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Reproductive Structure of the Vadde and Palle Fisherfolk from Kolleru Lake, India

This paper examines the reproductive behaviour of the Vadde and Palle fishermen populations of Kolleru Lake. An attempt is made to ascertain the amount of variation in the fertility and mortality rates among the villages of the Vadde which may be explained by population structural measures concerning effective population size, village endogamy, inbreeding coefficient, mean marriage distance (excluding within village marriages), surname diversity index, family planning, and frequency of more than one marriage for an individual. Also, pregnancy load is defined and its variation among the villages is studied.

Both the Vadde and Palle populations practice family planning, although the Vadde do so four times as frequently. Despite this, the Vadde exhibit a larger value of mean live births and surviving children. Relatively few women (5.9%) in the post-reproductive age (40+) fail to produce viable offspring among the Vadde as compared to the Palle (16%). The mortality rate is about 26% among the Vadde compared with some 31% among the Palle. Thus the Vadde are in an advantageous position reproductively.

Mean live births, surving children, and net reproductive index, especially among the Vadde, tend towards the upper end of the range observed for the Indian populations. Population structural measures are found to explain the variation in pre-reproductive mortality among the villages, but not the differences with respect to fertility. The demographic and evolutionary implications of the findings are discussed.

Key words: Reproduction, Fishermen, Kolleru Lake, Family planning, Pregnancy load, Fertility, Prereproductive mortality, Population structure.

In this era of great demographic transition, certain populations in different parts of the world still exhibit their traditional patterns. Such populations are numerous in the Indian sub-continent, belonging to diverse social, geographic, occupational, and cultural backgrounds. Of late, the family planning programs are making inroads into the remotest rural areas of the country, and people have started volunteering to participate in these in response to the problem of an ever decreasing standard of living due to a continuing decrease in each son's share of property. This, coupled with the increasing influence of urbanization, may affect the demographic structure of populations which have been relatively untouched up until now. The genetic implications of this may be relevant.

In this connection, ZUBRO (1976) has called for more descriptive studies of a wide range of population types. Up till now, only a few populations have been demographically explored in India. Among the relatively unexposed populations, fishing groups, both coastal and inland, constitute rather an important component, belonging to a special occupational and ecological category which depends solely upon traditional technology. Therefore, REDDY, (1983a, b, c, d, e, 1984) has recently studied both demographically and genetically three endogamous groups of marine fishermen of the Puri coast. The present paper deals with the reproductive behaviour of two endogamous castes of fishermen, namely the Vadde and Palle, from the Kolleru Lake in Andhra Pradesh. It also examines whether the variation in fertility and mortality among the villages is related to the population structural measures with respect to effective population size (N_e), village

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endogamy (VE), mean marriage distance excluding within village marriages (MMD), inbreeding coefficent (α), surname diversity index (DI), frequency of family planning (FP), and the frequency of more than one marriage for an individual (MM).

The People

Over 30,000 fishermen live in about 60 villages distributed in and around the Kolleru Lake (*Figure 1*). During most of the rainy and winter seasons, many of these villages are surrounded by water, thus forming isolates. Most of these 60 villages are inhabited by members of the Vadde caste, whereas in only two of them are Palle fishermen found. A few families belonging to other castes e.g. Kapu, Kamma, Balija etc. also live in many of the villages. The population size of the Vadde is about 30,000. In this area, the Palle number only about 1000 individuals; they are densely distributed in the neighbouring east and west Godavari districts, and fish in the sea as well. The members of Vadde and Palle castes do not intermarry. However, the Vadde has absorbed 19 of the male spouses (1%) from the non-Vadde and non-fishing castes (REDDY *et al.*, 1987). Both the Vadde and Palle speak Telugu, the local language spoken by the people of Andhra Pradesh.

