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Consanguinity and Reproductive Health Among Kurichias: A Tribal Population of Kerala

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INTRODUCTION

Health and disease are the expression of the relative degree of success or failure experienced by an organism in its effort to respond adaptively to an environmental challenge. Fertility, mortality and morbidity are the different health indicators which give meaningful conclusions to understand the structure of a population against the background of a number of ecological factors, both biological and social leading to the human well-being. In any population the rate of mortality and morbidity will depend on the recessive alleles detectable from the type of marriage (consanguineous marriage or non-consanguineous) existing in that particular population.

The present study is aimed to know the consanguinity and reproductive health among Kurichias (a tribal population of Kerala). So far, no study attempted to depict the consanguinity and reproductive health among Kurichias and hence, the present study is undertaken.

MATERIALS AND METHODS

The data for the present study have been collected from four areas (Mananthavady, Kunjam, Panamaram and Kambi Paleyam) of Wayanad District, Kerala. The information on marriages, fertility, mortality and morbidity was collected using a pretested proforma devised for the purpose by direct interview method from 224 couples following a complete village (settlement) survey method. All couples of different ages were visited and interviewed at their houses by ascertaining the detailed pedigrees drawn from the respondents families. We have cross-checked the reproductive histories of various women with the local mid-wives who attended the deliveries. In this connection, it is of significance to mention that the other members of the concerned families also helped in the correct assessment of the information sought from their families. Further more, our close association with the informants and the assistance given by the Tribal Development Office Personnel, Mananthavady helped us in making our data as accurate as possible.

The data collected has been treated with descriptive statistics, 't' test and 'z' test.

1. 't' test: (test for the significance of difference between means)

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{SD_1^2}{n_1} + \frac{SD_2^2}{n_2}}}$$

Where $\overline{X}_1$ = Mean of the sample one

$\overline{X}_2$ = Mean of the sample two

SD_1^2 = Standard Deviation of the Sample one

SD_2^2 = Standard Deviation of the Sample two

n_1 = Number of the sample one

n_2 = Number of the sample two

2. 'z' test: Proportion test (test for measuring the difference between two populations)

Sample - 1	*Sample - 2*
Consanguineous Marriages	Non-consanguineous Marriages
n_1 = total number of pregnancies	n_2 = total number of pregnancies
P_1 = Proportion of abortions and still births to pregnancies and various post-natal deaths to live births =	P_2 = Proportion of abortions and still births to pregnancies and various post-natal deaths to live births =
$\frac{P_1}{n_1} \times 100$	$\frac{P_2}{n_2} \times 100$

Standard error of difference found between proportions

$$P = \frac{n_1p_1 + n_2p_2}{n_1 + n_2}$$ assuming the null hypothesis is true

Standard error of difference between the proportions

$$S(p_1 - p_2) = \sqrt{\frac{pq}{n_1} + \frac{pq}{n_2}}$$

where $q = 1 - p$ ($q = 100-p$, if p is given in %)

$$\text{Critical Ratio} = \frac{\text{Difference in Proportion}}{\text{S.E. of the difference in Proportion}}$$

$$= \frac{P_1 - P_2}{\sqrt{\frac{pq}{n_1} + \frac{pq}{n_2}}}$$

3. Chi-square: (for testing the significance of the difference between the observed (o) and the expected (e) frequencies)

$$\chi^2 = \Sigma \frac{(O - E)^2}{(E)}$$

O = Observed values
E = Expected values

4. Inbreeding Co-efficient (autosomal and sex-linked) is calculated according to Wright (1922)

$$\alpha = \Sigma \frac{Fc \times n}{N}$$

where, 'n' frequency of a certain category of consanguineous marriages,
eg., uncle-niece, first cousin etc.,

Fc = Coefficient of Inbreeding (autosomal/sex-linked) for a particular category of consanguineous marriage;
Σ = the sum for different category of consanguineous marriages observed;
N = total number of marriages enquired, concerning a certain group.

RESULTS AND DISCUSSION

The percentages and frequencies of type of marriage are presented in table 1. Kurichias opted more towards consanguineous marriages (53.57%) than the non-consanguineous (46.43%). When the percentage of consanguinity of the present study population is compared with other tribals of India, except Gonds (59.04%) of Madhya Pradesh and Bhils (59.33%) of Maharashtra, all the other tribals like Kolams (20.00%), tribes (mixed) (48.11%), Raj Gonds (34.50%), Andhs (22.22%), Mathuras (6.50%) of Andhra Pradesh; Tribes (mixed) of Kerala (9.87%), and Kota (12.69%) of Tamilnadu show low percentage of consanguineous marriages. But, Pradhans (53.50%) of Andhra Pradesh show an almost all equal percentage (Das, 1994). Among consanguineous marriages (53.57%), 93.33% were first cousins under which matrilateral cross-cousin were higher (57.14%) than the patrilateral cross-cousins (42.86%). The marriage type of first cousin once removed is 6.67%.

