

Lack of change in birthweights of infants by generational status among Indian, Pakistani, Bangladeshi, Black Caribbean, and Black African mothers in a British cohort study

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Aim	To test the hypothesis that an intergenerational increase would occur in birthweights of babies born to UK-born compared with overseas-born (migrant) minority women.
Method	Live singleton births to mothers present at the 1991 Census in a national longitudinal study were classified by mother's country of birth and ethnic origin as reported in the census. During 1983–2000, 52 554 White, 1788 Indian, 1538 Pakistani, 995 Bangladeshi, 300 Black Caribbean, and 299 Black African live singleton births were identified. Mean birthweights were adjusted for maternal age, socio-economic circumstances, gender, year of birth, and birth order.
Results	Adjusted mean birthweights were: 3400 g (95% CI: 3395, 3405) for infants of UK-born White mothers; 3033 g (95% CI: 2980, 3087) of UK-born Indian mothers and 3066 g (95% CI: 3034, 3097) of migrant Indian mothers; 3110 g (95% CI: 3049, 3172) of UK-born Pakistani mothers and 3123 g (95% CI: 3087, 3159) of migrant Pakistani mothers; 3026 g (95% CI: 2922, 3130) of UK-born Bangladeshi mothers and 3110 g (95% CI: 3076, 3145) of migrant Bangladeshi mothers; 3268 g (95% CI: 3177, 3359) of UK-born Black Caribbean mothers and 3238 g (95% CI: 3089, 3388) of migrant Black Caribbean mothers; and 3167 g (95% CI: 3004, 3330) of UK-born Black African mothers and 3302 g (95% CI: 3208, 3395) of migrant Black African mothers. The proportions of low birthweight infants (<2500 g), generally greater among migrant mothers than White UK-born mothers, were similar by generational status within the ethnic groups.
Conclusion	There are no significant differences in mean birthweights of infants by generational status among mothers from these main ethnic minority groups in the UK.
Keywords	Birthweights, ethnicity, generational status

Birthweight is strongly correlated with maternal health and nutrition, factors which seem to contribute substantially to the consistent difference in birthweights between developing and developed countries. Birthweight provides a measure of growth

and fetal nutrition *in utero*, is the single most important determinant of neonatal and infant survival and general health, and is linked to an infant and child's position on postnatal growth centiles, as well as probably to later development of chronic disease.¹ Babies born in the UK to women born in the Caribbean, sub-Saharan Africa, and the Indian subcontinent have been and continue to be lighter than the UK average.² Stillbirth and infant mortality rates are higher for babies whose mothers were born in Pakistan, the Caribbean, and West Africa.³ Similar findings occur for African Americans compared with other ethnic groups in the US.⁴

The high prevalence of diabetes and coronary heart disease in South Asians (defined as those of Indian subcontinent origin),

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and of diabetes and hypertension in African origin people is well known,^{5,6} and the relationship between constrained intrauterine growth and these outcomes is under intense debate.^{7–9} This issue is of considerable importance for the excess of hypertension-related disease in African Americans whose mean birthweights are lower, and hence proportions of defined low birthweight are greater, than other US ethnic minority groups. One method of examining how and whether rapid environmental changes and improvements affect birthweights is through migrant studies. For example, if the more affluent environment of Britain compared with home countries leads to better pre-conceptional health, we would expect UK-born babies of UK-born mothers to be heavier than those of migrant mothers. Three local studies have investigated intergenerational differences in birthweights of babies born to South Asian mothers in Britain.^{10–12} Two^{10,12} found no change and one,¹¹ the smallest, that there had been a significant increase in birthweight in babies of second generation South Asians.

Ethnic origin is not recorded in the UK at-birth registration and the previous studies were conducted on local area samples in which South Asian ethnicity was identified by name or other information on maternity records. However, ethnic origin was collected in the 1991 Census and because of the record linkage in the Office for National Statistics Longitudinal Study (LS), we were able to classify births registered in the UK by reported ethnicity in the 1991 Census. This provided the opportunity to use nationally representative data on all major ethnic minority groups (Indians, Pakistanis, Bangladeshis, Black Caribbeans, and Black Africans) to test the hypothesis that birthweights of babies born to UK-born mothers would be higher than that of those born to migrant mothers in the same ethnic group.

