

Trend in Sex Ratio by Age of Mother in Greater Bombay

SEX ratio at birth is a biological phenomenon. It is influenced by various factors such as mother's age, birth order and other socio-economic conditions. Number of attempts have been made to study the effect of these factors on sex ratio at birth.^{1,2,3} Analysis of 3.7 million births in Japan during 1975-76 shows a weak and negative association between sex ratio and birth order. Further when maternal age was considered, negative effect of paternal age and birth order with sex ratio at birth was observed.⁴ A study of sex ratio at birth in India by using hospital data concludes that there was a little effect on the sex ratio of selectivity of hospital births by age of mother.⁵ The investigation based on Australian data for 1902-65 revealed that masculinity ratio tends to decline as the age of either parents increases and it was high when both parents were young.⁶ In Greater-Bombay sex ratio at birth was found to be fluctuating between different birth orders for different periods of time.⁷ Further regressing sex ratio at birth on birth order and maternal age establishes a curvilinear relationship. Keeping these concepts in view this paper investigates the trend in sex ratio at birth in Greater Bombay in relation to age of mother.

Material and Methods

Data were collected from the annual reports of the executive Health Officer, Greater Bombay Municipal corporation for the years 1964-1980,⁸ where the information on births have been recorded according to age of the mother by sex of the baby. The information was made available from 1964 onwards. Deriving conclusion from secondary data depends on the accuracy of the secondary data. But, unlike many other cities in Bombay an extremely high proportion of deliveries take place in the maternity hospitals and the

registration of events are accurate upto 99 percent.^{9,10,11} Hence conclusions drawn on the basis of these data can be considered fairly reliable and accurate. Sex ratio at birth was usually expressed as the numbers of males per thousand females (M/F) or female per thousand males (F/M) and also expressed as proportion of male births among all births (Masculinity ratio M). In this study sex ratio at births is defined as M/F and M/T accordingly.

Sex ratio at birth (M/F) was 105 in 1960 having fluctuation upto 1970 (Fig. 1) and during 1971 to 1977 sex ratio at birth was found to be very high (110-119.42). Generally, sex ratio at birth lies between 102-107 male births per 100 female births. High fluctuation in excess of male births over female from Table 1, clearly indicates that proportion of male births were higher during 1971 to 1977

