FIRST COUSIN MARRIAGES AND X-HETEROSIS IN WOMEN

Pages with reference to book, From 55 To 59

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Abstract

The study of X-heterosis in women, in the four types of first cousin marriages, was carried out on 516 families in sample population of Punjab, Pakistan. Secondary sex ratio in X-outbrcd subsets is higher than in X-inbreds. Tertiary sex ratio shows higher postnatal male deaths in X-outbreds than in X-inbreds. Prenatal loss (stillbirths + abortions), male stillbirths in particular, is higher in X-inbreds compared with X-outbreds. Females are more protected in X-outbreds than in X-inbreds. Fertility is comparatively higher in X-outbred subsets than X-inbreds (JPMA 31:55, 1981).

Introduction

Extensive studies have been carried out regarding the effects of consanguineous marriages on viability, malformation, sex ratio (Schull, 1958); birth weight, gestation time and measurements of infants (Morton, 1958) in the Japanese population. The effects of inbreeding were observed on morbidity and early mortality in the Indian population (Sanghvi, 1966). These authors showed that one of the causal factors of the rare recessive diseases in man is the parental consanguineous marriages. The outcome of such marriages is the reduction of heterozygosity in the population.

The question that how far the heterozygosity at X-linked loci contribute to survival of the XX-females, was examined in an interesting study by Hook and Schull (1973). This study is based on sex ratio data from first cousin marriages in the population of Japanese Island of Hirado. These authors showed that X-heterosis contributes considerably to female survival during gestation, and this trend is consistent with an X-heterotic effect on postnatal survival.

The present report is an investigation of sample population of Punjab (Pakistan) on the same lines to see the racial differences for X-heterosis in the two populations.

Material and Methods

The data were collected from three places, Lahore, Mianchannu and Muridke in the Province of Punjab, Pakistan. Door to door interviews of families were carried out in Mianchannu and Muridke. The data from Lahore were collected from two sources, one, through door to door interviews of families (Lahore-I) and the other by interviewing women admitted in the Lady Willingdon Hospital (Lahore-11).

The information collected contains the relationship of husband and wife, dates of birth of children, their birth orders and sex, stillbirths, abortions, and deaths after birth. The data presented here include only that of first cousin marriages.

Results

The first cousin marriages were classified into four types on the basis of their parental relationships (Fig. I).

