

SELECTION INTENSITY AMONG FEMALES LIVING ALONG SOME SELECTED WASTE WATER DRAINS OF RURAL AREAS OF PUNJAB

TEJINDER KAUR AND A. K. SINHA

ABSTRACT

The present communication deals with an investigation of the selection intensity, on the basis of Mortality Index (Im) and Fertility Index (If), of two different population groups exposed to similar environmental condition of Ludhiana and Patiala Districts of Punjab. The Data for the present study were collected from 300 rural households situated along two waste water drains of the aforesaid two districts of Punjab State. The women who had completed their fertility career were considered for the calculation of the selection intensity estimates. Data collection involved personal interview based on structured schedule, case study and in-depth interview. In the present study, the contribution of fertility component of total selection was higher than the mortality component. The total index of opportunity for natural selection (Crow's Index) was found to be increased in Arnetu Village as compared to Wallipur Village. As compared to other studies the total index of selection were found to be lower.

Keywords: Selection intensity, Mortality Index (Im), Fertility Index (If) and Total Selection Intensity Index (I), Punjab.

INTRODUCTION

Natural selection is one of the major evolutionary forces that bring about changes in the gene frequencies in a population through the action of differential fertility and mortality over generations. Differential fertility and mortality are the basic events of natural selection, which operate singly or jointly to determine the fitness of a particular population in a given environment (Livingstone and Sphuler, 1965). Population components are considered important not only in studying the population structure and trends but also in measuring micro evolutionary dynamics. Two major forces of natural selection, differential fertility and mortality are responsible for changes in the gene frequencies in a population and the selection intensity is a measure of the fitness of a population as expressed by the ongoing patterns of differential fertility and mortality combined in a particular manner. Crow (1958) devised an index that facilitates quantitative

Dr. Tejinder Kaur, Post-Doctoral Fellow, Department of Anthropology, Panjab University, Chandigarh; **Dr. A.K. Sinha, Professor**, Department of Anthropology, Panjab University, Chandigarh.

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). Whereas, Cavalli-Sforza and Bodmer (1971) suggested that index of total selection (I) might be considered as an index of 'opportunity for selection'. But, in practice, the genetic component in differential fertility and mortality is not the sole factor, as the reproductive outcome of an individual and or/population is a result of the interaction of variety of socio-cultural factors that affect the fertility and mortality behaviour of a particular population. Thus, the index only sets 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, i.e., selection due to differential fertility and selection due to differential mortality. It is more descriptive than analytical (Crow, 1972) and can lay out the facts that can be derived from vital statistics. Though several authors have pointed out the difficulties in using and interpreting the index, (Spuhler, 1972; Morton, 1968) Crow's index is considered to be one of the most feasible means of inferring selection as it is difficult to measure selection directly in human population. As such this is the index mostly used worldwide. Later, the index was modified by Johnston and Kensinger (1978) to include prenatal mortality.

While going through the related studies the researcher found most of the studies were based on tribal areas and tribes of India. Whereas, the present study explores the reproductive history of women residents of two rural areas of Punjab situated near two waste water drains of Punjab. It has been aimed to investigate the selection intensity of two different population groups exposed to similar environmental condition of two different districts, namely Ludhiana and Patiala Districts of Punjab State on the basis of the Mortality Index (I_m), Fertility Index (I_f) and Total Selection Intensity Index (I).

MATERIALS AND METHODS

The objective of the present study was to investigate the intensity of selection of two different population groups exposed to similar environmental condition of two different districts, namely Ludhiana and Patiala Districts of Punjab State. The data were largely collected from Arnetu Village of Patiala District and Wallipur Village of Ludhiana District. The Mortality index (I_m), Fertility index (I_f) and total selection intensity index (I) were analyzed among the studied population.

The material for the present study consists of a sample collected from 300 households. The women who had completed their fertility career were considered for the calculation of the selection intensity estimates. In the present study, married women of 45 years and above were taken into consideration for the sake of comparison with other Indian published data. Data collection involved personal interview, based on structured schedule, case study and in-depth interview.

