PRINT: ISSN 0970-9274 ONLINE: 2456-6608
J. Hum. Ecol., 18(3): 199-201 (2005)
DOI: 10.31901/24566608.2005/18.03.06

Selection Intensities and Effective Population Size and Variance Due to Drift Among the Madigas in Andhra Pradesh

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KEYWORDS Selection Intensity. Variance. Madigas. Consanguineous. Non-consanguineous.

ABSTRACT The total index of selection computed for Madigas of Cuddapah (MDCDP) and Chittoor (MDCTR) districts of Andhra Pradesh, inhabiting in two different geographical areas, show the value is relatively higher in former group than in latter. The value of intensity in the pooled Madigas falls within the range of Indian Populations. Breeding size (N) is more or less same in MDCDP and MDCTR. But the effective population size (N_e) is relatively lower in the former group than the latter. When the frequency of an allele is 0.5, the estimated random genetic drift in the pooled Madigas is 0.0000711, the effect of which is negligible in the two groups.

INTRODUCTION

Selection is one of the major evolutionary factors that brings about changes in the gene frequency in a population. Crow (1958) devised an index that facilitates quantitative estimation of the selective pressure, given the reproductive pattern of a population. This is a generation analogue of Fisher's (1930) fundamental theorem of natural selection and measures the proportion by which fitness would increase with specific birth and death rates if they were all selective and the heritability of fitness were complete (Crow, 1972). But, in reality, the genetic component in differential fertility and mortality is rather small, as the reproductive outcome of an individual and/or a population is a result of the interaction of a variety of socio-cultural factors (Crow, 1966; Cruz-Coke et al., 1966). Therefore, the index sets only an upper limit for the potential action of natural selection and is accordingly renamed as Opportunity for Natural Selection (Crow, 1966). It can be divided into two components – one due to differential fertility and the other due to differential mortality – and does not reveal more than that which is contained in vital statistics. It is therefore descriptive and not analytical (Crow, 1972).

Number of studies has been made to explore the relationship between the indices of selection and socio-economic conditions (Rajanikumari et al., 1985; Suri Babu and Bhasin, 1991) and other population structural measures like population size (Chengal Reddy and Lakshmanudu, 1979) and inbreeding (Barua, 1976; Rao and Murty, 1984). Few studies have implicated the note of family planning programmes in imposing characteristic differential fertility. In India, Rajnikumari et al. (1985) found a lower index of total selection among the women who had completed their fertility by family planning methods than in women who completed their fertility by attaining menopause. The present study was attempted to estimate the index of selection potential among the two groups of Madigas i.e. Madigas of Cuddapah district (MDCDP) and Madigas of Chittoor district (MDCTR) in Andhra Pradesh.

MATERIAL AND METHODS

The study sample was collected from Cuddapah and Chittoor districts of Andhra Pradesh and comprised of 108 MDCDP and 128 MDCTR mother who have completed their reproductive life span. The fertility and mortality data were collected on different aspects of socio-economic variables and reproductive performance of the women by using the questionnaires. The methodology of Crow (1958) and Johnston and Kensinger (1971) were used to compute the index of total selection.

The effective population size was computed for both Madiga populations according to Wright's formulae (Sen, 1976). The variance due to random drift has been computed according to the Wright's formula (Wright, 1940).

RESULTS AND DISCUSSION

Selection Potential: The indices of mortality, fertility and total selection potential in both consanguineous (C) and non-consanguineous (NC) matings of both groups of Madigas according to Crow's Original (1958) and Modified (Johnston & Kensinger, 1971) methods were furnished in table 1. A higher value of total selection intensity index(I) is found in Modified method(0.8433) than the Original method (0.6837) among the pooled Madigas, which is due to the contribution of a very high proportion of prenatal mortality component (P_{ed}) to total selection intensity index(I) in the Modified method. A great deal of disparity is also observed in the consanguineous and non- consanguineous matings of two groups of Madigas.

The total selection intensity index (0.8443) for the pooled Madigas shows smaller selection due to fertility (I_f = 0.2067) component than the mortality component particularly childhood mortality (I_{mc} = 0.4183). This is very unusual feature of this population indicating that the selection is more due to mortality than the fertility component. The value of total selection intensity is relatively lower in consanguineous (0.8262) than in non-consanguineous (0.8626) marriages due to higher value of the differential mortality of the former one than the latter one. Thus higher differential mortality value in the consanguineous group suggests that average general fitness of a population may be lowered due to consanguineous matings.

