DECLINING SEX RATIO IN INDIA, 1901 — 81.

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Certified that the thesis entitled " Declining Sex Ratio in India, 1901-81 " submitted by Sri S. Anantharam for the Degree of Doctor of Philosophy is a bonafide work of the candidate to the best of my knowledge and may be placed before the examiners for their consideration.

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C O N T E N T S

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CHAPTER I

I N T R O D U C T I O N

Female population has registered a lesser growth rate in comparison to male population between 1901-71 in India with a slight increase in 1971-81 which has been termed as illusory by Dyson (1981) and Visaria (1981). The sex-differential in growth rate of Indian population has been consistent althrough the period 1901-71. The increase in 1981 over that of 1971 is felt due to, higher undercount of females to that of males in 1971 which has been examined in Appendix I.

Sex ratio has been internationally defined as number of males per 100 females but Indian Census defines it inversely, that is, number of females per 1,000 males. The latter definition has been adopted here. Sex ratio, an indicator of imbalance between the sexes, declined from 972 in 1901 to 930 in 1971, and showed an increase to 933 in 1981. The decline in the sex ratio from 941 in 1961 to 930 in 1971 was very large in comparison to the declines in any of the earlier decades. Consequently, some doubts have been raised on the census count of 1971. If one were to omit 1971 count, sex ratio of Indian population declined from 941 in 1961 to 933 in 1981 which seems more probable decline. Sex ratio, "is the result of the interplay of several demographic

factors such as the sex ratio at birth, sex-differential in mortality, sex-differential in migration and sex-differential in population enumeration" (United Nations, 1982, P.67).

(Increasing sex-differentials in mortality has been found as the most significant factor for the low sex ratio of Indian and Pakistan populations (Runakuddin, 1967; Desai, 1969; Visaria, 1969; Jain, 1976; Mitra, 1978; Sen, 1985). Visaria (1969) and Runakuddin (1967) who have examined the question of changes in the sex ratio at birth conclude that the same is not very high as to explain the low sex ratio. International migration in India has throughout been negligible, consequently, it has not played any role in the declining sex ratio of Indian population.)

Based on the information available from post-enumeration checks of 1951 and 1961, Visaria (1969) concluded that underenumeration of females was not a factor of low sex ratio. An increase in the sex ratio in 1971-81 has, however, induced the researchers to the possibility of greater female undercount in 1971 as an explanation for the phenomenon (Dyson, 1981; Visaria, 1981). There seems to be a consensus in the studies that sex-differentials in mortality has been the only significant factor in explaining declining sex ratio of Indian population.

Though one would not like to contradict the role of sex-differentials in mortality, one finds that role of sex ratio at birth has not been looked into in Indian studies. The hypothesis that sex ratio at birth is constant for a population over time has been contradicted by Thompson (1974) while studying populations of some of the British colonies and by Imaizumi (1981) in case of Japan. The fact that sex ratio at birth varies in the range 102 to 108 is sufficient for its consideration as an explanatory variable for India over time. This study is an attempt to examine this aspect in detail and also to understand its role in the overall decline in sex ratio of India's population.

World View

After examining the various questions to be examined in discussing the declining trend of sex ratio in India, this section deals with the pattern of sex ratio observed in different regions of the world and neighbouring populations of the recent past. In all, 86 populations were selected for the study which had, (a) population of 1,000,000 + as per latest census but no earlier than 1960, (b) at least 3 census counts and (c) sex-wise break up. Of the 86 populations, the largest number 25, were situated in Europe (including U.S.S.R.), while 24, 14, 20 and 3

populations were in America (North and South), Africa, Asia and Oceania respectively (Appendix II). Of the 49 populations in Europe and America, only Cuba, Panama, Ireland and Albania recorded low sex ratios (sex ratio less than 990). Out of these four, three depicted an increasing trend in the period for which data were available, while Albania recorded almost a stagnant sex ratio of 947 at the three points of time, the last being in 1960. Oceania, with three populations, recorded low sex ratios for Papua New Guinea while for the other two populations, sex ratio was just above 1,000 in 1980. In the two continents, Asia and Africa, quite a good number of populations had a low sex ratio. Some of the populations of Africa, particularly Egypt and Angola, registered declines in sex ratio to a very large extent (while Angola registered a decline from 1,108 to 918 in just 30 years, 1940-70, Egypt with an increase from 998 to 1,020 during 1937-47, registered a decline to 964 between 1947-76). South Africa, which registered a decline in decade 1970-80 (from 1,028 to 966), had an increasing trend earlier. In view of the troubled situation prevailing in that country, the reasons can be anyone's guess. Many of the Muslim majority populations of Africa and Asia (Libya, Sudan, Tunisia, Uganda, Bangladesh, Iran, Iraq, Jordan, Kuwait, Pakistan, Syria and Turkey) generally had low sex ratio while populations of Mongolian origin - Burma, Japan, Korea, Mongolia, Phillippines and

Thailand- had sex ratio in the neighbourhood of 1,000 or above 1,000 in the 1980's. It was only in Indonesia that an increasing trend was observed though it was a muslim majority population.

Sex Ratio in India and Neighbouring Populations

Of the six populations in the South Asian peninsula for which data are available, Nepal, India and Bangladesh had declining trends, while Burma, Sri Lanka and Pakistan had increasing trends. While Burma started with a low sex ratio and reached a sex ratio of 1,000 in 1981, Nepal with a sex ratio of 1,033 in 1952 had a sex ratio of 952 in 1981.

All the three populations in the Indian peninsula were parts of a single British colony before 1947. It is expected that populations of Bangladesh and Pakistan follow the same trends as adjacent zones in India in respect of sex ratio. It is noteworthy that northern zone in India had an increasing trend in sex ratio right from 1921. Pakistan (between 1947 and 1971 refers to Western Pakistan) - a part of zone till 1947- also had increasing sex ratio after its emergence as a separate colony. Similarly, Bangladesh (Eastern Pakistan between 1947-71) has shown declining sex ratio as has been found in the eastern zone of India. Table I.1 gives sex ratio for populations in South Asian peninsula and for different zones of India in the period 1901 onward.

Table I.1

Sex Ratio in India by Zones and Neighbouring Populations

Year	Pakis-tan	Bangla-desh	Sri Lanka	Burma	Nepal	India	Zones				
							*N	*C	*E	*W	*S
1	2	3	4	5	6	7	8	9	10	11	12
1901	848	899	877	962	-	972	873	951	1,010	970	1,006
1911	829	957	907	959	-	962	856	935	1,001	960	1,000
1921	817	948	911	-	-	955	855	927	986	948	1,002
1931	818	944	-	958	-	950	863	924	967	946	1,000
1941	834	930	918 (46)	962	-	945	871	925	951	946	992
1951	856	912	897 (53)	-	1,033 (52)	946	883	926	945	944	995
1961	863	929	925 (63)	-	1,030	941	880	922	944	938	986
1971	886 (72)	929 (74)	943	1,012 (73)	987	930	885	899	932	932	979
1981	906	941	962	1,016 (83)	952	933	894	902	934	939	981

*N= Northern, C= Central, E= Eastern, W= Western, S= Southern

1. Northern Zone: Jammu and Kashmir, Punjab, Haryana, Rajasthan, Delhi, Himachal Pradesh and Chandigarh
2. Central Zone : Uttar Pradesh and Madhya Pradesh
3. Eastern Zone : Bihar, Orissa, West Bengal, Assam, Meghalaya, Manipur, Arunachal Pradesh, Tripura, Nagaland, Sikkim, Mizoram and Andaman & Nicobar Islands
4. Western Zone : Gujarat, Maharashtra, Dadra Nagar and Haveli and Goa, Daman and Diu
5. Southern Zone: Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Pondichery and Lakshadwip

The trend in Sri Lanka has been of increasing sex ratio which has been explained through the increasing proportion of female migrants from southern zone of India (United Nations, 1980). Even with an increasing trend in the sex ratio during the last 80 years, Sri Lanka, however, had a lower sex ratio to that of southern zone in India. Within India, all the zones except northern zone depicted trends similar to that of general population with respect to sex ratio.

Sex Ratio and Stages of Demographic Transition

Blacker (United Nations, 1973) has identified the following 5 stages of changes from high birth and death rates to low birth and death rates in a country in the theory of demographic transition;

(a) the high stationary stage, with high birth rates and high death rates,
(b) the early expanding stage, with high birth rates and high but decreasing death rates,
(c) the late expanding stage, with falling birth rates but more rapidly decreasing death rates,
(d) the low stationary stage, with low birth rates balanced by equally low death rates and
(e) the declining stage, with low death rates, lower birth rates, with deaths exceeding births.

The time required for moving from one stage to another has been found to vary from one population to another. On the basis of above groupings the population of different regions of world were grouped into six categories in order to understand the pattern of sex ratio of populations in different stages of demographic transition. The data were collected at two points of time from United Nations Demographic Yearbook, 1974 and 1983. Only those populations were selected for this analysis which satisfied the following conditions; (a) data should have been classified as reliable; (b) populations as per census enumeration with sex-wise break-up; (c) reference date of census should not be earlier to 1960 for 1974 set and 1970 for 1983 set; (d) size of population should be above 1 million and (e) the sex ratio should not be below 750. The last has been included as a sex ratio of 750 and less cannot be attributed to the influence of birth rate and death rate variables only (Appendix III).

In view of the fact that birth rates all over the world registered slower declines to that of death rates, the two were classified separately into high, declining and low categories. On the basis of these categories various populations have been classified into six groups, viz., high-high, high- declining, declining- declining, declining- low, low- declining and low- low. The number of populations and

the average of sex ratios in each of the six categories for 1974 and 1983 respectively are given in table I.2.

Table I.2

Average of sex ratios for populations by crude birth and death rates, 1974 and 1983

Group	Crude Birth rate	Crude Death rate	1974 No. of populations	1974 Average of sex ratios	1983 No. of populations	1983 Average of sex ratios
1	High 40 +	High 25 +	6	1,023	3	1,034
2	High 40 +	Declining & low 25	32	993	24	993
3	Declining 40-20	Declining 25-10	4	959	8	978
4	Declining 40-20	Low 10	12	1,001	15	1,003
5	Low 20	Declining 25-10	11	1,062	10	1,058
6	Low 20	Low 10	16	1,035	21	1,030

The first group of populations with high fertility and high mortality represents the first stage of demographic transition while the second group with high fertility and declining mortality represents the second stage. It is followed by the third stage wherein both fertility and mortality start declining and there were 4 populations in 1974 and 8 in 1983. In the fourth group where mortality has reached lower levels

but not the stable stage with fertility continuing to decline represents fourth stage. The fifth and sixth groups together represents the fifth stage of demographic transition.

The sex ratios in different groups (Table I.2) show an U-shaped curve in both 1974 and 1983 periods. Thus, while one moves from one stage to another stage of demographic transition it is found that high sex ratio prevails during earlier and later stages with low sex ratio in the middle. When medical facilities are non-existent, females enjoyed advantage over males in terms of survival while with the availability of medical facilities, but not in sufficient quantities females were at disadvantage (Dandekar 1975). In the stage where medical facilities are available in sufficient supply, females enjoy advantage due to their biological strength (Madigan 1957). As such, one can easily see that sex ratio is high in the first and last stages (stages of stable rates either high or low fertility and mortality rates) while sex ratio is low in the other stages (stages of instability in fertility and mortality rates). Hans Van Hentig (1952) has substantiated this view in his study of pre-industrial and European societies. It would have been useful if time series analysis were done for countries with high sex ratio at present to test the above statements but for the lack of data for earlier periods this has not been feasible.

India can be placed in the third group as the current birth rate is below 40 and is declining, and the death rate is also declining. It is well-known that India was in the first stage upto 1921 when both birth rate and death rate were high. Movement of India from first stage of demographic transition to the third stage and the declining sex ratio should therefore be considered as natural. With further decline in birth rate in India in future one should also expect improvement in sex ratio.

Review of Literature

Discussion relating to low sex ratio in the Indian population started right from the first census reports. The sex ratio in the Indian population improved between 1881 and 1901 which was explained through improved coverage of females in the censuses (Natarajan 1972, page 40). It was generally assumed that underenumeration of females was the reason for low sex ratio and thus it was generally believed that India also had a sex ratio comparable to European populations. With the declining trend in sex ratio after 1901 census, the hypothesis of underenumeration of females could not be advanced. The low sex ratio of 972 in 1901, was explained by the Census Commissioner as due to higher female mortality and, particularly, female infanticide (Natarajan 1972, p.55). While substantiating the hypotheses of earlier Census Commissioners,

the Census Commissioner of 1911 also felt that, (a) status of women, (b) early marriages and (c) sex-differential in deaths due to famines were also responsible for low sex ratio (Natarajan 1972, p 73). It was in 1921, that the Census Commissioner stated, "the statistics of birth suggest that the proportion of females born to males born, if anything, declined during the period" (Natarajan 1972, p 86). The Census Commissioner, 1921, also felt that mortality due to plague, influenza and famines had a differential impact on sexes leading to higher female mortality (Natarajan 1972, p 86). The Census Commissioner for the census 1931, however, thought that, (a) non-remarriage of widows and (b) marriages within caste were possible causes of low sex ratio of Indian population (Census of India 1931, 1932). However, he felt that conclusive evidence could be given only if reliable data could be collected in this regard. It was in 1951 that the Census Commissioner felt, "the true explanation has to be found in two factors, first, males and females are not born in equal numbers, and secondly, they do not die in equal numbers either in infancy and childhood or in old age or in any particular age group or at all ages taken together" (Natarajan 1972, p 102).

In view of the above, it is necessary to review the literature dealing with the patterns of sex ratio at birth and on differential mortality by sex. As regards the first

aspect, sex ratio at birth is found to vary between 102 to 108 for different populations. It has also been found that populations of negroid origin have sex ratio at birth around 103 (Visaria 1967) whereas for white populations the same has been observed to vary around 107. For India, the sex ratio at birth is assumed to be 105. The excess of male to female births is assumed to be an insurance by nature for biological disadvantage experienced by males in comparison to females (Madigan 1957).

Sex ratio at birth, has been studied extensively from civil registration data largely by western scholars for European populations and for the United States of America (Tietelbaum 1972- gives a sort of survey of literature quoting various studies on this issue). Civil registration data in India being unreliable could not be utilized for any analysis of sex ratio at birth. Except the data for North West Frontier Agency, where an act titled "Proclaimed Clans Act" was passed to curb large scale female infanticide in this region, registration was almost complete during 1875-1880 (for which data are available). These data gave the first ever reliable estimate of sex ratio at birth in India for North West Frontier Agency part which stood at 106.47 (Census of India, 1960). The Census Commissioner of 1911 estimated sex ratio at birth to vary between 104.4 to 108.2 around 1911 in different regions of India (Census of

1911, 1911) and compared the same with prevailing sex ratio at birth for European populations. The Vital Statistics division, Office of Registrar General, India, computed sex ratio at birth in one of the analytical reports based on sample Registration Scheme (SRS) data and arrived at a sex ratio at birth of 108.4 for 1968 and 107.8 for 1969 for rural India (Vital Statistics, 1972b).

Several researchers in India have analysed hospital records on births and have computed sex ratios for different regions and different points of time (Das, 1934; Nair, 1936; Mathew, 1947; Ramachandran, 1964; Karkal, 1976). In his study of sex ratio at birth from hospital records Ramachandran (1964) did not find any regional differences in it.

In the study of sex ratio at birth by order of birth from hospital records, Mathew (1947) observed higher sex ratio for the first order births. Pakrasi (1973) also found the same pattern in his analysis of National Sample Survey data. In contrast, Karkal (1976) did not find influence of birth order on sex ratio at birth in her study. Visaria (1969) in his study found that sex ratio at birth has not been exceptionally high and was not significant but sex-differentials in mortality was mainly responsible for low and declining sex ratio of Indian population.

The Census actuaries prepared life tables for every census for India from 1881 onwards. All these life tables

(Census of India, 1960), and those prepared by Davis (1951), Dasgupta (1971) and Mukherji (1977), for Indian population depicted widening of gap between expectation of life at birth between males and females to the disadvantage of females. This widening gap of expectation in life at birth between sexes was taken as a pointer by some other scholars (Dandekar 1975; Mitra 1978) for Indian population to substantiate the findings of Visaria (1969) regarding sex-differentials in mortality. It was more so by Dandekar who while looking at the declining trend felt that female status vis-a-vis male status was better in 1931 than the position depicted in 1971. She attributed this factor to low availability of medican facilities, such that males utilize them more often putting females to a disadvantageous condition.