One of the field areas, Ludhiana City, was founded on a ridge of *Buddha Nallah* a tributary of river Sutlej. The untreated sewage of the city is discharged into this *Nullah*. *Buddha Nullah* runs parallel to Sutlej, on its south for fairly large section of its course in the district and ultimately joins Sutlej at Gorsian Kadar Baksh in the north western corner of the district. The water of the stream becomes polluted after it enters Ludhiana City. The other field area, Patiala District, is situated in the south-eastern part of the state.

RESULTS AND DISCUSSION

The fertility performance of the residents from Arnetu and Wallipur Villages has been given in Table-1. The table shows that there were 69 mothers aged 45 years and above in Arnetu village and 47 mothers from Wallipur village. These respondents (aged 45 years and above) were further divided into contraceptive users and non-users. The total number of women aged 45 years and above in Arnetu Village were 69 (among these 11 were user and 58 were non-user) and it was 47 in Wallipur (33 were contraceptive user and 14 non-user). The total number of live births in Arnetu were 258 (34 were contraceptive users and 224 non-users) whereas 166 live births in Wallipur (39 were contraceptive users and 127 non-users). Only 2 still births and 3 abortions were noted among the non-users of Arnetu Village.

The mean number of live births from Arnetu Village among contraceptive users was found to be 3.09 with a variance of 1.29, whereas in case of contraceptive non-users it was 3.96 with a variance of 2.20. Similarly, the mean number of live births to such mothers from Wallipur Village who were contraceptive users was found to be 2.78 with the corresponding variance of 0.95 whereas in case of contraceptive non-users it was 3.78 with a variance of 1.98.

Table 1: Fertility performance among the respondents of Arnetu and Wallipur Villages

Parameters	Arnetu Village			Wallipur Village		
	Total population N (%)	Contraceptive measures		Total population N (%)	Contraceptive measures	
		Users N (%)	Non-users N (%)		Users N (%)	Non-users N (%)
Number of women aged 45 years and above	69	11 (15.9)	58 (84)	47	33 (70.21)	14 (29.78)
Number of reported pregnancies	263	34 (12.92)	229 (87.07)	166	39 (23.49)	127 (76.50)
Number of live births	258	34 (13.17)	224 (86.82)	166	39 (23.49)	127 (76.50)
Still Birth	2	-----	2 (0.76)	-----	-----	-----
Abortions	3	-----	3 (1.14)	-----	-----	-----
Death before 15 years of age	6	-----	6 (2.32)	2	-----	2 (1.20)
Total living children	252	34 (13.49)	218 (86.50)	164	39 (23.78)	125 (76.21)
Mean number of live birth per mother of 45 years and above (X)	3.77	3.09	3.96	3.48	2.78	3.78
Variance of live births	2.26	1.29	2.20	1.86	0.95	1.98

The results revealed that in Arnetu Village 15.9% of the female respondents used contraceptives measures while 84% were non-users. On the contrary the picture was reverse in case of Wallipur Village. The use of contraceptive measures were very high in Wallipur where 70% of females were users while, 30% were non-users. The mean number of live births per women was slightly higher in Arnetu which was (3.77) than that in Wallipur (3.48). Similarly, the mean number of live births was higher in contraceptive non-users than users in both the villages.

The indices of intensity of selection and their components, based on the methods of Crow as well as Johnston and Kensinger are given in Table 2. The Johnston and Kensinger's Index showed the same trend of more contribution of fertility component to the total index of natural selection than mortality component. The total index of opportunity for natural selection (Crow's Index) was found to be increased in Arnetu Village as compared to Wallipur Village.

Table 2: Indices of opportunity for natural selection intensity

Index	Arnetu village			Wallipur village		
	Total population N (%)	Contraceptive Measures		Total population N (%)	Contraceptive Measures	
		Users N (%)	Non Users N (%)		Users N (%)	Non-users N (%)
Crow's Index (1958)						
Total Index (It)	0.182	0.135	0.167	0.166	0.123	0.138
Mortality Component (I_m)	0.02 (10.98)	0	0.026 (130)	0.012 (7.22)	0	0
Fertility Component (If/Ps)	0.162 (89.01)	0.135 (100)	0.143 (85.62)	0.154 (92.77)	0.123 (100)	0.138 (100)
Johnston and Kensinger's Index (1971)						
Total index (It)	0.189	0.135	0.171	0.163	0.123	0.138
Prenatal mortality component (I_{me})	0.011 (5.82)	0	0.008 (4.67)	0	0	0
Fertility component (If/Pb.Ps)	0.158 (83.59)	0.135 (100)	0.137 (80.11)	0.151 (92.63)	0.123 (100)	0.138 (100)
Post-natal mortality component ($I_{mc/Pb}$)	0.02 (10.58)	0	0.026 (15.20)	0.012 (7.36)	0	0