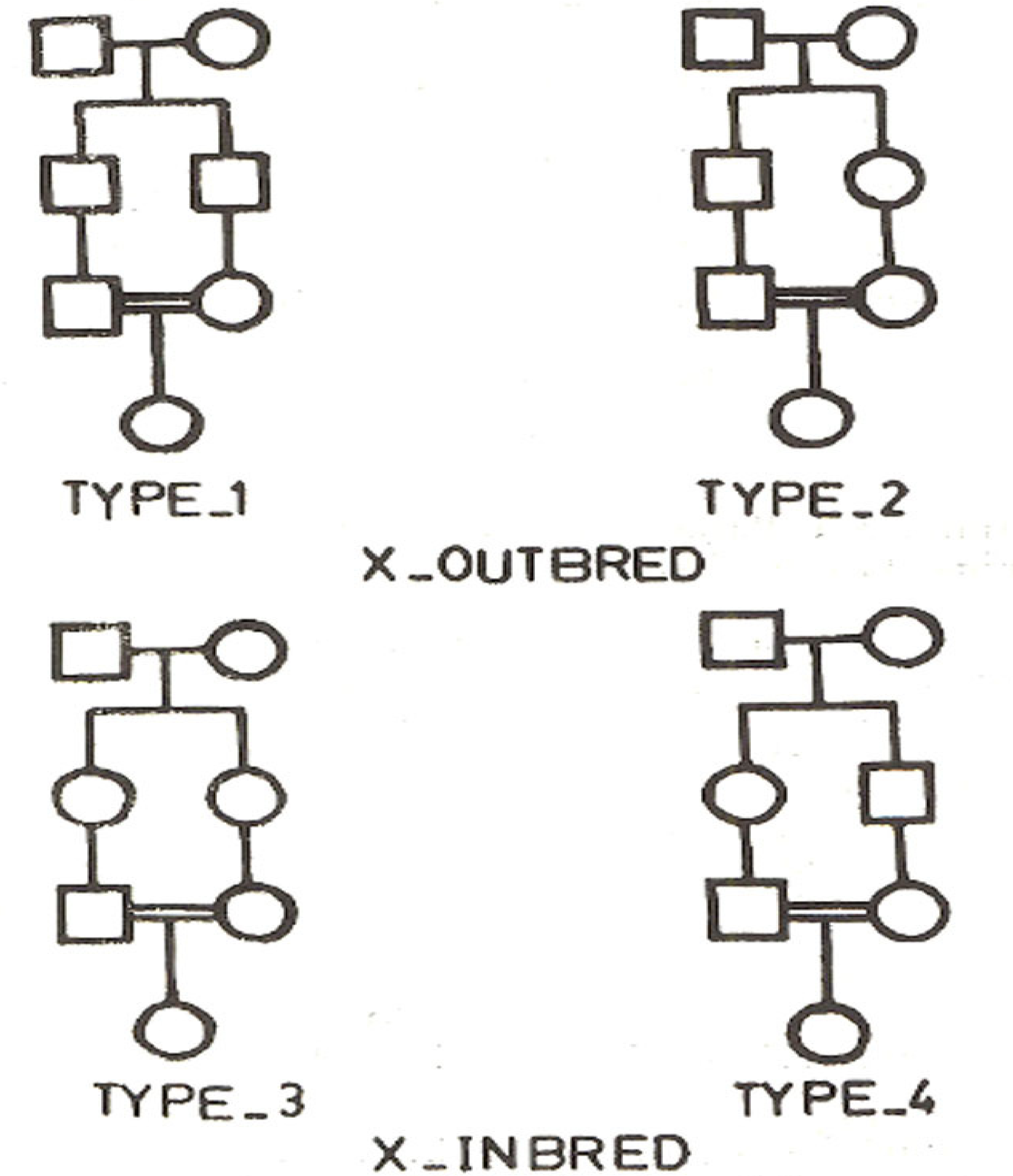

Fig. 1 : Pedigrees of XX-offspring of first cousin marriages.

Type-1. The sibs may be brothers-Brother-Brother, i.e., woman married to her paternal uncle's son.
Type-2. The female cousin's mother may be the sib of the male cousin's father-Brother-Sister, i.e., woman married to her maternal uncle's son.

Type-3. The sibs may be sisters-Sister-Sister, i.e., woman married to her maternal aunt's son.
Type-4. The female cousin's father may be the sib of male cousin's mother-Sister-Brother, i.e., woman married to her paternal aunt's son.
Hook and Schull (1973) have termed Type-1 and Type-2 as X-outbred, and Type-3 and Type-4 as X-inbred. The same classification was followed for the present analysis.
The analyses were based on the number of fertile families, livebirths, stillbirths, abortions and natural deaths in the four types of first cousin marriages (Table 1).

Table 1: Number of Live Births, Stillbirths, Abortions and Natural Deaths in the Four Types of First Cousin Marriages.

Type of Marriage	*No. of Families*		*Livebirths*		*Stillbirths*		*Abortions*	*Natural Deaths*	
	Total	*Fertile*	M	*F*	*M*	*F*		*M*	*F*
X-outbred Type-1									
Muridke	44	44	110	101	1	0	0	17	9
Mianchannu	12	11	21	14	0	0	2	3	1
Lahore-I	23	23	65	43	2	1	4	11	6
Lahore-II	85	82	139	112	20	16	46	24	15
Total	164	160	335	270	23	17	52	56	31
X-Outbred Type-2									
Muridke	23	23	62	57	1	1	1	9	7
Mianchannu	15	13	30	39	1	0	0	8	7
Lahore-I	23	23	65	38	3	0	5	8	6
Lahore-II	29	25	38	34	1	2	12	7	7
Total	90	84	195	168	6	3	18	32	27
X-inbred Type-3									
Muridke	15	15	28	30	0	0	0	1	4
Mianchannu	9	8	27	25	0	0	0	7	10
Lahore-I	30	30	68	59	3	4	8	6	7
Lahore-II	78	70	110	103	20	13	20	22	15
Total	132	123	233	217	23	17	28	36	36
X-inbred Type-4:									
Muridke	14	14	34	31	1	0	1	1	2
Mianchannu	13	12	35	31	2	0	0	5	5
Lahore-I	22	22	47	36	1	1	5	4	2
Lahore-II	81	79	128	104	21	9	25	25	15
Total	130	127	244	202	25	10	31	35	24
X-outbred (All)	254	244	530	438	29	20	70	88	58
X-inbred (All)	262	250	477	419	48	27	59	71	60

M—Male F—Female.

