

## **An Increase in the Sex Ratio of Births to India-born Mothers in England and Wales: Evidence for Sex-Selective Abortion**

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THE AVERAGE SEX RATIO at birth worldwide (the number of male live births per 100 females births) is around 105 (Garenne 2002) and may fluctuate over time within narrow limits (Gini 1955; James 2000a; Pollard 1969). Geographic and ethnic differences in the sex ratios at birth between white (105–106), African and African-American (102–104), and Asian (often 106 and above) populations are well documented (Garenne 2002; James 1984; Marcus et al. 1998). These differences are variously attributed to hormonal and other physiological distinctions and also, in the case of high sex ratios in countries such as China, South Korea, and India, to practices associated with cultural preferences for boys over girls (Basu 1999; Bhat and Zavier 2003; Hesketh and Xing 2006; Park and Cho 1995). Genetic variation may also underlie some of this variation as a result of the long-term effects of cultural preferences (Kumm et al. 1994).

Recently a pronounced increase in the sex ratio at birth to levels exceeding 107 males per 100 females has been reported in India (Das Gupta and Mari Bhat 1997), China (Zeng et al. 1993), Taiwan (Gu and Roy 1995), and South Korea (Park and Cho 1995). Sex ratios have risen above 115 in several provinces of China (Gu and Roy 1995). In India the regional pattern of sex ratios at birth is well documented (Bhat and Zavier 2003; Retherford and Roy 2003). Generally, in most of the south and eastern parts of the subcontinent, low sex ratios around 105 have been documented, although local variability has recently been reported (Guilmoto 2005). Very high values have been recorded in northwest India, with sex ratios at birth of 114 in Haryana and

120 in Punjab in 1984–98 (Retherford and Roy 2003). Those differences correspond to regional differences in the status and treatment of females (Retherford and Roy 2003) and show a persistence in the regional pattern of mortality arising from postnatal bias against females (Visaria 1967). The trends have been interpreted as evidence of an increase in sex-selective induced abortion (Das Gupta and Mari Bhat 1997; Edlund 1999; Griffiths et al. 2000; Jha et al. 2006; Park and Cho 1995; Retherford and Roy 2003; Zeng et al. 1993).

Vital statistics in India have long been known to be inaccurate (Chandrasekhar 1946; Visaria 1967). The high masculinity ratio in the past was generally attributed to the undercounting of girls, possibly associated with sex-selective neglect of newborn children, infanticide, or abandonment (Dyson 1987; Pakrasi and Halder 1971). However, the underenumeration reported by Dyson (1996) between 1981 and 1991 appeared to be relatively stable. Underreporting of female births is thought to have contributed only moderately to the sharp increase in the sex ratio at birth since the 1980s (Griffiths et al. 2000). Because male fetuses are more likely than female fetuses to be stillborn, health care improvements may preferentially reduce the number of male stillbirths, contributing to an increase in the secondary sex ratio<sup>1</sup> (Griffiths et al. 2000). Therefore the high sex ratio at birth in India may not reflect only sex-selective abortion and may need to take into account the factors mentioned above (Bhat 2002, 2006; Griffiths et al. 2000).

High sex ratios registered since the 1980s in China, South Korea, and India are particularly marked at higher birth orders in families where only daughters have been born (Das Gupta and Mari Bhat 1997; Gu and Roy 1995; Jha et al. 2006). This may account for the more frequent use of sex-selective abortion when parents approach the desired family size (Retherford and Roy 2003) or, in the case of China, reach the mandated number of births. In these three countries fertility has fallen sharply on average, and the technique and availability of prenatal sex determination have greatly increased (Bhat and Zavier 2003; Das Gupta and Mari Bhat 1997; Park and Cho 1995; Zeng et al. 1993). No simple link has been identified, however, between a decline in fertility and the sharp increase in the sex ratio at birth, as the latter appears to depend also on the persistence of son preference (Basu 1999; Bhat and Zavier 2003; Das Gupta and Mari Bhat 1997).

Comparative studies of the sex ratio at birth between countries are limited, partly because physiological and/or genetic variation appears to exist between populations, and partly because methodological differences in data acquisition and birth registration practices may bias estimates of the ratio. Although many immigrants to Britain come from cultures with a high degree of son preference, no quantitative evidence has been reported that addresses the possibility of sex-selective abortion by immigrants from these countries.

Using the robust data registration system for births in the United Kingdom by birthplace of mother, we compare sex ratios at birth between major categories of immigrant mothers and mothers born in the UK.

## Data source and methods

Annual data on 23,420,189 live births for England and Wales from 1969 to 2005 were obtained from the Office for National Statistics (ONS) by sex, birthplace of mother, and birth order within marriage. The proportion of male births was determined for each year between 1969 and 2005 (defective data for 1981 were excluded<sup>2</sup>) by mother's place of birth and by birth order. Our interest here relates to immigrant mothers only. The limitation of data on births by parity to those births occurring within marriage is problematic. In England and Wales in 2004, only 57.8 percent of all live births occurred within marriage. The situation is quite different, however, in the Asian immigrant populations. Births outside marriage to women born in the Indian subcontinent have never exceeded 2.5 percent, so the sex ratio of births within marriage by parity is representative of all births to women of those parities. The same is true for Pakistani and Bangladeshi mothers, but not for births to women born in Africa and the Caribbean (see Table 1).

Correlation analysis and linear regressions were used to examine the trend in the annual sex ratio at birth over time between 1969 and 2005. The statistical significance, if any, of a birth-order effect was determined by Chi-square tests.