The comparative study of the two villages has revealed several interesting things. The Crow's index of selection intensity was higher in Arnetu Village than that of Wallipur Village. Again, on the basis of contraceptive measures the total index of natural selection was higher in contraceptive non-users than users in both the villages.

The results of the present study were compared with the data available for other caste and some of the tribal populations of India (Table-3). Sphuler's review

(1962,1963, 1976) of world wide data and studies at the National and State levels (Crow 1958, 1972; Jacquard and Ward, 1976 and Hed, 1984) suggest that the effect of demographic transition on the opportunity for natural selection among the populations of industrialized nations are a marked reduction in the total index a decline in selection due to pre reproductive mortality, an increase in the fertility index initially, followed by a gradual decline and increase in the relative contribution of fertility component to the total selection. It is worthwhile to mention the study by Ulizzi et al. (1979), who had investigated the change of selection opportunities with a changing environment of Italy over a century, explained the relevance of socio-economic and cultural changes to the evolution of selective patterns.

Similarly, Sohkhlet (2013) concluded the analysis of data which indicated that the index due to fertility seems to contribute more towards selection than mortality. The trend might be because of better living condition and health-care system among the Gowdas which have a positive impact on the lower contribution of mortality for the evolution mechanism of the Gowda population through natural selection. In the present study too, the contribution of fertility component of total selection was higher than the mortality component.

The postnatal mortality contributes more than prenatal mortality to the total index of opportunity of natural selection (Reddy and Chopra, 1990). Studies from India and elsewhere indicated that mortality contribute heavily to the total selection among tribal, pre-agrarian and agrarian populations. While in developed and industrialized societies, the contribution of mortality is low and selection is mainly manifested through fertility (Spuhler,1976; Reddy and Chopra, 1990). The index of selection due to fertility component was more than mortality component among two endogamous sub-populations of Andhra Pradesh. Johnston and Kensinger's index showed the same trend of more contribution of fertility component to the total index of natural selection than mortality component. The higher contribution of fertility component to the total index among the two subgroups of *Salis* supports the contention that it was due to better living conditions and proper medical care(Rao et al., 2015).

Table 3: Comparison of Selection Intensity indices of present sample with other populations

Population studied	Total Index (It)	Crow's Index (1958)			Johnston and Kensing Index (1971)			Prenatal mortality component (Ime)
		Index of selection due to fertility (If)	Mortality Component (Im)	Total Index (It)	Index of selection due to fertility (If)	Index of selection due to child mortality (Imc)		
Present study	Ametu Village	0.182	0.159	0.020	0.189	0.159	0.02	0.011
	Wallipur Village	0.166	0.153	0.012	0.163	0.153	0.012	0
Dharani et al.(2003) rural & urban Kshatriyas of coastal Andhra Pradesh		0.426	-----	0.098	0.553	-----	0.098	0.089
Lakshmi et al., (2005)	Arya Vysya	0.480	0.338	0.106	0.692	0.338	0.106	0.142
	Kalinga Vysya	0.403	0.221	0.149	0.541	0.221	0.149	0.097
	Thrivarnika	0.430	0.260	0.134	0.627	0.260	0.134	0.137
Rao et al.(2006)Khonds of Andhra Pradesh		0.613	0.372	0.324	1.106	0.372	0.324	0.159
Prakash & Narayanan (2009)Yerukula tribe of Andhra Pradesh		1.242	-----	0.190	1.610	-----	0.190	0.163
Raju et al. (2009)Kapu, of Andhra Pradesh		0.715	-----	0.056	0.762	-----	0.056	0.046
Prakash & Sudhakar(2011) Settibalija, endogamous group of Andhra Pradesh		0.463	0.386	0.055	0.450	0.386	0.055	0.020
Kapoor and Kaur (2012) Andaman Indians		1.26	0.020	0.120	1.439	0.020	0.120	0.077
Devi(2012) Chiru tribe of Manipur		0.173	0.165	0.007	0.307	0.165	0.007	0.114
Sarman (2013)	The Mishings (Arunachal Pradesh)	0.294	0.084	0.193	0.552	0.084	0.193	0.199
	The Minyongs (Arunachal Pradesh)	0.427	0.107	0.288	0.643	0.107	0.288	0.151
Sohkhlet (2013) Gowdaof Karnataka		0.479	0.266	0.168	0.655	0.266	0.168	0.202
Malakar & Roy (2014) BirbhumDdi strict, West Bengal	Santhal Affected Group	0.395	0.204	0.159	0.482	0.204	0.159	0.062
	Santhal Control Group	0.587	0.322	0.200	0.606	0.322	0.200	0.013
Kuiti & Bose (2014) Bhuiyans of Haldirpani District (Odisha)		0.780	-----	0.587	0.770	-----	0.587	0.0628
Rao et al. (2015) Salis, of Andhra Pradesh		0.441	-----	0.161	0.585	-----	0.115	0.146

