J. Hum. Ecol., 9(5): 463-466 (1998)

Effects of Inbreeding on Mortality: A North Indian Study

Badaruddoza and Mohammad Afzal

Section of Genetics, Department of Zoology, Aligarh Muslim University, Aligarh 202 002, Uttar Pradesh, India

KEY WORDS Consanguinity. Mortality & Morbidity. North India.

ABSTRACT Consanguineous marriages are common among the Muslims of India and the frequency of sub-types of consanguineous marriages differ significantly. Two Muslim castes (Quraishi and Ansari) with low socio-economic levels and different localities (sub-urban, rural) have been selected from Uttar Pradesh, North India. A total of 9705 pregnant women have been studied. Total mortality (including prenatal and postnatal) is found to be two times higher in the inbred sub-sample than in non-inbred sub-sample in both castes and areas (sub-urban, rural). The total foetal loss is significantly higher ($P<.05$) in rural areas among consanguineous as well as non-consanguineous marriages. The mortality rate has been found to increase proportionately with the coefficient of inbreeding. The mortality rate (including prenatal, postnatal, abortions, still birth, infant and juvenile mortality) is quite high in rural areas among the Ansari group.

In the present paper, an attempt has been made to analyse marriage patterns and pre-natal and post-natal mortality rates among two Muslim caste groups in Uttar Pradesh, a northern province of India which provides a fertile field for studies of this type because consanguineous marriages are quite important to Muslims in the province.

MATERIALS AND METHODS

Aligarh is a district headquarter of the Northern Indian state of Uttar Pradesh. In the 1991 census, the population of this city was 3.20 lakhs, with Muslim numbering 1,10,572 (or 34.5% of the total population) in an area of 34.05 km^2 (census of India, 1991). Representative sample of the city, comprising about 12,490 couples constituted the suburban sample. A population sample of about 8,778 couples from a rural area contiguous to Aligarh constituted the rural sample. The samples chosen are quite typical of the suburban and the rural sections of Muslims in North India as a whole. With the objective of assessing the effect of consanguinity on mortality, two Sunni Muslim caste groups of lower middle class one each from the suburban and the rural areas were selected for field study. One group is that of meat sellers called Quraishis, and the other is from the weaver caste of Ansaris which is at the bottom of the social ladder and recognised by the Government of India as a socially backward caste among Muslims. The selection of the two castes from different socio-economic levels and localities (suburban and rural region) has been made because this might have a differential impact, both on the mortality of the offspring as well as on the frequency of consanguineous marriages.

The sampling plan was purposive (based upon geographical location) with proportional allocation according to stratum size. In total, 21,268 couples were ascertained in this study, and the sample populations were taken from large administrative blocks (suburban and rural region respectively) so as to further control for any effects of socio-economic factors. On the basis of pilot survey, it has been found that there are only four blocks where these tow castes are represented. Prominent elders of these areas were approached with the help of female village social workers, particularly those of the two castes. Local women interviewers who were fluent in the local language (Urdu, Hindi) and who had undergone the auxiliary nurse/midwives or some other basic course in health science, were appointed in the research project (sanctioned by Indian Council of Medical Research, Govt. of India) and were given extensive orientation in interview methods. The interviewers were given adequate training, and the standardizations of assessment were also made. After the rapport was established, all married couples in the selected areas were contacted by the interviewers in an attempt to gather the data on socio-economic, geneologic and demographic aspects. Information was also recorded on consanguinity of marriages and on past reproductive performance, including the outcome of each pregnancy. Women absent at first visit were revisited, thus

the response rate was 100%. Cross checking was also done by the supervisory personnel. There was practically no difference in the interview-reinterview information, specially on first cousin and first cousin once-removed matings, or on non-consanguineous marriages, while negligible variations were noticed in information on second cousin matings.

The coefficient of inbreeding (F) was calculated from the pedigree data using slightly modified Wright's (1922) formula: $F = \sum (1/2)^n (1 + F_a)$, where n is the number of persons along the path through common ancestor connecting the two parental gametes, and F_a is the inbreeding coefficient of that common ancestor. However, as verified from the pedigrees, the inbreeding coefficients, of the common or most of the ancestors of parents (F_a) pointed out to be zero in all the present cases. Therefore, to use sizable samples of subjects with the same F values, the rare cases with same values of F in common ancestors were left out from this study. Assuming that very little error exists in calculating the F values obtained for the subjects, it can be strictly considered as the minimum estimates of F- values. An additive model of Chi-square analysis (Snedecor and Cochran, 1967) has been used to show the difference between the two proportions of inbreeding on different parameters.

RESULTS

The distribution of marriage types has been presented in table 1. The frequency of consanguineous marriages is found to be highest among the Ansari caste (39.19%) in rural areas followed by the Quraishis (27.14%) in the suburban areas. Both castes exhibit a higher proportion of first cousin marriage in both rural and suburban areas, respectively.