Impact of Low Sex Ratio

A monotonically declining sex ratio over time is not good for any society. For example, Punjab in India which had substantially low sex ratio gave rise to illegal traffic of females (Wattal 1934), a similar phenomenon witnessed in frontier area settlements for the earlier periods in the United States (Thompson 1965). An important factor which was witnessed in the 19th century, particularly in the later half, related to prevalence of female infanticide in the north-western region of India. To curb this menace the British Government enacted a special act called, "Proclaimed Clans

Act" (Census of India, 1960) in the North West Frontier Agency. The prevalence of female infanticide in the region even after enactment of the above act has been studied by Pakrasi (1970).

Paucity of females in a particular region gives rise to early marriage as many bridegrooms feel insecure in getting a bride at a later age. In contrast, bride's parents try to marry off their daughters early due to low cost. In his study on factors affecting age at marriage, Gulati (1969) found low sex ratio to induce early marriages. If one looks at marriage practices in India, child marriages, even cradle marriages have been prevalent in northern region, particularly, Rajasthan.

Early age at marriage not only gives rise to higher birth rates but also high death rates in the form of high infant and child mortality and high maternal mortality.

Factors Influencing Sex Ratio at Birth

The demographic situation in a population has an impact on sex ratio at birth. Several variables influence it individually and severally. Consequently, their role vis-a-vis the sex ratio at birth is discussed in the following paragraphs.

(a) Age at marriage : Low age at marriage for females leads to a higher incidence of still births and foetal losses,

particularly, if the age at conception is very low (Jain 1975). It has been found that in cases of very early conceptions there are high foetal losses, high still births and high neo-natal deaths where males predominate. The sex ratio at birth in a population with early marriages of girls and early conceptions would have been much higher than the observed values but for the higher losses as indicated above. It is, therefore, one can expect that the influence of greater male foetal losses and of still births would be of a lesser degree in the recent past than in the distant past.

(b) Birth rates : Birth rate has a direct impact on sex ratio at birth. A lower birth rate implies a lower number of children for mother in the reproductive period thus leading to a higher proportion of lower order births. It has been found that there is a greater preponderance of males over that of females in lower order births, and there is a declining trend in it when one proceeds from birth order one to higher order births (Tietelbaum 1972). Any reduction in birth rate would imply in truncation of higher order births. This in turn would mean an increase in the overall sex ratio at birth.

(c) Mortality rates : High mortality rates imply, (i) high infant mortality (United Nations, 1955), (ii) high maternal mortality and (iii) high incidence of widowhood. High infant

mortality rate leads to a larger number of issues per woman. As the sex ratio at birth in higher order births is lower than for lower order births, high birth rate because of high death rate implies lower sex ratio at birth. Reductions in infant mortality imply, (i) increases in lower order births and (ii) reduction in still birth rates, increases survival chances of male babies more than female babies. In India, where infant mortality rate in 1981 was about 35 per cent of what in 1901, one can easily see that the decline in infant mortality has led to some increase in the sex ratio at birth.

A reduction in maternal mortality and widowhood rates gives rise to higher order births but the reduction in these mortality rates have not been as large as infant mortality rates.

Objective

Having this perspective in view, the objectives of this present study can be described as below.

1. To examine whether sex ratio at birth for a population is constant over time or does it vary.
2. To discern the factors that are responsible for changes in the sex ratio at birth if it is not constant.
3. To analyse the pattern of sex ratio at birth in India and interpret it for the period 1901-81.

4. To analyse the extent of the decline in overall sex ratio, that is of the Indian population explained by the sex-differentials in mortality and sex ratio at birth.

From the objective described above the following hypotheses emerge.

1. Sex ratio at birth for a population is not constant.
2. Higher the proportion of still births to live births, lower the sex ratio at birth.
3. Higher the proportion of lower order births higher the sex ratio at birth.
4. Sex ratio at birth in India has increased in the last 80 years.
5. Sex-differentials in mortality does not explain completely the decline in sex ratio in Indian population over time.

Chapter Outline

Various types of data would be needed to test the hypotheses above. These data are required both at international level for different countries of the world and for India. Chapter II of the thesis describes the data sources, examines quality of data specially on age. The factors responsible for the trend in declining sex ratio have been analysed by taking the whole country. Data on sex ratio at birth are however taken from the Sample Registration Scheme for

Karnataka only. The factors for this choice are explained in Chapter II. This Chapter also describes the methodology adopted for analysis.

On the basis of data for certain selected countries, Chapter III examines the changes in sex ratio at birth. The Chapter also presents the influence of crude birth rate, infant mortality rate, proportion of still births to live births, proportion of 1, 2 and 3 order births to total births and mean age of mother at first birth on sex ratio at birth.

Utilizing the longitudinal data for 1966-76 for rural Karnataka, an effort has been made in Chapter IV to analyse whether there have been changes in sex ratio at birth in the Indian population.

The role of age composition, sex-differentials in mortality and sex ratio at birth on the trend of sex ratio for a particular population has been analysed in Chapter V through certain simulation exercises. This would help in quantifying the share of (1) sex-differentials in mortality and (2) increase in sex ratio at birth on the changes in the overall sex ratio of Indian population.

The impact of the population policies of the Government of India to limit the family size, and to raise the age at marriage on the overall sex ratio has been analysed

and predicted till 2021 in Chapter VI.

The final Chapter presents a brief summary of the findings of this study, the limitations of the data used here and present the scope for further studies in this area.

CHAPTER II

DATA BASE AND METHODOLOGY

Need and Availability of Data

The objective and hypotheses specified in earlier Chapter require data on sex ratio at birth, proportion of still births to live births, sex-differentials in mortality by age, female age at marriage and the proportion of lower order births in total births. Most of these data are generally available from civil registration system if the system is complete and the information is reliable. In countries where the vital statistics from the civil registration system are unreliable, recourse is taken to sample registration scheme or other alternatives. The age data for a population however are obtained from the census count.

In India the civil registration system has not been reliable at all and the data thrown by that system cannot be utilized for any serious research work. The census has provided systematic data every 10 years since 1881 and these data have been widely analysed. In particular, the census actuaries have used the age data for estimating fertility and mortality levels and also to generate decadal life tables for males and females separately. Two special monographs prepared by (1) Visaria (1969) and (2) Natarajan (1972) after 1961 census have helped the present research a great deal in understanding the historical pattern in the overall sex ratio and the thinking of different Census Commissioners from time to time on this subject.

The need for reliable vital statistics system was recognised in India for a long time and steps were taken in the past for bringing improvement in the civil registration system. Some progress was made during the early part of this century in improving the same but the system deteriorated during the two world wars to a considerable extent. Efforts were made to bring improvements in the coverage of births and deaths in civil registration system after independence but because of various reasons the data remained incomplete and unreliable. It was because of this, that the census organization decided in 1961 to introduce certain short term measures for collecting reliable data on births and deaths at least on a sample basis. This led to the introduction of Sample Registration Scheme in India in 1964 on pilot basis and from 1966 onwards in rural areas on a regular basis. The scheme was introduced in the urban areas in 1969@. One of the significant features of sample registration scheme is that, in the selected villages/urban blocks, data are collected continuously with the help of specially appointed enumerators. A supervisor conducts an independent survey in the same selected village/urban block independently every six months

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@ The details of the scheme with respect to sample size, sample design, estimation procedure etc. has been published in "Sample Registration of Births and Deaths in India, 1969-70" (Vital Statistics, 1972a).

and the two sets of data are matched for missing events. The final list of events of births and deaths has been found to cover almost all the events happening in the survey areas. Accordingly, sample registration scheme has been providing reliable estimates of birth rates, death rates and infant mortality rates for India, individual states and union territories.

The National Sample Survey Organisation has been providing immensely useful data on fertility and mortality and on certain other aspects of socio-economic life of the people in India in the form of rounds. The survey entered 43rd round in July 1988. Since, national sample survey is a multipurpose enquiry, data on fertility and mortality have not been collected every year. The data in the National Sample Survey although collected throughout the whole year, the events on births and deaths occurring in a particular household are collected for the 12 months preceding the date of the survey, consequently, they have suffered from substantial recall lapse.

One of the requirements of this study is to know the proportion of different orders of birth in the total births. This requires knowledge of the distribution of births by birth order every year. In the cross-sectional data for any particular year there have been certain problems in identifying exactly the birth order of each birth. However, it is

possible to identify fairly accurately the birth order of each birth if fertility history can be constructed for a certain set of women.

In the sample registration scheme the villages selected in 1966 remained constant till 1976 and the procedure covered all households in the selected village or in a part of village when the village was very large in size. Consequently, it became possible to construct fertility histories of women from 1966 to 1976@ in the sample blocks from information collected in form numbers 1, 2, 3, 4, 5, 6, 7 and 10 (the format of these forms is given in Appendix IV).

The volume of work involved in constructing the fertility history was enormous. In the first instance, one had to trace the same woman in different forms, starting from the household schedule and in all the 120 monthly records. Of the 150 rural blocks of Karnataka, 59 blocks were selected from three natural regions. The period of continuous availability being only 7 years for urban areas (since the scheme started in 1969 only for urban areas), only rural blocks were taken. The procedure of constructing the fertility histories of women in the sample blocks is explained in detail in the section on Methodology.

@Due to the fact that in 1976 some more blocks were added alongwith a few replacements (due to operational difficulties), the collection of data was limited to the period 1966-76 only.

Data on Age Composition of Indian Population

Collection of data on age has been a regular phenomenon in all censuses in India (Census of India, 1983). Enumerators were asked to record ages of respondents in the individual slip after ascertaining the age. It is quite common knowledge that data on age suffers from discrepencies even in developed countries. The common bias in age reporting observed are : (a) deliberate mis-statement, (b) a tendency to report ages ending in certain preferred digits and to avoid others, (c) exaggeration of age at older ages, (d) carelessness in reporting, and (e) ignorance of correct age (Census of India, 1961, 1963). In India, where literacy levels are very low, ignorance of age is prominent and it is quite normal practice for the respondents to leave estimation of his or her age to enumerators which can be nothing but wild guesses. In cases where the head of the household who normally supplies information for other members of the household, it is easy to imagine the quality of reporting, since the head of the household may not be knowing even his own age correctly. Further, the ages reported for daughter-in-laws can only be wild guesses of the respondent.

With the quality of data known, different methods of smoothening were adopted by census actuaries from one census to another on the data furnished to them by the Census Commissioners. Here also, the tabulation procedures differed

from census to census. Till 1951, the actuary was furnished with a statement giving population in prescribed quinquennial age groups. He was also supplied with the single year age distribution of a limited number of persons of each sex ranging from 25,000 to 1,00,000 who were selected at random from representative tracts in some of the major provinces, and he had to make do with it for study of age biases and to construct decadal life tables (Census of India, 1961, 1963). In 1951, population count in individual ages for 10 per cent sample was made available and from 1961, tables for individual age returns were made available for the entire population.

As Dandekar (1975) has put it, in view of (a) undependable vital registration system, (b) high cost of collecting reliable mortality index periodically, (c) faith in the census enumeration agency and lastly (d) the fact that no other source exists, life tables constructed with census counts have been depicting mortality trends in India till now.

Methodology

Various procedures were adopted in this study to establish findings. First of all, to understand the role of different factors on sex ratio at birth, data were collected for some European populations for current period. The

influence of (a) crude birth rate, (b) proportion of still births to live births, (c) infant mortality rate, (d) proportion of lower order births and (e) age of mother at first birth, was looked into with the help of multiple regression analysis.

In order to establish the hypothesis that sex ratio at birth in India has increased in the last 80 years, it is necessary to see whether the above factors influence sex ratio at birth in India also. This is done with the help of data from sample registration scheme for Karnataka. The set of forms 1, 2, 3, 4, 5, 6, 7 and 10 taken together for a continuous period of time could produce data of reliable quality on the above variables which was not available so far for demographic research in India.

For constructing fertility history of females in sample rural blocks of Karnataka forms 1 to 7 and 10 (Appendix IV) were utilized. Form 10, had a column (later eliminated in 1972) wherein the number of children born alive or dead earlier to the current birth was collected. This information was utilized to fix the order of birth for those females who had higher order births. For lower order births, only those females who entered the block after 1966 as wives of the residents of the block were taken. The following were the steps in constructing fertility history.

Step I : All formats (numbering 120) of form No.10 were collected. They were in chronological order according to the number of the block. With the help of information in col.10 of form No.10 the names of those women, who had given birth to children during 1966 and 1972, and who had births of order 2 and above were listed. With the help of form 2 it was checked whether they outmigrated from the block in the rest of the period till 1976. These women formed set I of this study for whom fertility history was constructed.

Step II : All the four sets of form No.2 for a particular block were collected (form No.2 is prepared fresh after every 3 years). The females who entered the block after 1966 as wives of normal residents were identified and checked whether they stayed on for the whole period (till 1976). This group of females formed set II.

Step III : The relevant columns of the fertility history for women of set I and set II with the help of form 10 for the period 1966 to 1976 were filled in.

Step IV : The entries were cross-checked with information available in format 3, 4, 5 and 6 for the block for the ten year period. This was cross-checked with the help of form 2 prepared after every 3 years.

The fertility history constructed in this manner was utilised for analysis. The above data are quite reliable in nature to study the role of order of birth in sex ratio at birth for Karnataka, and later generalised for Indian population.

To identify the role of sex ratio at birth and sex-differentials in mortality, simulation exercises were undertaken. The variables (a) age composition, (b) sex ratio at birth, and (c) sex-differentials in mortality were taken to understand their influence on the trend. By taking sex ratio at birth to vary from 104, 105,.... to 108, and with census actuary life tables of 1891-1901, 1921-31 and 1961-71 for different levels of sex-differentials in mortality, simulations were done with an initial sex ratio of 1,000 and 930. In respect of 1891-1901 life table, one had a condition where female mortality was lower to male and in 1961-71 life table one had vice-versa, with 1921-31 giving almost an identical mortality level for both the sexes. The populations were projected by component method.

Lastly, by assuming different levels of fertility and mortality levels at present and also the likely movements expected by the policy statements and with trends of sample registration scheme, this study has tried to understand the possible movement of sex ratio of Indian population. The next stage attempts at a hypothetical exercise in under-

standing the sex ratio of Indian population if the number of births are restricted to two, three or four with the help of family welfare measures.

CHAPTER III

SEX RATIO AT BIRTH

Variation in Sex Ratio at Birth

Sex ratio at birth, also referred to as Secondary sex ratio (United Nations, 1958) has been found to be above 100 for all human populations. Though sex ratio at birth varies in the range 102 to 108 for different populations it has, however, been generally considered to be constant for any specific population over time. In general, populations of negroid origin have a lower sex ratio at birth in comparison to white populations. Of the 80 populations studied by Visaria, 23 populations had sex ratio at birth lower than 104, of which 15 were of negroid origin (Visaria, 1967). Wherever birth statistics were maintained separately for blacks and whites (United States, Rhodesia (Zimbabwe), South Africa), blacks have had a lower sex ratio at birth in comparison to whites.

In order to understand the recent pattern in sex ratio at birth in different countries, an attempt was made to collect data on births by sex for those countries whose information was classified as reliable by the United Nations Population Division and which had more than a million births during the entire period of 1962-80.

Sex ratio at birth varied between 103.1 for Tunisia and El Salvador to 107.4 for United Kingdom (Table III.1).

Table III.1

Sex ratio at birth for populations 1962-80

Sl. No.	Name of Country	Period	Births (000's) Male	Female	Sex Ratio at birth
1	2	3	4	5	6
1	Egypt	62-78	11,020	10,297	107.02
2	Libya	63-79	757	718	105.40
3	Tunisia	65-72,74, 76-78	1,203	1,167	103.07
4	Canada	62-79	2,914	2,759	105.61
5	Cuba	65-77	1,515	1,436	105.47
6	El Salvadar	62-80	1,460	1,416	103.12
7	Guatemala	62-79	2,134	2,042	104.49
8	United States	62-79	32,596	30,995	105.17
9	Chile	62-80	2,461	2,366	104.04
10	Japan	62-80	17,856	16,742	106.65
11	Malayasia	62-79	2,855	2,712	105.26
12	Sri Lanka	62-74, 76-79	3,271	3,152	103.79
13	Austria	62-80	1,070	1,015	105.42
14	Belgium	62-80	1.346	1,272	105.82
15	Bulgaria	62-80	1,328	1,252	106.08
16	Czechoslovakia	62-79	2,310	2,187	105.61
17	France	62-80	7,995	7,602	105.17
18	German Democratic Republic	62-80	2,327	2,205	105.51
19	Federal Republic of Germany	63-80	7,308	6,916	105.68

Table III.1 (Contd.)