Table 1: Percentage and frequency of type of marriages among Kurichias

Type of Marriage	*N*	*%*
Consanguineous Marriages	120	53.57
1. First Cousins	112	93.33
a) Matrilateral Cross Cousin	64	57.14
b) Patrilateral Cross Cousin	48	42.86
2. First Cousin Once Removed	8	6.67
Non-consanguineous Marriage	104	46.43

Table 2 shows the total inbreeding co-efficient with different degrees of consanguinity. Both autosomal and sex-linked was given. The autosomal inbreeding co-efficient is 0.0604 and the sex-liked inbreeding co-efficient is 0.0688. When this is compared with the other populations, all the other tribals inbreeding co-efficient is less than the study population (Das, 1994).

Table 2: Inbreeding co-efficient

Type of Marriage	*Inbreeding Co-efficient*	
	Autosomal	*Sex-linked*
1. First cousin	0.0583	0.0667
a) Matrilateral	0.0333	0.0667
b) Patrilateral	0.0250	0.0000
2. First Cousin Once Removed	0.0021	0.0021
	0.0604	0.0688

The mean age at puberty is 14.79 and 17.07 is the mean age at marriage (Table 3). The age at puberty is 14.20 and the age at marriage is 16.60 which is less when compared to non-consanguineous couples (age at puberty = 15.46 and age at marriage = 17.62). Both age at puberty and age at marriage differ significantly ($p < 0.01$) between consanguineous and non-consanguineous marriages. The age at puberty among consanguineous couples is close to the total population mean age at puberty, but the total age at marriages is close to that of non-consanguineous couples.

Table 3: Frequency and percentage of age at puberty and marriage

Parameter	*Type of Marriage*					
	Consanguineous		*Non-consanguineous*		*Total*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Age at puberty	14.20	1.42	15.46	1.24	14.79	1.52
Age at Marriage	16.60	2.52	17.65	2.50	17.07	2.56

t-test: Puberty = 7.021 ($p < 0.01$)
Marriage = 3.122 ($p < 0.01$)

In table 4, the rate of fertility, mortality and congenital malformation measures are given. A slight lower fertility rate (49.66) is observed in

consanguineous marriages than the non-consanguineous couples (50.34), but the prenatal mortality among consanguineous is higher (9.59) than the non-consanguineous (6.75). The postnatal mortality also shows the same picture as prenatal mortality (consanguineous = 9.59 and non-consanguineous = 8.11). In total, among Kurichias, the postnatal mortality is higher (9.63) than the prenatal mortality (8.16). In prenatal mortality, the abortions are more (5.44) than the still births (2.72). When consanguinity is taken into consideration, abortions are more in consanguineous (8.22) than the non-consanguineous but a quite reverse picture is observed with regard to still births (consanguineous = 1.37 and non-consanguineous = 4.05). To know the difference between all the variables *i.e.,* fertility, live births, prenatal, postnatal and total mortality among consanguineous and non-consanguineous marriages, proportion test has been applied and showed a significant difference at 1 % level of probability.

The total mortality rate is 17.01 among which consanguineous marriages resulted higher (19.18) than to the non-consanguineous marriages (14.86).

The congenital malformations rate is 1.36 among the sample. But when compared with the type of marriage, only consanguineous couples conception resulted in abnormality (2.74).

Table 4: Rate (per 100) of fertility, mortality and congenital malformations

Result of	*Number*		*Rate*		*Total*	
Conception	*C*	*NC*	*C*	*NC*	*Number*	*Rate*
Pregnancies	584	592	49.66	50.34	1176	100.00
Live Births	528	552	90.41	93.24	1080	91.84
Prenatal Mortality	56	40	9.59	6.75	96	8.16
Abortions	48	16	8.22	2.70	64	5.44
Still Births	8	24	1.37	4.05	32	2.72
Postnatal Mortality	56	48	9.59	8.11	104	9.63
Total Mortality	112	88	19.18	14.86	200	17.01
Congenital Malformations	16	0	2.74	0.00	16	1.36
Physically Handicapped	8	0	1.52	0.00	8	1.52
Mentally Retarded	8	0	1.52	0.00	8	1.52

C=Consanguineous Marriage
NC=Non-consanguineous Marriage
'Z' test: 8.1497 ($p < 0.01$)

Table 5: Congenital malformations and birth order

Abnormality	*Order of Birth*			
	1	*2*	*3*	*4*
Physically Handicap (Dumb & Deaf)	8	-	-	-
Mentally Retarded	-	-	8	-

Among the abnormalities, only physically handicapped and mentally retardation are found in which these two are in equal rate (1.52).

The percentage prevalence of abnormality in relation to the order of birth is presented in table 5. It is of significance to note that all the physically handicapped children and mentally retarded abnormality is observed only at 1st and 3rd birth orders. And it is also to observe that ancestors of the abnormal inbred were totally consanguineous*i.e.,* interviewed couples parents (both father and mother) were consanguineous.