A total of 9705 pregnant women have been studies of which 4463 were Quraishi and 5242 Ansari respectively. The detailed break-up has been presented in table 2.

The inbreeding effects among the two castes have been found to be statistically significant ($P<0.05$) for all the categories of morality in sub-urban and rural areas respectively (Table 3). The total mortality rate including prenatal and post-natal cases of upto 15 years of age among inbred children, is two times higher than non-inbred cases, in both castes and areas (suburban and rural). A similar trend has been found in various sub-categories of abortions, still births and in-

Table 1: Frequency of consnaguineous marriages among two castes and habitat variations

Nature of marriages	*Quraishi Population*			*Ansari Population*		
	Sub-urban	*Rural*	*Total*	*Sub-urban*	*Rural*	*Total*
2 C						
N	315	287	602	375	324	699
%	5.90	6.66	6.24	5.24	7.24	6.01
1½ C						
N	255	185	440	216	66	282
%	4.78	4.29	4.56	3.01	1.47	2.42
1C						
N	877	620	1497	1086	1362	2448
%	15.45	14.39	15.53	15.17	30.67	21.05
TC						
N	1447	1092	2539	1677	1752	3429
%	27.14	25.25	26.34	23.43	39.19	29.49
NC						
N	3885	3216	7101	5481	2718	8199
%	72.86	74.65	73.66	76.57	60.81	70.51
TM						
N	5332	4308	9640	7158	4470	11628

2C = Second cousin (Coefficient of inbreeding F = 0.01562), 1½C = First Cousin once removed (F = 0.03215), 1C = First Cousin (F = 0.0625). TC = Total consanguinity, NC = Non-Consanguineous (F=0), TM = Total marriage, N = Number studied.

Table 2: Frequency of pregnancies obsered.

Types of	*Quraishi Population*			*Ansari Population*		
marriages	*Sub-urban*	*Rural*	*Total*	*Sub-urban*	*Rural*	*Total*
2C						
N	301	290	591	338	304	642
%	13.74	12.76	13.24	11.92	12.63	12.25
1½ C						
N	120	125	245	177	122	299
%	5.48	5.50	5.50	6.24	5.07	5.07
1C						
N	784	771	1555	956	791	1747
%	35.8	33.92	34.84	33.70	32.88	33.32
TC						
N	1205	1186	2391	1471	1217	2688
%	55.02	52.17	53.57	51.87	50.58	51.28
NC						
N	985	1087	2072	1365	1189	2554
%	44.97	47.82	46.43	48.13	49.42	48.72
TP						
N	2190	2273	4463	2836	2406	5242

2C = Second cousin, 1½C = First cousin once removed, 1C = First cousin, TC = Total consanguinity, NC = Non consanguineous, TP= Total pregnancies, N = Number studied.

Table 3: Effects of inbreeding on mortality among different castes and habitata (expressed as percentage)

	Quraishi Population				*Ansari Population*				*Total Population*			
	Sub-urban		*Rural*		*Sub-urban*		*Rural*		*Sub-urban*		*Rural*	
	C	*NC*	*C*	*NC*	*C*	*NC*	*C*	*NC*	*C*	*NC*	*C*	*NC*
AB	2.75	1.33	2.91	1.47	2.91	1.87	3.12	2.10	2.83	1.60	3.01	1.78
SB	5.18	2.85	6.34	3.14	6.11	3.51	6.61	3.42	5.64	3.18	6.48	3.31
TFL	7.93	4.18	9.25	4.61	8.02	5.38	9.72	5.52	8.47	4.78	9.49	5.09
IM	15.48	6.91	16.82	7.21	16.16	7.23	17.56	7.81	15.82	7.07	17.21	7.51
JM	13.72	4.71	14.12	5.33	14.17	5.60	15.71	5.91	13.95	5.15	14.91	5.62
PRM	29.20	11.12	30.95	12.54	30.33	12.83	33.27	13.72	29.77	12.22	32.12	13.13
TM	37.13	15.30	40.20	17.15	38.35	18.21	43.0	19.24	38.24	17.0	41.16	18.22
TP	1205	985	1186	1087	1471	1365	1217	1189	2676	2350	2403	2276

AB = Abortions, SB = Still births, TFL = Total foetal loss, IM = infant mortality, JM = Juvenile mortality, PRM = Pre reproductive mortality, TM = Total mortality, TP = Total pregancies, C = Consanguineous, NC = Non Consanguineous.

fant and juvenile deaths. The higher mortality rates are observed in the respective rural areas. The total foetal loss is significantly higher($P<0.05$) in rural areas among the consanguineous and non-consanguineous marriages as compared to that in the suburban areas.

