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Twinning and Inbreeding in India: The Fraternal Component

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Abstract. It is suggested that the rise in a population depends not only on the number of females per thousand males, their fecundability, and the survival of offspring (mean live births), but also on the genetic background or inbreeding status of the fetuses. Abortions and stillbirths add to the interference. A hypothetical formula has been devised $\frac{Mb \times G}{(F \times Sa)^{Sr}} = FC$, where Mb = mean birth rate, G = growth percentage of population sample from preceding Census, F = inbreeding coefficient, Sa = Stillbirths + abortions, and Sr = Sex ratio. It is intriguing that the product, being termed Fraternal Component (FC), is found to be almost equal to the DZ twinning rate of the population sample. Should that be confirmed, one could perphaps estimate the DZ twinning rate by an altogether new approach.

Key words: Twinning rates, Inbreeding, Fertility

INTRODUCTION

India is a subcontinent exhibiting numerous ethnic, cultural, geographic, sociobiological and climatic variations. The trends in population growth, as revealed by the census data [1] have also shown differences in the same region on account of the genetic variability of the population. As is well known, India offers excellent opportunities for human genetic studies because caste-community marriage systems, leading to high consanguinity levels, continue to adhere to the cultural core of people. While collecting data on twinning from various parts of the country and in particular in Madhya Pradesh, it became clear that genetic factors also must have a definite role to play and that there may be some

intricate relationship among mean birth rate, sex ratio and the inbreeding status of the population. An attempt to verify such a relationship has therefore been made.

MATERIAL AND METHODS

A total of 2640 mothers belonging to 1380 families were interviewed with respect to their reproductive histories: menarche, number of abortions, stillbirths, live births (singletons, twins, etc.) age at the time of each birth, incidence of sporadic bleeding during pregnancy, (without affecting pregnancy), etc. This family-oriented approach also included pedigree construction and estimation of inbreeding levels [5-6]. Children of consanguineous marriages (uncle-niece; first, second, and third cousin marriages) and nonconsanguineous marriages (ascertained up to three generations) were also recorded during 1978-85.

RESULTS

Data on 2130 mothers of 40-45 years only are presented, on the assumption that in this age group the majority of women must have attained the maximum likelihood of having children. The mean birth rate per mother for each place of study was thus calculated. Consanguinity, abortions and stillbirths have also been considered in regard to twinning rates.

In a separate study we have found that twinning increases with the inbreeding coefficient (F from 0.010 to 0.025). An immediate decline in twinning rates is observed as F reaches 0.03 or more. High inbreeding may "weaken" reproductive performance by reducing the number of live births [8]. Thus the inbreeding coefficient was assumed to interfere with population increase. The percentage growth rate was taken for each sample from census data and the last column of Table 1 was computed on the hypothetical formula:

$$FC = \frac{Mb \times G}{(F \times Sa)^{Sr}}$$

where FC = fraternal component; Mb = mean birth rate; G = growth percentage in the population sample (based on ten-year census data); F = inbreeding coefficient; Sa = stillbirths +abortions and Sr = sex ratio. Interestingly, it turns out that FC per thousand is generally close to the DZ twinning rates per thousand (Table 2).

DISCUSSION

The observed regional differences in the trends of population growth may be partly due to the variability in the marriage systems and to sociobiological and climatic conditions. But these factors alone cannot account for differences in population increase, particularly when the sex ratio is not equally affected. For example, in Raipur (Table 1) the number of females is higher than males (Sr = 1.007) but the percentage of population

Table 1 - Fraternal component for different areas of Madhya Pradesh

Area	Mean birth rate (Mb)	No. of mothers studied	Frequency of growth in population (G)	Inbreeding coefficient (F)	Frequency of Stillbirths + abortions (Sa)	Sex ratio (Sr)	Fraternal component $FC = \frac{Mb \times G}{(F \times Sa)Sr}$
Bhind	4.5	107	0.2216	0.010	0.12	0.832	9.21967
Bhopal	4.0	415	0.5656	0.028	0.18	0.871	12.48786
Bilaspur	5.0	110	0.2094	0.019	0.20	0.993	4.81452
Datia	4.1	86	0.2288	0.009	0.12	0.853	8.22705
Indore	3.5	92	0.3714	0.010	0.10	0.900	13.13030
Jabalpur	3.8	115	0.3043	0.010	0.09	0.913	12.66530
Raigarth	3.8	84	0.2440	0.010	0.10	0.935	9.01507
Rewa	4.5	102	0.2328	0.021	0.12	0.972	7.6438
Morena	3.0	215	0.3206	0.010	0.10	0.835	10.47142
Ujjain	3.5	84	0.2942	0.010	0.09	0.927	11.10787
Raipur	4.5	126	0.1767	0.022	0.18	1.007	3.90900
Gwalior	3.0	490	0.2950	0.009	0.07	0.041	13.32050
Bastar	4.5	104	0.2141	0.038	0.25	1.003	3.33546

Table 2 - Fraternal component and twinning rates

Area	Total no. of births	Total no. of twins	Twinning rate MZ	Twinning rate DZ	Fraternal component/1000	χ^2
Bhind	11219	133	0.00419	0.0076	0.0092	26.085*A
Bhopal	240865	1319	0.003775	0.0112	0.0124	01.161
Bilaspur	17560	789	0.00418	0.0065	0.0048	65.133*B
Datia	14200	178	0.0032	0.0093	0.0082	1.475
Indore	239266	3778	0.00375	0.0120	0.0131	0.198
Jabalpur	12152	190	0.0035	0.0121	0.0126	0.960
Rajgarth	4920	53	0.00205	0.0085	0.0090	0.960
Rewa	3055	34	0.00332	0.0078	0.0076	0.052
Morena	14560	253	0.00337	0.0140	0.0104	12.461*C
Ujjain	18541	284	0.00360	0.0117	0.0111	0.324
Raipur	38405	354	0.0041	0.0051	0.0039	3.692
Gwalior	276233	4856	0.00362	0.0139	0.0133	0.270
Bastar	95078	717	0.00197	0.0055	0.0033	14.666

* Differences are highly significant: A and C show very high rates of triplets, included in total number of births but not among twins; B includes high rate of abortions due to venereal diseases.

growth, based on the 1981 census, is only 17.67 per thousand. Conversely, other towns, having lower sex ratio; show higher population growth. A possible explanation could be found in the variable fecundability of women,but there could also be some role of consanguinity, frequency of abortions and stillbirths [2,3]. We recently found that high inbreeding (F = 0.020-0.025) is associated to high twinning rates. However, twinning rates decline, and abortions increase, at higher levels of inbreeding (F = 0.026 and above). Quite pertinently, Gedda and Parisi [3] inferred that inbreeding mainly affects prenatal loss and stillbirths.

As show in Table 2, FC values appear to be fairly close to the DZ twinning rate in almost all areas. In fact, an attempt to use FC values per thousand as an estimate of the DZ twinning rate of the population, is giving encouraging results.

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