On the basis of changes in trends for the sex ratio between 1969 and 2005, we subdivided the complete time series into shorter periods and calculated averages for those periods individually. This facilitated the comparison of sex ratios between different periods for foreign-born mothers with higher confidence than for individual years, as inter-annual variability tends to

**TABLE 1 Percentage of live births outside marriage to women living in England and Wales, by birthplace of mother, selected years, 1971–2004**

Birthplace of mother	1971	1984	1994	2004
United Kingdom	8.4	18.5	32.4	42.2
India	1.7	1.5	2.5	1.8
Pakistan	0.8	0.7	1.6	2.1
Bangladesh	— <sup>a</sup>	0.4	0.8	1.8
East Africa	3.7	5.0	11.0	25.5
Southern Africa	— <sup>b</sup>	— <sup>b</sup>	20.3	22.0
Rest of Africa	4.6	16.0	39.3	36.7
Caribbean	36.3	49.6	47.1	59.4
Far East	— <sup>b</sup>	— <sup>b</sup>	13.4	14.5
Mediterranean	4.7	9.4	18.6	29.8
Rest of New Commonwealth	5.8	7.7	10.2	6.8
Rest of world	6.5	9.3	18.4	24.2

<sup>a</sup>Bangladesh 1971 included with Pakistan.

<sup>b</sup>Southern Africa and Far East 1971 and 1984 data not separately available.

SOURCES: ONS Birth Statistics Series FMI 2004 table 9.6, ONS Monitor FMI 85/4 14.

increase with smaller numbers. All calculations were performed on the proportions of births that were male (males/total births), which were then converted into the conventional sex ratios (males/100 females) to allow for easier comparison with other studies. Confidence intervals (CI) of 99 percent were employed throughout.<sup>3</sup>

## Results

### Sex ratios at birth overall in England and Wales, 1969–2005

For all years taken together, considerable variation is apparent in the sex ratio of children born to mothers of various geographic origins (see Figure 1), some of it statistically significant. The lower sex ratios of births to mothers from the Caribbean, East Africa, and the “Rest of Africa” are in line with data from their respective national populations (James 1984). Many of the mothers from South Africa living in England and Wales are white. Hence the sex ratio close to 105 for this group is not surprising.

Asian populations have been reported to have higher sex ratios than white Caucasians (James 1985). However, the sex ratios observed here for mothers born in Asian countries vary, and we do not observe high average sex ratios compared to mothers born in the UK or Western countries in general (see Table 2 and Figure 1). The sex ratios of the Far East group vary considerably owing to the small annual number of births within the UK for this group.

### Change over time

Our data confirm the well-known slight decline in the sex ratio of all live births in England and Wales in recent decades (see Figure 2). The average sex ratio at birth between 1969 and 1979 was 106.1 (99% CI: 105.9–106.3), and between 1980 and 2005 it was 105.2 (99% CI: 105.1–105.4). Within these periods, however, there is no evidence of a decreasing trend, a finding familiar from previous work (Dickinson and Parker 1996). Similar low-amplitude trends are seen in other Western countries (Dickinson et al. 1996; James 2000a; Møller 1996; van der Pal-de Bruin et al. 1997; Vartiainen et al. 1999).

### Differences in the trend of sex ratios of births to mothers born in the UK and abroad

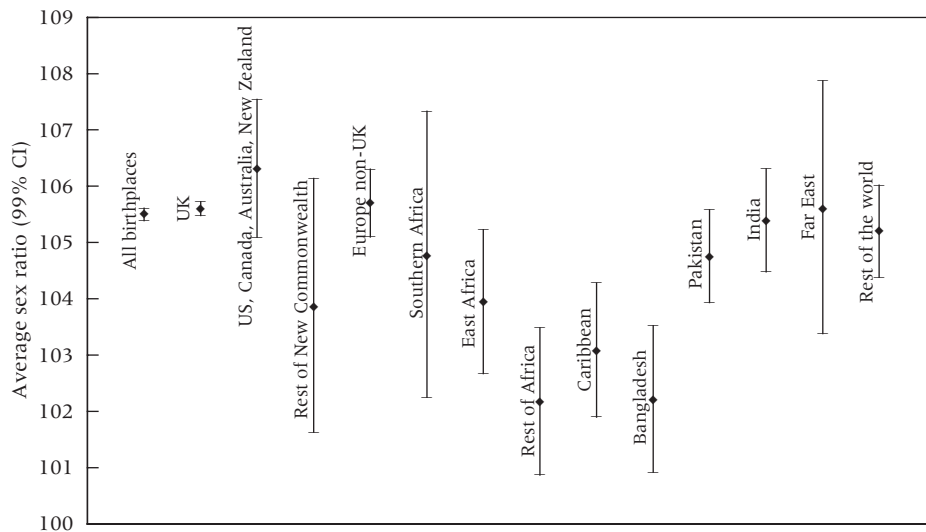
Inevitably, sex ratios of live births to mothers born in the UK follow the general trend for all births in England and Wales (Figure 2), although the proportion of births to mothers born in the UK fell from 88 percent of all

**TABLE 2 Total births, ratio of male/female births, and average sex ratios at birth between 1969 and 2005 in England and Wales, by birthplace of mother**