Method

The LS is based on a representative sample of approximately one per cent of the population of England and Wales (about 550 000 people) and contains information from censuses and routinely registered vital events.¹³ Live singleton births, 1983–2000, to mothers present at the 1991 Census were classified by mother's country of birth and ethnic origin as reported in the census. The term 'generational status'/'intergenerational' is used in the text to distinguish between mothers born in home countries and those born in the UK. The latter could be second or third generation mothers but their exact generation could not be identified in most cases, as this requires country of birth of parents and grandparents of mothers. The data quality for birthweights before 1983 and for reported number of previous births is known to be poor. We thus included only births to women nulliparous at the start of 1983. Nulliparity was assumed if women had not registered a birth before 1983, and, if present at the 1971 Census, had not reported any children. Births to mothers whose age at registration was recorded as <13 years (22 births) or >49 years (21 births) were excluded. A further 760 births were excluded because birthweight was either not recorded or recorded as zero. There were only 536 births without a birthweight and 502 of these were to White UK born mothers. There were fewer than five births with missing birthweights in any of the other ethnic groups, and there was no difference between generations within ethnic groups in the

proportions of missing birthweight. Similarly 224 births had a birthweight of zero recorded and 205 of these were to UK-born White mothers and very few to the other ethnic groups. The overall impact on generational differences in birthweight within ethnic groups is therefore expected to be negligible. The final sample was based on 57 674 births.

Birth order was constructed using data from UK-registered births. Mean birthweights were adjusted for maternal age at birth registration, gender, year of birth of infant, birth order, and socio-economic circumstances using linear predictions from regression models, derived separately for each ethnic group. More than half of the women could not be classified by occupational social class at birth registration and this was supplemented by social class at the nearest census. Socio-economic position was also measured from other census indices nearest to the birth—access to cars, housing tenure, and overcrowding. Low birthweight (LBW) was defined as <2500 g. Gestational age is recorded in obstetric records and not in civil registrations. Obstetric records are not linked to the LS so it was not possible to control for gestational age in these analyses.

It is possible, in spite of the restrictions imposed to ensure that women were nulliparous at the start of 1983, that reporting of previous births at the 1971 Census could be inaccurate. Our analyses showed that birth order was positively related to birthweight. An underestimation of birth order would therefore contribute to an upward shift in mean birthweight. A sensitivity test was conducted by using births from women who were <13 years at the 1971 Census and were, therefore, very unlikely to have ever had a birth before arriving in the UK. This additional restriction resulted in much smaller samples (a total of 43 325 births), and provided a measure of replicability and reliability of the results for the Indian and Pakistani groups. This was not possible for the other groups as the number of Bangladeshis was too small (births to UK-born mothers 45, migrant 79), as were the number of births to migrant Black Caribbeans (10) and Africans (10). This reflects differences in migration histories and in the absolute sizes of the groups (Indians arrived mainly in the 1950s and 1960s and Bangladeshis, the most recent migrants, in the 1980s. Indian migration was, in contrast to Black Caribbeans, more family centred, which resulted in sizeable numbers of those <13 years at the 1971 Census. Indians are also the biggest non-white ethnic minority group in the UK.)

Results

Table 1 shows key characteristics of the sample. In comparison with White UK-born mothers, UK-born Indian and migrant Black Caribbean mothers had, on average, fewer births and migrant Pakistani and Bangladeshi mothers had more births. UK-born South Asian-origin women had their births at a younger mean age than White UK-born mothers. Babies born to ethnic minority mothers were generally significantly lighter than babies born to White UK-born mothers, regardless of generational status. Female babies of UK-born and migrant Black African mothers and male babies of migrant Black Caribbean mothers were lighter but not significantly so. The proportion of LBW infants was greater among UK-born and migrant South Asian mothers and among UK-born Black Caribbeans compared with White UK-born mothers.