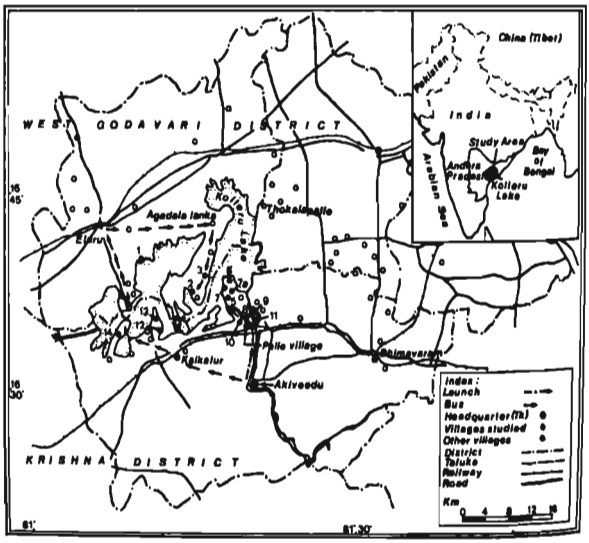

Figure 1. Map showing the Kolleru area and the distribution of fishermen villages.

Ethnographic reports have described the Vadde as a backward caste who are stone workers, not fishermen. This particular Vadde population is scattered throughout Andhra Pradesh. Recently, however, there have been some efforts to enumerate the fishing communities of Kolleru Lake. According to local tradition, the Vadde who are fishermen migrated from Orissa, a neighbouring state to the north. The history of their migration to this lake is not known, although most elder members of the Vadde acknowledge the possibility that their forefathers might have been migrants. However, the Oriyas in general are referred to as Vaddes in coastal Andhra Pradesh. For this reason, one may surmise that this name was given to them because they were migrants from Orissa.

Fishermen are generally low in the social hierarchy, and the Vadde and Palle are no exception. Like other Indian castes, these groups are stratified into exogamous units which are locally called "intiperus" and act like gotras in guiding marital interactions. The marital bond is relatively unstable among them, and their customary laws include provisions for divorce and remarriage. Child marriages are in vogue. There is an obvious preference for consaguineous marriages. The inbreeding coefficient is estimated to be 0.019 and 0.021 among the Vadde and Palle, respectively. The marriage age is generally low. Most of the females marry soon after they attain puberty i.e. at about 15 years of age, while the males generally marry before they turn 20. Each fishing village is a socioeconomic and political unit controlled by a group of headmen. The influence of the dowry system is creeping in at the expense of the traditional system of bride price.

Communication between fishing villages occurs largely by boat. In spite of recent development programs, medical facilities are inadequate. There is no hospital in the area to look after the medical needs of the people. In case of emergency they must rush to a nearby town. The lack of proper communications becomes crucial under such circumstances. This community and the Kolleru area in general, which has been largely isolated until recently, is fast becoming affected by urban influences.

Material and Methods

During 1982, data on the reproductive histories of 2263 Vadde women, who had been married at some time, and of 125 Palle women were collected along with other demographic information, from interviews with women. Special care was taken in recording the pregnancy wastages, since in the literature it is often complained that these are probably under reported. It was also ascertained whether a woman was pregnant at the time of study. The data for the Vadde population was collected from the 15 villages, encompassing about 80% of the couples. The data for the Palle could be collected from only one of the two villages that they inhabit in this area. The 15 villages of the Vadde form approximately four clusters on the basis of geographical propinquity.

As is typical of illiterate societies, the Vadde and the Palle do not keep records. For this reason, ages were estimated and are approximate. Maximum care was taken to obtain the nearest possible estimates. The reported ages were cross checked.

The distances between the birth places of spouses were recorded in miles through travel routes. Distances for those who were born in the same village were scored as zero. Local terms for different degrees of consanguineous relationships were found useful in ascertaining the exact relationship between spouses.

The surname diversity index is defined as a function of the number and relative frequency of surnames in a village, i.e.

$$DI = 1 - \sum_{i=1}^{K} p_i^2$$

where p_i values ($i = 1 \ldots, K$) are the relative frequencies of K surnames existing in the village. This is analogous to the average heterozygosity measure (NEI, 1973) and provide an indication of the diversity (both in terms of number and strength) existing with reference to surname in a village. This measure has the property of taking values in the interval 0.1; it takes the value zero when there is only one surname in a village. Since surnames are exogamous units, the relative magnitude of these indices may indicate the extent of opportunity of interaction with heterogenous surnames within any particular village.