Among the various hereditary diseases prevalent among Kurichias (Table 6), Arthritis is high (7.14%) and hypertension is low (1.34%). Diabetes and Asthma show an equal prevalence. The heart disease stood at 2.33%. Besides, the diabetes and asthma of hereditary diseases, the other diseases stands next (5.36%) which are communicable diseases such as malaria, tuberculosis etc. Inbred individuals show a higher rate than non-inbred except arthritis and diabetes, and asthma was absent among non-inbred. The chi-square value revealed a significant difference between inbred and non-inbred ($p<0.05$).

The Diabetic persons are more in 2nd and 3rd birth orders (Table 7). The 3rd birth order of both the type of marriages show hypertensive

Table 6: Percentage of disease prevalence among the offspring of the interviewed couples

Type of Disease	*Type of Marriage*					
	N		*%*		*Total*	
	I	*NI*	*I*	*NI*	*N*	*%*
Diabetes	8	0	6.67	0.00	8	3.57
Hypertension	2	1	1.67	0.96	3	1.34
Heart Disease	4	1	3.33	0.96	5	2.23
Asthma	8	0	6.67	0.00	8	3.57
Arthritis	8	8	6.67	7.69	16	7.14
Others	7	5	5.80	4.81	12	5.36

I = Inbred NI = Non-inbred
χ^2 - value between inbred and non-inbred = 11.156 ($p<0.05$)

Table 7: Prevalence of diseases and order of birth

Type of Disease	*Order of Birth*							
	Inbred				*Non-inbred*			
	1	*2*	*3*	*4*	*1*	*2*	*3*	*4*
Diabetes	-	5	3	-	-	-	-	-
Hypertension	-	-	2	-	-	-	1	-
Heart Disease	-	-	3	1	-	-	1	-
Asthma	4	3	1	-	-	-	-	-
Arthritis	2	5	1	-	7	1	-	-
Others	2	3	1	1	1	1	2	1

patients. The heart disease is observed in 3rd and 4th birth orders of consanguineous marriage and 3rd of non-consanguineous marriage. 1, 2 and 3 order of birth show Asthma people in consanguineous marriages. The Arthritis is seen in 1,2 and 3 of consanguineous marriages and 1 and 2 of non-consanguineous marriages. But, other diseases are found in all birth orders.

The Kurichias opted more towards consanguineous marriages may be to maintain closeness with the relatives to protect their property and to strengthen the family with more number of members in the linearity of the society and to have cordial relations with the mother-in-law and father-in-law (Reddy et al., 1993; Reddy et al., 1997). The less mean age at marriage among consanguineously married women is may be due to the recruitment of males and females into marital union and parenthood is rather early among them due to the decision made by the elders when they born and also due to low literacy rate (Govinda Reddy, 1984 and Reddy et al., 1997). And also, it is understood from our study that the consanguinity lead to the increase in the prenatal and postnatal mortality with a slight decrease in fertility, live-births, survival offspring and increase in abnormalities when compared with non-consanguinity, a well known finding reported in earlier studies as well (Parvathi Kumara Reddy et al., 1993; Reddy and Govinda Reddy, 1996). In the present study, the degree of failure of fertility experienced by the Kurichias through mortality is high (1.27 times) in consanguineous marriages to the non-consanguineous marriages. The fertility is 1.01 times less in consanguineous than non-consanguineous. Among consanguineous marriages, 1/3 of the pregnancies proned to mortality and 1/4 in the case of non-consanguineous which indicates high mortality among the offspring of consanguineous than the non-consanguineous. Further, in total, it is to state that 1/6th of the offspring resulted to mortality. In this context of low mortality, the present population may have a maximum life expectancy which will be ascertained in future research by our team by calculating the life expectancy and by framing the index of ageing comparing with other tribal and non-tribal populations of India. Due to consanguineous marriage and inbreeding, the disease prevalence, prenatal and postnatal mortality is very high due to the increase in homozygosity and enhanced risk of hereditary diseases transmitted through recessive alleles (Kumar and Swaminathan, 1967, Reddy and Govinda Reddy, 1996), keeping the influence of the other socio-ecological factors apart.

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KEY WORDS Consanguinity. Fertility. Mortality. Morbidity.

ABSTRACT The degree of success or failure experienced by an organism in its effort to respond adaptively to an environmental challenge is estimated by different health indicators like fertility, mortality and morbidity. The rate of fertility, mortality and morbidity which are the expression of health and disease are studied among Kurichias - a tribal population of Kerala, in relation to consanguinity to understand the structure of a population. Consanguineous marriages are practised more than the non-consanguineous. The autosomal and sex-linked inbreeding co-efficients are 0.0608 and 0.0688 respectively. The age at marriage is less among the women of consanguineous marriages than the non-consanguineous marriages. Low fertility, live births and, high prenatal, postnatal mortality rate and hereditary diseases are observed among consanguineous couples than

the non-consanguineous couples. The congenital malformations are observed only in consanguineous marriages. Among consanguineous marriages, the disease prevalence, prenatal, postnatal mortality and morbidity are very high due to the increase in homozygosity and enhanced risk of hereditary disease transmitted through recessive alleles.

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