Table 1 Key characteristics of births of migrant and UK-born ethnic minority mothers, 1983–2000. Mothers present at the 1991 Census in the Office for National Statistics Longitudinal Study, England and Wales

Ethnicity of mother	No. of births	Mean no. of live births	Mean maternal age (all births)	Females—mean birthweight	95% CI	Males—mean birthweight	95% CI	% low birthweight ^a	95% CI
White UK, born Indian	52 554	2.3	28	3338	3332, 3345	3457	3451, 3464	4.7	4.5, 4.9
UK, born	491	2.1 ⁺	25.2 ⁺	2999 ⁺	2936, 3061	3037 ⁺	2963, 3111	12	9.1, 14.9
Migrant	1297	2.3	28.2	3052 ⁺	3013, 3091	3089 ⁺	3047, 3131	10.9	9.2, 12.6
Pakistani									
UK, born	417	2.4 [*]	23.8 ⁺	3013 ⁺	2942, 3084	3111 ⁺	3039, 3183	11.8	8.6, 14.9
Migrant	1121	3.1 ⁺	27.6	3101 ⁺	3055, 3147	3174 ⁺	3122, 3226	10.9	9.1, 12.7
Bangladeshi									
UK, born	99	2.7	23.7 ⁺	2843 ⁺	2707, 2979	3184 ⁺	3027, 3341	12.1	5.6, 18.7
Migrant	896	3.1 ⁺	26.9	3046 ⁺	3002, 3090	3161 ⁺	3113, 3209	9.6	7.7, 11.5
Black Caribbean									
UK, born	209	2.3	29.4 ⁺	3232 ⁺	3104, 3360	3275 ⁺	3157, 3394	9.1	5.2, 13.0
Migrant	91	2.0 ⁺	32.8	3129 ⁺	2965, 3293	3320	3137, 3504	5.5	0.7, 10.3
Black African									
UK, born	75	2.1	28.3 ⁺	3180	2942, 3417	3230 ⁺	3018, 3443	8	1.7, 14.3
Migrant	224	2.3	30.3	3300	3182, 3417	3315 ⁺	3208, 3422	6.3	3.1, 9.4

^a Low birthweight: <2500 g^{*} Significantly different from migrant $P < 0.05$.⁺ Significantly different from White UK-born $P < 0.05$.

There were few significant intergenerational differences within each ethnic group. UK-born Indian and Pakistani mothers had significantly fewer births than migrant mothers in those groups. UK-born South Asian mothers had a younger mean age than those who were migrants. Within each ethnic group, mean birthweights were generally not different by generational status of the mother except for Bangladeshi females. In this group, mean birthweight of female babies born to UK-born Bangladeshis was less than that of those born to migrant Bangladeshis. Figure 1 shows that the distribution of birthweights for babies born to UK-born Bangladeshi mothers is shifted to the left of that for migrant mothers. In contrast, the distribution for babies of UK-born Black Caribbeans was intermediate to those for migrant Black Caribbeans and UK-born White mothers. After adjusting for potential confounders (socio-economic circumstances and age of mother, and gender, birth order, and year of birth of infant), ethnic minority babies remained lighter than babies born to UK-born White mothers babies, and mean birthweights of babies of UK-born mothers were not significantly different from those of migrant mothers in the same ethnic group (Table 2).

Birth order was significantly related to birthweight in the South Asian and Black African groups. Table 3 shows adjusted birthweights for birth order one and two for Indians and Pakistanis. The number of babies was too small to examine differences between overseas and UK-born mothers in the other groups. As observed earlier, mean age for UK-born mothers was younger than for migrant mothers and there were no differences in mean birthweights. These patterns remained even after selecting mothers who were aged ≤ 13 years at the start of

follow-up, for whom birth order could be assumed to be reasonably accurate (Table 4).

Discussion

This study is the first to use nationally representative data in the UK to examine differences in birthweights by generational status of the mother in the same ethnic group. The findings show that birthweights did not increase across the generations, as yet refuting our hypothesis and suggesting potentially continuing adverse health implications. This concurs with the previously reported findings for South Asians based on two local area studies.^{10,12} Comparable data for Black Caribbeans and Black Africans in the UK have not been reported before.

