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Incidence of Inbreeding in Different States of India

INDIAN populations offer a good material for genetic study as they are known to practise varying degree of inbreeding. But no comprehensive data are available to compare the amount of inbreeding in different States of India. The late Professor J. B. S. Haldane had a great interest in this problem and upon his advice a survey on the incidence of inbreeding in all the States and Union Territories was undertaken by the Government of India. As a part of the 1961 census, the survey was conducted in 587 villages spread over the country. The selection of the villages was purposive to represent three types of villages containing *(a)* one dominant community with one dominant occupation, (&) dominant scheduled tribes of the States and (c) multi-ethnic communities with variegated occupation. Information on all the marriages in each selected village was recorded.

In this survey the investigators were instructed to draw pedigree, whenever they would come across any consanguineous relationship between husband and wife. The relationship is said to bs consanguineous when both the spouses have at least one common ancestor. The pedigree taking method was adopted presumably for cross checking with verbal statements of the marriage relationships and avoiding confusion among full blood, step and affinal relations. All the marriages upto first cousin level both in full blood and step relations were recorded separately in terms of husband's relationship with his wife.

In 1974, a monogarph entitled 'Marriages with Consanguineous & Affinal Relations' (Census, 1961) showing the results of 330 villages has been published. In this monograph all the communities having records of consanguineous and affinal marriages are enlisted for all States and Union Territories excepting Delhi and Lakshadweep. The records of consanguineous marriages can be utilised for computing consanguinity rates and inbreeding coefficients for populations in different States of India. With this aim in view the records were collected and analysed and the results are presented in this paper. These results will provide a base for any future study on the genetic consequences of inbreeding in relation to regional and ethnic distribution.

Materials and Methods

From the records given in the monograph (Census, 1961) the frequencies of different types of consanguineous marriages for all communities in each State were arranged in a tabular form. Another monograph (Census, 1971) published in 1975 supplied the total number of marriages surveyed in the selected villages for all States excepting Andhra Pradesh, Assam, Bihar, Kerala, Punjab and West Bengal. Relevant information for these States was collected from the Office of the Registrar General of India. Since the records about consanguineous marriages in Delhi and Lakshadweep were not available, nine villages from these two Union Territories could not be considered. It may be noted that the records of Assam State given in the monograph represent for present Assam, Mizoram, Meghalaya and Nagaland; similarly those of Madras, Mysore and NEFA (North Eastern Frontier Agency) stand for the States Tamil Nadu, Karaataka and Arunachal respectively.

To analyse the data for this paper, all the groups, castes and sects under survey in each State were broadly classified into main religious communities (Hindus, Muslims!, Christians, etc.) and tribes. The consanguinity rates and mean inbreeding coefficients (a) of the populations have been calculated (Table 1) and their distribution in different States of India is shown in Figure 1.

Inbreeding coefficient *(F)* is defined as the probability that two allelic genes in an individual are identical by descent, i.e., both are descended from a single gene present in one of the ancestors common to both the parents. For example, the inbreeding coefficient of an individual from uncle-niece marriage is .1250 and that from first cousin marriage is .0625. The over-all amount of inbreed-

ing in a population is generally measured by the mean inbreeding coefficient (a) and it is calculated by the following formula

$$a = \Sigma\, p_i F_i$$

where p_t is the proportion of marriages or individuals with inbreeding coefficient *Ft.* This formula includes the marriages with $F_0 = 0$, i.e., non-consanguineous marriages.

Results

Consanguineous marriage among the Hindus is confined mainly in southern States. Inbreeding coefficient higher than .02 was found in Andhra Pradesh, Karnataka, Tamil Nadu and Pondicherry. Moderately high value (.008-.010) was observed in Rajasthan, Maharashtra and Kerala and low value (.002-.003) in Madhya Pradesh and Orissa. The amount of inbreeding was negligible in northern States, especially Assam, Bihar, Gujarat, Himachal Pradesh, Jammu and Kashmir, Punjab, Uttar Pradesh, West Bengal and Tripura.

Unlike the Hindus, the Muslims both in the north and in the south practise consanguineous marriages. The coefficient of inbreeding was generally high (.020-.030) in Andhra Pradesh, Rajasthan, Gujarat and Tamil Nadu, intermediate (.010-.020) in Karnataka, Jammu and Kashmir and Kerala and low (.001-.009) in Uttar Pradesh, Bihar, West Bengal, Tripura and Punjab.

