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## **An Enquiry into the Effect of the Disequilibrium in Sex Ratio on Marriage in India**

MOST studies on sex ratio concentrate on accounting for the imbalance in sex ratios. Keyfitz and Flieger (1971) and Norland (1975) have, for example, suggested methods to account for the changes in sex ratio. As regards social consequences of the imbalances in sex ratio there had been quite a number of interesting speculations with remarkably little research. Thompson (1974) summarizes succinctly the current status as regards the speculations and the research done on the social consequences of the imbalances in sex ratio. But even in his long list of consequences, the possibility of adjustment on age at which men and women marry is not to be found. However, it seems there is a great amount of adjustment possibility in age at which man and women marry. If this difference in marriage age between men and women can accommodate a sizeable level of imbalances in sex ratio, then many of the consequences speculated by many writers would be least significant in reality.

This paper attempts to develop a stable population model to\* find out what should be the age difference between husband and wife at the time of marriage in order to have monogamy for a sex ratio arising out of difference in mortality between sexes. This then is applied on Indian population which is known for its male surplus.

## 2. Model for Age Difference between Couples

Let  $b^f$  be the number of births of female babies at time 0 and  $kb^f$  be the number of male babies at time 0, where  $k$  is a constant. If the population is a stable one and the life table survivorship function of female is  $l_x^f$  and male is  $l_x^m$  (with radix  $l_0 = 1$ ), the number of women aged  $x$  at time  $x$  is  $b^f l_x^f$ . Assume that these women have to marry men of age  $y$ , that is, there is to be as many men at age  $y$  as women at age  $x$ . These men are the survivors of those who were born  $y$  years before, i.e. at time  $(x - y) = -(y - x)$ . Given the rate of increase  $r$ , the number of births of male babies at time  $-(y - x)$  is then

$$e^{-(y-x)r} kb^f.$$

Therefore, the survivors from this cohort to age  $y$  is

$$e^{-(y-x)r} kb^f l_y^m.$$

If the number of women at age  $x$  and men at age  $y$  are equal then

$$e^{-(y-x)r} kb^f l_y^m = b^f l_x^f.$$

Dividing both sides by  $e^{xr} kb^f$ , we get

$$e^{-yr} l_y^m = \frac{e^{-xr} l_x^f}{k}. \quad (1)$$

Note that the equation does not involve the birth rate. The right-hand side of the equation becomes constant for any given age of wife. The left-hand side is a monotonically decreasing function. Therefore, there is only one value of  $y$  which would correspond to a given value of  $x$ .

## 3. The Indian Situation

### a. Sex Ratios

The overall sex ratio (number of males per 100 females) has increased from 103.8 in 1901 to 107.4 in 1971, which is presented in the Table 1. From the same table it is also clear that the expectation of life has more than doubled during the same period. However, the expectation of life for men was lesser

than for females in 1901 and the expectation of life increased faster for men and became greater than that for females in 1971. Though regional variation in sex ratio at birth has been noticed by K. V. Ramachandren *et al.* (1964), it is explained mostly by the considerable errors of various sorts. It is believed, on the basis of births occurring in hospitals, that the sex-ratio at birth is 106 males per 100 females. In so far as the assumption of constant sex-ratio at birth goes, the existing (rend in sex ratio in the population may have to be accounted only by the difference in the risk of mortality between males and females. Ruled-out is the effect of migration as the international migration is practically negligible for India.

In order to find the consequence on marriage of this disequilibrium in sex ratio we also need data on age distribution. Unfortunately the census age returns for India have errors of various kinds and specifically the errors in age are highly dependent upon sex. Table 2 clearly brings out the sex differential in misreporting of age. If there is no differential misreporting of age, the dip seen in the age group 20-25 in 1901 should have persisted and should reflect in the age group 40-45 in 1921. From the table it can *be* seen that it is not the case. Hence we conclude that age and sex data cannot be directly used for the analysis. It may also be argued that there would be differential error in age data between marital status groups. In the absence of any reliable method by which we could make adjustments for these errors, we depend heavily on the assumption that percent married in each age group is reasonably reliable than the actual numbers. Also we depend on stable population age distribution. Though quasi-stable population might be better suited, the age distribution is not much different between stable and quasi-stable population and hence stable age distribution is taken for ease in calculations. Since the birth rate for India has been almost constant over the long period of time the assumption of stable (quasi-stable) age distribution is not far from reality.

