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Effects of Inbreeding on Morbidity : A Study Among Three South Indian Communities

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ABSTRACT Effects of Inbreeding on the incidence of congenital anomalies was studied in Chittoor district surveying 27 villages of four taluks: Chandragiri, Chittoor, Puttur and Srikalahasti with a sample of 1500 couples on three communities: Akuthota Reddy, Odde and Madiga. Of all marriages 49% were consanguineous among Akuthota Reddy and Odde, and 50.4% in Madiga. In all the three communities congenital malformations are more in consanguineous than the non-consanguineous. Early birth orders show higher frequency of morbidity than the later birth orders, and higher frequencies in the offspring of related couples in almost all the maternal age groups. The type of malformations seen in the consanguineous marriages are similar to, and occur no more often than, those seen in the non-consanguineous marriage group.

INTRODUCTION

Different organ systems mature at different rates during gestation (WHO, 1974). Consequently the new born are subject to differential risks of acquired congenital malformations. However, the human foetus relatively, inaccessable for any systematic scientific study of the various body systems, except through opportunities afforded when deliveries taken place after various weeks of gestation.

Congenital malformations appear to be seen in consanguineous couples in most individual populations studied, although the rates of increase may not always be very high. It is of course high in a Kerala study (Kumar et al., 1967). In this case additional factors like increased rates of natural irradiation from monozite sands which might increase mutation rates and also in other studies made so far show some increase in the incidence of congenital malformation with inbreeding more so far those with a possible genetic origin and those with complex manifestation. This paper also describes and assess the effects of parental consanguinity on congenital malformation among three different ethnic groups *i.e.*, Akuthota Reddy, Odde and Madiga.

MATERIAL AND METHODS

The sample for this study was taken from Chittoor district in Andhra Pradesh state surveying 27 villages belonging to four taluks (Chandragiri, Chittoor, Puttur and Srikalahasti) on three caste groups Akuthota Reddy - a forward community, Odde - a backward community and Madiga - a scheduled community. These three castes have been selected because they represent different socio-economic levels, which inturn might have a differential impact on the frequency of consanguineous marriages and on morbidity of the offspring. The sample size of the present study is 1500 couples in which each community comprises 500 couples. Genealogical particulars thoroughly gathered through intensive interviewing both men and women. Cross checks were made to verify the data. Information was collected on past reproductive history which includes the outcome of pregnancy and on the consanguinity of the couples. Purposive sampling technique had been adapted in collecting the data. 'Z' tests have been used to test the significance of the differences between the proportions of the data.

RESULTS AND DISCUSSION

Table 1 shows the frequencies of consanguineous (CG) marriages among Akuthota

Reddy (AK), Odde (O) and Madiga (M) in which AK (49.0%) and O (49.0%) show the same percentage of CG marriages and lower to that of the non-consanguineous (NCG) marriages, where as M population shows higher rate of CG marriages (50.4%) over NCG marriages (49.6%). Among different degrees of consanguinity, higher percentage is observed in first cousin marriages (AK = 23.0%; O = 28.6%; M= 30.6%) and lower in beyond first cousin once removed type of marriage (AK = 6.0%, O = 2.4%, M = 4.4%). Of the first cousin marriages in all the three communities, the matrilateral cross cousin marriages (AK=16.6%, O = 16.2% and M = 18.2%) account for more than the patrilateral cross cousin marriages (AK = 6.4%, O = 12.4% and M = 12.4%). But aunt-nephew marriages are found only in AK (0.4%). The descending order of percentages in different degrees of consanguinity in the three communities is:

FC > UN> FCOR> BFCOR > AN*

The incidence of congenital malformation by consanguinty has been given in table 2. In CG marriages, among AK, 9 offspring were with congenital malformations with an incidence of 11.08 per 1000, in 0, 3 offspring were abnormal with an incidence of 4.46 per 1000 and in M, 3 inbred are malformed with an incidence of 3.98 per 1000. In all the three communities CG marriages show higher rate of abnormality than the NCG marriages (AK = 5.34, O = 2.59 and M = 1.32).

AK and M show a significant difference ($P < .01$) in Congenital malformations between CG and NCG marriages.

The incidence of congenital malformations by parental consanguinity and birth order is shown in table 3. Among the different birth orders, early birth orders (1, 2) show higher frequency of congenital malformations than the later birth orders. In the 1,2 birth orders, CG marriages show more abnormality than the NCG marriages.