The inbreeding coefficients of the Christians were found to be lower than those of the Hindus and the Muslims in Andhra Pradesh, Tamil Nadu and Kerala and higher than those of the Hindus in Assam and Bihar. The tribes following Christian religion in Manipur showed an appreciable value (.007) of inbreeding coefficient.

As expected the inbreeding coefficients of the tribes were higher than those of the Hindus, Muslims and Christians in Maharashtra, Kerala, Andhfa Pradesh, Orissa and Bihar. The Bhil tribe of Maharashtra showed the highest incidence of inbreeding (.046). In general, inbreeding level (.002-.003) is low in north-east India compared to southern India. The tribes with Buddhist religion in Arunachal and Tripura had inbreeding level of .006 to .007.

The most frequent type of consanguineous marriage for all religious communities and tribes in India is that between first cousins. There are four kinds of

first cousin marriages, namely marriages with mother's brother's daughter (MBD), father's sister's daughter (FSD), mother's sister's daughter (MSD) and father's brother's daughter (FBD). The first two kinds are called cross cousin marriages and the last two are parallel cousin marriages. The Hindus practise only cross cousin marriages preferably with MBD than with FSD. Even in step relations, similar marriage practice is observed among the Hindus in Tamil Nadu and Kerala. Except in Orissa, the tribes in Andhra Pradesh, Maharashtra, Kerala, Bihar and Arunachal prefer to marry MBD to FSD.

Both cross and parallel cousin marriages are prevalent among the Muslims. The former type of marriage was preponderant in Andhra Pradesh, Tamil Nadu, Gujarat and Bihar while the latter type in Jammu and Kashmir, Rajasthan and West Bengal. The Buddhists practise both cross and parallel cousin marriages in Tripura but they are found to marry only MBD in Arunachal.

Marriage with elder sister's daughter is a common kind of uncle-niece marriage in India. It is of general prevalence among the Hindus in Andhra Pradesh, Karnataka, Tamil Nadu and Pondicherry. The Muslims in Andhra Pradesh and Karnataka were found to practise uncle-niece marriage, although it is forbidden by their custom. The tribes in Andhra Pradesh and Orissa showed similar marriage practice. There was a small incidence of uncle-niece marriage among the Christians in Tamil Nadu and among the Buddhists in Arunachal.

Discussion

Before execution of the marriage survey in 1961, Sanghvi *et* a/'s. (1956) report on twelve endogamous groups in Bombay, and Dronamraju and Meera Khan's (1960) on the people in Andhra Pradesh were probably the only documents on consanguineous marriage in India. Since 1961, a number of workers (Dronamraju and Meera Khan, 1962; Sanghvi, 1966; Centerwall and Centerwall, 1966; Kumar *et al.,* 1967; Ali, 1968; Ghosh, 1972; Goswami, 1970; Murty and Jamil, 1972; Reid, 1973; Veerraju, 1973) studied the problem of incidence of inbreeding in some southern States, especially Andhra Pradesh, Kerala, Tamil Nadu and Madhya Pradesh. A few studies have also been made on the Muslims in north India (Basu, 1975; Huq, 1976). The work on inbreeding in Indian populations has recently been reviewed (Roychoudhury, 1976).

All the results presented in Table 1 are not strictly comparable with those obtained by individual workers, for the time of survey, locality and composition of the people are not exactly the same. The Hindus considered in the persent analysis are composed of all hierarchial castes, namely Hindu high castes, scheduled castes, backward castes and scheduled tribes (Census, 1961). If any Hindu scheduled tribe with high level of inbreeding is included, the mean inbreeding coefficient of the Hindus will be increased. For example, if the Bhil tribe of Maharashtra were not separated from the Hindus, the mean value of the inbreeding would have been .015. Even after exclusion of the Bhils, the coefficient of inbreeding of the Hindus in Maharashtra is found to be higher than that obtained by Sanghvi *et al.* (1956). On examining the data it revealed that more than 15% of the marriages surveyed among the Hindus were from one backward caste (Dhangar) whose inbreeding coefficient was as high as ,020. Furthermore, one Hindu high caste (Hatkar), one scheduled caste (Mang) and three backward castes (Ramoshi, Dhangar and Valhar) were found to practise uncle-niece marriage (Census, 1961), while Sanghvi *et al.* (1956) did not come across such type of marriage. All these factors pushed up the level of inbreeding of the Hindus in Maharashtra.