The effective population size of the villages was calculated using WRIGHT's (1938) formula:

$$N_e = \frac{4N-2}{\delta^2 K+2}$$

where N is the number of parents in a village and δ^2 K is the variance in the number of gametes contributed to the next generation.

The fertility of Indian women has been observed to decline relatively early (MUKHERJEE, 1973; TALUKDAR, 1977); we found no pregnant women, among the Vadde and Palle, who were then aged approximately above 40 years. They were, therefore, considered to have completed their reproductive period. The comparative analyses of the data were made at three levels: 1. population-wise, 2. village-wise, and 3. age-wise. To examine the relationship between reproductive differential and measures of population structure, villages were considered as independent units. Mean fertility, % mortality, and the population structural measures were found to be non-normally distributed. Therefore, to test the interrelationships in a sample of a small number of villages, Spearman's rank correlation technique was employed.

Results

Tubectomy and vasectomy have been observed to be the only systematic means of controlling reproduction in these communities. The inhabitants are not even aware of such other methods as birth control pills, IUD etc., with the result that these are not practiced. The frequencies of the two types are given in *Table 1*. The Vadde practice both tubectomy and vasectomy, the Palle only tubectomy. In six of the 14 villages, vasectomy was not observed in practice. The tubectomy rate ranges from 5.5% to 44% among the Vadde villages, vasectomy only between 0 and 5.5%. Villages are significantly heterogenous with respect to the frequency of tubectomy ($X^2 = 153.9$; d.f. 13, $p < 0.001$). On the whole, while about 24% of the Vadde women and 1.4% of their men had undergone the operation, only 5.9% of the Palle women have done so. This difference in the frequency of tubectomy is highly significant between the two groups ($X^2 = 21.8$; d.f. 1, $p < 0.001$).

The age-wise frequency of this practice among the Vadde is given in *Table 2*. The largest number (about 45%) of women in the 30-39 year age group were found to have undergone tubectomy. Moreover, 5.2% of the women and 3.3% of their men in 50-59 age group had been treated in this way, and 24.3% and 3.6% of the women and men

TABLE 1 - *Frequency and type of family planning measures adapted and frequency of never pregnant women in different age groups and villages of the Vadde and Palle.*

Sl. No.	Villages	No. of women studied	Adapted family planning		% Never pregnant (NP) in different age groups									
					<20		20-29		30-39		40-49		50+	
			Tubec-tomy	Vesec-tomy	No.	%	No.	%	No.	%	No.	%	No.	%
1.	Gudakalanka	229	24.1	0.4	21	33.3	79	2.5	53	1.9	55	1.8	21	0.0
2.	Prathikudalanka	230	40.9	1.3	27	55.6	60	0.0	57	0.0	53	0.0	33	3.0
3.	Paidichintapadu	122	32.5	1.6	15	53.3	40	2.5	21	0.0	29	3.5	17	0.0
4.	Komatilanka	37	10.8	0.0	2	0.0	14	0.0	5	0.0	9	0.0	7	0.0
5.	Sringarayathota	289	10.1	2.8	33	48.5	114	1.8	63	1.6	53	5.7	26	11.5
6.	Gummalapadu	91	28.6	0.0	11	63.6	31	3.2	19	0.0	20	5.0	10	10.0
7.	P. P. Gudem	295	26.4	3.1	48	45.8	83	3.6	76	4.0	48	2.1	40	7.5
8.	Peddakottada	85	6.9	0.0	13	23.1	34	0.0	16	6.3	13	7.7	9	11.1
9.	Chinnakottada	59	20.3	0.0	15	33.3	22	9.1	9	0.0	9	0.0	4	0.0
10.	Penchakallamarri	147	9.7	1.4	20	60.0	51	9.8	25	4.0	25	12.0	26	7.7
11.	Vadlakudathippa	109	5.5	0.0	9	66.7	44	4.6	19	10.5	21	4.8	16	6.3
12.	Daichintapadu	124	43.9	0.8	13	30.8	47	4.3	24	4.2	24	0.0	16	0.0
13.	Kovvadalanka	131	27.7	1.5	25	52.0	48	0.0	27	0.0	16	6.3	15	26.7
14.	Penumakalanka	140	25.7	0.0	16	31.3	57	0.0	20	5.0	33	6.1	14	0.0
Total	Vadde	2088	23.4	1.4	268	45.9	724	2.8	434	2.1	408	3.7	254	6.3
	Palle	119	5.9	0.0	13	69.2	40	12.5	29	3.5	25	8.0	12	16.7