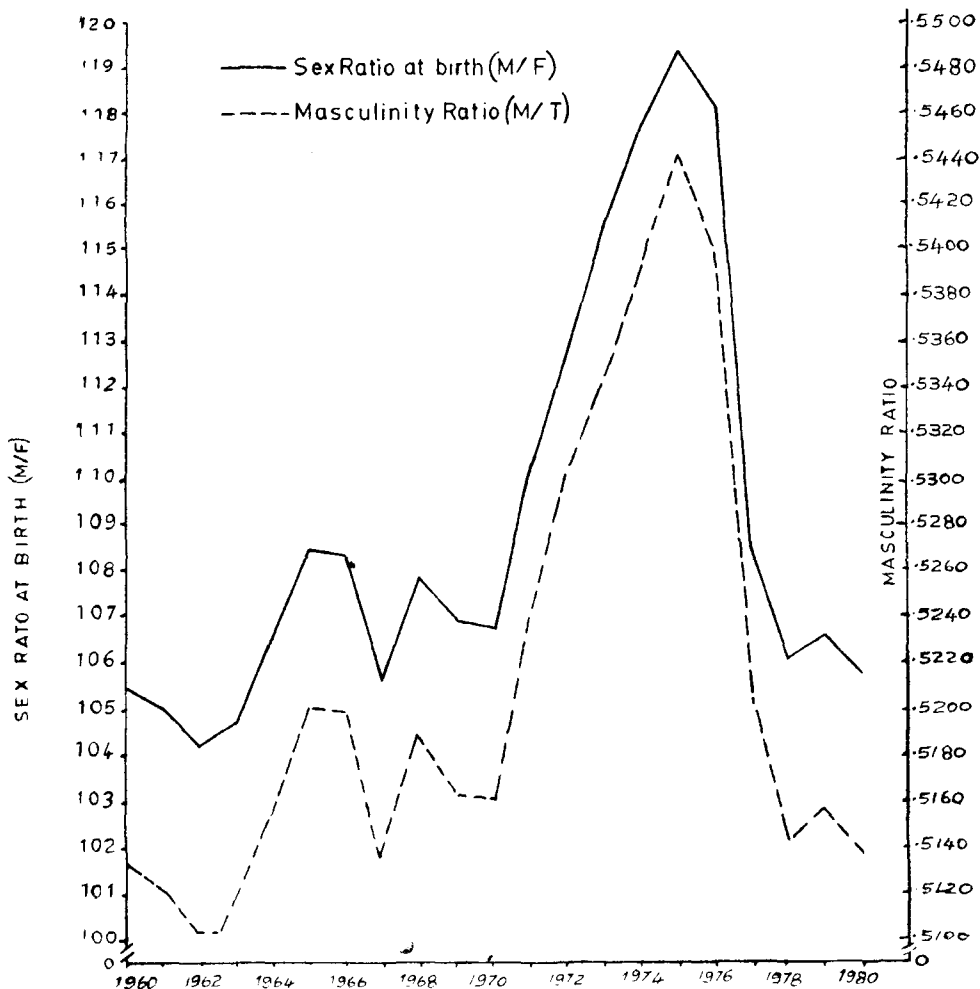


Fig. 1. Sex ratio at birth during 1960-1980 in Greater Bombay.

TABLE 1—SEX RATIO, PROPORTION OF MALE BIRTHS AND STANDARD
ERROR OF SEX RATIO FROM 1960-1980 IN GREATER BOMBAY

Year	Male	Female	Sex Ratio at Births M/F x 100	Proportion of Male Births (M)	Standard Error of Sex Ratio
1960	55121	52263	105.47	.513307	.610107
1961	59603	56734	105.06	.512331	.586191
1962	61904	59401	104.21	.510317	.574114
1963	67464	64367	104.81	.511746	.550683
1964	68378	64214	106.48	.515702	.548981
1965	74295	68486	108.48	.520342	.528853
1966	76982	71004	108.42	.520198	.519475
1967	78722	74508	105.66	.513751	.510733
1968	81424	75456	107.91	.519021	.504582
1969	82471	77100	106.97	.516829	.500388
1970	83333	77979	106.87	.516595	.497688
1971	86150	78143	110.25	.524368	.492838
1972	89006	78815	112.93	.530363	.487309
1973	96674	83735	115.45	.535860	.469657
1974	96840	82183	117.83	.540936	.471102
1975	97977	82041	119.42	.544262	.469530
1976	103422	87493	118.21	.541718	.456135
1977	96371	88840	108.48	.520331	.464341
1978	97756	92161	106.07	.514730	.458733
1979	105548	99047	106.56	.515887	.441940
1980	106654	100852	105.75	.513980	.438879

than any other period. The reasons, related to socio-economic factors, for this high sex ratio during period (1971-1977) could not be brought out here because of paucity of the data. However, mother's age which is a very important vari-

able, has been considered in determining the variation in sex ratio at birth and defined as masculinity ratio (M/T). Data regarding proportion of male births by mothers age was available from 1964 up to 1980, Hence analysis has been restricted to that period only.

Results

For each age group of mother (< 15, 15-19, . . . 45 +) average proportion of male births for the period 1964-1980 has been calculated (Table 2). This masculinity ratio was high when the age of mother less than 15 years (.5206), reached a peak in the age group 15-19 and then declined upto 30-34 age group! Later a slight increase followed for higher age groups This clearly indicates that during the study period, younger mothers (15-19 years of age) had high proportion of male births than in any other age group. Hence knowing the proportion of mothers by age group who are delivering at different points of time may explain the reasons for fluctuations in masculinity ratio which is reflected in Figure 1.

For each given age group of mother, the relation between masculinity ratio and the time period has been calculated (Table 2). This relation is found to be very low and insignificant. The reasons are that during the study period, it was observed a peak fluctuation between 1971-1977 (Fig. 1) and this might have affected the masculinity ratio trend. Hence the study period 1964-1980 has been divided into two parts as period I : 1964-1970 and 1978-1980 : and period II : 1971-1977. For these two periods, for each given age group of mother the

TABLE 2—MASCULINITY RATIO FOR DIFFERENT AGE GROUPS OF MOTHER IN GREATER BOMBAY FOR THE STUDY PERIOD (1964-1980)

<i>Age of Mother</i>	<i>Average Masculinity ratio</i>	<i>Coefficient of Correlation</i>
Less than 15	.520598	-.1246
15-19	.544009	-.0645
20-24	.524531	-.2706
25-29	.514088	.3913
30-34	.527550	.2929
35-39	.536866	.2730
40-44	.551599	.4292
45+	.543438	.1925
All ages	.523816	.2134

correlation coefficient and regression has been calculated between masculinity ratio and the time period (year). Table 3 and Table 4 gives the results.