The value of total intensity index is relatively higher in MDCDP (0.8831) than in MDCTR (0.8123), which may be due to the relatively lower incidence of consanguineous marriages, higher differential fertility as well as mortality components that increase the average general fitness in the former group than the latter.

Effective Population Size and Variance Due to Drift: Effective population size is an important parameter of population structure. It is a measure of the reproductive potential of a population in which the number of individuals really contributes to the genetic composition of the next generation. Due to a series of factors such as extreme differences of fertility among indivi-duals, high distortions of the sex-ratio and high inbreeding rate (Freire-Maia, 1974), estimates of breeding size for the Madigas may be some-what biased. Therefore, effective size (N_e) has been calculated correcting the breeding size (N) for the said reproductive situations by applying Wright's (Sen, 1976) formula among the Madigas (Table 2).

Table 1: Indices of selection potential along with the basic data among the Madiga groups

Madiga-groups	*Type*	*Basic data*						*Indices of selection potential*						
					Live births			*(Crow,1958)*			*(Johnston & Kensinger,1971)*			
		Mothers aged 40 yrs and above	*Preg-nan-cies*	*Survivors upto 15 yrs of age*	*N*	$\bar{X}$	V_f	$I_m(P_d/P_s)$	$I_f(V_f/\bar{X}^2)$	$I(I_m+I_f/P_s)$	I_{me}	I_{mc}	I_f	*I*
MDCDP	C	43	267	173	254	5.9070	6.3634	0.4682	0.1824	0.7360	0.0512	0.4682	0.1824	0.8249
	NC	65	395	255	367	5.6462	7.7056	0.4393	0.2417	0.7872	0.0763	0.4393	0.2417	0.9235
	T	108	662	428	621	5.7500	7.1875	0.4510	0.2174	0.7664	0.0660	0.4510	0.2174	0.8331
MDCTR	C	77	552	326	469	6.0909	5.1995	0.4386	0.1402	0.6403	0.1130	0.4386	0.1402	0.8256
	NC	522	309	207	273	5.3529	5.2941	0.3189	0.1848	0.5626	0.1319	0.3189	0.1848	0.7688
	T	128	831	533	742	5.7969	5.4587	0.3922	0.1624	0.6183	0.1199	0.3922	0.1624	0.8123
Pooled	C	120	789	499	723	6.0250	5.6244	0.4489	0.1549	0.6733	0.0913	0.4589	0.1549	0.8262
	NC	116	704	462	640	5.5172	6.7669	0.3853	0.2223	0.6932	0.1000	0.3853	0.2223	0.8626
	T	236	1493	961	1363	5.7754	6.2394	0.4183	0.1871	0.6837	0.0954	0.4183	0.2067	0.8443

Table 2: Effective population size and variance due to drift among the Madiga groups

Madiga groups	*Sample size*	*No. of parents or Breeding size(N)*		*No. of children per parent*		*Effective population Size (N_e)*		*Variance due to random genetic drift ($\sigma^2 dq$)*
		No.	*%*	*Mean*	*variance*	*No.*	*%*	
MDCDP	2605	1101	38.81	2.73	4.38	828	31.79	0.0001510
MDCTR	2693	1060	39.36	2.87	4.06	926	34.39	0.0001350
Pooled	5298	2071	39.09	2.81	4.21	1759	33.20	0.0000711

The number of parents or Breeding size (N) among the pooled Madigas is 39.09% of their actual (sample) population size, with a slightly lesser proportion in MDCDP (38.81%) than in MDCTR (39.36%). The effective population size (N_e) of the pooled Madigas is 33.20% of the population size, which is smaller than the breeding size (N) due to the larger variance of the mean number of chi1dren per couple (4.21) than the mean number of children (2.8l). Effective population size is relatively lower in MDCDP (31.79%) than in MDCTR (34.39%). Thus an overall 6% of the reduction is observed from breeding size to effective size.

The effect of 'drift' on gene frequencies is based on the product of effective size and migration rate of the population (Wright, 1940). As there appears to be no migration among the Madigas, the operation of drift on genetic diversity will be solely dependent upon their effective sizes. Assuming the allele frequency as 0.5 variance due to random drift in a single generation has been calculated as $\sigma^2 dq = q(1 - q)/2N_e$. The estimate of Random genetic drift among the pooled Madigas is 0.0000711. It's difference between MDCDP (0.0001510) and MDCTR (0.0001350) is negligible. From these values it is known that the large effective size of the population will lead to small drift effects.

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