TABLE 2 - *Age trends in the adoption of family planning among the Vadde and Palle.*

Age group	Vadde			Palle		
	No.of couples	% Tubectomy	% Vesectomy	No. of couples	% Tubectomy	% Vesectomy
<20	268	0.4	0.0	13	0.0	0.0
20-29	724	25.4	0.0	40	0.0	0.0
30-39	434	45.3	1.4	29	14.3	0.0
40-49	408	24.3	3.6	25	12.0	0.0
50+	254	5.2	3.3	12	0.0	0.0
Pooled	2088	23.4	1.4	119	5.9	0.0

respectively, in the age group 40-49 years. One woman aged less than 20 years had also done so after having had two children. All of the Palle who had undergone tubectomy were aged between 30 and 49 years. The fact that the women aged above 50 years who had undergone tubectomy were found only in Sringarayathota, Paidichintapadu, Prathikudalanka, P.P. Gudem, Daichintapadu, and Kovvadalanka may suggest that these villages have come under the influence at an earlier date than the others. However, since the data concerning the age at which the tubal ligation was performed are not available, this conjecture can not be verified.

Frequency of never pregnant women

Table 1 also presents the frequency of women who had never been pregnant. Only about 46% of the Vadde women below 20 years, as compared with some 67% among the Palle, had been never pregnant. This may indicate an earlier onset of reproductive life among Vadde women than among the Palle. The pooled sample of the Vadde had 45.9, 2.8, 2.1, 3.7, and 6.3% of the never pregnant women in the <20, 20-29, 30-39, 40-49, and 50+ age groups, respectively. Among the Palle these proportions are about two times greater in each of the age groups. Among the villages, the frequency of never pregnant women aged <20, ranges from zero in Komatilanka to 66.7% in Vadlakudathippa.

Pregnancy load

The age wise distribution of pregnant women in the Vadde population is presented in *Table 3*. These estimates can be considered at best minimum ones, for the recent conceptions were most probably unrecognized. No women beyond 40 years of age was found to be pregnant at the time of field work. The pregnancy load defined as the number of pregnant women per 100 women in reproductive age (15-40) was similar between the Vadde (7.0) and Palle (6.1) populations. Ninety-eight out of 1399 and 5 out of 82 women, among the Vadda and Palle populations, respectively, were found to be pregnant at the time of field investigation. The largest frequency of such women was found in the 15-19 age group followed by 20-24 etc., with a rapid decline thereafter among the Vadde. This

TABLE 3 - *Pregnancy load in different age groups of the Vadde women.*

Age group in years	No. of women	Pregnant	Pregnancy load
15-19	257	37	14.4
20-24	414	46	11.1
25-29	314	11	3.5
30-34	214	3	1.4
35-40	200	1	0.5
Total	1399	98	7.0

may be taken as qualitatively corresponding to an age specific fertility rate in that the women of the 15-19 age category were most active reproductively. The small Palle sample, however, did not show any consistent pattern.