TABLE 3—MASCULINITY RATIO FOR DIFFERENT AGE GROUPS OF MOTHER IN GREATER BOMBAY (PERIOD I 1964 TO 1970, 1978 TO 1980)

<i>Age of Mother</i>	<i>Average Masculinity ratio</i>	<i>Coefficient of Correlation</i>	<i>Step b</i>	<i>Intercept a</i>	Ψ^2
Less than 15	.468989	— .406471	--.006740	13.751133	.411304
15-19	.533725	— .336943	--.001686	3.856119	.117048
20-24	.521126	— .708329	--.001393	3.266328	.035098
25-29	.511227	.368748	.001021	—1.500244	.065707
30-34	.512549	.208057	.000412	— .299088	.049371
35-39	.507197	.142204	.000525	— .526487	.093663
40-44	.520063	.258839	.001683	—2.816722	.160584
45+	.525993	.160303	.002709	—4.812587	.414120
All ages	.516704	— .548084	--.000218	.446133	.008428

TABLE 4— MASCULINITY RATIO FOR DIFFERENT AGE GROUP OF MOTHER IN GREATER BOMBAY (PERIOD II, 1971 TO 1977)

<i>Age of Mother</i>	<i>Average Masculinity ratio</i>	<i>Coefficient of Correlation</i>	<i>Step b</i>	<i>Intercept a</i>	Ψ^2
Less than 15	.594326	— .363720	--.021692	43.413849	.386807
15-19	.558701	.205017	.001733	-2.861889	.058450
20-24	.529395	.374865	.002860	—5.116456	.051648
25-29	.518175	.342425	.002669	—4.750008	.053663
30-34	.548981	-.770348	.004280	8.997348	.025283
35-39	.579250	— .589264	--.009533	19.397462	.089475
40-44	.596678	.390873	.009756	—18.661666	.159358
45+	.568359	— .380307	--.008771	17.882877	.150192
All ages	.533977	.159117	.000679	-.805594	.03046F

Table 3 shows that the average masculinity ratio for all age groups was .5167 and it was lowest for the mothers age less than 15 years and found to have peak in the age group of mother 15-19. The correlation coefficient showed a negative relation for the age group of mother less than 15, 15-19, and 20-24. For 20-24 age group, the correlation coefficient (r) was highly significant indicates that masculinity ratio declines as time period increases. Further for the age groups 25-29 to 45 +, the correlation coefficient exhibited a positive, insignificant value, indicating that for the older mother (more than 25 years of age) the masculinity ratio increases according to time period

Table 4 shows the masculinity ratio for different age group of mother for the period II. Masculinity ratio was very high for the younger mother (.5943) and later increased, reaching peak in the age groups 40-44. During this period, mothers who are very young (i.e. less than 15 years age) and mothers aged more than 30 years have shown high proportion of male births. When we look at the correlation coefficient between the masculinity ratio and time period for each given age group of mother in Table 4, it shows a high negative relation for less than 15 years and above 30 years age groups of mother. We can conclude that even though proportion of male births are very high for the younger (< 15) and older (30 +) mothers, masculinity ratio tends to decline as time period increases.

From the given two periods of time, it is evident that during period I, younger mothers (15-19 years) were found to deliver a larger number of male children and as the year increases this proportion declined. Whereas in period II, mothers of age group 15-29 exhibit a very low masculinity ratio. Further, time trend relation in this period for given age group of mother is positive, whereas it was negative in the period I. From this analysis one can conclude that the age of mother is an important variable in determining the trend in masculinity ratio at birth.

To examine the relation between masculinity ratio and age of mother, a regression equation has been fitted for the data pertaining to period I, period II and for total period (Fig. 2). From the Fig. 2 it was evident that second degree equation has been found to be the best fit. The equations are as follows :

$$\text{Period 1: } Y = .4580 + .3038x - .00004x^2;$$

$$\text{Period II : } Y = .6640 - .0086x + .0002x^2;$$

$$\text{Total Period : } Y = .5428 - .0016x + .00003x^2.$$

Where the dependent variable (Y) is masculinity ratio and x , the independent variable is mothers' age.