Excepting minor differences, the pattern of consanguinity and inbreeding coefficients of the Hindus and tribes in Andhra Pradesh are similar to those obtained by Dronamraju and Meera Khan (1962), Sanghvi (1966) and Veerraju (1973). Four cases of marriage with FED found in a Hindu backward caste (Samanthu) and a scheduled tribe (Vada Baliga) appear to be deviations from the general custom of the communities (Census, 1961). Due to small sample size, the inbreeding coefficients of the Muslims and Christians cannot be compared with Sanghvi's (1966) results.

The pattern of the first cousin marriages among the Muslims in Andhra Pradesh, Kerala, Tamil Nadu and Karnataka is more or less same as that among the Hindus in these States. Like the Hindus, the Muslims in Andhra Pradesh and Karnataka practise uncle-niece marriage. Sanghvi (1966) found similar marriage practice among the Muslims in Andhra Pradesh and pointed out that the local custom of consanguineous marriage had deeper roots than could be modified by the influence of religion which came there at a later stage.

Small incidence of marriage with sister's daughter was noticed in Orissa and Kerala. One backward caste (Nolia) and one scheduled tribe (Koya) in Orissa

and two Hindu high castes (Asari and Brahmin) and five scheduled tribes (Konga Malayan, Kurumban, Mudugar, Paniyan and Uraly) in Kerala were found to practise uncle-niece marriage. All these communities seemed to be influenced by the marriage systems of the neighbouring States, Andhra Pradesh and Tamil Nadu (Census, 1961). Isolated cases of marriage with mother's sister and brother's daughter were recorded mainly in Tamil Nadu, Jammu and Kashmir, Punjab and Maharashtra. They are considered to be aberrant and their frequency varies from .02 to .20 percent.

In the present analysis the Muslims and Christians in Kerala showed respectively the highest and lowest level of inbreeding as it was observed by AH (1968) and Kumar *et al.* (1967). But unlike Ali's results, high level of inbreeding was noticed among the tribal populations. One of the reasons for small incidence of consanguineous marriage among the Hindus, Muslims and Christians in Kerala is higher rate of literacy in comparison with Andhra Pradesh, Tamil Nadu and Karnataka. Again, high percentage of Christian population in Kerala (21%) compared to other southern States (2-5%) seems to have a great influence in reducing the level of inbreeding.

Due to the spread of Christian religion, the tribals in north east India are more advanced in social and educational matters than their counterparts in other regions. This might explain the low incidence of inbreeding among the tribes in Assam, Tripura, Manipur and Arunachal as compared to that in southern States.