Average Fertility and Offspring Mortality

Reproductive details for women of all ages, who had ever been married, are presented in *Table 4*, and for those of 40+ years in *Table 5*. It is evident from these tables that the Vadde population, with a relatively larger number of mean live births and surviving children, larger value of net reproductive index, relatively lower mortality rate and with a low proportion of post-reproductive women without a surviving child, is in a reproductively more advantageous position compared to the Palle. However, no statisti-

TABLE 4 - *Reproductive details for married women of all ages among the two fishing populations.*

	Vadde	Palle
No. of married women	2088	119
LIVE BIRTHS		
Mean	3.01	3.69
Variance	7.52	8.68
SURVIVING CHILDREN		
Mean	3.05	2.75
Variance	5.22	5.25
% DEAD		
<1 year	15.4	14.1
<5 years	20.4	22.1
<15 years	22.0	25.5
SEX RATIO		
Live births	51.1	52.9
Dead	53.8	54.5

TABLE 5 - *Reproductive details of the women aged 40 years and above.*

	Vadde	Palle
No. of women	662	37
LIVE BIRTHS		
Range	0-15	0-12
Mean	6.03	5.60
Variance	8.51	9.38
SURVIVING CHILDREN		
Range	0-11	0-9
Mean	4.48	3.87
Variance	5.14	5.79
% dead (<15 years)	25.6	30.9
Net Reproductive Index	2.25	1.73
No. of women without a child	39 (5.9%)	6 (16.2%)

cally significant difference is observed between the Vadde and Palle populations in any of the reproductive measures. Of those individuals who died before reaching reproductive age, 75% of the Vadde and 64% of the Palle died before 1 year of age, and 92.7% and 86.7%, respectively, died before 5 years of age.

For the sake of brevity, the results of the village-wise analysis are not presented here. However, a wide variation is evident among the villages in mean live births and surviving children. ANOVA yielded significant F-values suggesting the heterogeneous distribution of mean live births ($F=4.47$; $p<0.01$, for women of all ages, and $F=2.79$; $p<0.01$, for those aged 40 years and above). Similarly, mean surviving children are found heterogeneous among the villages when women of all ages were considered ($F=2.72$; $p<0.01$). For post-reproductive women (40+ years), mortality of children is found highly significantly heterogeneous ($X^2=41.1$; $p<0.001$).

Table 6 presents the results of age-wise analysis. In the Palle, the women of 50+ years of age had a smaller number of live births as compared to the previous age group which may be due to the sampling fluctuations. On the other hand, the differential effect of family planning may have resulted in the larger mean value of live births in the 50+ age group in the Vadde. The proportion of prereproductive deaths increased steadily with mother's age in both the groups, partly indicating secular increase in the mortality rates. There was a slight decline in the sex ratio of live births and dead children among the older women.

Relationships of fertility and mortality with the components of population structure

Since a wide and significant variation in mean live births and pre-reproductive mortality was observed among the villages, an attempt was made to ascertain if this variation can be explained with the help of the variation in the measures of population

TABLE 6 - *Mean live births and surviving children, % of children dead before 15 years of age, and sex-ratio of live births and dead children according to age of women.*

Age group	No. of women	Live births	Surviving	Dead		Sex-ratio	
				No.	%	Live	Dead
VADDE							
<20	268	0.71	0.63	22	11.6	52.6	59.1
20-29	724	2.87	2.37	362	17.4	51.3	54.4
30-39	434	4.41	3.49	396	20.7	52.0	56.3
40-49	408	5.90	4.57	539	22.4	50.1	52.8
50+	254	6.23	4.34	481	30.4	50.9	52.0
PALLE							
<20	13	0.31	0.31	0	0.0	75.0	—
20-29	40	2.13	1.75	15	17.7	54.1	60.0
30-39	29	4.93	3.79	33	23.1	46.9	45.5
40-49	25	6.00	4.32	42	28.0	56.7	61.9
50+	12	4.75	2.92	22	38.6	54.4	50.0

TABLE 7 - *Values of Spearman's rank correlation component of the population structure with mean live births and % of offspring mortality for women aged 40 years and above.*