However, a few of the recent studies undertaken among tribal and rural agrarian populations reported the lower contribution of mortality and inferred that the natural selection is manifested mainly through the fertility (Babu et al.

1995; Babu and Kusuma 2002; Bhasin and Kshatriya 1990; Bhasin and Nag 2002, 2007; Reddy and Reddy 1984; Reddy et al. 1987; Sudhakar et al. 1998).

According to Sarma (2013), the Crow's index of selection due to mortality component was higher (0.1937) than the fertility component (0.0842) among the Mishing and the Minyong of Arunachal Pradesh. It was probably because of additive effects of the proportion of embryonic deaths and premature deaths up to pre-reproductive age (i.e., deaths before 15 years of life). On the other hand the Johnston and Kensinger's formula clearly indicated that of the mortality component the index of selection due to embryonic mortality (0.1992) was contributing more towards the total index of selection intensity than the index of selection due to child mortality (0.1937).

Several studies have suggested that infant and child mortality is a useful indicator of community health. Because, children are most susceptible towards harmful effects of environment including infections, malnutrition, poor maternal and health care facilities (Watson et al., 1996; Kapoor et al., 2003; Das and Sikdar, 2010; Sikdar, 2012). In the present study, occurrence of infant, child and pre-reproductive deaths was relatively much lower in both the areas under consideration.

Thus, as compared to other studies, the total index of selection in the present sample from Punjab was found to be lower. The difference may be on account of better health care services and socio-economic conditions provided in the state of Punjab, in general, as compared to those available in the tribal areas or the marginalised areas in the other parts of India.

REFERENCES

- Babu, B.V., Kusuma Y. S., and J.M.Naidu, 1995. Opportunity for natural selection among four caste populations. *Journal of Human Ecology*, 6: 63-64
- Babu, B.V., Kusuma Y. S., and J.M.Naidu, 1995. Selection intensity among some tribes from Andhra Pradesh. In: J.B.S. Haldane Birth centenary Memorial Volume. P.K.Das (ed.). Bhubaneswar: Utkal University.
- Bhasin, M.K., and G. Kshatriya, 1990. Fertility and mortality differentials among the different groups of Sikkim, India. *Journal of Human Ecology*, 1: 267- 276.
- Bhasin, M.K., and S. Nag, 2002. A demographical profile of the people of Jammu and Kashmir 1. Population structure. *Journal of Human Ecology*, 13 (1-2):1-55.
- Bhasin, M.K., and Shampa Nag, 2007. Demography of the Tribal Groups of Rajasthan: 4. Selection Intensity. *The Anthropologist*, 9(2): 93-97
- Cavalli-Sforza, L.L. and W.F. Bodmer, 1971. *The genetics of human populations*. W.H. Freeman & Co: San Francisco.
- Crow, J.F., 1958. Some possibilities of measuring selection intensities in man. *Human Biology*, 30:1-13.
- Crow, J.F., 1966. The quality of people: human evolutionary changes. *Bioscience*, 16:863-7.
- Crow, J.F., 1972. Some effects of relaxed selection and mutation. In: *Proceedings of the Fourth International Congress of Human Genetics*. De. G.J., F.J.G., Ebling, I.W., Henderson (Eds.). Amsterdam: *Experta Medica*.