### *b. Marriage Patterns*

About 83 percent of Indians are Hindus and about 11 percent are Muslims. Among Hindus polygamy is permissible with the consent of the first wife. Among Muslims also polygamy is permissible under certain less stringent conditions. Hence one might naturally expect a good proportion of polygamous marriages. Since there is no direct statistics on polygamy, we might attempt an understanding through the ratio of currently married women to currently married men.

From Table 3 we may conclude that approximately one in 100 men has two wives.

Marriage is almost universal in India. However, there is a small percentage of men and women who never marry. Table 4 represents the percent never married among men and women in each age group for the years 1901, 1921, 1941 and 1971. There has been an increase in the percent never married among the age groups 15-19 and 20-29 among men and women during 1901-71, which is indicative of increasing age at marriage for both men and women. An additional striking observation from the table is that the percent never married has declined among higher age groups among both men and women, which suggests that increasing proportion of people getting married in 1971 than in 1901. In other words, bachelorhood is declining over the years. Increasing age at marriage coupled with declining bachelorhood seems to be a unique feature of India.

Table 5 provides the mean age at marriage for males and females in India published by the Government of India (1974) and Operations Research Group (1971). There was an increase in age at marriage both for men and women, but at the same time the age difference between bride and groom has declined over the years. This is contradictory to what one might expect under the increasing male surplus. When male population is more than the female population, there would be high bachelorhood among men or large difference in age between bride and groom so that there could be one male to each female.

### *c. Mortality and Widowhood*

Before going into the enquiry of the mortality difference between men and women and widowhood frequency, it is worthwhile to have an understanding on the remarriage custom in the culture. Though there has been quite a social revolution supporting widow remarriage, nothing significant has been achieved in terms of proportion of widows remarrying. However, widower remarriage has been a common practice in Indian population, but these widowers marry only single women. Divorce is relatively insignificant in Indian population. Earlier it has been noticed that improvement in mortality has been dramatic during 1901-71. This must then reduce the proportion of widowhood among men and women, since joint survival is increased by the declining mortality. One of the interesting speculations on relatively larger improvement in longevity among men than among women is that widowhood among women should be declining faster than widowhood among men. Owing to paucity of data sepa-

rately on widowed, divorced and separated persons, only the proportion of the sum of these are presented for 1901 and 1971 in Table 6 for each sex. As there is very insignificant fraction of divorced and separated cases in this population, treating all these categories as widowed might not affect the broad conclusions arrived at. From the foregoing speculation we might expect (a) the age specific proportions of widowed among men and women should be less in 1971 compared to 1901; and (b) the ratio of proportion of widowed men to proportion of widowed women should be higher for 1971 than 1901. Table 6 shows exactly the same situation. The ratios of proportion of widowers to proportion of widows in the next younger five year age group have also been presented in the same table. Under the conditions of equal mortality among the sexes, almost equal chance of male and female births, approximately five year difference between bride and groom (grooms are five years elder to brides) and no remarriage, this ratio should be unity. For 1901 the ratios are far from unity whereas for 1971 it is closer to unity among younger ages but not among older ages. This is an indication of reduction in remarriage among men during 1901-71. This reduction in remarriage among men may be due to two factors. First, as has been noticed earlier, there has been an improvement in mortality and hence an increase in joint survival of couples. So the incidence of widowhood decreases among men (as well among women) and hence a decrease in remarriage. The second factor might be that even among widowers, the probability of remarriage might have declined.

#### 4. Improvement of the Model to Account for Proportion Marrying and Polygamy

Since it was found earlier that there is a proportion who never marry, we have to modify the equation (1) to take this into account. If  $p^m$  is the proportion who ever marry among men and  $p^f$  is the proportion among women, then equation (1) becomes

$$e^{-y_r} l_y^m = \frac{e^{-x_r} l_x^f p^f}{k p^m} \quad (2)$$

The equation needs further modification in order to take into account the proportion of polygamy. If we assume that among men who marry and among women who marry there is a ratio 1 : c (that is, one man marries c women), then the equation (2) becomes

$$e^{-yr} l_y^m = \frac{e^{-xr} l_x^f p^f}{k p^m c} \quad (3)$$

From equation (3), we can estimate the age of men at marriage for a given age of women at marriage, proportion of men and women ever marry and information on polygamy.