1	2	3	4	5	6
20	Greece	62-79	1,381	1,292	106.88
21	Hungary	62-80	1,523	1,433	106.31
22	Italy	62-79	8,157	7,710	105.77
23	Netherlands	62-79	1,998	1,897	105.29
24	Poland	62-80	5,846	5,485	106.57
25	Portugal	62-79	1,725	1,670	103.29
26	Rumania	62-74	2,560	2,419	105.83
27	Spain	62-76, 78-81	5,775	5,453	105.91
28	Sweden	62-80	1,066	994	107.31
29	Switzerland	62-79	869	823	105.58
30	United Kingdom	62-79	6,509	6,058	107.45
31	Yugoslavia	62-79	3,614	3,379	106.94
32	Australia	62-79	2,205	2,088	105.59
33	U.S.S.R.	62-73	26,821	25,502	105.17

Out of 6 populations having sex ratio at birth below 105-El Salvador, Tunisia, Portugal, Sri Lanka, Chile and Guatemala - only Portugal can be considered as more developed than others. The European populations as well as Canada, United States and Australia all had their sex ratio at birth well above 105. The case of Egypt with a sex ratio at birth of 107 seems to be unique and requires some probe which, however, has not been feasible with the available data. Similarly, Portugal with low

sex ratio at birth needed further probe but it could not be carried out for similar reason.

At this stage a question arises as to whether sex ratio at birth for any country has been constant over time or has it changed. This question becomes more pertinent in the light of the data presented in the table III.1 which has shown variation in the sex ratio at birth among the developed populations, particularly, the white populations of Europe and people of European origin settled in Australia, Canada and United States of America. The next section therefore presents data on the sex ratio at birth for countries for which time series data covering period of about 100 years or more have been available.

Sex Ratio at Birth for Earlier Time Periods

Keyfitz and Flieger compiled historical data for some European populations to build certain demographic indicators (Keyfitz and Flieger, 1968). Time series data on births by sex have been available for five populations- Sweden, France, United Kingdom, Netherlands and Belgium. While data for Sweden has been from 1780, data for France has been from 1851 and United Kingdom since 1861. Belgium and Netherlands statistics have been available since the turn of this century only. The authors were also able to collect data on crude birth rate, crude death rate and infant mortality rates for the various

Table III.2

Trends in sex ratio at birth for some populations

Population	Period	Sex ratio at birth		Crude birth rate		Crude death rate		Infant Mortality rate	
		*I	*L	I	L	I	L	I	L
Sweden	1780-1980	104.3	107.2	34.5	15.9	26.6	10.1	211.6	13.5
France	1851-1980	104.4	105.2	27.1	14.9	22.3	10.3	237.8	9.6
United Kingdom	1861-1980	103.5	107.4	34.6	13.1	21.6	11.8	178.1	11.2
Belgium	1900-1980	104.8	105.8	29.4	12.7	19.5	11.2	194.9	11.7
Netherlands	1901-1980	105.2	105.3	32.6	12.0	17.4	8.2	115.8	8.2

*I= Initial; L= Last

periods covered above. Table III.2 gives the initial and recent sex ratio at birth, crude birth rate, crude death rate and infant mortality rate for the above five populations.

From the above table it is clear that sex ratio at birth has changed substantially over time in Sweden* and United Kingdom. There has been some increase in sex ratio at birth in France between 1851 and 1980, Belgium and Netherlands between 1900 and 1980 but the increases has not been very strong.

During the period while Sweden and United Kingdom experienced increases in sex ratio at birth, they experienced very substantial declines in the infant mortality rates, crude birth rate as well as crude death rate. The small increase in the sex ratio at birth of France between 1851 and 1980 can probably be due to a comparatively low birth rate at the initial stage. In contrast, France had comparatively high death rate and high infant mortality rate during the later half of the 19th century. This kept the growth rate of population of that country at a low level.

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*In an exercise on moving averages, Hoem and Linnemann found the sex ratio at birth to have increased from about 104 in 1749 to about 106 in 1982. The chart from the publication is reproduced as Diagram I.

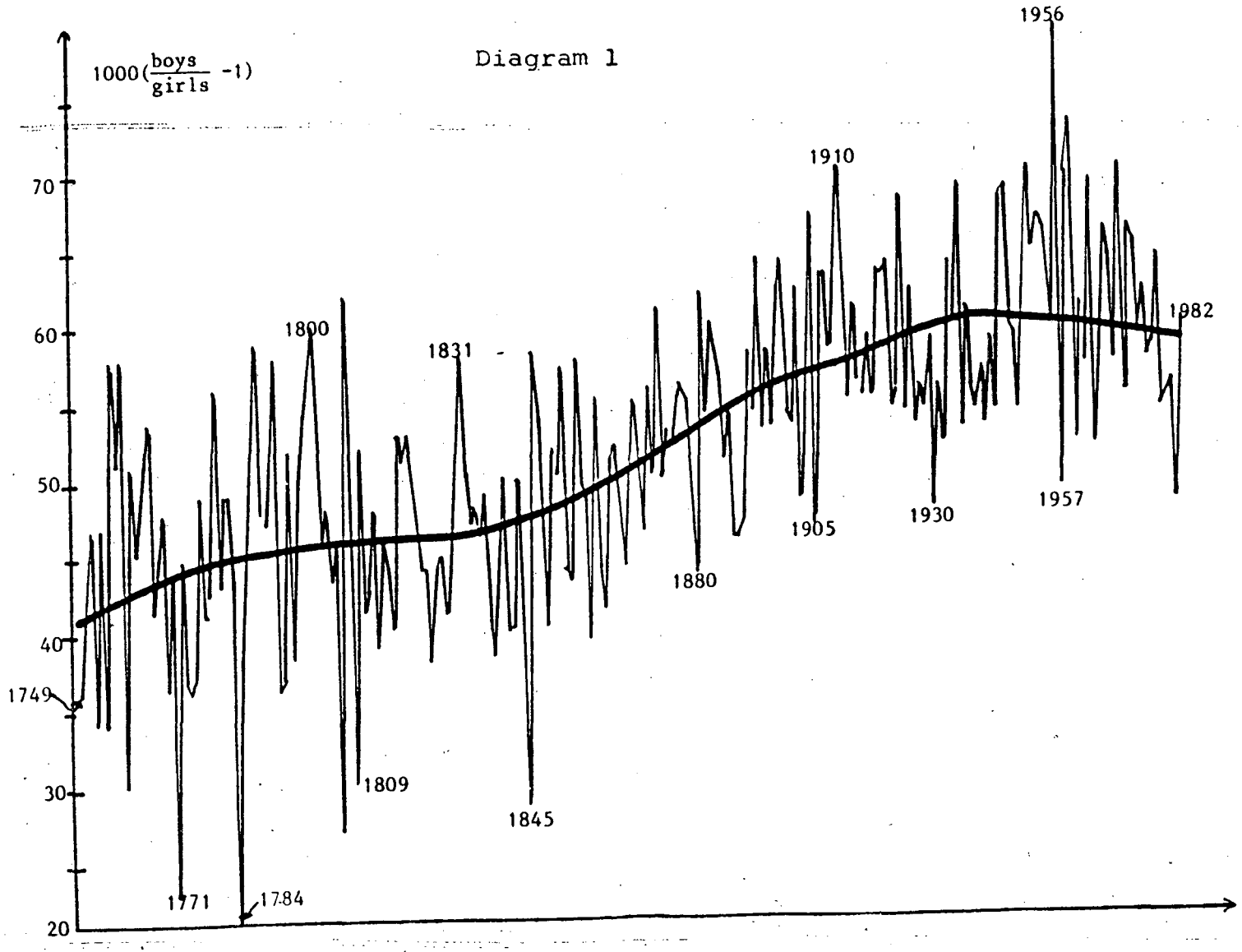

Figure 6. Annual sex ratios for live births in Sweden, 1749-1982. Graduated by the 81 term min-R_1 band matrix solution exact for straight lines.

As there have been substantial increases in the sex ratio at birth of sweden and United Kingdom, it becomes necessary to consider the reasons that might have been responsible for the observed changes in the sex ratio at birth.

Factors Influencing Sex Ratio at Birth

The biological explanations advanced for sex ratio at birth being above 100 for human populations are (a) nature's insurance for higher mortality risks experienced by males althrough their life span, (b) Y spermatozoa travels faster than X, so that Y reaches X earlier than X to X for fertilization, thus increasing chances of male embryo formation and (c) female egg which contains only X, attracts Y more oftener than X (Yung Sun Kang and Wan Kyoo Cho, 1962).

While surveying literature on sex ratio at birth and its association with different factors Teitelbaum (1972) has identified 29 different factors that are supposed to have an impact on it. Of these (a) birth order and (b) age of mother/father/parents, have been studied extensively. While explaining the low sex ratio of negroes, the researchers thought race to be an influencing factor. Several studies have, however, did not find race to influence sex ratio at birth (Ciocco, 1938; Strandskov, 1945; Visaria, 1967; Tietelbaum, 1970). Hawley(1961) and Visaria(1967) have opined that the low sex

ratio at birth for negroid origin population could be due to the prevalence of high proportion of still births to live births.

Sex Ratio of Still Births

Sex ratio of still births has always been found to be above sex ratio at birth for any population with reliable data (Visaria, 1967). Data for 12 populations on still births which have been classified as reliable by the United Nations Population Division have been collected from 1959-80. In all these cases the total number of still births for the 22 year period exceeded 10,000. The sex ratio of still births varied from 106.2 in United Kingdom to 133.7 in Romania.

All the above populations except United Kingdom had much higher sex ratio of still births than sex ratio of live births (sex ratio at birth)(Table III.3). The sex ratio of still births was well above 110 in most cases. Strandskov (1945) found sex ratio of still births to be 133.5 for United States while Winston (1932) arrived at 128.3, 142.2, 131.1 and 132.2 for German, French, Italian and Australian populations respectively.

With the knowledge that populations of negroid origin have higher proportion of still births to live births, this might be one of the reasons for low sex ratio at birth depicted for black segments of populations where mixed races live together. The higher sex ratio of still births in

Table III.3

Sex ratio of Still Births (Late Foetal Deaths) and Live Births

Sl. No.	Country	Period	Still Births		Sex ratio	
			Male	Female	*S.B.	*L.B.
1	2	3	4	5	6	7
1	Canada	60-75, 77,78	38,495	35,149	109.5	105.6
2	Japan	59-71, 73-80	361,135	288,787	125.1	106.7
3	Austria	60-80	13,432	11,439	117.4	105.4
4	Bulgaria	60-80	15,010	12,161	123.4	106.1
5	Czechoslovakia	59-65, 69-80	18,171	16,288	111.6	105.6
6	France	60-76	109,692	92,268	118.9	105.2
7	Federal Republic of Germany	59-68, 70-80	100,939	87,563	115.3	105.7
8	Hungary	60-80	16,980	15,260	111.3	106.3
9	Netherlands	60-79	26,831	22,957	116.9	105.3
10	Rumania	60-74	46,876	35,051	133.7	105.8
11	Switzerland	60-79	9,366	8,242	113.6	105.6
12	United Kingdom	60-79	108,407	100,048	106.2	107.4

*S.B.= Still Births; *L.B.= Live Births

Source : United Nations Demographic Yearbook, 1965, 1969, 1975 and 1981.

comparison to that of live births leads the discussion into two directions, viz., (a) what is the sex ratio in a population for aborted foetuses, and (b) what are the impacts of a decline in proportion of still births to live births on sex ratio birth.

Sex Ratio in Aborted Foetuses

It is now very much accepted that Y spermatozoa has a higher probability of reaching X, than X reaching X at the time of fertilization (Smart and Smart 1976) but one does not know the exact value of this probability. The sex of the embryo can be identified very clearly in the sixth week of pregnancy (Tarner et al. 1966). If one were to take as a pointer that sex ratio of still births is higher than sex ratio at birth, one may safely assume that sex ratio at conception would be much higher than sex ratio of still births.

When we look at earlier attempts to know primary sex ratio (sex ratio at conception), some scholars have tried to guess on the basis of whatever scanty data they could lay their hands on. They have analysed data provided by hospitals on foetuses aborted at different stages of pregnancy.

Some attempts to determine primary sex ratio have been made by several scholars on the basis of data provided by hospitals on foetuses aborted at different stages of

pregnancy. For example, Degenhardt et al.(1980) arrived at primary ratio of 125 for German population while Winston (1932) found the primary sex ratio to vary around 160 for different European populations. Bohle and Heinz (1956) found the range to vary between 160 and 146. A study with data for 371,625 aborted foetuses for United States gave a sex ratio of 175 (Strandskov 1945).

The various studies cited above indicate that sex ratio of aborted foetuses has been generally higher than the sex ratio of still births. A decline in the proportion of abortions as also still births should therefore lead to a rise in sex ratio at birth.

Impact of Reduction in Still birth Proportion on Sex Ratio at Birth

To illustrate this point, a hypothetical mathematical exercise is taken up where the population is undergoing reduction is still birth to live birth proportion over time, with all other factors remaining unchanged.

Assumptions :

1. Number of live births and still births together per year	..	1,000,000
2. Initial sex ratio at birth	..	105
3. Still birth sex ratio	..	115
4. Reduction in still birth per quinquennium	..	10%
5. Initial proportion of still births to live births	Set. I	0.15
	Set. II	0.20
	Set.III	0.25

Table III.4

Hypothetical Cohort of live and still births under varying proportions of still births

Year	Still birth proportion 15 per cent					Still birth proportion 20 per cent					Still berth proportion 25 per				
	Live births		Still births			Live births		Still births			Live births		Live births		
	M	F	M	F		M	F	M	F		M	F	M	F	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
x	445,387	424,178	69,768	60,667	105.0	426,829	406,504	89,147	77,520	105.0	409,756	390,244	106,977	93,023	105.0
x+ 5	452,364	430,245	62,791	54,600	105.1	435,744	414,256	80,232	69,768	105.2	420,454	399,546	96,279	83,721	105.2
x+10	458,643	435,705	56,512	49,140	105.3	443,767	421,233	72,209	62,791	105.4	430,082	407,918	86,651	75,349	105.4
x+15	464,294	440,619	50,861	44,226	105.4	450,988	427,512	64,988	56,512	105.5	438,747	415,453	77,986	67,814	105.6
x+20	469,380	445,041	45,775	39,804	105.5	457,487	433,163	58,489	50,861	105.6	446,545	422,235	70,188	61,032	105.8
x+25	473,958	449,022	41,197	35,823	105.6	463,336	438,249	52,640	45,775	105.7	453,564	428,338	63,169	54,929	105.9
x+30	478,078	452,604	37,077	32,241	105.6	468,600	442,827	47,376	41,197	105.8	459,881	433,831	56,852	49,436	106.0
x+35	481,785	455,828	33,370	29,017	105.7	473,337	446,946	42,639	37,078	105.9	465,566	438,774	51,167	44,493	106.1
x+40	485,122	458,730	30,033	26,115	105.8	477,601	450,654	38,375	33,370	106.0	470,683	443,224	46,050	40,043	106.2
x+45	488,126	461,341	27,029	23,504	105.8	481,439	453,991	34,537	30,033	106.1	475,288	447,228	41,445	36,039	106.3

M = Male; F = Female

Col.6, 11 and 16 represents Sex ratio of Live Births

Table III.4 gives Mathematical calculations for the above hypothetical population. Table III.4 clearly show that, with all other demographic indicators under control, reduction in proportion of still births to live births, over a period (say 50 years wherein the proportion of still births reduces approximately to 1/3rd to its initial point), sex ratio at birth increases to 105.81, 106.05 and 106.70 respectively in the three sets from 105. The higher the reduction, the higher the increase in sex ratio at birth.

The above discussion helps in understanding the reasons for low sex ratio at birth for the populations of negroid origin. In this regard, Hawley states, "as a rule, the sex ratio at birth exceeds 100 and varies inversely with the frequency of prenatal losses". He further adds, "where prenatal losses are low, as in high level-of-living areas of the west, the sex ratios at birth are usually around 105 and 106. On the other hand, in low level-of-living areas, when the proportion of prenatal losses are relatively high, sex ratios vary around 102" (Hawley, 1961). Thompson (1974) has also subscribed to this view. Consequently one can presume that during the different stages of reduction in still birth to live birth proportion, (from high, decreasing, low and stable) the sex ratio at birth increases if other conditions are kept under control.