Some similarities can be found in US studies, where migrant Black women have better pregnancy outcomes than their US-born Black counterparts.^{4,14–17} It has been suggested that migrant women were less likely to engage in behaviours (such as smoking) that negatively affect pregnancy outcomes, and that they were less economically disadvantaged. A lack of improvement in birthweights across generations in the UK is surprising given the evidence of intergenerational upward social mobility for most groups.¹⁸ Health-related data on second-generation ethnic minority groups is sparse but there is some evidence of an increase in the prevalence of adverse health behaviours across the generations. UK-born South Asians are more likely to smoke and consume alcohol and Black Caribbeans are more likely to smoke than their migrant counterparts.^{19,20} A change in health behaviours is also

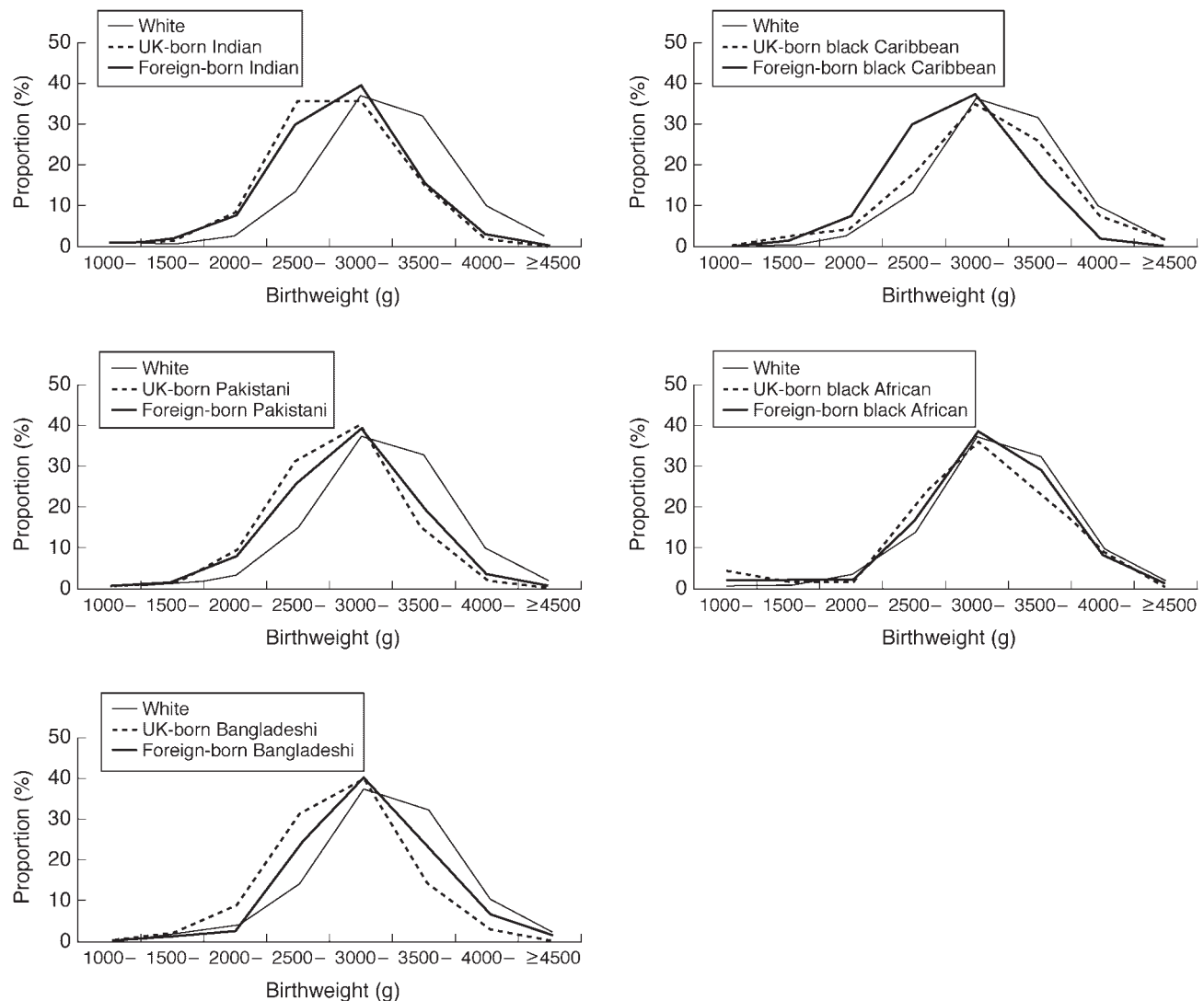


Figure 1 Distribution of birthweights of babies of migrant and UK-born mothers by ethnic group, 1983–2000

assumed to have contributed to the higher reported rates of limiting long-term illness in second generation ethnic minority groups compared with the first generations¹⁸ and also to the increasing cardiovascular mortality rates with increasing duration of residence among South Asians.²¹ This discordance between improvement in social conditions and reduction in health advantage requires research about the environmental stresses underlying the generational shift in behavioural norms.