Birthplace of mother	Total number of births	Male / female births	Average sex ratio at birth
All birthplaces	23,420,189	12,023,607 / 11,396,582	105.5
UK (England and Wales, Scotland, N. Ireland)	20,282,327	10,417,453 / 9,864,874	105.6
US, Canada, Australia, New Zealand	199,719	102,912 / 96,807	106.3
Rest of New Commonwealth	56,316	28,691 / 27,625	103.9
Europe non-UK	831,345	427,077 / 404,268	105.7
Southern Africa	45,137	23,093 / 22,044	104.8
East Africa	174,411	88,892 / 85,519	103.9
Rest of Africa	162,301	82,021 / 80,280	102.2
Caribbean	199,356	101,192 / 98,164	103.1
Bangladesh <sup>a</sup>	163,484	82,635 / 80,849	102.2
Pakistan	428,707	219,326 / 209,381	104.8
India	353,567	181,423 / 172,144	105.4
Far East	58,745	30,173 / 28,572	105.6
Rest of the world	433,433	222,315 / 211,118	105.2

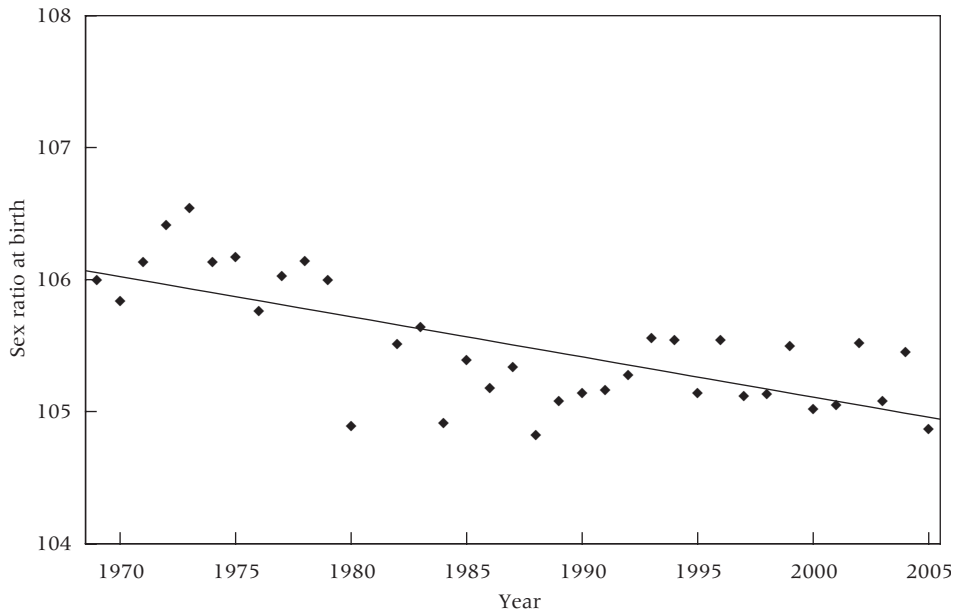
NOTE: Rest of New Commonwealth: British Antarctic Territory, British Indian Ocean Territory, Cook Islands, Falkland Islands, Fiji, Gibraltar, Kiribati, Maldives, Nauru, Papua New Guinea, Pitcairn Islands, St. Helena, Solomon Islands, Sri Lanka, Tonga, Tuvalu, Vanuatu, Western Samoa; Europe non-UK: EU countries including Irish Republic of Ireland, all other European countries including Turkey, Russia, and the rest of the former Soviet Republics; Southern Africa: Botswana, Lesotho, Namibia, South Africa, Swaziland; East Africa: Kenya, Malawi, Tanzania, Uganda; Rest of Africa: Cameroon, Gambia, Ghana, Mauritius, Mozambique, Nigeria, Seychelles, Sierra Leone; Caribbean: Anguilla, Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Christopher and Nevis, St. Lucia, St. Vincent, Trinidad and Tobago, Turks and Caicos Islands; Far East: Brunei, Malaysia, Singapore; Rest of the world: all other countries not listed here or individually identified in the figure. <sup>a</sup>Mothers from Bangladesh are counted separately from 1973. Previously, they were counted with mothers from Pakistan.

**FIGURE 1 Average sex ratios at birth between 1969 and 2005 in England and Wales, by birthplace of mother**



NOTE: For definition of birthplaces, see Table 2.

**FIGURE 2** Trend in the annual sex ratio of live births in England and Wales, 1969–2005



NOTE: Regression equation:  $y = -0.0304x + 106.05$ ,  $R^2 = 0.499$  (based on 1969 as year 0).

births in 1969 to 79 percent in 2005. Between 1969 and 2005, there is a significant temporal autocorrelation, based on a one-year lag analysis, for mothers born in the UK ( $r = 0.58$ ), indicating that the variation is nonrandom over time. Births to mothers born outside the UK show a variety of levels and most often with random inter-annual variability (see Figure 3). Only the increase in the sex ratio of live births to mothers born in India over time is statistically significant (linear regression:  $R^2 = 0.535$ ,  $r = 0.73$ ). Between 1969 and 2005, there is a temporal autocorrelation in the sex ratio of births to India-born mothers ( $r = 0.62$ ), indicating, as with births to UK-born mothers, a nonrandom variation of the sex ratio over time. No significant temporal autocorrelation and trend were found for the other categories of foreign-born mothers (Figure 3).