## 5. Analysis and Findings

Appropriate stable population (life table) model has been chosen using cumulated age distribution for males and females for different years viz. 1901, 1921, 1941 and 1971. The levels so chosen from Coale and Demeny (1966) are given in Table 7. The sex ratio at birth is assumed to be 106 male births per 100 female births. Proportion ever married is obtained from the proportion never married at age group 50-59. Number of married women per ever married man (the index of polygamy but not serial monogamy) is also presented in the same table.

Application of equations (1), (2) and (3) for this set of information provides expected age difference between bride and groom : (a) when every one gets married only once; (b) when there is a given proportion who never marry and others marry only once; and (c) when there is a given proportion who never marry and some men marry more than one wife at the ratio of polygamy. Table 8 gives the expected difference of age between bride and groom for these above situations and the observed difference. The last column in the table is the difference between observed and expected age difference under the conditions of sex ratio in population, level of polygamy (excluding serial monogamy) and proportions never married. Hence this difference can be attributed to serial monogamy, that is, mostly widowers marrying single women, since widow remarriage is quite insignificant. Therefore, the decline in the difference between observed and expected (figures in the last column) is an indication for the rapid decline in remarriage among men. This might have been due to (a) improvement in longevity *vis-a-vis* joint survival of husband and wife and/or (b) genuine decline in the probability of remarriage among men.

The above method of analysis at least gives an insight into why the trend in observed age difference between bride and groom is just the reverse of what might be expected from the trend in the sex ratio of the population.

## 6. Conclusions

Simple model (Stable Population Model) has been developed to find out what should be the age difference between bride and groom so that every one marries only once for a sex ratio arising out of difference in mortality between the sexes. This is further modified to take into account polygamy (but not serial monogamy) and proportion ever marrying among men and women.

Changes in sex ratio and mortality in India have been described with the census data. The sex ratio has been increasing since 1901 which is explained by the faster decline in mortality among men than among women. Under this circumstance, one might expect the age difference between bride and groom to increase in response to the changes in sex ratio. On the contrary, observed age difference of couples has only declined.

The model developed has been used as a procedure of finding out the expected age difference between couples, and that is compared with the observed difference. The difference between observed and expected has declined faster, which indicates the decline in remarriage of widowed men, when the cultural aspects are taken into consideration. This decline in remarriage might be due to increasing joint survival of couples because of decline in mortality and/or due to genuine decline in the rate of remarriage among widowed men. That is the reason why the disequilibrium caused by the decline in mortality on sex ratio has not affected very much the first marriage age difference because the same decline in mortality had a counter effect through increasing the joint survival of couples. Further enquiry is required to investigate whether there had been a genuine decline in the age specific widower remarriage rate.

The analysis carried out in this paper indicates that seven percent more men than women require about four years of age difference between bride and groom, groom being older. This indicates that non-availability of marriage partner does not arise for small changes in sex ratio in a society, since by changing the age difference between bride and groom suitably every individual in that society can get a marriage partner.

The limitations in the deterministic model proposed in this paper are obvious. The variance in age at marriage is small in Indian population and so the model will not affect very much the broad conclusions arrived at. However, model which takes into account the stochastic elements and the dynamic situation is

needed for detailed study of the effect of sex ratio on marriage pattern and the effect of fluctuating birth rate on marriage squeeze.

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## Appendix

**TABLE-1 SEX-RATIO AND EXPECTATION OF LIFE FOR DIFFERENT YEARS IN INDIA**

<i>Year</i>	<i>Sex-Ratio</i>	<i>Expectation of life for</i>	
		<i>Female</i>	<i>Male</i>
1901	103.80	23.3	22.6
1921	105.75	26.6	26.9
1941	106.28	31.7	32.4
1971	107.36	47.3	49.7