Table 1 : Distribution of consanguineous and non-consanguineous marriages among the three communities

Type of Marriage	*Akuthota Reddy*		*Odde*		*Madiga*	
	N	*%*	*N*	*%*	*N*	*%*
Non-consanguineous	255	51.0	255	51.0	248	49.6
Consanguineous	245	49.0	245	49.0	252	50.4
Uncle-Niece	62	12.4	58	11.6	51	10.2
Aunt-nephew	2	0.4	-	-	-	-
First cousin	115	23.0	143	28.6	153	30.6
a) Patrilateral	32	6.4	62	12.4	62	12.4
b) Matrilateral	83	16.6	81	16.2	91	18.2
First cousin once removed	36	7.2	32	6.4	26	5.2
Beyond First cousin once removed	30	6.0	12	2.4	22	4.4

Table 2 : Incidence of congenital malformations by consanguinity

Relationship	*Akuthota Reddy*		*Odde*		*Madiga*	
	Live births	*Rate per 1000*	*Live births*	*Rate per 1000*	*Live births*	*Rate per 1000*
Non-Consanguineous	749	5.34	772	2.59	756	1.32
Consanguineous	812	11.08	673	4.46	753	3.98
Uncle-niece	186	-	166	18.07	144	-
First cousin	408	14.70	382	-	454	6.61
First cousin once removed	118	8.47	88	-	94	-
	't' = 4.1001 P<.01		't' = 1.9401 NS		't' = 3.2167 P<.01	

* found only in AK but absent in O and M

Table 3 : Incidence of congenital malformations by consanguinity and birth order

Birth order	*Akuthota Reddy*		*Odde*		*Madiga*	
	NCG	*CG*	*NCG*	*CG*	*NCG*	*CG*
1, 2	4	6	1	2	-	3
3,4	-	1	1	1	-	-
5,6	-	2	-	-	1	-

The congenital malformation by consanguinity and maternal age (table 4) in the three communities shows higher frequencies in the offspring of related couples in all the maternal age groups except 28-37 years group in AK.

Table 4 : Congenital malformation by consanguinity and maternal age

Maternal age (Yrs)	*Akuthota Reddy*		*Odde*		*Madiga*	
	NCG	*CG*	*CG*	*NCG*	*NCG*	*CG*
18-27	1	3	-	-	-	-
28-37	2	-	1	3	1	1
38-47	-	1	-	-	-	1
48-57	-	2	-	-	-	1
58 & above	1	1	-	-	-	-

Major congenital malformations in CG and NCG samples is given in the table 5. The types of malformations seen in the CG marriages are similar to, and occur no more than, those seen in the NCG marriage goup.

Table 5 : Type of malformation by consanguinity

Type of Malformation	*Akuthota Reddy*		*Odde*		*Mediga*	
	NCG	*CG*	*NCG*	*CG*	*NCG*	*CG*
Cleft lip	1	-	-	-	-	-
Dwarfism	-	-	-	-	-	1
Hearing impaired	2	1	-	-	1	-
Heart disease	-	-	-	1	-	-
Mentally retarded	-	2	-	1	-	1
Multiple handicap (Hearing impaired + Mentally retarded + Heart disease)	1	-	-	-	-	-
Orthopaedically Handicapped	-	-	2	1	-	-
Polydactyly	-	2	-	-	-	-
Visual Impairment	-	4	-	-	-	1

Congenital malformations are the important cause of perinatal mortality. Various environmental and genetic factors may influence the incidence and the spectrum of birth defects. Congenital malformations have been found among the offsprings of CG marriages (Hirai, 1985; Richieri, 1986; Zolotogora, 1987). Neel (1961) roughly estimated that not more than 20 per cent of all congenital defects in man could be explained on the basis of simple dominant recessive inheritance with full penetration, while some 10 percent may be due to the known viral infections or other extrinsic factors and another 10 per cent may be counted major chromosomal abnormalities. Binyou (1986) noted that the total incidence of congenital malformations in new born babies was 2.14% (91/4, 258 live births) in two hospitals. Most of the mothers giving birth to malformed babies were in the age of 25-34 age group (89.6%); 96.67% (46/60) were primipara, and found a significant effect of consanguinity on birth defects.

Many studies have shown higher frequency of congenital malformations among inbred children than in the non-inbred children (Schull, 1958; Morton, 1961; Marcallo et al., 1964; Stevenson, 1966; Centerwall and Centerwall, 1966; Murthy and Jamil; 1972; Chakraborthy and Chakravarti, 1977; Rao and Inbaraj, 1977 and Kasavan, 1978). In the Japanese studies of Schull (1958) and Yanase (1961), it is noticed that a higher frequency of complex anamolies among the inbred children than in the non-inbred ones. Further, it was not found any role of recessive genes in the manifestation of abnormalities. Our results are in good agreement with the earlier works.

The aetiology of congenital malformations includes both genetic and environmental factors, and genetic predisposition seems to be multifactorially determined rather than through the action of a single mutant gene (Carter Co, 1965; WHO, 1966 and Klingberg et al., 1971). Most studies exploring the role of inbreeding on congenital anamolies are retrospective in nature and based on cases in hospital. Although a high

rate of parental consanguinity has been observed among those affected (Costeff, et al., 1972; Pensoresos, 1957 and Sinclair, 1971), in most studies no serious search seems to have been made for other factors in the family that might have contributed to the congenital malformations (Chung, 1969) nor were inferences drawn after comparison with adequate control groups (Centerwall and Centerwall, 1966).

Evidence from studies done so far shows some increase in the incidence of congenital malformations with inbreeding, more so for those with a possible genetic origin and those with complex manifestation (Yanase, 1965 and Schull, 1958).

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