Measures of population structure	No. of pairs	% mortality	Mean live births
Effective population size (N_e)	14	−0.138	−0.468
Village endogamy (VE)	14	0.042	−0.033
Inbreeding coefficient (α)	14	0.600 *	0.225
Surname diversity index (DI)	14	0.582 *	0.328
Mean marriage distance (MMD)	14	−0.574 *	−0.244
% Family planning (FP)	14	0.292	−0.064
% Married more than once (MM)	14	0.324	−0.203

* $p < 0.05$.

structure found among them. Of the factors affecting population structure, inbreeding is theoretically expected to elevate homozygosity and thus affect fertility and mortality. However, this hypothesis is not always supported by the empirical evidence. Effective population size, VE, MMD, and DI have been found to be related in varying degrees to inbreeding in general and particularly among the Vadde population (REDDY, 1983e). Therefore, these parameters are expected to exert some influence upon the reproductive outcome. The effects of family planning in reducing the mean and variability of fertility, and marrying several times, either due to death or divorce of the earlier spouse, on interrupting the active reproductive life are obvious. Therefore, it would be worthwhile to examine the nature and extent of the influence of these parameters of a population on the reproductive outcome.

The Spearman's rank correlation (*Table 7*) was significant between pre-reproductive mortality and α, DI, and MMD. The mean live births did not show any such association.

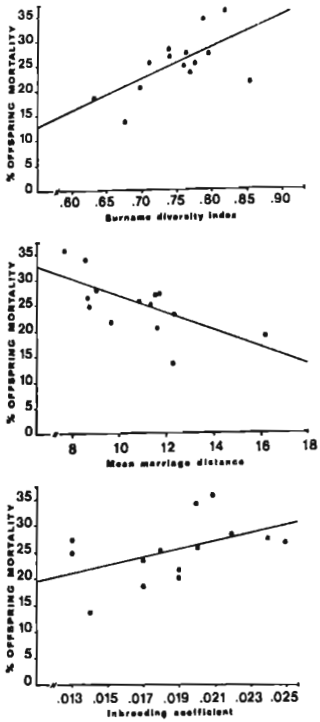

Figure 2. - Bivariate scatter and the fitted regression line of % prereproductive mortality on DI, MMD, and α, respectively.

Although small and nonsignificant, the correlation of fertility with FP and MM is in the direction expected: mean decreases with an increasing frequency of FP and MM in the villages. Simple linear regression and variance analysis were performed with prereproductive mortality as the dependent variable and DI, MMD, and α each as independent variables. The bivariate scatters and the fitted regression lines can be seen from *Figure 2*. The a and b coefficients are $a = -21.41$, 43.17, and 12.11, and $b = 61.92$, -1.67, and 701.19, respectively, in the three cases. ANOVA for closeness of fit of linearity of the regressions (*Table 8*) suggests that only MMD and DI individually provide sufficient statistical explanations of the variation in pre-reproductive mortality among the villages. The r^2 turns out to be 0.42 and 0.36 for MMD and DI, respectively.

TABLE 8 - *Results on the analysis of variance for closeness of fit of linearity of regression of prereproductive mortality on the DI, MMD, and (α).*

Source	DF	Sum of squares	Mean squares	F-value	p>	Regress pair
Model	1	171.16	171.16	7.74	0.02	Mortality on DI
Error	12	265.25	22.10			
Corrected total	13	436.41				
Model	1	182.16	182.16	8.60	0.01	Mortality on MMD
Error	12	254.25	21.19			
Corrected total	13	436.41				
Model	1	88.92	88.92	3.07	0.11	Mortality on α
Error	12	347.49	28.96			
Corrected total	13	436.41				

