Understanding the Sex Ratio in India: A Simulation Approach

Paula Griffiths, Zoe Matthews and Andrew Hinde (summarised by Akmal Rafiq)

1 Introduction

Highly masculine sex ratio increased substantially in India over 20th century. Possible reasons include: highly masculine sex ratios at birth (SRB), excess female mortality throughout life and underenumeration of women. A fourth factor often quoted as influential is differential migration. When India is studied at the national level, however, the effect of migration on the whole country's sex ratio is likely to be minimal. This paper uses population projections that simulate population dynamics to find the reasoning behind this.

1.1 Sex ratio at Birth

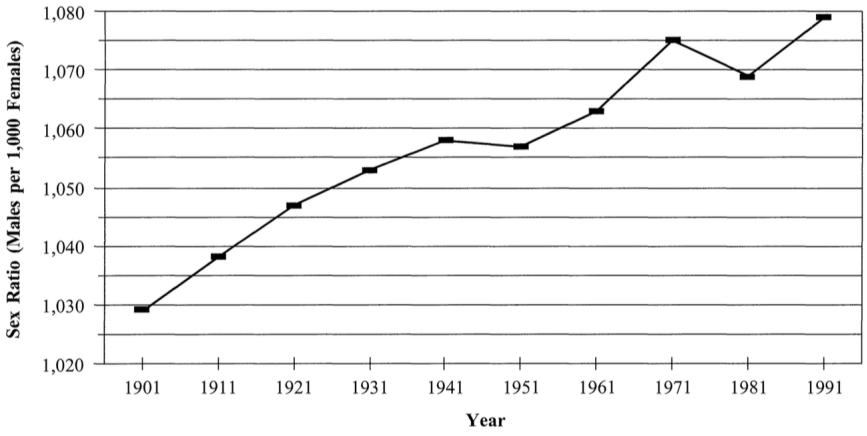

Figure 1: Sex Ratio at Birth in India 1901-1991 according to census

These fluctuations are likely to indicate problems in the consistency of data collection between censuses as well as differences in female underenumeration from one census to the next. Another way to collect the data was the Indian National Family Health Survey (NFHS) in 1994. This gave the ratio as 1045- lower than the census. Combinations of sex ratio at birth and differential mortality that would result in each of these estimates from both census and survey.

1.2 Excess Female Mortality

Year	1901	1977
Female	23.3	50.0
Male	22.6	50.8

During the period from 1947 to 1985, life expectancy in India increased from 34 years to 55 years. This recent change in the life expectancy gap in favor of females depends strongly on differential mortality changes under

age 5. The NFHS also has provided new insights into levels of childhood mortality. Using nationwide aggregates calculated from the survey, it was found that the neonatal period was the only time when males' death rate was higher than females' during the early years of life.

If excess female mortality is decreasing in India, what can explain the positive trend in sex ratio that India is displaying? It is suggested that small levels of excess female mortality produced during the demographic transition might give rise, over time, to high population sex ratios that continue to increase, because of population momentum, even after the excess female mortality begins to decline.

1.3 Are Females Underenumerated by the Indian Census?

Females are more likely than males to be underenumerated in the censuses of India. The Indian government's own postenumeration checks suggest that the gap in the enumeration of the sexes has been decreasing in recent decades. Differential underenumeration is likely to account for a small amount of the unusual sex ratio observed in India. The difference between the sex ratio reported in the Indian Census and in the NFHS needs further investigation.

1.4 State Variations

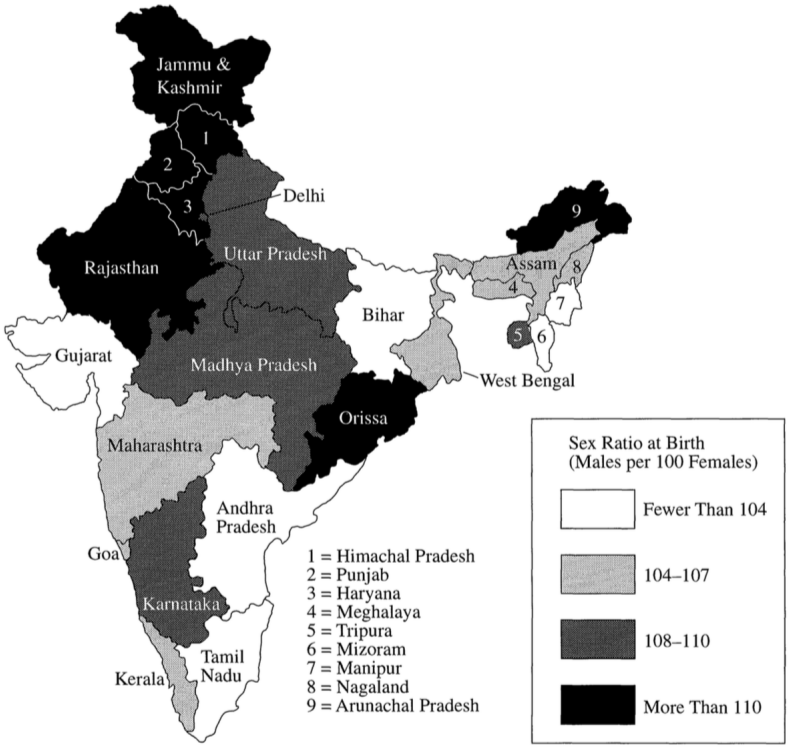

Figure 2: Sex Ratio at Birth by state

India's states are demographically and culturally very diverse. Mortality too varies regionally within India, particularly in the early years of life. Excess female child mortality is particularly high in northern states such as Haryana, Punjab, and Uttar Pradesh. In contrast, child mortality rates are favorable to females in the southern states of Tamil Nadu and Kerala. No researcher, however, has attempted to quantify the contribution of SRB and other demographic factors to overall population sex ratios. It seems clear that sex-selective abortion and regional differences in under reporting of female births play a part in India.