Other factors influencing Sex Ratio at birth

Having seen the influence of reduction in proportion of still births to live births in a population on sex ratio at birth, it is necessary to look into other factors, if any, which might be influencing sex ratio at birth. Tietelbaum enumerated 12 factors as associated with sex ratio at birth, namely, (a) Birth order, (b) Family size, (c) Sex of first born, (d) maternal age, (e) paternal age, (f) Relative ages of father and mother, (g) Blood groups, (h) Birth Control, (i) Geographic and climatic conditions, (j) Parental occupation, (k) Socio-economic status and condition and (l) Sex of last pregnancy (Teitelbum, 1970).

From the above list, one can easily see that some factors are interrelated with others and seem to be repetitive. While (a), (b), (c) and (l) can be explained with the help of the variable Birth order, (d), (e) and (f) can be explained with the help of age of mother at birth of child. As infant mortality rate and proportion of still births to live births are generally related with the type of parental occupation and socio-economic status of the family, factors (j) and (k) could be assumed to be represented with the level of infant mortality rate and proportion of still births to live births. In view of the fact that data constraint is there, the other factors have not been taken in this study and it is felt that the above variables would

be in a position to explain the sex ratio at birth variation sufficiently.

On the basis of discussion above, an attempt to understand the factors associated with sex ratio at birth has been taken up in an exercise on some populations for which reliable data is available.

Data base

To identify the factors influencing sex ratio at birth, data has been collected from United Nations Demographic yearbooks (Appendix V). In all 31 populations had reliable data with more than 20,000 live births per year. For these populations, data were added for 5 years and average was taken for all variables.

In all 5 indices (independent variables) were selected to study their influence on sex ratio at birth (dependent variable), viz., crude birth rates, proportion of still births to live births, infant mortality rate, proportion of 1 to 3 order births to total live births (lower order births in total births), and mean age of mother at first birth calculated as,

$$\sum_{i=1}^{n} \frac{\text{Midyear of age-group x number of births}}{\text{Total number of 1st order births}}$$

Crude birth rate : This acts as an indicator of fertility level of a population at a particular point of time. Even with its defects, this assures sufficient reliability as far as one uses it to understand the level of birth control and the number of babies born in a particular population over period.

Still Birth ratio : Still births divided by live births per 1,000 for every year has been calculated to understand the impact of decline in still births for a particular population. As the sex ratio of still births is higher than sex ratio of live births, it is anticipated that reduction in still birth ratio increases Sex ratio of live births.

Infant Mortality Rate : This acts in two ways and represents two variables (a) Mortality level of the population and (b) Birth interval. A reduction in Infant Mortality rate amounts to reduction in Crude death rate and also increased birth interval due to longer post-partum ammenorhea period. Further, it reduces higher order births.

Proportion of 1, 2, 3 order births to total births : This variable represents birth order variable as an increase in this proportion suggests a reduction in higher order births.

Mean age of mother at first birth : As age of mother at subsequent births is influenced by her age at first birth, the variable mean age of mother at first birth is taken here.

The impact of the above 5 variables on sex ratio at birth has been analysed through regression analysis. 31 populations for which data were available for recent years have been considered.

Results of Multiple Regression Analysis

The correlation matrix obtained is,

Y	X_1	X_2	X_3	X_4	X_5
1.000	-0.606	-0.520	-0.443	0.717	0.244
	1.000	0.532	0.638	-0.809	-0.419
		1.000	0.626	-0.690	-0.211
			1.000	-0.745	-0.326
				1.000	0.376
					1.000

Y= Sex Ratio at Birth

X_1= Crude Birth Rate

X_2= Proportion of Still Births to Live Births

X_3= Infant Mortality Rate

X_4= Proportion of Lower Order Births to Total Births

X_5= Mean Age of Mother at First Birth

Except for the variable mean age of mother at first birth, the other four independent variables have significant correlation coefficients with dependent variable sex ratio at birth. As proportion of lower order births to total births has the largest correlation coefficient with sex ratio at

birth, it enters the regression analysis first and explains 71.7 per cent of the variation in sex ratio at birth. Entry of additional variables does not increase the value of R^2 value and beta coefficients are insignificant. This is due to the high values of partial correlation coefficients, which explains the existence of multi-colleniarity within the independent variables.

In order to understand the effect of other variables also on sex ratio at birth, the different variables were forced into the regression analysis one by one separately. Though the variables crude birth rate, proportion of live births to still births and infant mortality rate had significant beta coefficients in the first step, proportion of lower order births to total births entered the regression in the second step and the earlier variable became insignificant as beta coefficient was low. This shows the prominence of proportion of lower order births to total births for this set of data.

In a second exercise the variable, proportion of lower order births, was eliminated and regression was done. In this exercise, crude birth rate took the position vacated by the variable proportion of lower order births to total births. A similar position was observed in this exercise as in the earlier one, as entry of crude birth rate variable in the regression reduced the significance of other

variables those were significant otherwise. However, the fact that correlation coefficients of proportion of still births to live births and infant mortality rate on sex ratio at birth were significant, they merit consideration for analysis.

CHAPTER IV

SEX RATIO AT BIRTH IN INDIA

The aim of this Chapter is to see how far birth order, infant mortality rate, still birth to live birth proportion and age of mother influence the sex ratio at birth for India.

Studies on Sex Ratio at Birth in India

The low sex ratio in India led the earlier Census Commissioners to formulate many hypotheses to explain this phenomenon. As the sex ratio in Britain and most of the European countries during the latter part of the 19th century was favourable to females, earlier Census Commissioners were at a loss to find sex ratio in India which was more masculine. The census reports prior to 1901 explained under-enumeration of females as a significant factor. This hypothesis sustained in the 1881, 1891 and 1901 censuses as the sex ratio improved with each census. The Census Commissioners for 1901 census studied this aspect in some detail and was of the view that the low sex ratio in India was due to differential registration by sex of vital events compared to the actual occurrence of the events. He implied that sex ratio at birth was an important factor in explaining the low sex ratio of Indian population. He referred to the discussions which took place in Britain on the variations in the sex ratio at birth for some of the European

populations. These discussions indicated that sex ratio at birth was related with race, climate, consanguineous marriages, polyandry and age of parents (Natarajan, 1972) mainly but because of non-availability of data on these factors he could not examine this issue further. Some other Census Commissioners also felt the need to explain the low sex ratio of Indian population and were of the view that probably sex ratio at birth was responsible for the observed phenomenon. Because of the non-availability of data, it remained basically a speculation.

Analysing data from the civil registration system Visaria (1969) found no ground to assume that sex ratio at birth in India was exceptionally masculine as, according to him, it was within the normal range of 104 to 107. Visaria had also found that sex ratio at birth for the population of negroid origin varied within the range of 102 to 104 (Visaria, 1967). As the factors that could affect the sex ratio at birth, viz., high birth rate, high infant mortality rate, high proportion of foetal losses, low proportion of lower order births and low age at marriages for females, in India in the early part of this century were quite similar to those that prevailed in the negroid populations, it is not clear as to why a different range of sex ratio at birth was assumed for India by him. Although Visaria was of the view that the proportion of still births is a significant

factor in determining the sex ratio at birth, he left the matter at that probably because no reliable data were available to him at that time. It is noteworthy, that by saying that the sex ratio at birth in India was within the range of 104 to 107, he probably accepted the fact that sex ratio at birth changes within a certain range.

The analysis of hospital data for different regions of India covering the period 1949 to 1958 by Ramachandran (1964) gave a sex ratio at birth of 106.4. Das et al.(1934) and Nair (1936) also analysed hospital data and got the values of sex ratio at birth between 107 and 108. All these researchers felt that the estimate of sex ratio at birth was a little too high because of small sample size available to them. The high sex ratio at birth based on hospital records could also be due to higher proportion of lower order births and in many cases due to the fact that still births could be saved substantially due to better medical attention at the time of deliveries.

Estimates of Sex Ratio at Birth for Indian Population

The earliest registration system of reliable quality was for "proclaimed clans" (Census of India, 1960) and was utilized by Hardy, the census actuary for the 1881, 1891 and 1901 censuses, for construction of life tables for India for 1872-81, 1881-91 and 1891-1901 decades. The data was utilized to estimate mortality at age 0. Hardy considered

the data on births by sex for the proclaimed clans of the North West Frontier Agency to be reliable only from 1875-80 wherein the police was given the responsibility to register all births and deaths of infants. He arrived at a sex ratio at birth of 106.47 for that period.

The sex ratio at birth as reported in the 1911 census report (probably based on civil registration system) varied from 104.4 to 108.2 for different regions of the country (Census of India 1911, 1911). This sex ratio at birth was largely comparable with the sex ratio at birth observed in contemporary European populations. It is noteworthy that the sex ratio at birth in Punjab was 110 and that of North-Western Frontier Province was 122.1. These observed sex ratios at birth became doubtful in view of the fact that the highest sex ratio at birth observed for the European countries was 113.2 for Greece. As indicated earlier the Government of India initiated the sample registration scheme on a pilot basis for rural areas in 1964 and this was made permanent from 1966 onward. The sample registration scheme estimates of sex ratio at birth for 1968 and 1969 were 108.4 and 107.8 respectively (Vital Statistics, 1972b).

As indicated above the sample registration scheme starting from 1966 has continued over years and has established itself as the only source of reliable data on births, deaths, infant deaths, sex ratio at birth etc. As already

explained in Chapter II, sample registration scheme provided longitudinal data for a set of villages for a period of 10 years by 1976. These data can be utilised to estimate the proportion of still births to total births, age of mother for all births, births by birth order etc. Although theoretically it was possible to carry out this exercise for the whole of the country, the work involved was tremendous and original sample registration scheme forms could not be obtained for different parts of the country. The Registrar General, India, was kind enough to allow this researcher to go into the sample registration scheme records from 1966 to 1976 for Karnataka which helped him to obtain estimates on these variables for that State.

Data from Sample Registration Scheme, Karnataka

Data for 210 blocks of Karnataka were analysed for three kinds of analysis, viz., (a) to estimate the ratio of still births to total births, (b) sex ratio at birth and (c) age of mother and sex ratio at birth. Longitudinal data relating to 59 rural blocks covering 2,298 women in reproductive ages between 1966 and 1976 were analysed to estimate the distribution of live births by birth order. The methodology adopted for creating the data by birth order was explained in Chapter II.

Order of Birth

Non-availability of reliable data on order of birth in the past has hampered attempts to study the relationship of sex ratio at birth and order of birth in India. Many studies were undertaken in European countries and United States to find relationship of birth order on sex ratio at birth with the help of registration data. On the basis of data for United States for different periods Macmohan (1951), Macmohan and Pugh (1953), Myers (1954), Novitski and Sandler (1956) and Russell (1969) found higher masculinity in sex ratio in lower order births than in higher order births. Studies for other populations undertaken by Runakuddin (1957), Salamon (1959), Edwards and Fraccaro (1960), Pollard (1969) and Garfinkel and Servin (1976) for Pakistan, Hungarian, Swedish, Australian and New York city populations respectively, have substantiated the findings arrived at for United States population. Kullback (1971) on the basis of data for 36,636 families found a consistent declining trend for the first four lower order births and they were 108.0, 106.5, 105.4 and 105.5 respectively. Renkoken (1962) found a linear declining trend with increasing birth order. Mathew (1947) on the basis of data from Indian hospitals found results similar to those in European countries and United States. Pakrasi (1971) on the basis of data from National Sample Survey found that in the first order births males

significantly predominate but found no significant relationship for second and higher order births. Karkal (1976) found no relationship between sex ratio at birth and birth order after analysing fertility history for 3,509 women by birth order. Sample registration system found a very clear trend with increasing birth order for year 1968 while for 1969 no clear trend was visible (Vital Statistics, 1972b). No attempt has been made by the Vital Statistics Division to look into this aspect though data were available in 1972 (Vital Statistics, 1976).

Data from different schedules of sample registration scheme for 10 years were taken to construct fertility history of women belonging to 59 villages from all the four regions of the State. Data were collected in household form No.2 by the village level enumerators at the beginning of the period and updated from time to time by the enumerators after making entries for the persons joining the household either through migration or by birth and deleting the earlier entries if some outmigration from the household has taken place or if a death has taken place over time. This form is replaced after a lapse of three years (six half yearly surveys) and the process is repeated during the next half-yearly survey and is maintained for the next three years in the same fashion as was done in the earlier block of three years. For this study, three sets of household forms were

taken into consideration. These sets helped in identifying these women who lived continuously within the block between 1966 and 1976. These forms helped in creating the fertility histories for all those women who were within the block from the beginning of the scheme. This became feasible because between 1966 and 1972 an additional information regarding the total number of previous births was recorded along with the information about the current birth which took place during this period. Fertility histories were also created for those women who entered the block through marriage and started reproduction after 1966. It is quite possible that in a number of cases the fertility histories created this way covered only a part of the total reproductive period for a majority of women.

In all, fertility histories were created for 2,298 women. These women gave birth to 5,989 babies between 1966 to 1976, giving an average of 2.6 births per mother over a ten year period. The sex ratio at birth worked out to 104.3. Table IV.1 gives the distribution of 5,989 births by birth order and sex.

The table also gives the sex ratio at birth by birth order as well as the cumulative sex ratio at birth taking into consideration the particular birth order and all births prior to that birth order. It is clearly observed from this table that the sex ratio at birth declined systematically between

Table IV.1

Distribution of babies by birth order and sex

Birth order	1	2	3	4	5	6	7	8	9	10+	Total
Births											
M	463	546	538	504	402	279	155	100	45	26	3,058
F	377	483	527	509	403	294	196	90	40	12	2,931
Sex-ratio at birth	122.8	113.0	102.1	99.0	99.8	94.9	96.5*				
Cumulative sex-ratio	122.8	117.3	111.5	108.2	106.7	105.4	104.3*				

*96.5 and 104.3 represent sex ratio at birth and cumulative sex ratio at birth respectively for order of birth 7+.

the first order births to the fourth order births. The later order births had sex ratio at birth of less than 100 but they did not show any consistent pattern. The declining trend in the sex ratio at birth with the inclusion of higher order births is more clearly observed when one examines the cumulative sex ratio at birth.

Impact of the Reduction in Still Births on Sex Ratio at Birth

The data for 150 rural blocks of Karnataka from 1967-1976 (10 years) gives a sex ratio at birth of 104.3 (Table IV.2). It is to be noted that the sex ratio at birth arrived at for the

Table IV.2

Sex ratio of live births and still births for rural Karnataka 1966-76

Year	Live birth		Still birth		Sex ratio		
	M	F	M	F	Live births	Still births	All births
1967	3,027	3,048	72	58	99.3	124.1	99.8
1968	2,945	2,638	58	52	116.6	111.5	116.6
1969	3,019	2,788	76	52	108.3	146.2	109.0
1970	3,073	3,048	65	64	100.8	101.6	100.8
1971	3,076	2,803	55	45	109.7	122.2	109.9
1972	2,944	2,866	74	59	102.7	125.4	103.2
1973	2,723	2,623	61	52	103.8	117.3	104.1
1974	2,623	2,659	51	44	98.6	115.9	98.9
1975	2,777	2,670	40	52	104.0	76.9	103.5
1976	2,952	2,814	59	33	104.9	178.8	105.8
TOTAL:	29,159	27,957	611	511	104.3	119.6	104.6

M = Male; F = Female

births of 2,298 women also was 104.3. The sex ratio of still births based on 1,122 events was 119.6. The estimate of sex ratio at birth of 104.3 could be considered with 95 per cent confidence limits to lie between 104 and 105 for Karnataka (Visaria, 1969, p.26). It is clearly seen that the sex ratio of still births was well above the sex ratio at birth.

At this stage it was thought desirable to compute the sex ratio at birth in Karnataka by changing the proportion of still births to total live births (an exercise similar to the one carried out in Chapter III for a hypothetical population). For this purpose it was assumed that the proportion of still births to live births was ten per cent and it declines to just one per cent under the schedule of decline as indicated in Table IV.3. The sex ratio at birth in the population of Karnataka changed from 103.0 when the proportion of still births to live births is assumed to be 10 per cent to 104.4 when this proportion fell down to one per cent only. This exercise clearly indicates the effect of reduction in still births on sex ratio at birth.