Since the population structural measures were found to be intercorrelated, a step-wise regression analysis was also performed. The equation used was

$$Y = a + \sum_{i=1}^{K} bi.Xi,$$

where K is the number of independent variables in the equation. The number K and the variables X_i are determined in a step-wise manner, the stopping rule for the entry of variables being to stop at any stage when no further significant contribution (as measured by appropriate F-ratio) to the regression sum of squares is obtained. The analysis was performed using BMDP packages. Only MMD was selected by this procedure. Because of colinearity, DI was eliminated. When log pre-reproductive mortality was used, DI instead of MMD was selected, reaffirming the colinearity and near complementarity of their relationship with pre-reproductive mortality. Since only one variable was selected by this procedure, the F-ratio is identical to that of the simple regression between these variables (*Table 8*). R^2 suggests that the remaining four variables (Ne, VE, DI, and α) added only 20% to the variation already explained by the MMD (42%). On the other hand, none of the 7 measures (FP and MM included) either individually or in linear combination with the others, explained significantly the variation in mean fertility among the villages. Together, the 7 population structural measures account for only about 30% of the variation in mean fertility. A log transformation of the dependent variable did not improve the fit significantly.

Discussion

The reproductive process among the Vadde and Palle is not completely natural, for they practice family planning. Although its influence seems negligible in women above 40 years of age, among the younger generations, the indications are that the impact is considerable. The desired number of children is not two, but more. Post-reproductive

women who had tubal ligations had undergone the procedure only after almost fully completing the active reproductive period and having 5 or 6 children. Therefore, the effects of this should be negligible, a finding which is brought out by the correlation analysis. Most of the men and the women in the older age group had been sterilized due to the lure of incentives which were initially offered to make family planning programs popular among the rural masses. Most young couples now, however, are conscious of the need to limit the family and volunteer for family planning after having two or three children. The villages that are nearer to towns show a greater frequency and earlier origin of this practice.

The reproductive life of the Vadde and Palle women starts quite early. The mean number of live births among women who had ever been married varies considerably among the villages, but do not show any consistent pattern except for a seemingly close relationship with the proportion of women who have never been pregnant. For example, Komatilanka, with no case of a never pregnant woman, showed the largest mean while the Penchakallamarri, with the largest fraction of such women, possessed the smallest value of mean live births. Pre-reproductive mortality follows a trend similar to that in mean live births, implying that high fertility is associated with high mortality (UN, 1953). The correlation between mean fertility and mortality is rather high ($r = 0.46$). The variation observed in the fertility of post-reproductive women is also associated with the fraction of women who could not produce viable offspring. While significant heterogeneity is seen in the mean live births, the surviving number of siblings is homogeneous among the villages. The Palles, who are relatively recent migrants into the area, show a larger mortality rate and a smaller number of mean live births, thus considerably differing from the Vadde. This may suggest that the impact of family planning has not been considerable among the Vadde, eventhough about 20% of their women (40+ years) have undergone tubectomy, compared to only 7% among the Palle. In spite of careful recording, the pregnancy wastages were found to be very infrequent (<1%) in both populations. No case of severe malformations was detected. This finding is compatible with earlier observations that long term inbreeding may reduce the frequency of deleterious genes (SANGHVI, 1966, RAO & IMBARAJ, 1979).

The mean number of about six live births per women among both groups is similar to that observed among the three groups of marine fishermen of Puri (REDDY, 1984), while it is towards the upper extreme of the range observed for the Indian populations under natural conditions (for example, BASU, 1969; RAKSHIT, 1972; MURTHY & RAMESH, 1978). Still, it is low compared to the high biological limit of 10.9 observed among the Hutterites (EATON & MAYER, 1953). The net reproductive index is also towards the upper extreme of the range observed for Indian populations (GARG *et al.*, 1981). Although mortality rates are high, they are not as great as those of two of the three goups of Puri fishermen (REDDY, 1984). On average, a woman looses about 1/3 of her children before they attain reproductive age. Even considering the loss at a slightly higher rate, the Vadde and Palle couples typically leave behind a minimum of three children each to contribute to the next generation. With such a fertility and mortality schedule, they can be considered as young and progressive populations (DATTA, 1972) with a high proportion of children. The demographic pattern of the Vadde and Palle also conform to the general observation that a population with uncontrolled birth and death rates will be a young one with an above average proportion of males (COWGILL, 1963; SATIN, 1969).