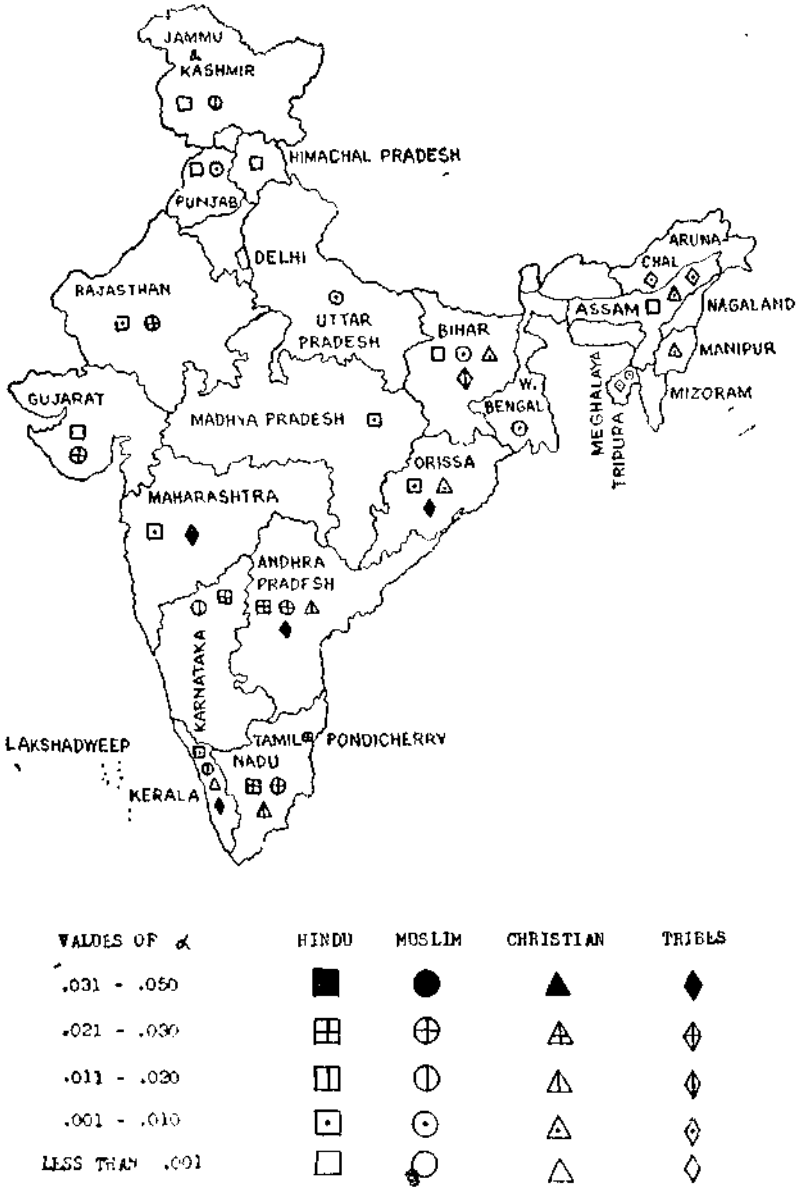
JAMMU & KASHMIR
HIMACHAL PRADESH
PUNJAB
DELHI
RAJASTHAN
UTTAR PRADESH
BIHAR
ARUNA CHAL
ASSAM
NAGALAND
MANIPUR
MIZORAM
MEGHALAYA
TRIPURA
W. BENGAL
GUJARAT
MADHYA PRADESH
ORISSA
MAHARASHTRA
ANDHRA PRADESH
KARNATAKA
LAKSHADWEEP
TAMIL NADU
PONDICHERRY
KERALA
VALUES OF ∝
HINDU
MOSLIM
CHRISTIAN
TRIBES
.031 - .050
.021 - .030
.011 - .020
.001 - .010
LESS THAN .001

Fig. 1

TABLE 1— FREQUENCY OF CONSANGUINEOUS MARRIAGES (IN PER CENT) AND INBREEDING COEFFICIENTS («) FOR RELIGIOUS COMMUNITIES AND TRIBES IN DIFFERENT STATES OF INDIA

States!*	*Total*	*Uncle-*	1/2 *Uncle-*	*First cousin***				1/2 *First*	*Total con-*	
Communities	*marriages*	*niece*	*niece*	*MBD*	*FSD*	*MSD*	*FBD*	*Total*	*cousin*	*sanguineous marriages*	*x.*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Aadhra Pradesh (25)											
Hindus	2396	4.05	.08+	20.20	10.23	—	.17	30.59	.04	34.77	.024
Muslims	65	1.54	—	23.08	13.85	1.54	6.15	44.62	—	46.15	.030
Christians	24	—	—	16.67	4.17	—	—	20.83	—	20.83	.013
Tribes	204	2.94	—	25.49	23.53	-	—	49.02	—	51.96	.034
Assam (13)											
Hindus	1071	.09	—	.47	.09	.09	—	.65	—	.75	.0005
Christians	516	.19+	—	1.16	.97	.19	—	2.33	—	2.52	.002
Tribes	49	—	—	2.04	2.04	—	—	4.08	—	4.08	:003
Bihar (17)											
Hindus	4628	.02	—	.30	.50	—	—	.80	—	.82	.0005
Muslims	388	.26	—	3.61	2.58	1.55	1.55	9.28	—	9.54	.006
Christians	257	—	—	1.17	1.17	_	_	2.33	—	2.33	.001
Tribes	215	.47	—	20.93	9.77	.47	—	31.16	—	31.63	.020
Gujarat (16)											
Hindus	2583	—	—	.35	.08	—	—	.43	—	.43	.0003
Muslims	735	.27	—	13.88	8.71	4.35	12.79	39.73	—	40.fO	.025