The sex ratio of births to mothers born in India was relatively stable in the 1970s and 1980s but increased after the 1980s, in this respect deviating markedly from the trend in the sex ratio of births to all women. As in India itself, this increase accelerates over the 1990s (see Figure 4). The average sex ratio at birth was 104.1 (99% CI: 103–105.2) between 1969 and 1989, 107.9 (99% CI: 106.3–109.6) between 1990 and 2005, and averaged 108.3 in the last ten years (1995–2005: 99% CI: 106.3–110.3). A quadratic regression ( $R^2 = 0.56$ ) gives the best fit to the trend from 1969 to 2005.

**TABLE 3** Number of live births and sex ratio of third and higher-order births among India-born women living in England and Wales, 1969–2005

Period	Number of births <sup>a</sup>	Sex ratio (99% CI)
1969–79	51,635	103 (100.7–105.3)
1980–89	32,338	104 (101–107)
1990–2005	26,662	113 (109.5–116.6)
1990–2000	19,049	112.5 (108.4–116.8)
2000–2005	7,613	114.4 (107.9–121.4)

<sup>a</sup>Calculated from the annual number of births for mothers with two or more previous children.

SOURCE: ONS annual birth registrations from 1969 to 2005, England and Wales, special tabulation.

In China, India, and South Korea a strong correlation has been observed between sex of birth and birth order, particularly where the previous births were female. The data available here, however, permit analysis only by simple birth order within marriage. In these data the only statistically significant relationship between the proportion of males and birth order is found among mothers born in India between 1990 and 2005 (Chi square = 18.45, based on 48,935 first births, 38,924 second births, and 26,662 third and higher-order births) (see Table 3). Sample size did not permit separate analysis of births beyond the third. Analysis of residuals confirmed that India-born mothers of parity two are more likely to have a boy as their third or later child. In the earlier period between 1969 and 1989, there was no significant relationship between sex and birth order. Furthermore, a significant trend is apparent only among births of order three and higher, from 103–104 males per 100 females between 1969 and 1989 to 113 between 1990 and 2005 (see Figure 5).

## Discussion

The small overall decline in the sex ratio at birth in the United Kingdom is clearly a different phenomenon from the more substantial and contrary trend evident among India-born mothers. The decline in Western countries has been variously attributed to contaminant exposure affecting male and female hormone levels (James 1998, 2001) and other environmental and physiological factors (Davis et al. 1998; Dickinson et al. 1996; Jacobson et al. 1999; Rostron and James 1977; Vartiainen et al. 1999). With more than a 4-point increase over time, the trend among India-born mothers is too sudden and pronounced to have a likely biological or environmental cause. This trend is consistent with an increase in the sex ratios of young children (age 0 to 6 years) measured by national censuses and used as a proxy for the sex ratios at birth in India (104 in 1981, 106 in 1991, and 108 in 2001). It is