The two major evolutionary forces that are thought to bring about changes in the genetic composition of any population are random genetic drift and natural selection. Selection is operative through differential fertility and mortality. A statistically significant

TABLE 9 - *Breeding and effective population size and the variance due to drift in different village units of the Vadde.*

Village number	Breeding size	Variance of number of siblings	Effective population size	Admixture rate	Coefficient of breeding isolation (N_{em})	δ^{dq}
1.	372	3.87	253	0.322	81.5	0.0222
2.	303	3.31	228	0.414	94.3	0.0234
3.	135	4.88	78	0.383	30.0	0.0400
4.	45	3.17	35	0.388	13.5	0.0599
5.	390	3.50	283	0.390	110.5	0.0210
6.	109	3.64	77	0.485	37.3	0.0403
7.	410	4.25	262	0.287	75.2	0.0218
8.	123	3.80	85	0.475	40.1	0.0385
9.	79	5.93	40	0.407	16.1	0.0562
10.	204	4.76	120	0.316	36.1	0.0322
11.	123	5.77	63	0.385	24.3	0.0445
12.	224	4.02	149	0.297	44.1	0.0290
13.	263	3.56	189	0.339	64.2	0.0257
14.	243	5.38	131	0.481	63.2	0.0308

variation has been observed in both the mean live births and the pre-reproductive mortality among the villages, suggesting that the populations of different villages are exposed to different degrees of opportunity of selection. This is confirmed by the Crow's indices of selection reported elsewhere (REDDY *et al.*, 1987). On the other hand, drift is an effective force when the population is extremely small and isolated. Population of the magnitude of Vadde (30,000) is unlikely to experience any perceptible shift in the gene capital over generations, however small the admixture rate may have been. However, the coefficient of breeding isolation (N_{em}), estimated considering villages as independent units, turns out to be quite small, i.e., < 50 in some of the villages, and the estimates of variance due to drift are considerable (*Table 9*). One may gain the impression that drift may be playing a moderate role. Yet, although the frequency of intra-village marriages is high (7 to 43%), mating contacts outside the villages are fairly wide spread (REDDY *et al.*, 1987). Therefore, under such a heavy pressure of gene flow throughout the range of population distribution, it would be difficult to conceive the net effect. Furthermore, some of the villages which show greater scope for drift also show greater oppportunity for selection. By nature being opposing forces, the kind of residual effect which these would have on the genetic composition of the Vadde population is difficult to judge, and remains unclear at the present time.

Now the problem is to assess how much of the variation in the reproductive pattern of the villages can be accounted for by the structural variation between them. The empirical relationship between the mean live births and measures of population structure is not significant. The linear relationship between them is difficult to realize, as the fertility of an individual and/or a population is a result of biological potential mediated by a large variety of sociocultural and behavioural attitudes associated with an individual and/or a population that are difficult to quantify. On the other hand, it is theoretically expected that a greater MMD and conversely a smaller DI and α are associated with greater heterozygosity. However, the extent to which such a phenomenon has caused the observed relationship with mortality in this particular population could not be ascertained

empirically. In other words, we do not know whether an inbreeding homozygosity effect exists in this population which is sufficient to be detected in this analysis. BARRAI *et al.* (1983), for example, found no evidence for increasing heterozygosity with the increase in geographical distance between the birth places of parents in a limited area, although WOLANSKI (1980) had suggested such a possibility. Nevertheless, the residual amount of pre-reproductive mortality is believed to be caused by severe conditions which are often genetically determined (TERRENATO *et al.*, 1979). Among the Vadde, about 70% of the pre-reproductive deaths are reported to occur before 1 year of age (most of these are within one week), and therefore the observed relationship may be assumed to have some genetic significance. The relatively restricted variability found among the small number of villages, however, prevents from drawing firm conclusions about the correlations or causes.

Despite the small sample size, the present study reveals a significant aspect in that the population structural measures do explain an important part of the variation in the mortality pattern of the villages. The inclusion of such variables in the study of reproductive behaviour at population level may, therefore, help in understanding the variation observed in the mortality pattern of different populations.

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