Maternal birthweight itself may be the more important predictor^{22,23} if birthweights of UK-born and migrant minority mothers themselves were not different. This would be explicable on the basis of stronger selection effects (better health and favourable socio-economic circumstances) from later migration of the migrant mothers compared with the earlier migration of the mothers of UK-born ethnic minority mothers. It is possible that the end of right of entry from British colonies to the UK after the 1962 Commonwealth Act of the British Parliament resulted in more selective migration as most migrants would have had to come as foreign students or of independent means

rather than as workers. Furthermore, the environments of the home countries would have changed over time with different consequences for the health capital of migrant mothers; for example if birthweights have increased in developing countries over the last 50–60 years, then the birthweight of migrant mothers would be greater than the birthweight of the migrant mothers of the UK-born ethnic minority mothers. Arguably, birthweights could have increased across the vertical generations such that birthweight of the UK-born mother is greater than that of her own mother but less than that of her infant. Testing such relationships require multigenerational data.

Maternal birthweights of ethnic minority mothers are probably lower than that of White mothers in the UK, which could contribute to the lower mean birthweights among ethnic minority babies compared with White babies. This has been suggested as an important determinant of the Black–White differences in birthweights in the US.^{23,24} Maternal birthweight and adult height, measures of health capital, are likely to be influenced by the health and social and economic circumstances

Table 2 Mean birthweights for babies of migrant and UK-born ethnic minority mothers, 1983–2000. Mothers present at the 1991 Census in the Office for National Statistics Longitudinal Study, England and Wales

Ethnicity of mother	No. of births	Mean birthweight adjusted for gender	95% CI	Adjusted mean birthweight ^a	95% CI
White UK, born Indian	52 554	3399	3394, 3404	3400	3395, 3405
UK, born	491	3018 ⁺	2971, 3065	3033 ⁺	2980, 3087
Migrant	1297	3071 ⁺	3042, 3100	3066 ⁺	3034, 3097
Pakistani					
UK, born	417	3065 ⁺	3009, 3120	3110 ⁺	3049, 3172
Migrant	1121	3139 ⁺	3105, 3173	3123 ⁺	3087, 3159
Bangladeshi					
UK, born	99	3015 ⁺	2916, 3115	3026 ⁺	2922, 3130
Migrant	896	3102 ⁺	3069, 3135	3110 ⁺	3076, 3145
Black Caribbean					
UK, born	209	3253 ⁺	3166, 3340	3268 ⁺	3177, 3359
Migrant	91	3222 ⁺	3091, 3354	3238 ⁺	3089, 3388
Black African					
UK, born	75	3207 ⁺	3063, 3351	3167 ⁺	3004, 3330
Migrant	224	3308 ⁺	3251, 3391	3302 ⁺	3208, 3395

^a Within each ethnic group, adjusted for age at birth registration and socio-economic circumstances of mother, and year of first birth, birth order, and gender of infant.

⁺ Significantly different from White UK-born $P < 0.05$.

Table 3 Mean birthweights of first and second order births to migrant and UK-born ethnic minority mothers,^a 1983–2000. Mothers present at the 1991 Census in the Office for National Statistics Longitudinal Study, England and Wales

Ethnicity of mother	Birth order 1				Birth order 2			
	No. of births	Mean maternal age	Adjusted mean birthweight ^b	95% CI	No. of births	Mean maternal age	Adjusted mean birthweight ^b	95% CI
White UK, born Indian	24 495	26.9	3324	3317, 3331	19321	28.6	3463	3456, 3470
UK, born	251	23.9 ⁺⁺	2975 ⁺	2900, 3051	172	26.0 ⁺⁺	3010	2916, 3104
Migrant	485	26.3 ⁺	2943 ⁺	2889, 2997	489	28.7	3093	3041, 3146
Pakistani								
UK, born	194	21.9 ⁺⁺	3010 ⁺	2934, 3087	121	24.0 ⁺⁺	3092	2981, 3203
Migrant	250	23.4 ⁺	2955 ⁺	2886, 3025	279	25.8 ⁺	3079	3008, 3150

^a Groups with <50 births excluded.