Combined data of the four samples of first cousin marriages were used for the analyses. Out of 516 families of first cousin marriages 50.78% are X-inbred subsets and 49.22% X-outbred subsets. Typc-1 first cousin marriages are 31.78%, Type-2 17.44%, Type-3 25.58% and Type-4 25.20% of the total number.

Table II: Percentage Prenatal Loss, Fertility, Sex Ratio and Natural Deaths in X-inbred and X-outbred First Cousin Marriages.

Items	*Inbred First cousin marriages*	*Outbred First cousin marriages*
Prenatal loss (Stillbirths+Abortions)	11.95	9.65
Stillbirths	M— 4.28	2.35
	F— 2.41	1.62
	T— 6.69	3.97
Abortions	5.26	5.67
Fertility:-		
(1) mean pregnancies/family ..	4.28	4.85
(2) mean live births	3.42	3.81
Secondary sex ratio	100 ♀♀:114 ♂♂	100 ♀♀:121 ♂♂
Natural deaths	M— 7.92	9.09
	F— 6.69	5.99
	T— 14.62	15.08
Tertiary sex ratio	100 ♀♀:114 ♂♂	100 ♀♀:116 ♂♂
Fertile families	95.42	96.06

M—Male F—Female T—Total

Table II gives the analysis of X-inbred and X-outbred subsets. Prenatal loss (stillbirths+ abortions) is higher in X-inbreds (11.95%) than the X-outbreds (9.65%). Higher abortions are associated with X-outbreds (5.67%), but higher stillbirths with X-inbreds (6.69%). The male (4.28%) and female (2.41%) stillbirths are higher in X-inbreds than in X-outbreds(0=2.35%; = 1.62%). The difference in male and female stillbirths in X-inbred and2X-outbred is statistically non-significant (X^2_1=0.2931; P>0.50).1
Fertility was calculated in two ways (i) mean pregnancies per family, based on total number of pregnancies divided by the number of families and (ii) mean livebirths, from total livebirths divided by the number of families. The X-outbreds show higher mean pregnancies (4.85) and mean livebirths (3.81) than the X-inbreds (4.28 and 3.42 respectively).
Secondary sex ratio (M/F) is higher in X-outbreds (100 ?$: 121 c?c?) than X-inbreds (100 ?$: 114 The difference between the two is not significant (X^2_1=0.4349; P>0.50). Natural deaths of offspring recorded upto the age of 10 years, show less female deaths in X-outbreds (5.99%) than X-inbreds (6.69%). There is higher male deaths in X-outbreds (9.09%) than X-inbreds (7.92%). The natural deaths, sexes combined, in X-outbreds (15.08%) is higher than in X-inbreds (14.62%). The differential mortality in X-inbreds and X-outbreds is statistically non-significant (X^2_1= 1.0396; P~-0.30). The tertiary sex ratio, based\ on livebirths minus natural dea hs, shows dec-rease in X-outbreds (100 $$: 116 c^c?) but in X-inbreds change in sex ratio is not observed (100 $$: 114 The deaths of males among X-outbreds is, however, not significantly different from livebirths (X^2_1=0.1721; P>0.50).

Discussion

Hook and Schull (1973), while investigating consanguineous marriages in the Japanese population of Hirado, carried out in detail the analysis of X-hctcrosis in women from the first cousin marriages. The results obtained by these authors show higher secondary sex ratio in X-inbred subsets than in X-outbreds, and higher female postnatal deaths in the former than in latter, with no effects on male postnatal deaths. Their findings were in consonance with their predictions.