**FIGURE 3** Trend in the sex ratio at birth in England and Wales, by mother's birthplace, 1969–2005

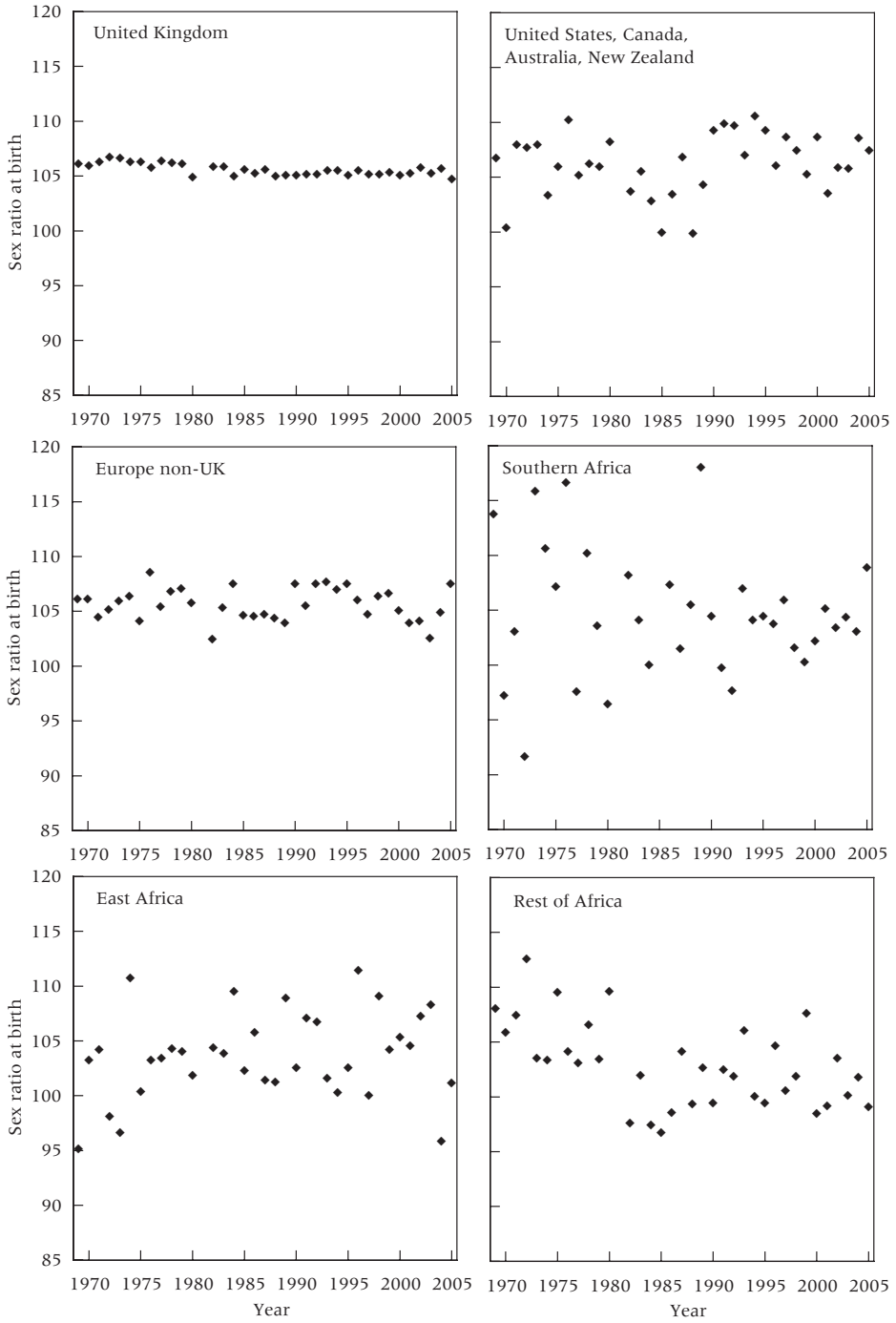
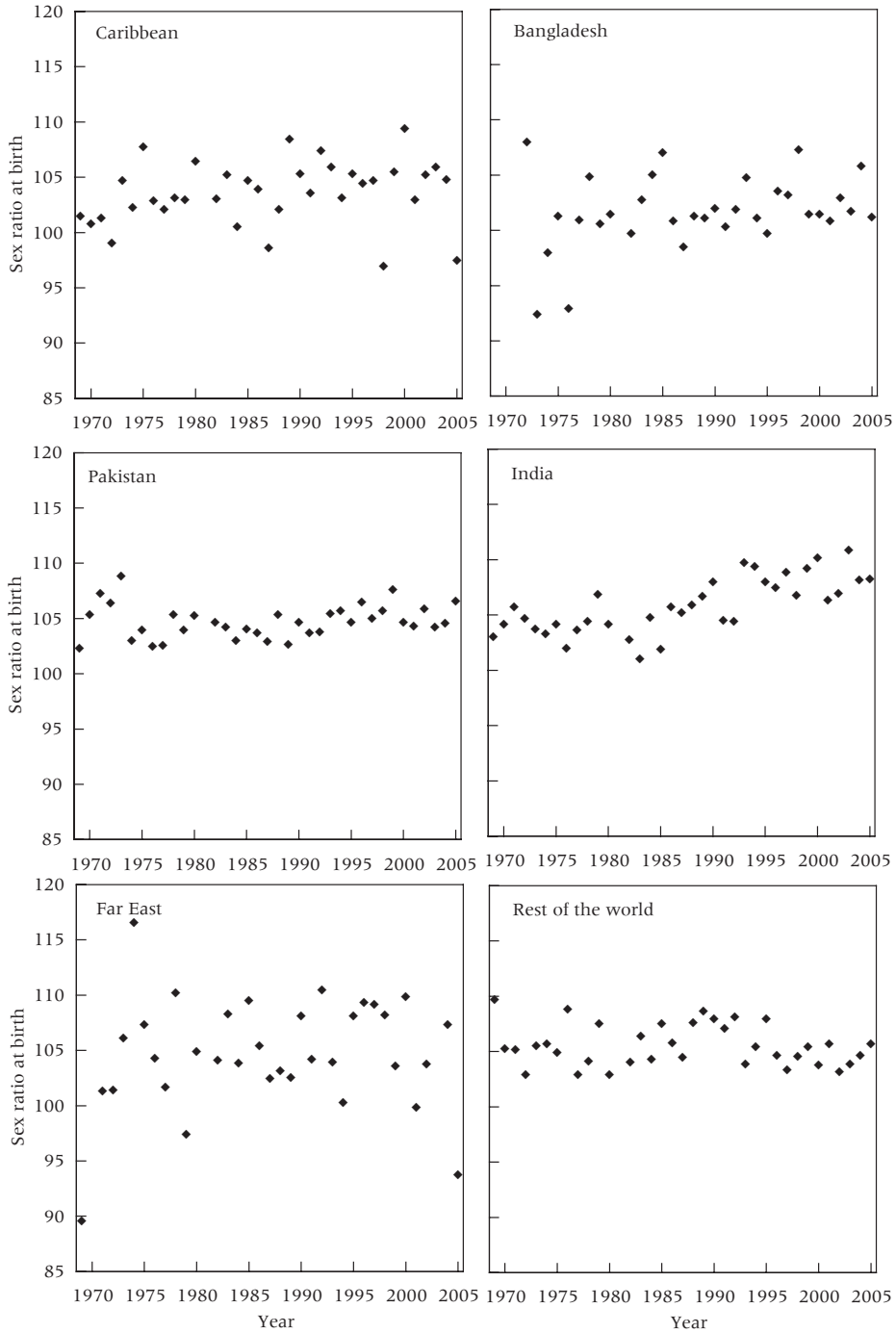