Table four shows that the mortality rate proportionately increases with the coefficient of inbreeding. The total mortality rates in suburban area, for children from marriages to second cousins, first cousins once-removed, and first cousins are about 31%, 37% and 45% respectively where the same in the rural areas are 32%, 40% and 50% respectively. The mortality rate in general, is quite high in rural areas among the Ansari group. The above trend for the total mortality rate repeats itself if we look at the picture of prenatal and postnatal death rates or the other sub-categories of observations such as abortions, still-births and infant and juvenile mortality.

DISCUSSION

Consanguineous marriages have been known to be practised by all socio-economic classes of Muslims for a long time in history. Generally speaking, first cousin marriages were more preferably contracted by Asian Muslims due firstly to easy availability of brides in the joint family system, and secondly also because of desirability

Table 4: Effects of inbreeding on mortality with degree of consanguinity (expressed as percentage)

Parameters	Sub-urban			Rural		
	2C	1½C	1C	2C	1½C	1C
Quraishi Population						
AB	1.34	1.92	2.51	1.78	2.16	3.55
SB	2.05	4.57	7.67	2.95	5.15	8.75
IM	14.15	15.83	17.32	13.25	16.71	18.21
JM	11.75	13.81	15.75	13.14	13.92	17.81
TM	29.29	36.13	43.25	31.12	37.94	48.35
N	301	120	784	290	125	771
Ansari Population						
AB	1.92	2.16	2.92	2.15	2.75	3.65
SB	2.85	5.12	7.98	3.26	6.66	9.77
IM	14.91	16.72	18.81	14.50	17.17	19.95
JM	13.14	14.57	16.82	13.86	14.71	19.18
TM	32.85	38.57	46.53	33.77	41.29	52.35
N	338	177	956	304	122	791
Total Population						
AB	1.64	2.04	2.72	1.96	2.45	3.60
SB	2.45	4.84	7.82	3.10	5.90	9.26
IM	14.53	16.27	18.06	13.87	16.94	19.09
JM	12.44	14.19	16.28	13.50	14.31	18.49
TM	31.07	37.35	44.89	32.44	39.61	50.45
N	639	297	1740	594	247	1562

AB = Abortions, SB = Still births, IM = Infant mortality, JM = Juvenile mortality, TM = Total mortality, N = Number studied.

to keep the family's assets intact over generations. However, the frequency of first cousin marriages among Ansari groups declined in suburban areas as urbanization increased leading to break up of families for economic reason. This can be seen from the data for suburban as against rural areas.

The present study shows a relatively higher rate of abortions, still births, postnatal and total morality among consanguineous groups, specially in the rural areas and for Ansari groups. Although foetal loss or intrauterine mortality among consanguineous couples is generally expected to be less because of lesser immuno-incompatibility (Philippe, 1974; Schull et al., 1968), an increased frequency of intrauterine mortality has also been seen in the studies of Basu (1975), Rao and Inbaraj (1977) and Sutter and Tabah (1952). The inbreeding effects among the present two Muslim castes have been found to be statistically significant ($P<.05$) for all the categories of mortality. Also increased mortality is found to be associated with a higher degree of consanguinity.

In spite of the fact that all our inbred samples present a morbidity higher than that of the outbred ones, it must be recorded that infant mortality is also influenced by several socio-demographic and medical-obstetric factors. In the present study however, these factors have been found to be similar in all the marriage groups studied. In summary, this approach in evaluating inbreeding effects in human populations provides an insight into the magnitude of such effects (relative risks) as well as their impact in terms of prevention (attributable risk), which directly addressed public health issues of importance to epidemiologists and health planners.

ACKNOWLEDGEMENTS

First author would like to express his gratitude to the council of Scientific and Industrial Research, New Delhi for providing Research Associateship. This work was partially supported by the Indian Council of Medical Research (Sanction No. 5/7/18/8702860).

REFERENCES

Basu, S.K.: Effect of Consanguinity among North Indian Muslims *J.Pop. Res.* **2**: 57-68 (1975).

Phillippe, P.: Amenorrhea, intra-uterine mortality and Parental consanguinity in an isolated French-Canadian Population. *Hum. Biol.* **46**: 405-426 (1974).

Rao, P.S.S. and Inbaraj, S.G.: Inbreeding effects on human reproduction in Tamil Nadu of South India. *Ann. Gent. Hum. Genet.* **41**: 87-98. (1977).

Schull, W.J., Komatsu, I., Nagano, H. and Yamamoto, M.: Hirado: Temporal trends in inbreeding and fertility. *Proc. Nat. Acad. Sci.*, **56**: 671-679 (1968).

Snedecor, G.W. and Cochran W.G.: Two-way classifications with unequal numers and proportions. pp. 472-503. In: *Statistical Methods*. The Iowa State University Press, Iowa (1967).

Sutter, J. and Tabah, L.: Effects be la consanguinite et de l'endogamic: Une enquete in Morbihan et Loiret-Cher. *Population* **7**: 249-266 (1952).

Wright, S.: Coefficients of inbreeding and relationship. *Am. Nat.* **56**: 330-338 (1922).