The present sample population of Punjab does not show as highly positive results as Hook and Schull (1973) observed with Hirado population. Secondary sex ratio is higher in both the X-outbred subsets than the X-inbreds, but the difference is statistically non-significant. Tertiary sex ratio indicates more male postnatal deaths in X-outbreds than in X-inbreds, resulting in the decrease of sex ratio in X-outbreds, but no obvious change as a whole is observed in that of X-inbreds. The general population of Lahore and its suburbs show quite high secondary sex ratio (100$?: 115.59 c?&; Shami and Tahir, 1978), and tertiary sex ratio (100 : 116 c?tf; Shami, 1980). The highest postnatal male deaths arc seen in Type-1 (X-outbreds) and the lowest in Type-4. In Type-1 the females are protected more than the others. The highest decrease in postnatal sex ratio is observed in Type-1 (100?: 1\7&c?) and the highest increase in Type-4 (100 ++: 120cW). A slight decrease and increase in postnatal sex ratio is seen in Type-2 (100?$: 115d,dl) and Type-3 marriages (100??: 109 dV, Table III).

Table III: Livebirth, Sex Ratio and Percentage Natural Deaths in the Four Types of First Cousin Marriages.

Type of marriage	*Livebirth sex ratio*		*Natural deaths*	
	Secondary	*Tertiary*	*Male*	*Female*
X-outbred				
Type-1	100 ♀♀ : 124 ♂♂	100 ♀♀ : 117 ♂♂	9.25	5.12
Type-2	100 ♀♀ : 116 ♂♂	100 ♀♀ : 115 ♂♂	8.81	7.44
Total	100 ♀♀ : 121 ♂♂	100 ♀♀ : 116 ♂♂	9.09	5.99
X-inbred				
Type-3	100 ♀♀ : 107 ♂♂	100 ♀♀ : 109 ♂♂	8.00	8.00
Type-4	100 ♀♀ : 112 ♂♂	100 ♀♀ : 120 ♂♂	7.85	5.38
Total	100 ♀♀ : 114 ♂♂	100 ♀♀ : 114 ♂♂	7.92	6.69

Change in postnatal sex ratio is also due to differential female deaths in X-outbreds and X-inbreds. The postnatal female deaths in X-outbreds (Type-1 and 2) are less than those of X-inbreds (Type-3 and 4, Table III).

Prenatal loss (stillbirths+ abortions) is higher in X-inbreds (11.95%) than in X-outbreds (9.65%). A higher proportion of males in X-inbreds (4.28%) than X-outbreds (2.35%) is lost due to stillbirths. The average presental loss in the sample population of hospital from Lahore (Punjab, Pakistan) is 14.28% and male stillbirths and female stillbirths are 6.85% and 5.05% respectively (Shami and Sultana, 1980). The higher loss of males during gestation in this population could be one of the reasons that the secondary sex ratio in X-inbreds is less than in X-outbreds. In X-outbreds males seem to be protected during gestation. This may suggest that the males have fewer genes causing prenatal deaths but have many genes which express themselves causing death of males quite late after their birth in this population. The latter possibility derives support from the higher postnatal deaths of male progeny in X-outbreds. The information regarding the sex-linked Xg^a blood group systems is lacking in the present data. This factor shows that the incompatible matings when the father is Xg^a - positive and the

mother is Xg^a -negative, significant increase in male births is observed after the birth of the first daughter (Jackson et al., 1969). This needs investigation in the four types of cousin marriages.
Other factors like mean pregnancies per family and mean live births per family are higher in X-outbreds than in X-inbreds.
Hook and Schull (1973) suggested that XXs born to first cousins may have different X-chromosome inbreeding coefficients depending upon parental relationships. If heterozygo sity for X-linked loci has an effect on a particular attribute, i.e., survival, this effect should be less for X-inbred females who will be more homozygous, on the average than X-outbred females. Similar results, though statistically non-significant, are observed in the present data.'
Since prenatal and postnatal loss in X-outbreds is less than in X-inbreds, the inbreeding coefficients in the former would be less than the latter as suggested by Hook and Schull (1973).
The present data show majority of marriages occur among the children of parental relationships, Brother-Brother (Type-I, 31.87%), Sister-Brother (Type-4, 25.20%), Sister-Sister (Type-3, 25.58%), and the least in Brother-Sister (Type-2, 17.44%). This indicates that Type-3 and Type-4 X-inbreds contribute more in inbreeding than Type-1 and Typc-2. This corroborates with the evidence from prenatal loss in the hospital sample population and the present data.
The frequency of cousin marriages is quite high (46.00%) in the present sample population. The harmful effects of such marriages are known in other populations, and detailed information regarding the present population will be provided elsewhere (Shami and Zahida, unpublished data). The present results suggest that among first cousin marriages Type-I and Typc-2 are comparatively less harmful than Type-3 and Type-4.

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