In period I, the fitted equation shows that as the mothers' age increases, the masculinity ratio increases upto 30-34 years, later it starts declining (Fig. 2). Whereas in period II, masculinity ratio decreases as mothers age increases upto

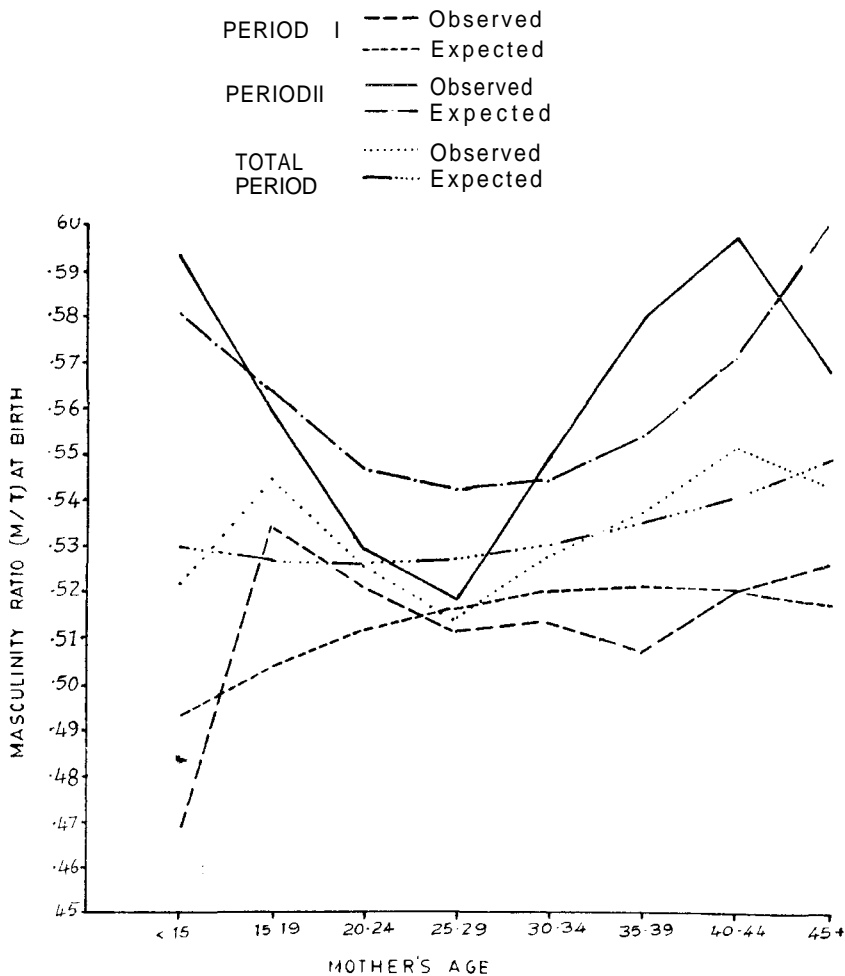


Fig. 2. Relation between masculinity ratio at birth by age of mother during 1964-1980 in Greater Bombay.

25-29 years and later the ratio increases and reaching peak after 40-44 years. Period II show an effect that is inverse of the one in Period I. For the total period, the relation between masculinity and mothers ages appears to be curvilinear.

Summary and Conclusions

Though the causes for determining sex ratio variations are still indistinct, it was well known that the proportion of male to female births varies from time

to time. These variations in sex ratio at birth was determined by external circumstances such as the degree of nourishment of mother, her age and that of father.¹¹ Further it was accepted phenomena that male births and female births, for a given period are not equal, but varies according to race, climatic season of gestation, food, consanguineous marriage, polyandry,⁹ and racial composition.¹⁰ Males have an edge over female births. The mortality in the early ages of life was much greater for males than for females and hence male outnumbering will be lost in other age groups. In the present study it was observed that males outnumbered females at birth for the study period and this is shown to be an increasing tendency. When the data were divided into small segments of time period, period II had a very higher masculinity ratio than period I. Age of mother was one of the important factors that influenced the masculinity ratio at birth. In period II, where masculinity ratio was high, mothers with age less than 19 and more than 35 have exhibited very much higher masculinity ratio than mothers in other age groups. It was the reverse in period I. Even though masculinity ratio is a biological phenomenon, it is evident from this study that mothers' age at delivery may influence the ratio.

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