Age of Mother

As indicated earlier, age of parent at the time of birth of the child has been widely discussed by scholars. Some researchers have restricted their discussions to one of the parents while others have discussed it with reference to both parents. Macmohon and Pugh (1953), Myers (1954), Moore (1958), Pollard (1969) and Rostron and James (1977) found a definite declining trend in sex ratio at birth with increases in age of mother while Mathew (1947), Macmahon (1952), Garfinkel and Servin (1976) and Karkal (1976) found no relation between those two variables. Macmahon (1952), however, found father's age to influence sex ratio at birth in the same way as others

Table IV.3

Sex ratio at birth for live births with varying proportion of still births (Still birth sex ratio assumed to be 120)

Proportion of still births to live births	Number of births M	F	Total	Sex ratio at birth
0.10	26,593	25,821	52,414	103.0
0.09	26,910	26,086	52,996	103.2
0.08	27,229	26,350	53,579	103.3
0.07	27,546	26,615	54,161	103.5
0.06	27,865	26,879	54,744	103.7
0.05	28,182	27,144	53,326	103.8
0.04	28,499	27,409	55,908	104.0
0.03	28,817	27,674	56,491	104.1
0.02	29,135	27,938	57,073	104.3
0.01	29,453	28,203	57,656	104.4

M= Male; F= Female

found with respect to mothers age. This result was further supported in studies conducted by Novitski (1953), Renkonen (1962) and Pollard (1969). One of the studies even contended that there existed a twelve year cycle in the life of males which reduced the production of Y spermatozoa in them.

In this study, data for all 150 rural blocks and 60 urban blocks of Karnataka has been taken up for analysis.

The sex ratio at birth for rural areas was 104.7 and for urban it was 107.5.

The actual equation comes out to be

$$Y = 105.64 + (-0.115)X$$

Since β coefficient is negative here, an increase in the age of mother implies a lower sex ratio at birth.

Discussion and Conclusion

The data for Karnataka have clearly indicated that sex ratio at birth rises with, (a) the higher proportion of lower order births to total births and (b) the declining proportion of still births to live births while a negative relationship has been found between age of mother and sex ratio at birth. Assuming Karnataka to be a representative State for India one can then safely assume that a higher proportion of lower order births (three or below three) to total live births and a decline in the proportion of still births to live births would have led to a rise in sex ratio at birth in India.

To establish that there has been a change in the proportion of lower order births to total births in India over a period of time one may take the crude birth rate as a proxy variable. The crude birth rate was at a high level of 49 in the beginning of this century. This was feasible with four or higher order births forming a substantial share of the total births. The reduction in birth rate observed specially during the 1960's and the 1970's should have resulted in an increase

in the proportion of lower order births (three or less than three) during this period and a consequent increase in the sex ratio at birth.

In a population where the infant mortality rate is very high, there is a great likelihood that the proportions of still births to live births would also be high. The estimates are that the infant mortality rate in India in the beginning of this century was around 300. Although we do not have any data to indicate what should have been the proportion of still births to live births with such a high infant mortality rate, it is believed that this proportion was sufficiently high at that time. There has been a monotonical decline in the infant mortality rate and one may safely assume that the proportion of still births to live births has also declined in the country over the past 80 years. If it is so, the implications are that the sex ratio at birth has increased substantially between 1901 to 1981.

Taking these two factors together, as a process of induction, one may deduce that the sex ratio at birth in India was somewhat lower at the beginning of this century compared to the one found in the post-world war II period. Further, if the above trend of increase in the proportion of lower order births to total live births and also the declines in proportions of still births to live births continues in the future as one may assume from the nature of the populations policies

pursued in this country one may expect a further improvement in the sex ratio at birth.

Keeping this in view, the next Chapter presents simulation analysis to bring out the impact of changes in sex ratio at birth on over all sex ratio of the population when the mortality differential by sex is controlled. It also presents the analysis when changes in the sex-differentials in mortality are also considered.

Table IV.4

Age of mother and sex of the child for rural and urban areas(Karnataka State 1967-76)

Age	Rural				Urban			
	No. of babies		Sex ratio at birth		No. of babies		Sex ratio at birth	
x	M	F	x	x+	M	F	x	x+
1	2	3	4	5	6	7	8	9
14	55	63	87.3	104.7	8	15	53.3	107.5
15	233	174	133.9	104.7	34	53	64.2	107.6
16	521	492	105.9	104.5	116	79	146.9	108.1
17	634	606	104.6	104.5	141	126	111.9	107.5
18	1,260	1,261	99.9	104.5	268	258	103.9	107.4
19	1,153	1,074	107.4	104.8	219	220	99.5	107.6
20	1,675	1,589	105.4	104.7	472	435	108.5	107.9
21	1,327	1,205	110.1	104.6	303	275	110.2	107.9
22	1,446	1,393	103.8	104.2	408	364	112.1	107.7
23	1,113	1,052	105.8	104.2	283	287	98.6	107.3
24	1,173	1,119	104.8	104.1	285	275	103.6	108.0
25	1,525	1,433	106.4	104.1	464	439	105.7	108.4
26	1,433	1,265	113.3	103.8	350	297	117.8	108.9
27	856	900	95.1	102.7	218	216	100.9	107.7
28	1,272	1,198	106.2	103.4	362	315	114.9	108.5
29	895	855	104.7	103.0	202	152	132.9	107.3
30-34	4,328	4,271	101.3	102.8	948	932	101.7	104.9
35-39	2,435	2,322	104.9		501	473	105.9	
40-44	900	869	103.6		185	156	118.6	
45+	242	230	105.2		46	41	112.2	
TOTAL :	24,476	23,371	104.7		5,813	5,408	107.5	

CHAPTER V

INFLUENCE OF CHANGING SEX RATIO AT BIRTH AND SEX-DIFFERENTIALS IN MORTALITY ON SEX RATIO IN INDIA

Introduction

By considering the possibility of decline in the proportion of still births to live births and increase in proportion of lower order births to total births in India's population over the past 80 years, the previous Chapter tried to establish the likelihood of changing sex ratio at birth, in the sense, that it was low earlier and increased over a period of time. It was, however, not feasible to establish as to what might have been the exact sex ratio at birth in the beginning of the present century.

As regards sex-differentials in mortality, the life tables generated by the census actuaries for the various decades have been utilized here[@] (Davis, 1951; Census of India, 1960; Census of India, 1961, 1980; Census of India, 1971, 1977a). Dasgupta (1971) constructed a fresh series of life tables for India from 1881 onwards upto 1961 adopting the stable population technique uniformly. He found that the gap between male and female expectation of life at birth had increased over time implying greater mortality for females in different age brackets compared to males. Similarly, Mukherji (1977) also found that the sex-differential in mortality increased over time.

@While analysing the low sex ratio of India's population and establishing that it is the sex-differentials in mortality which has been responsible for the observed pattern Visaria also utilized the available life tables (Visaria, 1969)

Having established that the sex ratio at birth in India was increasing over time and noting from the life tables that sex-differentials in mortality was increasing, becoming more and more unfavourable to females, it now remains to be seen as to what could have been the contribution of two factors separately in the decline of sex ratio of the total population. As it has not been feasible to carry out this analysis for the past, this Chapter presents simulation model to bring out the effect of these two factors by extending the exercise over a period of 100 years till the stable stage is attained.

Estimates of Mortality by Sex for India

In India, estimates of mortality of some reliability by sex and age have been available from census actuaries life tables. The criticism against the census actuaries estimates has been that (a) in the name of smoothening the age data, the heaps and troughs have been ironed out to such an extent that the validity of mortality index became suspect (Mitra 1978), and (b) the changing methodology utilized by the different census actuaries have affected comparability adversely.

With advances in stable population theory and with the development of Model life tables by United Nations (1955) and later by Coale and Demeny (1966), it has become feasible to adopt an uniform methodology to work out life tables for the past without necessarily going into the smoothening of age

data. As indicated earlier, Dasgupta constructed life tables for 1881,....., 1961 and Mukherji estimated expectation of life at birth and at age 5 for 1901, 1911, ... , 1971.

It would be useful to compare the estimates of expectation of life at birth by sex obtained by the various census actuaries including Davis (1951), Dasgupta (1971) and Mukherji (1977) starting from 1891-1901 decade to 1961-71. Table V.1 below gives estimates of expectation of life at birth by sex for three sets.

Table V.1

Estimates of Expectation of Life at Birth by Sex for India 1901-71

Period	Census actuaries		Dasgupta		Mukherji	
	M	F	M	F	M	F
1891-1901	23.6	24.0	22.9	24.1	20.1	21.8
1901-11	22.6	23.3	23.0	23.3	23.9	23.4
1911-21	19.4	20.8	25.2	24.5	20.1	20.9
1921-31	26.9	26.6	29.9	28.7	28.1	27.8
1931-41	32.1	31.4	32.3	32.9	33.1	31.1
1941-51	32.5	31.7	38.6	37.1	34.9	32.5
1951-61	41.9	40.6	49.0	45.2	37.9	37.7
1961-71	46.4	44.7	N.A.	N.A.	46.3	41.7

Source: (1) United Nations, 1982, p.153
(2) Dasgupta, 1971, p.410
(3) Mukherji, 1977, p.198, 202, 240

The male-female differential in the estimates of expectation of life at birth obtained by Dasgupta have fluctuated sharply over time, for example, the female expectation of

life at birth was higher than male expectation of life at birth during 1891-1901, which became unfavourable to females by 1911 decade and remained so during 1921-31 with a gap of 1.2 years (Table V.1). The expectation of life at birth for females however became higher according to his estimates during 1931-41 decade by 0.6 years but again declined in 1941-51 decade and the difference was 1.5 years. It is difficult to understand a gap of about 4 years in the expectation of life at birth for females in the 1961 decade.

Mukherji's estimates of male and female expectation of life at birth seem to be a little more consistent but a difference of 4.5 years in the expectation of life at birth for 61-71 decade does not seem to be reasonable. He has also not given any explanation for such a large differential when the differential in 1951-61 decade was only of 0.2 years. In contrast, the difference between male and female expectation of life at birth has not been even of 2 years in any of the 8 life tables of the census actuaries from which the estimates of expectation of life at birth have been taken. Further, the gap between the male and female expectation of life at birth has followed a linear trend without sudden fluctuations in the life tables constructed by the census actuaries. Consequently, for this exercise the present researcher preferred to utilize the census actuaries life tables over others to take account of the sex-differentials in mortality.

Although one could utilise all the available life tables generated by the census actuaries to take into account the changing pattern of sex-differentials in mortality, it was felt sufficient enough if three life tables could be picked out of the whole set which represented three different conditions, viz., (a) where the females had advantage over males in terms of expectation of life at birth, (b) where the advantage was wiped out and the expectation of life at birth for the sexes was almost similar and (c) where females had the maximum disadvantage over males.

In the census actuaries life tables, the life tables of 1891-1901, 1901-11 and 1911-21 had higher female expectation of life at birth than that of males. It is, however, noteworthy that the expectation of life at birth of males and females declined over time in those life tables. This was due to abnormal mortality conditions during both the decades (1901 to 1921) as has been documented by Mitra (1978). Consequently, it was thought more appropriate to take the life tables of 1891-1901 decade to represent the first condition.

The male expectation of life at birth became higher than that of female during 1921-31 decade by a small amount of 0.3 years. This was the decade which did not suffer by any severe epidemics or famine conditions. This is taken to represent the second condition. Finally, the life tables for 1961-71 decade which again refers fairly normal situation had the maximum gap

between the male and female expectation of life at births and therefore has been taken to represent the third condition.@

As said earlier the influence of changes in the sex ratio at birth and changes in the sex-differentials in mortality on sex ratio of the Indian population has been analysed below. The sex ratio at birth has been changed from a level of 104 to 108 changing it by one point every time. The life tables are used for 1891-1901, 1921-31 and 1961-71 decades.

The initial age distribution of the population can also influence the sex ratio of the population differentially. To take account of this factor one simulation exercise has been carried out by taking exactly the same age composition for the males and females at the starting point. Another exercise has been carried out by using the smoothened age distribution of the 1971 census (Census of India 1971, 1977b).

Component method has been adopted to project the population for future dates. Since this exercise is not really meant to generate population projections for future dates only one set of age specific fertility rates, obtained from the Fertility Survey 1972 (Vital Statistics, 1975), have been utilized.

@The life table for 1971-81 decade was not available when this exercise was undertaken and has not yet been published.

Results of Simulation Exercise

In order to analyse the impact of the change in sex ratio at birth only on sex ratio, in the first simulation the age composition of the male and female population at the starting point (1971) has been taken exactly the same. Further, mortality pattern for females has been taken exactly the same as that for males from the 1961-71 life table. The results are presented in Table V.2 and cover a period of 100 years (1971-2066) which also guarantees the stable population in the final stage.

Table V.2

Trends in Sex Ratio with 1961-71 Male Mortality Level and 1971 Male Age Composition for both Sexes

Year	Sex Ratio at Birth				
	108	107	106	105	104
1971	1,000	1,000	1,000	1,000	1,000
1976	988	989	991	992	994
1981	976	976	982	985	988
1986	967	971	975	979	983
1991	959	964	969	974	979
1996	953	958	964	970	976
2001	947	954	960	966	973
2006	943	949	956	963	970
2011	939	946	953	961	968
2016	935	943	951	959	967
2021	933	941	949	957	965
2026	931	939	947	955	964
2036	929	937	946	954	963
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
2066	926	935	944	953	962

The table indicates a monotonical decline in the sex ratio as you proceed from 1971 onward. The sex ratio in the stable stage comes to 962 if the sex ratio at birth is taken at 104 and to 926 if the sex ratio at birth is taken at 108. The table clearly brings out the impact of sex ratio at birth on sex ratio of any population.

To make the exercise a little more realistic, the age composition of India's population as obtained in 1971 census and smoothened by the office of the Registrar General (Census of India 1971, 1977b) has been utilized in the second exercise but the sex-differentials in mortality is still assumed to be nil. In this case the sex ratio has continuously increased if the sex ratio at birth is assumed at 104 to 107. It is only when the sex ratio at birth is taken at 108, there is a decline in the sex ratio to 926 in the final stage. It is noteworthy that the sex ratio would remain constant at 930 for a period of 35 years even in this extreme case. As one would expect the sex ratio in the stable stage is independent of the initial age composition as the last line in tables V.2 and V.3 have been exactly the same.

One may conclude from tables V.2 and V.3 that if the sex-differentials in mortality wipe out completely, probably 930 is the lowest sex ratio and one should expect that it would improve over time if sex ratio at birth remains between 104 and 107.

Table V.3

Trends in Sex Ratio with 1961-71 Male Mortality Level for both Sexes and 1971 Age Composition

Year	Sex Ratio at Birth				
	108	107	106	105	104
1971	930	930	930	930	930
1976	930	931	932	934	935
1981	930	933	935	938	941
1986	930	934	938	942	945
1991	930	935	940	944	949
1996	930	936	941	947	953
2001	930	936	942	949	955
2006	930	936	943	950	957
2011	929	936	943	951	958
2016	928	936	943	951	959
2021	928	935	943	952	960
2026	927	935	943	952	960
2031	927	935	943	952	961
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
2066	926	935	943	952	962

The next exercise shows that changing the level of mortality, whether it is very high (as depicted by 1891-1901 life table) or is comparatively low (as depicted by 1961-71 life table), when no sex-differentials in mortality is assumed, has no impact on the ratio in the stable stage as the same comes to be 952 if sex ratio at birth is taken as

105 in all the three cases, 943 when sex ratio at birth is taken as 106 and 935 when sex ratio at birth is taken as 107.

To analyse the impact of sex-differentials in mortality, in the next situation the age composition was taken as that of 1971, the sex ratio at birth was assumed to be at 105 and the life table for males and females of 1891-1901, 1921-31 and 1961-71 were used (table V.4).

Table V.4

Trend in Sex ratio (Age composition 1971 census count, sex ratio at birth 105)

Year	Life Table 1961-71	Life Table 1921-31	Life Table 1891-1901
1971	930	930	930
1976	929	931	936
1981	929	932	942
1986	930	929	947
1991	930	929	951
1996	930	930	954
2001	929	931	956
2006	930	931	958
2011	929	931	960
2016	929	931	961
2021	929	930	962
2026	929	931	963
2031	929	931	963
..	..	..	..
..	..	..	..
..	..	..	..
..	..	..	..
2066	929	931	965

Under the condition of higher female expectation of life at birth than males, as one would expect the sex ratio improves from 930 in 1971 to 965 in 2046. When the expectation of life at birth is similar, there is practically no change in the sex ratio over time. This has fluctuated between 929 and 932 stabilizing at 931. When the 1961-71 life table with male and female mortality schedules are used, again there is hardly any further change in sex ratio. It has remained almost at the same level and finally stabilized at 929.