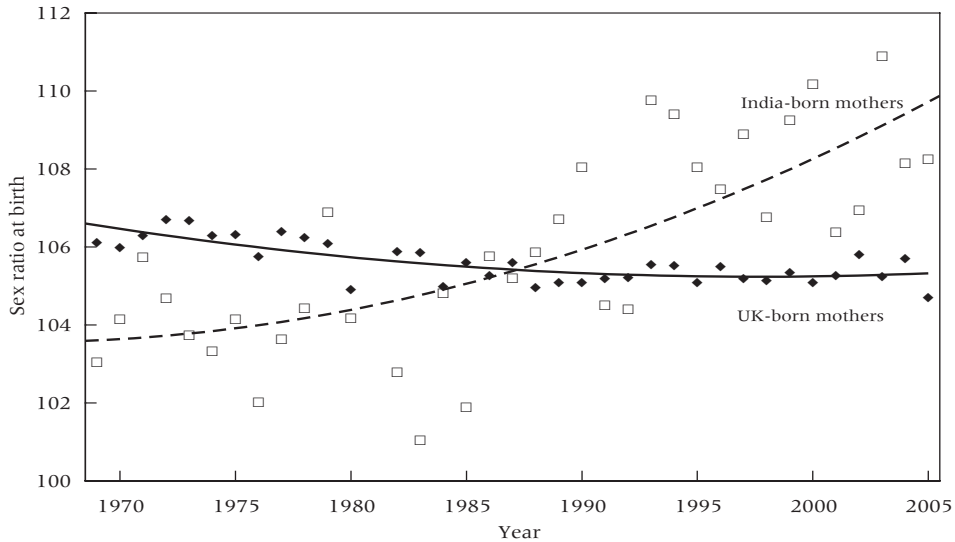


FIGURE 3 (continued)



NOTE: A scatterplot for each group shows the annual sex ratios at birth over time. Data off scale, not shown: Far East in 1970 (126) and 2003 (122) and Southern Africa in 1985 (122). For definition of birthplaces, see Table 2.

**FIGURE 4 Comparison of the trend in the sex ratio of live births for mothers born in the United Kingdom and mothers born in India, 1969–2005**



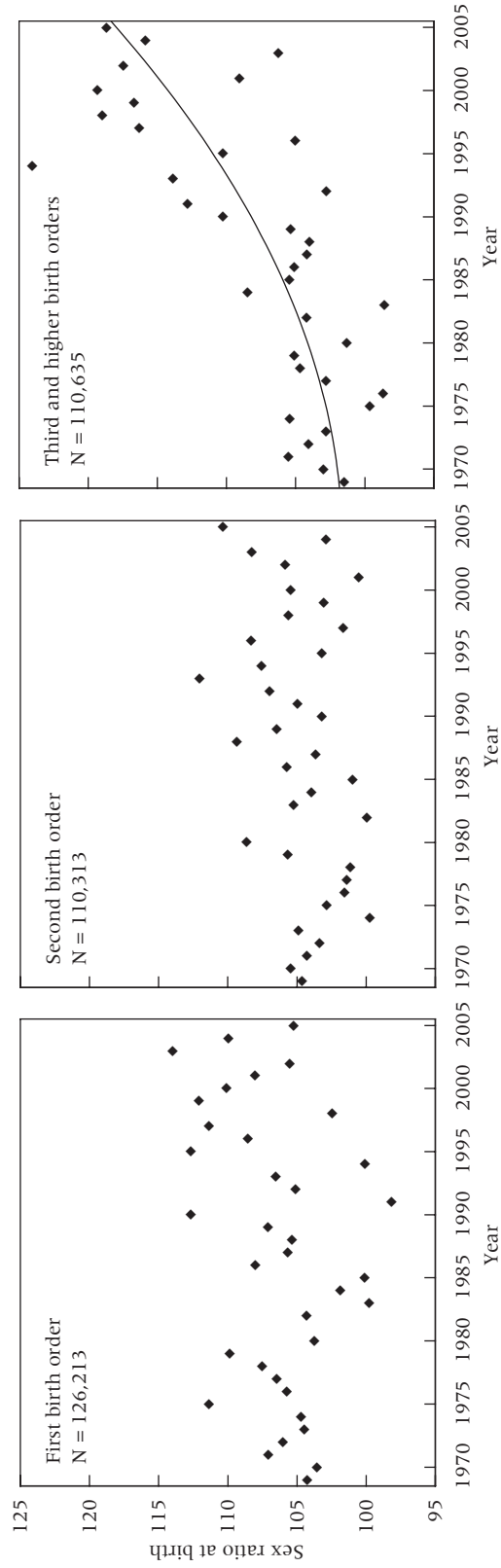
NOTE: Annual sex ratios at birth from 1969 to 2005 in England and Wales of births for mothers born in India (open squares) and the United Kingdom (diamonds).

India (quadratic):  $y = 0.004x^2 + 0.0275x + 103.6$ ,  $R^2 = 0.562$ ; (linear):  $y = 0.1694x + 102.79$ ,  $R^2 = 0.535$ . United Kingdom (quadratic):  $y = 0.0016x^2 - 0.0922x + 106.55$ ,  $R^2 = 0.59$ .

also consistent with measures of the sex ratio at birth in India: the average sex ratios at birth obtained for two partly overlapping periods using large national sample surveys between 1978 and 1992 (NFHS-1) and between 1984 and 1998 (NFHS-2) were 106 and 108 (Retherford and Roy 2003), and the sex ratio at birth in 2000 from the last national census was 110 (Census 2001; Bhat 2006). The last number may be overestimated because of underreporting of female births, as suggested by Bhat (Bhat 2006). In 2003, however, the Sample Registration System reported an all-India estimate of 113 (Haub and Sharma 2006).