^b Within each ethnic group, adjusted for age at birth registration and socio-, economic circumstances of mother, year of first birth, and gender of infant.

⁺ Significantly different from migrant $P < 0.05$.

⁺⁺ Significantly different from White UK-born $P < 0.05$.

of generations. So although there has been considerable upward inter/intra generational social mobility among ethnic minorities in the UK, it is likely that because of a historical lag in health and socio-economic circumstances the health advantage an ethnic minority mother transfers to her infant has not yet resulted in parity in risk between White and ethnic minority babies.

A potentially confounding factor in this and other studies using birth registration data is that birth order could be inaccurately estimated if babies born before migration of the mother were not reported at the registration of UK-born births. The longitudinal design of the LS allowed us to construct true birth order for mothers who were unlikely to have ever had

a birth before the start of follow-up in 1971. There were no significant shifts in mean birthweights between the generations in the ethnic groups when we imposed these restrictions on the sample. It was not possible to determine how these findings were related to gestational age, as it is not recorded at birth registration. The use of ethnic origin classifications in the census is also problematic. There is undoubtedly much heterogeneity among these prescribed categories. For example Black Caribbeans born in the Commonwealth Caribbean refer to those who were born in islands with diverse economic, political, and socio-cultural environments. Similarly the category 'Indians' obscures linguistic and religious heterogeneity, factors which could have influenced these results differently.

Table 4 Mean birthweights for babies born to migrant and UK-born ethnic minority mothers^a who were ≤13 years at the 1971 Census, 1983–2000. Mothers present at the 1991 Census in Office for National Statistics Longitudinal Study

Ethnicity of mother	No. of births	Mean no. of live births	Mean maternal age at first birth	Adjusted birthweight ^b	95% CI
White UK, born Indian	41 845	2.3	26.0	3405	3400, 3410
UK, born	403	2.1 ^{*+}	23.7 ^{*+}	3007 ⁺	2951, 3064
Migrant	218	2.4	26.0	2954 ⁺	2872, 3036
Pakistani					
UK, born	318	2.3 [*]	22.0 ^{*+}	3084 ⁺	3025, 3143
Migrant	180	3.1 ⁺	26.1 ⁺	3052 ⁺	2971, 3134

^a Groups with <50 births excluded.^b Within each ethnic groups, adjusted for age at birth registration and socio-economic circumstances of mother, year of first birth, birth order and gender of infant.^{*} Significantly different from migrant $P < 0.05$.⁺ Significantly different from White UK-born $P < 0.05$.

Conclusion

There were no significant differences in mean birthweights of infants by generational status of Indian, Pakistani, Black Caribbean, and Black African mothers living in the UK.

Understanding and monitoring these trends (or lack of them) and their longer-term health outcomes require longitudinal intergenerational data on mothers and babies from ethnic minority groups.

KEY MESSAGES

- Among mothers of Black Caribbean, Black African, Indian, Pakistani, and Bangladeshi ethnicity, mean birthweights of infants of migrant mothers were similar to that of infants whose mothers were born in the UK.
- The proportions of low birthweight infants (<2500 g) were generally greater among migrant mothers than White UK-born mothers, but were similar by generational status within these ethnic groups.
- Understanding and monitoring birthweight trends and their relationship to longer-term health outcomes require longitudinal, intergenerational data on mothers and babies from ethnic minority groups.