Here it was assumed that 1961-71 life table represented the worst situation in respect of sex-differentials in mortality. If the differentials enlarge further becoming still more unfavourable to females probably there may be a decline in the sex ratio below the 1971 level. In the alternative one may say that probably 1971 represented the Critical Point in this respect.

Impact of Simultaneous Changes in Sex Ratio at Birth and Sex-differentials in Mortality

Table V.5 represents the overall sex ratio for different quinquennia starting from 1971 upto 2066. Here the age distribution is taken as that of 1971, and the separate mortality schedules of 1891-1901, 1921-31 and 1961-71 decadal life tables for males and females have been taken. The sex ratio at birth is made to change from 105 to 107. However,

computations were also done with 1961-71 life tables with sex ratio at birth of 104 and 108. As one would expect, in the stable stage, the sex ratio increases from 930 to 965 if the mortality differentials are those of 1891-1901 life table when the sex ratio at birth is 105, to 956 when the sex ratio at birth is 106 and to 947 when the sex ratio at birth is 107. This implies that some of the advantage of lower mortality among females in comparison to males is nullified by the increase in sex ratio at birth.

When the 1921-31 life tables are used there is practically no change in the sex ratio if the sex ratio at birth is 105. The sex ratio declines by about 8 points in the stable stage if the sex ratio at birth is 106 and by 17 points if the sex ratio at birth is 107. If the sex ratio at birth of 104 were used with the 1921-31 life tables, looking at the above trend, which indicates a decline in the sex ratio by 9 points with an increase of sex ratio at birth of one point, the overall sex ratio would have come to 940.

With the use of 1961-71 life tables, with the sex ratio at birth of 104, one gets improvement in the overall sex ratio and it stabilizes at 938. There is again a decline in the sex ratio by 9 points with every unit increase in the sex ratio at birth. Hence, with a sex ratio at birth of 108 the overall sex ratio declines to 903 with 1961-71 life table.

Table V.5

Trends in Sex Ratio with 1971 age composition and different life tables

Year	Sex ratio at birth										
	108	107			106			105			104
	61-71	91-01	21-31	61-71	91-01	21-31	61-71	91-01	21-31	61-71	61-71
1	2	3	4	5	6	7	8	9	10	11	12
1971	930	930	930	930	930	930	930	930	930	930	930
76	925	934	928	926	935	930	928	936	931	929	930
81	921	937	926	924	939	929	927	942	932	929	932
86	919	940	922	922	943	925	926	947	929	930	934
91	916	942	920	920	946	924	925	951	929	930	934
96	913	943	919	919	949	924	924	954	930	930	935
2001	911	944	919	917	950	925	923	956	931	929	936
06	910	945	917	916	951	924	923	958	931	930	936
11	908	945	916	915	952	924	922	960	931	929	937
16	907	945	916	914	953	923	922	961	931	929	937
21	906	946	915	913	954	923	921	962	930	929	937
26	905	946	915	913	954	923	921	963	931	929	937
31	904	946	914	912	955	923	920	963	931	929	937
36	903	947	914	912	955	923	920	964	931	929	937
41	903	947	914	911	956	922	920	965	939	929	937
46	903	947	914	911	956	922	920	965	931	929	938
51	903	947	914	911	956	922	920	965	931	929	938
56	903	947	913	911	956	922	920	965	931	929	938
61	903	947	913	911	956	922	920	965	931	929	938
2066	903	947	913	911	956	922	920	965	931	929	938

Share of Sex Ratio at Birth and Sex-differentials in Mortality in the changes on overall Sex Ratio

In an exercise of the present nature it is useful to understand the impact of two factors - sex ratio at birth and sex-differential in mortality - on the overall sex ratio separately. For this purpose it is necessary to start with overall sex ratio of 1,000. The analysis has been carried out (Table V.6 which presents the trend in sex ratio) by taking 1961-71 life tables and sex ratio at birth of 105, 106 and 107. In the first, no sex-differentials in mortality has been assumed and in the second case the male and female survivorship schedule have been utilized. The impact of using the separate schedules of male and female survivorship is given in the column, "difference", which shows that in the stable stage its impact is of 23 points. In contrast, the share of sex ratio at birth in the decline in overall sex ratio is 48 points when the sex ratio at birth is 105, 57 points when the sex ratio at birth is 106 and 65 points when the sex ratio at birth is 107. This simulation exercise therefore indicates that the impact of the sex ratio at birth in bringing the change in the overall sex ratio is much higher than that of sex-differential in mortality.

Table V.6

Trend in sex ratio (common age composition for both sexes)

	Sex ratio at birth 107			Sex ratio at birth 106			Sex ratio at birth 105		
	Life table 61-71			Life table 61-71			Life table 61-71		
Year	M only	M & F separately	Difference	M only	M & F separately	Difference	M only	M & F separately	Difference
1	2	3	4	5	6	7	8	9	10
1971	1,000	1,000	-	1,000	1,000	-	1,000	1,000	-
76	989	984	5	991	986	5	992	987	5
81	979	970	9	982	973	9	985	976	9
86	971	959	12	975	963	12	979	967	12
91	964	949	15	969	954	15	974	959	15
96	958	941	17	964	947	17	970	952	18
2001	954	934	20	960	941	19	966	947	19
06	949	929	20	956	936	20	963	943	20
11	946	925	21	953	932	21	961	939	22
16	943	921	22	951	929	22	959	937	22
21	941	918	23	949	926	23	957	934	23
..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..
2066	935	911	24	943	920	23	952	929	23

M = Male; M & F = Male & Female

This Chapter has presented simulation model to bring out the influence of the age composition, changes in sex ratio at birth and changes in the sex-differential in mortality on India's population when it reaches the stable stage. The analysis has indicated that whereas the impact of sex-differential in mortality is of a constant magnitude, the share of sex ratio at birth in the decline in sex ratio depends on its level. If one takes the sex ratio at birth of 105, the total decline in the sex ratio due to both components is of 71 points out of which two-thirds is due to the particular level of sex ratio at birth and one-third is due to sex-differential in mortality. With a higher level of sex ratio at birth, its share in the total decline becomes greater and vice-versa.

CHAPTER VI

INDIA'S POPULATION POLICIES AND FUTURE TRENDS IN SEX RATIO

In order to make this study more purposeful, this Chapter examines the role of India's population policies on the past and future sex ratio. In doing so, some of the earlier projections of India's populations and the resulting sex ratio has been discussed.

As is well known, India was the first country in the world to formulate a national population policy in 1952. The main aim of that population policy was, "to arrest the growth in numbers at a level which could be sustained by the country's economy, so that people could live better life" (Planning Commission, 1957, p.280). It's thrust was to educate, motivate and assist couples to have a small family. Initially, the programme was clinical based, with the provision of facilities for those who came forward and asked for them. Although the First Five Year Plan had envisaged provision of such facilities would bring reduction in birth rate, however, no such reduction was observed during the 1950's and the 1960's. Every subsequent plan has also laid targets about the future course of reduction in fertility as is clear from Table VI.1.

The projections of India's population made during the period for next 20-25 years assumed varying declines in birth rate taking into account the prevailing fertility level and the nature of the family planning programme at that particular

Table VI.1

Desired demographic goals, India

Year	Specified goal(CBR)	Year by which goal to be achieved	Actual CBR in year as per Col.3
1962	25	1973	34.6
1966	25	as expeditiously	-
1968	23	1978/79	33.7
1969	32	1974/75	35.2
1969	25	1979/81	33.7
1974	30	1979	33.7
1974	25	1984	33.9
April 1976	30	1978/79	33.7
1st Population Policy	25	1983/84	33.9
April 1977	30	1978/79	33.7
II Population Policy	25	1983/84	33.9
January 1978 (Central Council of Health)	30	1982/83	33.7

CBR = Crude Birth Rate

Source : United Nations, 1982, p.162; Vital Statistics, SRS Bulletins

point of time and its like future impact. Coale and Hoover, who adopted component method of projection in 1959, did not accept sex ratio of 946 for the initial population of India for 1951, but assumed a sex ratio of 989 (Coale and Hoover, 1959). There have been several population projections which have been prepared in the past by individual researchers and

official agencies, like, the Expert Committees on Population Projections appointed by the Government of India from time to time, the United Nations and the World Bank. While looking at those projections, Natarajan found that, "projections are on an average as good as projections made elsewhere abroad for other countries" (Natarajan, 1989, p.62).

It is noteworthy here that in making projections, the various scholars, researchers, the Expert Committees appointed by the Government of India and the United Nations, have assumed a sex ratio at birth of 105 generally. One does not find any discussion in the various documents relating to those population projections as to how this particular sex ratio at birth was arrived at for India.

In the exercise below, an attempt has been made to explain the role of sex ratio at birth assumption on future sex ratio of the population by changing the same between 104 to 107 in the population projections of Expert Committee appointed by the Government of India in 1984 (Census of India, 1981, 1988).

It is observed from table VI.2 that after a period of 20 years, one point change in sex ratio at birth leads to 4 points difference in overall sex ratio, when the fertility is assumed as in the high projections. The overall sex ratio changes by 3.7 when the future fertility declines would be as assumed in medium projections, and changes by 3.6 points if the fertility decline of the low projections holds good.

Table VI.2

Sex ratio for projected population under varying sex ratio at birth

Fertility assumption	Y Sex ratio at birth	e 81	86	a 91	96	r 2001
1	2	3	4	5	6	7
	104	933.4	938.9	943.5	947.4	951.0
High	105	933.4	937.6	941.3	944.3	947.2
	106	933.4	936.4	939.0	941.0	943.2
	107	933.4	935.2	936.8	938.1	939.4
	104	933.4	938.9	943.5	947.2	950.7
Medium	105	933.4	937.6	941.2	944.2	947.1
	106	933.4	936.4	939.0	941.1	943.3
	107	933.4	935.2	936.9	938.2	939.6
	104	933.4	938.9	943.4	947.1	950.6
Low	105	933.4	937.6	941.2	944.1	947.0
	106	933.4	936.4	939.0	941.1	943.4
	107	933.4	935.2	936.9	938.2	939.8

Thus, an assumption of either a higher sex ratio at birth or lower sex ratio at birth than prevailing, would imply a somewhat different overall sex ratio. It is noteworthy here that the official population projections upto the year 2001 utilized those male and female life tables when the expectation of life at birth for the females was somewhat higher than those of males implying a better survivorship rates for females at all ages. This in turn implied an improved sex ratio of the projected population. The question that has been examined here has

been the impact of sex ratio at birth on overall sex ratio and nothing else. The researcher is aware that a higher ratio at birth implies a slightly lower number of female children in the younger ages immediately and a slightly lower number of women in the reproductive age group at a later date. This, in turn, would imply some reductions in crude birth rate.

The quantitative implications have not been taken up here because this exercise basically deals with the impact of sex ratio at birth on sex ratio.

Of India's present population policy, three main features are likely to influence the sex ratio at birth and, to certain extent sex-differentials in mortality. These are,

(a) rise in the age at marriage,
(b) envisaged decline in infant mortality rate and
(c) envisaged decline in the proportion of higher order births to total births.

The rise in age at marriage would automatically reduce early child bearing. It has been seen that child bearing before the age of 18 results in higher proportion of pregnancy wastages and high infant mortality. A rise in age at marriage should lead to reduction in both these components.

It was indicated in Chapter IV that a very high infant mortality rate as prevailed in India during early part of this century also implied a high proportion of still births

to live births. The current population policy envisages an infant mortality rate of about 60 by the end of this century. If this trend continues, one may get an infant mortality rate of around 40 by 2015. This would imply the mortality conditions of the developed world as they prevailed in 1950's. These countries at that time had expectation of life at birth for males at about 64-65 and that of females at about 68-69. The sex ratio at birth of the countries of the developed world around that time has been estimated to be nearly 107. The latest official population projections also assumed an expectation of life at birth for males 64.1 and that of females 65.6 by 2001. In view of this, India might have a sex ratio at birth between 106 to 107 at that time.

The third aspect of India's population relates to decline in birth rate. The policy as enumerated in the 6th Five Year Plan envisaged that Net Reproduction Rate of one should be reached in the country by 2001. The policy also stresses on a two-child norm. Although there has been a revision in the expected date of achieving net reproduction rate of one to 2010, but the stress on two-child norm continues. If the net reproduction rate of unity is achieved by 2010, the birth rate would fall to about 20 or 21. These would imply a sharp decline in proportion of third and higher births in total births. A rise in the proportion of lower order births also means a rise in the sex ratio at birth.

Considering all the three factors of India's population policy together, there is good reason to believe that, if the sex ratio at birth in India was 105 around 1981 or even in 1986, it is expected that it would increase by about one unit by the year 2001 and may further increase in the early part of 21st century.

Natarajan and Bawa, officers of the Office of the Registrar General, India have recently prepared population projections upto the year 2021 although these, (these are not official projections) have not been officially released. Taking these projections*, it has been assumed that the sex ratio at birth would remain the same at 105 as assumed by the Expert Committee upto 2001. The sex ratio at birth has been increased to 106 from 2001 to 2021 to determine a change in sex ratio at birth on the sex ratio of the total population in the year 2021.

Table VI.3

Sex Ratio of estimated population with sex ratio at birth of 105 and 106

Year		2001	2006	2011	2016	2021
Sex rate at birth	105	947.1	949.3	951.3	953.2	954.7
	106	947.1	948.5	949.8	951.0	951.9

*These projections have been obtained through the courtesy of Mr. K.S. Natarajan, Assistant Registrar General, India

Table VI.3 presents these computations in the form of resulting sex ratio of the total population and compares the same with the sex ratio in the projections obtained from Mr. Natarajan and Mr. Bawa. By 2021 the impact of increase of one point in sex ratio at birth comes to 951.9. A modification of overall sex ratio from 7.6 to 4.8.

Thus, one can see that if the current populations policy of India succeeds and sex ratio at birth improves as envisaged in this Chapter, the improvement in the overall sex ratio shall be somewhat dampened.

CHAPTER VII

S U M M A R Y

The low sex ratio of India's population has been studied in the past by Visaria (1969), Dandekar (1975), Jain (1976) and Mitra (1978). Four factors are generally identified for any change in sex ratio, viz., (a) Sex ratio at birth, (b) Sex-differentials in mortality, (c) Sex-differentials in migration and (d) Sex-differentials in population enumeration. Visaria finally concluded that it was the sex-differentials in mortality which caused a low sex ratio in India's population. He was of the view that the sex ratio at birth has been almost constant in India (Visaria, 1969). The other researchers have also substantiated this viewpoint.

This study, in the first instance, examined the impact of undercount and found that the female undercount has reduced in the population in comparison to male undercount although, though it was still somewhat higher than male undercount in 1981. A reduction in the comparative female undercount cannot lead to decline in sex ratio; consequently, this factor was not pursued further. Further, with international migration being negligible, this research exercise accepted that the sex-differentials in mortality had deteriorated between 1931 and 1971 to the disadvantage of females, felt that there could also be changes in the sex ratio at birth.

With this in view, this study examined the long range pattern of sex ratio at birth in respect of those countries where time series data relating to this index were available. It was shown, in the case of Sweden and United Kingdom, that the sex ratio at birth increased by 2.8 points and 3.9 points respectively between 1780-1980 and 1861-1980. This finding encouraged this researcher to think that there is a likelihood of changing sex ratio at birth in India too.

It was shown in Chapter III that the major component to affect sex ratio at birth is the proportion of lower order births to total births. The other factors which could have affected sex ratio at birth like crude birth rate, infant mortality rate and proportion of still births to live births were also considered. As long as the variable proportion of lower order births remained in the equation the impact of other factors did not become prominent. This was mainly due to the multicolleniarity of the independent variables with one another as is clear from the zero order correlation matrix.

The next step was to have some idea of the proportion of lower order births to total births in India's population and the proportion of still births to live births. These type of things are best studied from the civil registration system if the data are complete. In India, however, the civil registration has not at all worked well and the available data are not usable for any scientific work of the nature which

was involved in this exercise. The sample registration scheme which started in 1964 on a pilot basis in certain rural areas became full-fledged project from 1966 onwards in rural areas and from 1969 for urban areas. The sample units remained constant till 1976. Data were available at the household level for all the rural blocks of Karnataka for this period. These data provided an estimate of the proportion of still births to total births. Data for 59 blocks out of the total of 150 were utilised to generate fertility history of women falling in these selected blocks. The available data of sex ratio for each order of birth established that the lower order births implied a higher sex ratio at birth and higher order births implied a lower sex ratio at birth (Table IV.1). Extending the findings of Karnataka to India, these two statistics helped in inferring that the sex ratio at birth in India at the beginning of this century was probably somewhat lower than what it was in the 1960's or in 1970's.

