whose mother comes from the Indian subcontinent is higher than the average birth weight in the Indian subcontinent (by about 300 g),[14–16] but when compared with the general population in the UK is some 300 g lighter.[17]

It may be that much of the obvious difference in birth weight between South Asian babies born in the Indian subcontinent and the UK is most readily explained by environmental factors that lead to a higher infectious load and a poorer quality of diet during pregnancy. Hence, an immediate consequence of an improved environment, allows birth weight to increase by about 300 g. Whereas a change of this sort might be adequate to explain an initial improvement in birth weight, it is not sufficient to explain the continued difference in birth outcome between people from South Asia and the general population. Nor does it adequately address the apparent lack of intergenerational improvement. Indeed, in the study conducted by Draper the suggestion was that by the third generation the situation was, if anything, worse.[10] In our analysis we sought to explain the difference by adjusting for other factors that are known to affect birth weight, but we were not able to influence the lack of increase in birth weight over time.

There are two important underlying assumptions in this work; firstly that there is no biological reason why babies born to mothers of South Asian origin should not have the same potential as the general UK population. If this assumption is correct, the birth weights reported here represent a marker of constrained growth. Secondly, that babies who are born smaller than they should be, carry both a short and long term risk to their health, and that it is therefore important to do something about it.[18 19] Balarajan and Raleigh [20] have shown that perinatal mortality is higher in babies born to mothers from the Indian subcontinent, which they attribute, at least partly, to low birth weight associated with poor nutrition.

Heart disease and diabetes are much more common in immigrants from the Indian subcontinent than the general UK population.[21 22] Is this in some way related to their lower birth weight? Research in India, UK, and elsewhere, suggests that there is a close link between size, shape, and body composition at birth and subsequent risk of diabetes and heart disease, which can be moderated by changes in lifestyle, but not completely removed.[23] Based on our findings, the predicted decline in diabetes between first and second generation immigrants, based on improved early nutrition and environment may not materialise, because in fact the environment has not improved or at least has not yet affected fetal growth. Our data would suggest that it would not be appropriate to adopt a complacent approach that assumes simply that the problem will resolve itself in time as social circumstances improve. The persistence of low birth weight within this group of the population requires a focused approach for further research, to determine the specific biological factors that lead to constrained fetal growth. Identifying specific factors that may be amenable to intervention, and that hasten the process of achieving a more desirable, or optimal, birth weight should be an important component of the research agenda.

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