In Asia, increased sex ratios at birth and among young children are generally attributed to neglect of females and infanticide (Das Gupta 1987; Das Gupta and Mari Bhat 1997), to sex-specific induced abortion (Das Gupta and Mari Bhat 1997; Gu and Roy 1995), and to differential underreporting of female births (Das Gupta and Mari Bhat 1997). In the British context, abandonment or infanticide of concealed (unreported) births on this scale is inconceivable: birth registration is believed to be nearly complete. The most plausible explanation is that, just as in contemporary India and China, prenatal sex diagnosis of fetuses and subsequent abortion of female fetuses are becoming more prevalent in the context of continuing son preference but declining fertility.

**FIGURE 5 Sex ratio by birth order in England and Wales for mothers born in India, 1969–2005**



NOTE: Annual sex ratios at birth from 1969 to 2005 in England and Wales of births for mothers born in India by children's birth order as indicated. A significant increase over time was observed only for third and higher-order births:  $y = 0.0097x^2 + 0.0991x + 101.87$ ,  $R^2 = 0.559$ .

Total fertility of India-born women living in England and Wales, according to vital registration in combination with the census, has declined over time from 4.3 in 1971, to 3.1 in 1981, 2.5 in 1991, and 2.3 in 2001 (OPCS 1984: 2; OPCS 1992: Table 9.5; ONS 2006: Table 9.5). As fertility has fallen, the proportion of births of orders three and above has declined from 44.2 percent in 1969 to 12.7 percent in 2005. Total fertility of the Indian ethnic minority population in England and Wales, as determined by the "own-child" method using the Labour Force Surveys, has declined even further—to 1.63 in 1995–99 (Coleman and Smith 2005).<sup>4</sup> Total fertility of women in India has declined from 5.1 in 1981 to 3.9 in 1990–92 and 3.5 in 1996–98. Reduction in total fertility from (say) 5 to 2 children increases the chance of an all-female sibship from about one in thirty-two to about one in four. Provided continuation of son preference, it would be logical to expect that parental intervention would be more likely in order to increase the chance of having a son in smaller families. In India, China, and Korea sex ratios have increased as fertility has declined, particularly among births to higher-parity women, and in relation to son preference (Arnold et al. 2002; Basu 1999; Park and Cho 1995; Poston et al. 1997). In those three countries sex-selective abortion following prenatal diagnosis of sex is the main route.

The increase in the sex ratio observed in India and other Asian countries since the 1980s and the similar trend among India-born immigrant mothers in England and Wales coincide with the advent of recent advances in techniques of medical prenatal sex-testing technologies and their broader availability. Sperm-sorting is available from some clinics in the UK but is expensive and only partly effective. Couples undergoing fertility treatment by *in vitro* fertilization are able to choose the sex of embryos determined by preimplantation genetic diagnosis for medical reasons only (HFEA 2003). Neither approach is widely used, and the report of the Human Fertilisation and Embryology Authority (HFEA) recommended against making sex selection available on social grounds alone. Abortion is legal in the UK up to the 24th week of pregnancy (apart from specific cases) on defined grounds. But these do not include sex preference, in the absence of sex-linked medical conditions. Sex determination was not possible before 25 weeks of pregnancy in 1980 (Scholly et al. 1980). Ultrasound techniques of prenatal sex determination can now be effective at 12 weeks (Efrat et al. 2006) and are available in parts of Asia as well as in the UK. Widespread use of ultrasound techniques for sex determination and sex-selective abortion has been reported since the early 1980s in South Korea and China (Park and Cho 1995; Zeng et al. 1993) and since the late 1980s in India (Bhat and Zavier 2003; Das Gupta and Mari Bhat 1997), especially at higher birth orders.

This circumstantial evidence strongly suggests that since the 1990s, sex-selective abortions have become sufficiently prevalent among India-born

mothers in England and Wales to alter the secondary sex ratio, especially among higher-order births. No other explanation seems possible. Media reports claim that the practice has been widespread for some time, with mothers traveling to India if their request is rejected in Britain (McDougall 2006). This may be the case despite the fact that the practice is also illegal in India,<sup>5</sup> although the law has not been enforced until recently.

In China, India, and Korea the prospect of seriously unbalanced future marriage markets, as well as ethical considerations, has led to strong policies to reduce the practice of sex-selective abortion based on law enforcement and communication programs. These efforts have already been notably successful in Korea, where a reversal of the trend in the sex ratio at birth was reported in 2000 (Hesketh and Xing 2006; Kim 2003). In Britain, current trends in the sex ratio at birth will cause only a modest marriage squeeze affecting India-born males. A simple calculation enables the number of "missing girls" to be estimated, on the counterfactual hypothesis that no increase in the sex ratio (104.1) had occurred since the 1980s above the worldwide average sex ratio of 105. If births to India-born women are distributed by sex between 1990 and 2005, according to the predicted sex ratio values derived from the quadratic regression (Figure 4), then there would be a deficit of 1,480 female births compared to the actual values. The deficit could easily be countered by marrying women from the white population or from other groups (which account for about 10 percent of current unions of Indian men in recent years) or by finding more brides from the Indian subcontinent, where the pressure of the female deficit in some regions will be even higher than among Indian males in Britain.