Table 1 *(contd. on page* 116)

Table 1 *(contd. from page* 115)

(l)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Jammu and Kashmir (21)											
Hindus	713	—	.42+	.28	.14	.14	—	.56	—	.98	.0006
Muslims	3230	.31+	.03	4.52	3.13	2.84	7.80	18.30	—	18.64	.012
Karnataka (3)											
Hindus	1266	11.29	—	12.64	6.24	.08	.08	19.04	—	30.33	.026
Muslims	76	1.32	—	17.10	9,21	—	—	26.31	—	27.63	.018
Kerala(31)											
Hindus	3566	.42	.25	6.90	4.09	.03	—	11.02	.98	12.68	.008
Muslims	562	—	—	10.85	6.23	.18	—	17.26	—	17.26	.011
Christians	656	—	—	.76	—	—	-	.76	—	.76	.0005
Tribes	601	—	—	48.25	14.30	.17	—	62.73	1.00	63.73	.040
Madhya Pradesh (19)											
Hindus	2598	.07+	—	1.54	1.50	.04	.08	3.16	—	3.23	.002
Mabarashtra (7)											
Hindus	952	2.73	.10	6.20	2.50	—	—	8.72	.10	11.66	.009
Tribe (Bhils)	178	—	—	47.75	23.60	.56	1.12	73.03	—	73.03	.046
Orissa (10)											
Hindus	1008	.30	—	2.28	1.59	—	—	3.87	—	4.17	.003
Christians	158	—	—	3.80	.63	—	—	4.43	—	4.43	.003
Tribes	107	1.87	—	13.08	37.38	—	—	50.47	—	52.34	.034

Punjab (25)											
Hindus	1958	—	—	.41	.20	.05	.05	.72	—	.72	.0004
Sikhs	2168	.09+	_	1.20	.14	—	_	1.34	~	1.43	.001
Muslims	327			.61	.61			1.22		1.22	.001
Rajasthan (4)											
Hindus	363	—	—	7.16	4.68	4.41	—	16.25	—	16.25	.010
Muslims	79	—	—	13.92	5.06	6.33	17.72	43.03	—	43.03	.027
Tamil Nadu (48)											
Hindus	16535	6.86+	.19	+14.22	9.56	.13	.02	23.93	.83	31.81	.024
Muslims	983	.20+	—	14.14	11.60	2.44	4.68	32.86	1.12	34.18	.021
Christians	1041	1.34+	—	9.89	6.24	—	.10	16.23	—	17.58	.012
Uttar Pradesh (24)											
Hindus	4910	—'	—	.02	.02	3.98	.24	.40	——	.04	.0000
Muslims	1231			9.42	1.06			14.70		14.70	.009
West Bengal (5)											
Hindus	1963	—	—	—	_	—	—	—	_	—	.0000
Muslims	63	—	—	1.47	—	4.41	—	5.88	—	5.88	.004
Himachal Pradesh (4)											
Hindus	980	—	—	.10	—	—	—	.10	—	.10	.0001
Manipur (20)											
Christians	1045	—	—	9.47	.57	.19	.38	10.62	—	10.62	.007

Table 1 *(contd. on page* 116)

Table 1 *(cor.* *ltd. from page* 117)

(1)	*(2)*	*(3)*	*(4)*	(5)	(6)	(7)	(8)	(9)	*(10)*	*(11)*	(72)
Arunachal (17)											
Tribes	1013	.20	.10	1.78	.69	.20	.10	2.76	—	3.06	.002
Buddhists	108	3.70	—	2.78	—	—	—	2.78	—	6.48	.006
Tripura (9)											
Hindus	1404	–	–	–	.14	.07	_	.21	—	.21	.0001
Muslims	693	.14+	—	1.73	.87	.72	1.73	5.05	-v	5.19	.003
Buddhists	104	–	–	3.85	2.88	4.80	—	11.54	—	11.54	.007
Pondicherry (2)											
Hindus	465	9.68	—	10.75	8.39	—	—	1°.14	—	28.82	.024

*Figures in the parentheses represent the number of villages surveyed.
**For abbreviation see lext.
+Includes aberrant cases of marriage with father's sister, mother's sister and brother's daughter in full blood and step relations but their total frequency dees not exceed more than one in 500 marriages in any community.

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