2 Methodology

We constructed stable populations representing India, using population projections carried out for long spans. Stability of demographic rates does not necessarily represent conditions in India in the past few decades because there has been a decline in mortality and an associated drop in fertility. To account for this, we performed simulations that represent the Indian situation more realistically than a stable population.

We performed seven population projections. Starting with a stable female population age structure generated from the United Nations South Asian model mortality pattern with the growth rate set at 2.4% , we conducted projections A,B,C for a 100-year span. We performed three such projections each with a different SRB according to the probable range of values sug- gested by the earlier discussion of current estimates: 105, 107, 109.

We held fertility constant at a total fertility rate of 3.5 and held female life expectancy constant at 57.4 years. We repeated the resulting three simulations to obtain the lower estimate of 1,045 made by the NFHS in 1992/1993. These projections assumed no migration because international migrants to and from India form only a small percentage of the overall population. We performed another set of projections, D, E, F using a population derived as above. A subsequent fertility decline starting at a TFR of 6 was applied over the final 45 years of the projection.

We also performed another, similar projection, G, this time with a simulated decline in mortality as well as infertility. This final population is the most realistic simulation that we explored. In this case the mortality series for males and females were specified by historical estimates up to the present day.

3 Results of Projections

As the SRB increases in favor of males, the level of male life expectancy required to produce the overall sex ratio reported by the Indian Census and the NFHS must decrease; thus the life expectancy difference between the sexes also decreases.

The differences between the model's female advantage in life expectancy and the simulated Indian differential are consistent with the findings for the simulations performed to obtain the census sex ratio.

The findings show that when the fertility decline is included in the simulations, the result is a slight increase in the male life expectancy required to produce the overall population sex ratio, leading to a small increase in the gender difference in mortality.

3.1 Increasing the Sex Ratio at Birth

It was shown that an SRB of 113 males per 100 females would be needed to reproduce the high sex ratio reported by that census if India's sex differential in mortality was "normal". Population G required an SRB of 106 males per 100 females to produce the census estimate for the population sex ratio at the end of the projection period. It is suggested that excess female mortality has existed since the 1920s. This point demonstrates that small differences in mortality at young ages eventually result in a highly masculine sex ratio equivalent to the population sex ratio observed in India.

3.2 Differential Mortality Patterns

Small changes to females' survivorship in the early years of life substantially alter the population sex ratio, both because of the higher mortality rate in the earliest years of life and because of the large impact of early mortality on the expectation of life in the projections. The mortality gap between the sexes in India among

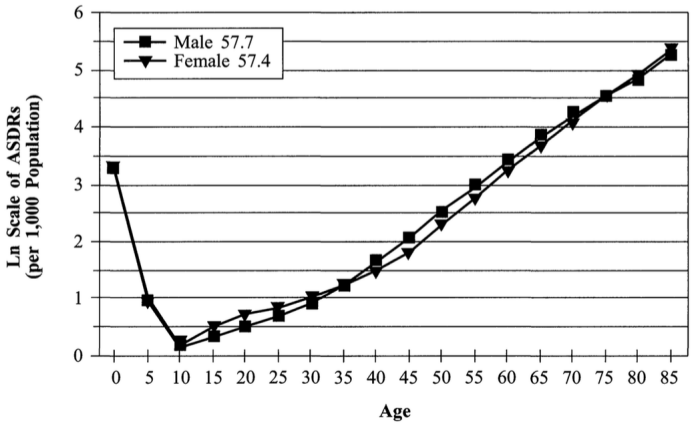

Figure 3: Nat. Log. of Age-Specific Mortality Rates

children has remained constant in recent years. Any further increases in the difference between male and female rates would have a large effect on the population sex ratio.

4 Conclusions

The simulation results have shown that if a low value for the Indian SRB is assumed, then the difference between men's and women's life expectancies would need to be very small to cause the overall sex ratio in the population to take the value reported by the 1991 Indian Census.

There is no direct evidence of changes in the Indian SRB in recent years. A small increase in the SRB could have occurred recently because of improvements in health care associated with a reduction in stillbirths due to birth injury. Stillbirths affect more males than females.

Many cultural factors existing in India predispose women to excess mortality, especially in childhood and during the childbearing years. The gender gap in overall mortality apparently has narrowed in the past decade in India despite a lack of change in the sex balance of mortality in childhood.

Projections suggest that the increase in the sex ratio observed between 1981 and 1991 is not necessarily due to a worsening of women's position relative to men in Indian society. Rather, persistent gender differences in mortality have led to today's highly masculine sex ratio in India. Male and female life expectancy are now approximately equal in India. The evidence therefore suggests that women's position is still inferior to that of men in the Indian population.

A more masculine SRB would require several decades to significantly influence the population sex ratio. Regional differences in the contribution of each of these demographic factors to the state-level population sex ratio. These state-level variations require further investigation, with the inclusion of data on gender differences in migration across state boundaries.

In conclusion, these simulations show that small differences in mortality at young ages, persisting over a long period, result in a highly masculine population sex ratio. Yet the use of this increasingly masculine sex ratio as an indicator of females' current status in India is problematic, given the built-in propensity of India's population sex ratio to increase despite the narrowing gender gap in mortality. Our findings therefore strengthen the argument that research must focus on direct measures of women's relative position in Indian society rather than on a measure such as the sex ratio, which is influenced by both the current and the historical pattern of vital demographic rates.