With this inference for India, a few simulation exercises were undertaken in Chapter V to examine the impact of unit change in sex ratio at birth on overall sex ratio as also the impact of change in sex-differentials in mortality. The results of this simulation exercise indicate that if one starts with exactly the same age composition of male and female population, then in the stable stage with sex ratio

at birth of 105, the influence of this factor on the overall sex ratio (which stabilizes at 952), is a reduction of 48 points and a change in the sex-differentials in mortality from the same pattern was found for males in 1961-71 life table to that as found separately for males and females in same life table leads to 929, a reduction of additional 23 points. The simulation exercise has further indicated that if the sex ratio at birth is taken to be somewhat higher, the share of sex ratio at birth in explaining the total decline in overall sex ratio increases by 9 points for every unit increase in sex ratio at birth.

Chapter VI then examined the effect of the envisaged population policy for India for the near future and its likely impact on sex ratio at birth. The exercise has indicated that if one takes the official population projections of the later Expert Committee and medium assumption of fertility decline, the sex ratio will decline by 3.7 points for every increase in the sex ratio at birth. A further exercise in which the sex ratio at birth was assumed to remain 105 till 2001 and increases to 106 from thereon till 2021, its impact on total sex ratio was found to be 2.8 points.

Limitation of This Study

This study, which primarily examined the variation in sex ratio at birth in India in the last 80 years, has not

been able even to spell out exactly as to what has been the prevalent sex ratio at birth. The analytical report of sample registration scheme (Vital Statistics, 1972b) on sex ratio at birth, gave estimates for rural India for 1968 and 1969 and that the values were 108.4 and 107.8 respectively. These values were, however, considered to be too high (Vital Statistics, 1972b) and have not been utilized for any purpose. The later sample registration scheme reports have not given information on sex ratio at birth. In this study, by taking the data from Karnataka for 150 rural blocks and 60 urban blocks for 1967-76 an estimate of 104.3 of sex ratio at birth was obtained. This way although it is feasible to estimate sex ratio at birth from the sample registration scheme data, but this cannot replace the estimate that one can obtain from civil registration system if they are complete because those would be the actual and one can estimate on year to year basis. One can also see if there are any changes in it.

As sample registration scheme data have births by sex, it should not be impossible for the Office of Registrar General, India to publish information on sex ratio at birth on yearly basis. It would have certainly been better if one could have done this exercise taking data of sample registration scheme from different States.

It is noteworthy that all the past Indian life tables prepared by census actuaries and others have utilized the

age data generated in the censuses for obtaining survivorship ratios. Thus, the life tables have been completely dependent on the available age distribution given to the census actuaries. It is also noteworthy that the census actuaries upto the 1931 census could not get age distribution of the complete population and many times the available age distributions were perhaps not representative of the country's total population. Accordingly, even the estimates of the sex-differentials in mortality for earlier periods cannot be considered strictly correct. The life tables constructed by Dasgupta (1971) and Mukherji (1977) although utilized uniform methodology for different time points, but as indicated in Chapter III, these could not be accepted.

After 1971, two life tables, one for the quinquennium 1970-75, and the other for 1976-80 have become available. In the first life table covering the period 1970-75, the gap of expectation of life at birth between males and females was 1.5 years which was smaller than observed in 1961-71 life table(Vital Statistics Division, 1986a). In the 1976-80 life table, the gap has almost completely wiped out (0.4 years) (Vital Statistics Division, 1986b). Dyson (1987) questions these life tables and observes that the evidence available is weak. If a life table for 71-81 period from the age distribution of the two census populations is obtained, utilizing the same methodology as was used

in constructing 61-71 life tables, it may probably throw more light on any changes in the sex-differentials in mortality which might have taken place during this decade.

Scope for Further Research

This study with the simulation models has established the role of sex ratio at birth and the role of sex-differentials in mortality in changing the overall sex ratio. As indicated earlier, estimate of overall sex ratio at birth and of sex ratio at birth by birth order could be obtained by constructing fertility histories of women in certain selected sample registration scheme blocks of Karnataka State. It would be useful to have more detailed studies on sex ratio at birth by birth order for the country as a whole. This can be done only if it becomes feasible to have collaboration and co-operation of the researchers and the data collecting agency.

It is also necessary to understand the relationship between crude birth rate and proportion of lower order births to total births and a detailed study for all India data would be in order.

In this study an important point was made that a higher proportion of still births to total live births involves a higher pregnancy wastage even otherwise. This was done by

examining the sex ratio of still births in comparison to sex ratio of live births. A study of this relationship, particularly, in the context of declining infant mortality rate would help in understanding its impact on sex ratio of live births.

APPENDIX I

Sex Ratio Trend of Indian Population, 1971-81

Indian census count of 1981 depicted a higher sex ratio in comparison to that of 1971. This increase was in contrast to the declining trend observed for the period 1901-71. Two explanations were advanced soon after the publication of census population count felt that, (a) there was a higher underenumeration of females in 1971 than those published on the basis of post-enumeration check 1971 (Dyson, 1981 and Visaria, 1981) and (b) sex-differentials in mortality has been more favourable to females (Dyson 1981). Table A.1 gives the estimates of ommission in census count by sex for India as per post-enumeration check reports of 1951, 1961, 1971 and 1981.

Table A.1

Net ommission in census count by sex 1951-81

Census Year	Net ommission (per 1000 population)			
	Total	Male	Female	F/M x 100
1951	10.9	9.6	12.2	127.1
1961	6.8	N.A.	N.A.	N.A.
1971	16.7	15.3	18.3	119.6
1981	18.0	17.1	18.9	110.5

Source : Srinivasan, K. India's Demographic Trends; A reassesment on the basis of 1981 census.

Although females have consistently been more under enumerated than males as is clearly from Table A.1 at least

from 1951 onward, while data on post-enumeration check have been available, there has been some reduction in the female under enumeration as is clear from the last column of the table.

Unsatisfied by the picture available from the post-enumeration check it was felt necessary to evaluate the census counts of 1971 and 1981, particularly of 1971, by using some other evidence. An analysis of population growth rates by sex has been undertaken for India and the major States and presented in Table A.2.

The last 3 columns of the table gives the ratio of female growth rate to male growth rate for the period 1961-71, 1971-81 and 1961-81. One would expect that unless there have been wild fluctuations in the sex-differentials in mortality and in migration pattern, the growth rates of males and females over period of time should be quite similar.

The ratio of female to male growth rate for 1961-71 decade were lower in all cases compared to those for 1971-81 decade. This could be partly due to reduction in sex-differentials in mortality. What is not clear is that this ratio was only 79 for Bihar and 81.6 for Uttar Pradesh. The increase in the male-female ratio of growth rates has been of 16 points in Bihar between 1961-71 and 1971-81 decades, and of 22% increase for Uttar Pradesh. The data for Kerala and Tamilnadu although do not show such substantial change, but

Table A.2

Growth rate by sex for India and major States, 1961-1981

Country/ State	Growth rate 1961-71			Growth rate 1971-81			Growth rate 1961-81			Growth rate Female / Growth rate Male x 100		
	P	M	F	P	M	F	P	M	F	1961-71	1971-81	1961-81
India	24.80	25.52	24.03	25.00	24.77	25.25	56.00	56.61	55.34	94.16	101.94	97.76
Andhra Pradesh	20.90	21.18	20.61	23.10	23.17	23.01	48.82	49.26	48.36	97.31	99.31	98.17
Bihar	21.33	23.82	18.82	24.06	24.56	23.55	50.52	54.23	46.80	79.01	95.09	86.30
Gujarat	29.39	29.80	28.96	27.67	27.17	28.21	65.20	65.06	65.34	97.18	103.83	100.43
Karnataka	24.22	24.34	24.09	26.75	26.38	27.12	57.44	57.15	57.75	98.92	102.81	101.65
Kerala	26.29	26.62	25.96	19.24	18.32	20.13	50.58	49.82	51.33	97.52	109.88	103.03
Madhya Pradesh	28.67	29.42	27.89	25.27	25.31	25.22	61.18	62.18	60.14	94.80	99.64	96.72
Maharashtra	27.45	27.84	27.04	24.54	24.12	25.00	58.73	58.67	58.79	97.13	103.65	100.20
Orissa	25.05	25.89	24.21	20.17	20.55	19.78	50.27	51.75	48.78	93.51	96.25	94.26
Rajasthan	27.83	27.64	28.04	32.97	32.41	33.60	69.99	69.01	71.06	101.45	103.67	102.97
Tamilnadu	22.30	23.16	21.43	17.50	17.57	17.42	43.70	44.80	42.59	92.53	99.15	95.07
Uttar Pradesh	19.78	21.68	17.68	25.49	25.10	25.94	50.31	52.23	48.20	81.55	103.35	92.28

point to large increase in the ratio between the two time periods.

As the growth rates of some of the States could have been affected by differential net intercensal migration, population data were adjusted for Bihar, Gujarat, Kerala, Maharashtra, Tamilnadu and Uttar Pradesh for migration component (Premi, forthcoming) and the growth rates were reworked (Table A.3).

Table A.3

Growth rates by sex 1961-81 with adjustments for net intercensal migration

State	Growth rates 1961-71		Growth rates 1971-81		Growth rate of female / Growth rate of male X 100	
	M	F	M	F	1961-71	1971-81
Bihar	25.50	19.38	26.03	24.17	76.00	92.85
Gujarat	29.29	29.73	26.38	28.70	101.50	108.79
Kerala	28.89	27.24	19.83	21.19	94.29	106.86
Maharashtra	25.44	25.80	21.36	23.24	101.42	126.99
Tamilnadu	23.55	21.71	18.30	17.83	92.19	97.43
Uttar Pradesh	23.57	18.55	27.34	27.16	78.70	99.34

This table also shows the same pattern in the male-female ratio growth rates as were reflected in Table A.2. In fact, Maharashtra had a very substantial increase in this ratio from a level of 101.4 for 1961-71 to 127.0 in 1971-81.

Of the 6 major states, the females in Bihar and Uttar Pradesh had substantially low growth rate in comparison to males. There does not seem to be sufficient evidence to indicate that between 1961-71 the sex-differentials in mortality in these two states was so high that it could explain so low growth rate of females compared to males. The only alternative then left is that, particularly, in Bihar and Uttar Pradesh, the 1971 census count of females suffered by greater underenumeration than the post-enumeration check indicated.

With this evidence one is led to conclude that there was greater female under count in 1971 census then reported in post-enumeration check and therefore, the sex ratio in 1971 was most probably higher than 930.

APPENDIX II

List of countries with sex ratio for three census counts

Sl. No.	Name of the country	Year	Sex ratio	Year	Sex ratio	Year	Sex ratio
1	2	3	4	5	6	7	8
1.	Algeria	36	1031	48	993	66	1032
2.	Angola	40	1108	60	964	70	918
3.	Egypt	37	998	47	1020	76	964
4.	Ghana	48	977	60	978	70	1015
5.	Kenya	48	1017	69	996	79	1015
6.	Lesotho	56	130	66	1342	76	1072
7.	Libyan Arab Jamahiriya	54	929	64	923	73	940
8.	Mozambique	40	1105	70	1023	80	1059
9.	South Africa	46	986	70	1028	80	966
10.	Sudan	56	979	73	977	83	970
11.	Tunisia	46	965	56	933	75	982
12.	Uganda	48	999	59	991	69	982
13.	Tanganyaika	48	1080	67	1053	78	1040
14.	Zambia	50	1078	60	1017	80	1039
15.	Canada	41	951	61	978	81	1017
16.	Costa Rica	27	981	50	1003	73	994
17.	Cuba	43	912	53	953	81	978
18.	Dominican Republic	35	971	70	1004	81	994
19.	El Salvador	30	1001	61	1027	71	1016
20.	Guatemala	50	978	64	974	81	1005
21.	Haiti	50	1058	71	1072	82	1064
22.	Honduras	45	994	61	1007	74	1017

1	2	3	4	5	6	7	8
23.	Jamaica	43	1068	60	1081	70	1047
24.	Mexico	40	1027	50	1031	70	1004
25.	Nicargua	40	1061	63	1026	71	1038
26.	Panama	40	949	70	973	80	971
27.	Puerto Rico	40	992	50	990	80	1053
28.	Trinidad and Tobago	46	995	70	1019	80	1004
29.	United States	40	993	60	1030	80	1059
30.	Argentina	14	865	60	1000	80	1032
31.	Brazil	40	1004	60	1003	80	1019
32.	Chile	40	1018	60	1041	70	1046
33.	Colombia	38	1018	51	1011	73	1050
34.	Equador	50	1008	62	1001	82	1005
35.	Paraguay	50	1047	62	1034	72	1017
36.	Peru	40	1024	72	996	81	1011
37.	Uruguay	08	965	63	1011	75	1036
38.	Venezuela	41	1018	61	969	81	1000
39.	Bangladesh	11	957	61	929	81	941
40.	Burma	31	958	73	1012	83	1016
41.	India	01	972	51	946	81	933
42.	Indonesia	20	990	71	1029	80	1011
43.	Iran	56	965	66	932	76	942
44.	Iraq	47	1146	65	962	77	941
45.	Israel	48	936	61	971	72	990
46.	Japan	25	990	50	1039	80	1033

1	2	3	4	5	6	7	8
47.	Jordan	52	969	61	967	79	913
48.	Republic of Korea	49	979	55	999	75	988
49.	Kuwait	57	564	75	830	80	749
50.	Mongolia	56	1012	63	997	69	1005
51.	Nepal	52	1033	71	987	81	952
52.	Pakistan	01	848	21	817	81	906
53.	Phillippines	39	984	70	1010	80	993
54.	Singapore	47	822	70	953	80	960
55.	Sri Lanka	53	897	71	943	81	962
56.	Syrian Arab Republic	60	947	70	950	81	958
57.	Thailand	47	1000	60	996	80	1008
58.	Turkey	60	960	70	975	80	940
59.	Albania	50	947	55	951	60	947
60.	Austria	39	1064	51	1155	71	1129
61.	Belgium	30	1019	61	1044	81	1047
62.	Bulgaria	34	990	56	1004	75	1003
63.	Czechoslovakia	47	1058	61	1050	80	1054
64.	Denmark	45	1020	60	1017	70	1014
65.	Finland	40	1062	50	1092	80	1069
66.	France	36	1080	54	1085	82	1041
67.	German Democratic Republic	46	1346	64	1195	81	1128
68.	Germany, Federal Republic of	46	1214	61	1127	70	1101
69.	Greece	40	1008	61	1050	71	1049

1	2	3	4	5	6	7	8
70.	Hungary	41	1043	60	1074	80	1064
71.	Ireland	41	978	51	965	81	991
72.	Italy	36	1061	61	1043	71	1045
73.	Netherlands	30	1013	47	1009	71	1013
74.	Norway	30	1051	60	1007	80	1018
75.	Poland	50	1132	70	1059	78	1053
76.	Portugal	40	1036	60	1089	70	1114
77.	Romania	30	1036	48	1069	77	1029
78.	Spain	40	1085	60	1061	81	1037
79.	Sweden	45	1009	65	1002	80	1018
80.	Switzerland	41	1070	50	1075	70	1030
81.	United Kingdom	31	1088	61	1069	81	1058
82.	Yugoslavia	31	1022	48	1086	71	1037
83.	Australia	47	995	61	981	81	1003
84.	New Zealand	45	1049	56	989	81	1002
85.	Papua New Guinea	66	916	71	924	81	910
86.	U.S.S.R.	59	1220	70	1170	79	1145

Source : United Nations Demographic Yearbooks

APPENDIX III

Countries with sex ratio, crude birth rate and crude death rate, 1974 and 1983

Sl. No.	Name of country	Year	Sex ratio	Birth rate	Death rate	Year	Sex ratio	Birth rate	Death rate
1	2	3	4	5	6	7	8	9	10
1.	Angola	70	918	49.1	16.9	70	918	47.5	24.6
2.	Congo	74	1028	44.4	22.8	74	1028	44.7	24.6
3.	Egypt	66	982	35.4	12.9	76	964	36.9	10.3
4.	Ivory Coast	74	922	46.0	22.7	74	931	45.9	19.5
5.	Kenya	69	996	47.8	17.5	79	1015	56.1	15.9
6.	Liberia	62	1018	49.8	20.9	74	980	49.8	20.9
7.	Madagascar	66	1033	46.0	25.0	75	998	46.0	25.0
8.	Malawai	66	1111	49.0	25.0	77	1075	48.5	25.1
9.	Mali	61	1010	56.0	30.0	76	1047	43.2	18.1
10.	Mauritania	65	996	44.4	22.7	76	996	50.0	22.5
11.	Niger	60	1060	59.0	32.0	77	1028	50.9	25.0
12.	Rwanda	70	1033	51.8	23.3	78	1045	51.0	22.0
13.	Senegal	61	1030	40.0	18.0	76	1033	47.9	22.5
14.	South Africa	69	986	48.4	14.4	80	966	38.2	15.2
15.	Tunisia	66	959	46.3	16.0	75	982	35.6	11.0
16.	United Republic of Tanzania	67	1050	47.0	22.0	78	1039	50.9	16.8
17.	Upper Volta	61	992	49.4	29.1	75	994	48.1	24.0
18.	Zambia	69	1042	49.8	20.7	80	1039	48.4	16.5
19.	Canada	71	998	15.5	7.4	81	1017	15.1	7.1
20.	Costa Rica	73	994	28.3	5.1	73	994	31.0	3.9
21.	Cuba	70	951	25.4	5.8	81	978	16.8	5.9
22.	Dominican Republic	70	1004	48.5	14.7	81	994	34.6	9.1
23.	El Salvador	71	1016	40.3	8.3	71	1016	31.4	6.9
24.	Guatemala	73	994	43.4	15.4	81	1005	41.2	7.5
25.	Haiti	71	1074	43.9	19.7	82	1064	41.8	15.7

APPENDIX III (CONTD.)