Why do other Asian-origin populations in England and Wales among whom son preference is known to be high in the countries of origin not show similar trends? As far as is known, sex ratios at birth in Pakistan and Bangladesh are not elevated, despite the adverse mortality pattern suffered by females from childhood onward, arising from their inferior status. Sex-selective abortion is much less widely accepted and less readily available in Pakistan and Bangladesh (Hesketh and Xing 2006). Although it is generally illegal in these countries except to save the mother's life, abortion (mostly illegal) is not uncommon (Akhter 2001). Nonetheless, no evidence of sex-selective abortion is reported from a recent study in Bangladesh (Bairagi 2001); traditionally, large family size provided the desired number of sons. Fertility in Pakistan is still moderately high (TFR in 2005, 4.6), but is lower in Bangladesh (TFR in 2005, 3.0). In contrast with the Indian community living in England and Wales, the fertility of Bangladesh- and Pakistan-born mothers living in the UK remains relatively high, with respectively 44.4 and 40.4 percent of marital births at order three and higher in 2005. Nevertheless, their fertility has fallen noticeably since the late 1980s, when births at order three and higher accounted for more than half of total births. If the desire

for sons remains strong within these communities, the preference for even smaller family sizes might become problematic.

It should be noted that decisions to end childbearing within a family once the child of the desired sex (or numbers of children with the desired sex) has been born affect the size of the family. It has been suggested that such practices could influence the sex ratio over time within a population with a particular sex preference—a phenomenon known as the Lexis variation (James 1975; James 2000b). The desire to obtain a certain number of boys would result in continued childbearing by a couple with a genetic predisposition for girls and hence larger families. Assuming vertical gene transfer that conveys a phenotype for the “predisposition for girls,” combined with large family size, could in principle reduce the sex ratio at birth of sibships. However, it has not been shown conclusively that Lexis variation plays a part in the variation of the sex ratio at birth (see also Jacobson et al. 1999). The remarkably low sex ratios at birth of 104 and below reported for the main Asian groups, including the Indian group prior to 1990, in England and Wales suggest that higher figures often reported in studies in Asia are due to cultural factors (infanticide, girl neglect, underreporting of births, and/or sex-selective abortion) rather than a “natural” high sex ratio at birth in the Asian population.

Data relating to mothers born in mainland China, Taiwan, and Hong Kong are all included in the broad ONS category “Rest of the world.” The category “Far East” is idiosyncratically defined by ONS to include only Brunei, Malaysia, and Singapore, which would include an unknown proportion of mothers of Chinese ethnic origin. It is therefore not possible to comment on the sex ratio of births in England and Wales to mothers born in China or from among the overseas Chinese.

Taken together, our results indicate an increase in the sex ratio of births to India-born mothers in England and Wales, especially for higher-order births, concomitant with the availability of prenatal sex-selective techniques. Our results mirror findings in India. This provides us with quantitative indirect evidence for sex-selective abortions among immigrants to a country where no son preference that might have affected the sex ratio at birth had previously been known. Importantly, our results based on reliable exhaustive vital statistics in England and Wales reinforce the findings by others (see, e.g., Dyson 1996; Griffiths et al. 2000) that the sharp increase in the sex ratio of births reported for India itself cannot mainly be explained by increases in the underregistration of female births. Instead, our results suggest that it is largely due to the extensive use of sex-selective abortion in the wake of widespread availability of prenatal sex-determination techniques.

Our results also suggest that parental sex preference appears to remain strong among some first-generation immigrants. An upward trend in the sex ratio at birth, leading to a deficit of female births, may most plausibly be attributed to the interaction of persistent son preference among India-born im-

migrant women whose fertility is declining and to the increased availability of prenatal diagnosis of fetal sex. Female-selective abortion raises issues of ethics and has led to the concern among the British medical services about disclosing the sex of the fetus at the time of the second routine pregnancy ultrasound scan (at 20 weeks of pregnancy). The apparent discrimination against female fetuses also calls into question the adherence of some India-born immigrants to the norms of a Western society.

## Notes

Part of this work was supported by a grant from the Nuffield Foundation. We are grateful to the Office for National Statistics for providing special tabulations.

1 The secondary sex ratio is the ratio of males to females at birth in instances where the ratio at conception is referred to as the primary sex ratio.

2 Data provided by the ONS for the year 1981 were aberrant. This information was communicated to the ONS, which confirmed that the data for 1981 were erroneous.

3 Results similar to some presented here (e.g., trend in sex ratio among births to India-born mothers) were first reported in an unpublished MSc thesis (Gilks 2004) supervised by Dr. John Bithell and one of the authors (DC), using a less up-to-date version of these data. All calculations and other material presented here, however, are original to this study.

4 The age-specific fertility rates used to determine the total fertility of women born in India were calculated by relating the number of births by age to women born in India, recorded through vital registration of England and Wales, to the number of women born in India in the population in the same years de-

rived from the respective censuses of England and Wales for the years stated.

The age-specific fertility rates used to determine the total fertility of the Indian ethnic minority population (including women born in the UK) were derived by the "own-child" method using data relating women of Indian ethnic origin to young children in the same household from several rounds of the Labour Force Survey (Cho et al. 1986; Smith 2005). The latter data refer to Great Britain, not England and Wales, but the great majority of the Indian ethnic minority population live in England and Wales.

5 Abortion is legal in India (The Medical Termination of Pregnancy Act was first enacted in 1971) up to the 20th week of pregnancy on defined grounds (e.g., health of the mother or the future baby at risk, socioeconomic conditions, and other circumstances). But these do not include sex preference, in the absence of sex-linked medical conditions. Furthermore, since 1994, the increase in the sex ratio at birth in India has led the government to forbid disclosure of the sex of the fetus to the parents when they undertake an ultrasound scan. Nonetheless, prenatal diagnosis of the sex of the fetus is still widely available (Retherford and Roy 2003).

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