**TABLE 2—SEX-RATIO FOR FIVE YEAR AGE GROUPS FOR 1901, 1921, 1941 AND 1971 FOR INDIA FROM CENSUS RETURNS**

<i>Age groups</i>	<i>1901</i>	<i>1921</i>	<i>1941</i>	<i>1971</i>
0—	97.2	96.6 }		103.2
5—	104.7	104.1 }	102.7	107.0
10—	121.3	121.7	114.1	112.8
15—	107.7	109.2	107.6	113.3
20—	91.6	93.1	95.1	99.2
25—	102.0	103.3	102.7	97.4
30—	103.5	104.8	107.6	101.0
35—	113.4	119.0	114.7	109.2
40—	103.2	105.9	112.2	113.4
45—	113.4	119.8	117.0	119.1
50—	100.3	104.9	114.4	118.0
55—	108.8	116.3	116.1	115.3
60+	87.0	96.2	100.0	107.0
All	103.8	105.8	106.3	107.4

**TABLE 3—NUMBER OF CURRENTLY MARRIED WOMEN PER 100 MARRIED MEN IN INDIA**

<i>Year</i>	<i>Number of married women per 100 married men</i>
1901	101.1
1921	100.8
1941	101.4
1971	102.4

TABLE 4—PERCENT NEVER MARRIED IN EACH AGE GROUP FOR 1901, 1921, 1941 AND 1971 IN INDIA

Year	Sex	Age group				
		15-19	20-29	30-39	40-49	50-59
1901	male	64.98	27.49	8.72	5.29	4.64
	female	17.91	4.04	2.15	1.38	1.21
1921	male	68.67	29.19	8.21	4.78	3.82
	female	18.75	3.41	1.72	1.36	1.16
1941	male	76.14	30.66	6.30	3.63	3.11
	female	29.19	3.99	0.91	0.57	0.45
1971	male	82.16	35.13	5.69	3.23	2.73
	female	42.92	5.59	0.71	0.52	0.41

TABLE 5—AGE AT MARRIAGE FOR MALES AND FEMALES IN INDIA FOR YEARS 1901, 1921, 1941 AND 1971

Year	Males	Females	Difference
1901	20.2	13.2	7.0
1921	20.5	13.6	6.9
1941	20.2	15.0	5.2
1971	23.8	18.3	5.5

TABLE 6—PERCENT WIDOWED (WIDOWED, DIVORCED AND SEPARATED) AMONG MEN AND WOMEN IN INDIA FOR 1901 AND 1971 AND THE RATIO OF PROPORTION OF WIDOWERS TO PROPORTION OF WIDOWS BY AGE GROUPS

Age groups	1901		1971		Ratio		Ratio with five years difference	
	male	female	male	female	1901	1971	1901	1971
20-25	3.22	7.31	0.87	1.53	0.44	0.57	0.63	1.08
25-30	4.59	11.13	1.66	2.48	0.41	0.67	0.54	1.03
30-35	6.06	18.51	2.55	4.62	0.33	0.55	0.39	0.69
35-40	7.31	25.78	3.19	7.70	0.28	0.41	0.39	0.64
40-45	10.11	40.18	4.95	14.84	0.25	0.33	0.31	0.42
45-50	12.44	46.40	6.29	21.06	0.27	0.30	0.36	0.48
50-55	16.79	63.18	10.08	37.03	0.27	0.27	0.32	0.33
55-60	20.22	62.60	12.25	41.50	0.32	0.29		

TABLE 7—MORTALITY LEVEL, PERCENT EVER MARRIED, SEX-RATIO AMONG MARRIED AND AGE AT MARRIAGE FOR WOMEN IN INDIA

Year	Mortality level (West model)		Percent ever married		No. of married women per 100 men	Age at marriage for women
	male	female	male	female		
1901	3.0	2.5	95.36	98.79	101.09	13.2
1921	4.5	3.5	96.18	98.84	100.75	13.6
1941	7.0	5.5	96.89	99.55	101.38	15.0
1971	14.0	12.0	97.27	99.59	102.40	18.3

TABLE 8—OBSERVED AND EXPECTED AGE DIFFERENCE BETWEEN BRIDE AND GROOM IN INDIA

Year	Observed age at marriage			Expected difference under model			(8) = (4) - (7)
	women	men	difference	(a)	(b)	(c)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	
1901	13.2	20.2	7.0	2.75	0.30	1.10	5.90
1921	13.6	20.5	6.9	3.95	2.56	2.94	3.96
1941	15.0	20.2	5.2	4.32	3.20	3.77	1.43
1971	18.3	23.8	5.5	4.11	3.23	4.12	1.38