1	2	3	4	5	6	7	8	9	10
26.	Nicargua	71	1038	46.0	16.5	71	1038	45.6	11.8
27.	Panama	70	973	41.1	8.8	80	971	31.0	6.0
28.	Puerto Rico	70	1039	23.3	6.5	80	1053	19.6	6.3
29.	United States	70	1054	15.0	9.1	80	1059	15.5	8.6
30.	Argentina	70	1014	22.9	9.4	80	1032	24.2	8.8
31.	Brazil	70	1018	37.8	9.5	80	1019	32.0	8.9
32.	Chile	70	1049	27.6	8.5	70	1046	23.9	6.1
33.	Ecuador	74	998	44.9	11.4	82	1005	41.6	10.4
34.	Peru	72	1000	41.8	11.1	81	1011	38.0	11.7
35.	Uruguay	63	1011	20.9	9.6	75	1036	18.3	9.5
36.	Venezuela	71	1004	40.9	7.8	81	1000	36.9	6.1
37.	Burma	73	1012	40.3	17.4	83	1016	38.5	14.2
38.	Democratic Yemen	73	1021	50.0	22.7	73	1021	47.6	20.9
39.	Hongkong	71	968	19.3	5.2	81	915	15.4	5.0
40.	India	71	930	42.8	16.7	81	933	33.3	12.5
41.	Indonesia	71	1033	48.3	19.4	80	1011	36.4	15.1
42.	Iran	66	932	45.4	16.6	76	942	42.5	11.5
43.	Iraq	65	962	49.3	15.5	77	941	47.0	13.0
44.	Israel	72	990	27.6	7.2	72	990	24.0	6.9
45.	Japan	70	1038	19.4	6.6	80	1033	12.8	6.0
46.	Jordan	61	967	49.1	16.0	79	913	46.9	10.5
47.	Republic of Korea	70	992	35.6	11.0	80	995	25.3	8.1
48.	Nepal	71	987	44.6	22.9	81	952	44.6	20.5
49.	Pakistan	72	895	36.0	12.0	81	906	42.8	11.5
50.	Phillippines	70	1010	44.7	12.0	80	993	33.9	7.7
51.	Singapore	70	953	19.9	5.3	80	960	17.3	5.2
52.	Sri Lanka	71	948	29.5	7.7	81	962	28.0	6.0
53.	Syrian Arab Republic	70	950	47.5	15.3	81	958	46.4	8.9

APPENDIX III (CONTD.)

1	2	3	4	5	6	7	8	9	10
54.	Thailand	70	1009	42.8	10.4	80	1008	31.4	8.4
55.	Turkey	70	975	39.6	14.6	80	939	39.6	14.6
56.	Belgium	70	1044	12.6	11.9	81	1047	11.9	11.3
57.	Bulgaria	65	1000	17.2	9.8	75	1006	13.6	11.4
58.	Czechoslovakia	70	1053	19.8	11.7	80	1054	14.8	12.1
59.	Denmark	70	1014	14.2	10.2	70	1014	9.9	11.2
60.	Finland	70	1071	13.3	9.6	80	1068	13.7	9.0
61.	France	68	1052	15.2	10.4	82	1041	13.7	10.2
62.	German Democratic Republic	71	1170	10.4	13.3	81	1128	14.0	13.3
63.	Federal Republic of Germany	70	1101	10.1	11.7	70	1101	9.7	11.7
64.	Greece	71	1049	16.1	8.5	71	1049	13.6	9.1
65.	Hungary	70	1063	17.8	12.0	80	1064	11.9	13.9
66.	Ireland	71	991	22.5	11.0	81	991	19.0	9.3
67.	Italy	71	1056	15.7	9.6	71	1056	10.9	9.4
68.	Netherlands	71	1003	13.8	8.0	71	1013	11.8	8.2
69.	Norway	70	1011	14.9	9.9	80	1018	12.0	10.2
70.	Poland	70	1059	18.4	8.2	78	1053	19.7	9.6
71.	Portugal	70	1033	19.3	11.1	80	1114	16.4	9.9
72.	Rumania	66	1043	20.3	9.1	77	1029	15.3	10.0
73.	Spain	70	1045	19.3	8.4	81	1037	13.4	7.4
74.	Sweden	70	1002	13.4	10.6	80	1018	11.0	10.9
75.	Switzerland	70	1029	12.9	8.5	80	1029	11.4	9.3
76.	United Kingdom	71	1060	13.1	12.1	81	1058	12.8	11.8
77.	Yugoslavia	71	1037	17.9	8.5	71	1037	16.7	8.9
78.	Australia	71	989	18.9	8.4	81	1003	15.8	7.6
79.	New Zealand	71	1001	20.5	8.5	81	1002	15.8	8.1
80.	Papua New Guinea	71	924	45.0	20.0	80	910	42.5	15.7
81.	U.S.S.R.	70	1170	18.2	8.7	79	1145	20.1	10.3

Source: United Nations Demographic Yearbooks 1974 and 1983

APPENDIX IV(ii)

SAMPLE REGISTRATION SCHEME
FORM 2- HOUSEHOLD SCHEDULE

House and Household No. Name of Head Religion Sample Code

Census Block No. & House No.1971 Census

Sl. No.	Name including Head	Relationship to Head	Sex M/F	Base-line Survey Status			HYS Status			HYS Status			HYS Status		
				Age	Marital	Residential	1-Age	-19 Marital	-19 Residential	1-Age	-19 Marital	-19 Residential	1-Age	-19 Marital	-19 Residential
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

APPENDIX IV(iii)

FORM 2-HOUSEHOLD SCHEDULE(CONTD.)

HYS 1- -19			HYS 1- -19			HYS 1- -19		
	Status			Status			Status	
Age	Marital	Resi-dential	Age	Marital	Resi-den-tial	Age	Marital	Resi-dential
17	18	19	20	21	22	23	24	25

APPENDIX IV(iv)

SAMPLE REGISTRATION SCHEME

FORM 3 - LIST OF BIRTHS

Village/Town

Tehsil/Taluka

District

Sample Code

Reference period
(Months covered)
From to

Survey Period
(Dates of field Survey)
From to

Sl. No.	House No. and Household No. Existing	House No. and Household No. 1971 Census	Name of Head of Household	Particulars of Mother Name	Particulars of Mother Status (URP/URA/V)*	Particulars of children born Sex M/F	Particulars of children born Date of birth	Particulars of children born Live/Still Birth (LB/SB)	Matching Remarks	Re-verification	Remark
1	2	2A	3	4	5	6	7	8	9	10	11

Signature & Designation

*Note:- The status in col.5 refer to the status at the time of occurrence of the event and not to the status at the time of HYS.

APPENDIX IV(v)

SAMPLE REGISTRATION SCHEME

FORM 4 - LIST OF DEATHS

Village/Town

Tehsil/Taluka

District

Sample Code

Reference period
(Months covered)
From to

Survey Period
(Dates of field Survey)
From to

Sl. No.	House No. and Household No.		Name of Head of Household	Particulars of Deceased: Name	Status (URP/URA/V)*	Sex M/F	Date of Death	Age at Death	Matching Remarks	Re-verification	Remarks
	Existing	1971 Census									
1	2	2A	3	4	5	6	7	8	9	10	11

Signature & Designation

*Note:- The status in col.5 refers to the status at the time of occurrence of the event and not to the status at the time of the HYS.

APPENDIX IV(VI)

SAMPLE REGISTRATION SCHEME
FORM 5 - BIRTH RECORD

Village/Town | Ward | Tehsil/Taluk | District | Sample Code

Particulars of newly born child							House No. & Household No.		
Sl. No.	Place of birth (in/out of unit)	Date of birth	Date of Enumeration	Live Birth/ Still Birth LB/SB	Type of Birth Single/ Multiple S/M	Sex M/F	Existing	1971 Census	Name of the Head
1	2	3	4	5	6	7	8	9	10

Information about mother who delivered the child										
Name of mother	Mother's Relation to Head	Residential Status URP/URA/V	Present Age in completed years	Religion	Type of attention at delivery	First information source	Enumerator's Signature	Date of death	Age of death	Remarks
11	12	13	14	15	16	17	18	19	20	21

APPENDIX IV(vii)

SAMPLE REGISTRATION SCHEME

FORM 6 - DEATH RECORD

Village/Town | Ward | Tehsil/Taluk | District | Sample Code

Sl. No.	Place of death (In/our of unit)	Date of death	Date of Enumeration	Name of the deceased	Name of Father/ Mother/ Husband of deceased	House No. & Household No. Existing	House No. & Household No. 1971 Census	Name of the Head	Relation of deceased to Head	Deceased's Status (URP/ URA/V)	Sex (M/F)
1	2	3	4	5	6	7	8	9	10	11	12

Age at death

Below 1 month (in days)	Below 12 months (in months)	One year & above (In completed years)	Date of birth/ Month/ year of birth if age at death is below 3 years	Serial No. of birth in Form 5/Form 2	Marital status	Religion	Medical attendance before death	First information source	Enumerator's Signature	Remarks
13	14	15	16	17	18	19	20	21	22	23

APPENDIX IV(viii)

SAMPLE REGISTRATION SCHEME

FORM 7 -LIST OF PREGNANT WOMEN

Village/Town | Tehsil/Taluka Anurn Block | District | Sample Code

Sl. No.	Date of Enumeration	House No. & Household No. Existing 1971 Census		Name of Head	Name of pregnant woman	Outcome of Pregnancy Live Birth 'LB' Still Birth 'SB' Abortion 'A'	S. No. in Form 5 if 'LB' or 'SB'
1	2	3	4	5	6	7	8

APPENDIX IV(ix)

To be dispatched by Enumerator by 1st of every month

SAMPLE REGISTRATION SCHEME

FORM (10) - MONTHLY REPORT

Report for the month of

District | Tehsil/Taluk | Village/Town | Ward | Sample Code

A-Birth

Particulars of newly born child							House No. & Household No.		
Sl. No.	Place of birth (In/Out of unit)	Date of birth	Date of enumeration	Live birth/ Still birth (LB/SB)	Type of birth Single/ Multiple (S/M)	Sex (M/F)	Existing	1971 Census	Name of the Head
1	2	3	4	5	6	7	8	9	10

Information about mother who delivered the child

Name of mother	Mother's relation to Head	Status (URP/ URA/V)	Present Age(in years)	Religion	Type of attention at delivery	First information source	Date of death	Age at death
11	12	13	14	15	16	17	18	19

APPENDIX IV(x)

Form 10-Contd.

B-Death

Sl. No.	Place of death (In/out of Unit)	Date of death	Date of enumeration	Name of the deceased	Name of Father/ Mother/ Husband of deceased	House No. & Household No. Existing	House No. & Household No. 1971 Census	Name of the Head	Relation of deceased to Head	Deceased's status (URP/URA/V)	Sex (M/F)
1	2	3	4	5	6	7	8	9	10	11	12

Age at death

Below 1 month (in days)	Below 12 months (in months)	One year and above (in completed years)	Marital status (M/UM/W/D/S)	Religion	Medical attention before death	First information source
13	14	15	16	17	18	19

APPENDIX IV(xi)

Form 10-Contd.

C-Informant system*

Informant		1st week		2nd week		3rd week		4th week	
Name	Vocation	B	D	B	D	B	D	B	D

*Applicable only in rural areas

APPENDIX IV(xii)

C.S.R.D., S.S.S., J.N.U., New Delhi

FERTILITY SCHEDULE

A. Identity

SAMPLE VILLAGE/TOWN CODE — R/U

NAME OF WOMAN — CENSUS HOUSE NO.

NAME OF HUSBAND — Household No.

AGE AT MARRIAGE — Age on 1-6-66

HALF YEAR when married — Date of entry into Sample

B. Fertility — H/M/O

Sl. No.	Parity No.	Name of child	LB/ SB	Sex	Date of Birth	Age of Mother	Infant Mortality	Mother's Mortality

APPENDIX V

Sl. No.	Name of the country	Sex ratio at birth	Crude birth rate	Still birth/ live birth proportion	Infant mortality rate	Proportion of lower order births	Mean age of mother at first birth
1	2	3	4	5	6	7	8
1.	Mauritus	103.00	26.80	41.0	62.70	0.58479	21.37
2.	Canada	106.00	17.10	9.8	18.70	0.83141	22.59
3.	Costarica	104.73	13.30	15.1	59.80	0.66168	20.75
4.	El Salvador	103.30	41.90	9.5	60.00	0.55961	20.52
5.	Guatemala	104.44	43.50	29.1	86.20	0.55162	20.39
6.	Panama	104.25	37.40	21.2	38.30	0.55737	20.43
7.	United States	105.29	17.30	13.7	20.00	0.81319	21.42
8.	Trinidad	103.25	25.40	23.2	32.60	0.61501	22.40
9.	Chile	103.77	26.30	20.7	78.30	0.66253	25.04
10.	Japan	107.35	19.00	15.0	13.40	0.97110	23.21
11.	Austria	105.68	15.50	10.2	25.60	0.83190	23.42
12.	Belgium	105.84	14.60	11.4	20.80	0.84975	21.33
13.	Bulgaria	106.26	16.30	9.6	27.40	0.93492	21.79
14.	Czechoslovakia	105.55	16.00	7.3	22.10	0.91184	22.98
15.	Denmark	106.33	14.90	8.3	14.20	0.91622	23.13
16.	Finland	104.91	14.10	8.7	13.30	0.90920	23.74
17.	France	105.15	16.90	13.5	18.30	0.84397	23.74
18.	Federal Republic of Germany	105.71	13.70	10.2	23.20	0.88529	24.26
19.	Hungary	106.80	14.80	9.9	35.10	0.91769	21.99
20.	Ireland	105.94	21.90	13.9	19.40	0.65440	24.62

1	2	3	4	5	6	7	8
21.	Italy	105.82	17.00	15.6	29.70	0.85403	23.98
22.	Netherlands	105.07	17.90	10.6	12.70	0.88215	23.76
23.	Norway	105.82	17.00	10.5	13.00	0.88237	20.03
24.	Poland	106.50	16.80	10.0	31.80	0.84379	22.33
25.	Portugal	106.90	20.90	23.3	53.10	0.71905	23.74
26.	Switzerland	105.88	16.00	9.2	14.90	0.90260	24.55
27.	England & Wales	105.99	16.00	13.2	17.80	0.88218	23.29
28.	Scotland	106.11	16.80	14.0	20.00	0.85029	23.21
29.	Yugoslavia	107.09	18.50	9.1	53.10	0.81220	21.91
30.	Australia	105.00	20.70	9.9	17.70	0.83926	23.17
31.	New Zealand (European population)	105.00	22.40	10.7	16.90	0.81578	22.78

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