References

- Barker DJP. *Mothers, Babies and Health in Later Life*. Edinburgh: Churchill Livingstone, 1998.
- Birth Statistics. *Review of the Registrar General on Births and Patterns of Family Building in England and Wales*. Series FM1 no. 29. London: Office for National Statistics, 2000.
- Mortality Statistics: childhood, infant and perinatal, England and Wales. *Review of the Registrar General on Deaths in England and Wales, 2000*. Series DH3, No 33. London: The Stationary Office, 2002.
- Pallotto EK, Collins JW, David R. Enigma of maternal race and infant birth weight: a population-based study of US-born Black & Caribbean-born Black women. *Am J Epidemiol* 2000;**151**:1080–85.
- Riste L, Farida Khan F, Cruickshank JK. High Diabetes prevalence in all ethnic groups including Europeans in a British inner city: poverty, history, inactivity or 21st century Europe? *Diabetes Care* 2001;**24**: 1377–83.
- Cruickshank JK, Mbanya JC, Wilks R *et al*. Hypertension in four African-origin populations: current 'Rule of Halves', quality of blood pressure control and attributable risk (fraction) for cardiovascular disease. *J Hypertension* 2001;**19**:41–46.
- Huxley R, Neil A, Collins R. Unravelling the fetal origins hypothesis: is there really an inverse association between birthweight and subsequent blood pressure? *Lancet* 2002;**360**:659.
- Eriksson JG, Forsen T. Correspondence—Unravelling the fetal origins hypothesis. *Lancet* 2003;**360**:2072.
- Cruickshank JK, Beith C, Koudsi A. Correspondence—Unravelling the fetal origins hypothesis. *Lancet* 2003;**360**:2073–74.
- Draper ES, Abrams KR, Clarke M. Fall in birth weight of third generation Asian infants. *BMJ* 1995;**311**:876.
- Dhawan S. Birth weights of infants of first generation Asian women in Britain compared with second generation Asian women. *BMJ* 1995;**310**:86–88.
- Margetts BM, Mohd Yusaf S, Al Dallal Z, Jackson AA. Persistence of low birthweight in second generation South Asian babies born in the United Kingdom. *J Epidemiol Community Health* 2002;**56**:684–87.
- Hattersley L, Creeser R. *Longitudinal Study 1971–1991: History, Organisation and Quality of Data*. London: HMSO, 1995.
- Guendelman S, English PB. Effect of United States residence on birth outcomes among Mexican immigrants: an exploratory study. *Am J Public Health* 1996;**86**:303–05.
- Cabral H, Fried LE, Levenson S *et al*. Foreign-born and US-born Black women: differences in health behaviors & birth outcomes. *Am J Public Health* 1990;**80**:70–72.
- Fuentes-Afflick E, Hessol N, Pérez-Stable EJ. Maternal birthplace, ethnicity and low birth weight in California. *Arch Pediatr Adolesc Med* 1998;**152**:1105–112.

- ¹⁷ Hummer RA, Beigler M, De TurkPB *et al.* Race, ethnicity, nativity and infant mortality in the United States. *Social Forces* 1999;**77**:1083–118.
- ¹⁸ Harding S, Balarajan R. Limiting long-term illness among Black Caribbeans, Black Africans, Indians, Pakistanis, Bangladeshis and Chinese born in the UK. *Ethnicity Health* 2001;**5**:41–46.
- ¹⁹ Nazroo JY. *The Health of Britain's Minorities*. London: Policy Studies Institute, 1997.
- ²⁰ National Institute for Ethnic Studies in Health and Social Policy. *Ethnic Differences in Drinking and Smoking*. London: Department of Health, 2000.
- ²¹ Harding S. Mortality of migrants from the Indian subcontinent to England and Wales: effect of duration of residence. *Epidemiology* 2003; **14**:287–92.
- ²² Emmanuel I, Filakti H, Alberman E, Evans SJW. Intergenerational studies of human birth weight from the 1958 birth cohort. Evidence for a multigenerational effect. *Br J Obstet Gynaecol* 1992;**99**:67–74.
- ²³ Emanuel I, Leisenring W, Williams MA *et al.* The Washington State Intergenerational Study of Birth Outcomes: methodology and some comparisons of maternal birthweight and infant birth weight and gestation in four ethnic groups. *Paediatr Perinat Epidemiol* 1999;**13**: 352–71.
- ²⁴ Costa DL. Race and pregnancy outcomes in the twentieth century: a long-term comparison. NBER Working Paper no.9593 (www.nber.org/confer/2003/daes03/costa.pdf) 2003.