- Das ,Farida Ahmed., and Mithun Sikdar,2010. Opportunity for natural selection among some selected population groups of Northeast India. *Indian J Hum Genet.*,16(2): 61–66.
- Fisher, R.A.,1930. *The genetical theory of natural selection*. London: Oxford University Press.
- Hed, H.,1984. Opportunity for natural selection during the 17th-19th centuries in the Diocese of Linkoping as estimated with Crow's Index in a population of Clergy -men's wives. *Hum Hered .*, 34:378-87.
- Jacquard, A. and R.H. Ward., 1976. The genetic consequences of changing reproductive behaviour. *J Hum Evol .*, 5:139-54.
- Johnston, F.E. and K.M. Kensinger,1971. Fertility and mortality differentials and their implications for micro-evolutionary change among Cashinahua. *Human Biology* ,43:356–64.
- Johnston, F. E., and K.M. Kensinger, 1978. Fertility and mortality differentials and their implications for micro evolutionary change among the Cashinahua. *Human Biology*, 43:356-364.
- Kapoor, A.K, Kshatriya ,G.K. and S. Kapoor, 2003. Fertility and mortality differentials among the population groups of the Himalayas. *Human Biology* , 75:729-747.
- Livingstone, F.B. and J.N. Sphuler, 1965. Cultural determinants of natural selection. *International Social Science Journal*,17:118–20.
- Morton, N.E., 1968. Problems and methods in the genetics of primitive groups. *American Journal of Physical Anthropology*, 28:191–202.
- Rao et al., 2015. Measuring opportunity for natural selection in two endogamous sub populations of Andhra Pradesh, South India. *International Journal of Current Research*, 7(05):15554-15558.
- Rao R .L.N., B. Dharma Rao, Rao, Ch. Seshagiri, K. Bharathi .,and B.R.Busi.2006. Selection Intensity Among Khonds of Andhra Pradesh. *Anthropologist*, 8(2):143-144.
- Reddy, B.M. and Chopra, V.P., 1990. Opportunity for natural selection among Indian populations. *American Journal of Physical Anthropology*, 83: 281-296.
- Reddy, B.M., Chopra V.P., and K.C. Malhotra, 1987. Opportunity for natural selection with special reference to population structural measures among the Vadde. *Ann. Hum. Biol.*, 14:249-261.
- Reddy, B.M., and V.P. Chopra,1990. Opportunity for natural selection among the Indian populations. *American Journal of Physical Anthropology .*, 83: 281-296.
- Reddy, V.R., and Reddy, B.K.C, 1984. Selection intensities among the Reddies of Chittoor district, Andhra Pradesh, India. *Comp. Physiol. Ecol.*,9:33-36.
- Sarma Maitreyee, 2013. Measuring opportunity for natural selection: Adaptation among two linguistically cognate tribes inhabiting two eco-situations of North-East India. *Indian Journal of Human Genetics*, 19(2): 159–164.
- Sikdar, M., 2012. Socioeconomic covariates and their impact on the opportunity for natural selection in a riparian tribe of Northeast India. *Anthropologischer Anzeiger* ,69(3):273–287
- Sohkhlet, B., 2013. Index of opportunity for natural selection among the Gowdas of Kodagahalli village, Karnataka, India. *Indian Journal of Human Genetics*, 19(3): 315–319.
- Sphuler, J.N., 1962. In: *UN/WHO seminar on the use of Vital and Health statistics for Genetic and Radiation studies*. WHO conference. Geneva: 1962. Empirical studies on quantitative Human Genetics. Pp. 241–57.

-
- Spuhler, J.N., 1963. The scope for natural selection in man. In: Genetic Selection in Man. WJ Schull (Ed). Ann Arbor: University of Michigan Press., 1-111.
- Spuhler, J.N., 1976. The maximum opportunity for natural selection in some human populations. In : Demographic Anthropology: Quantitative Approaches. EBS Zubro (Ed). Albuquerque: University of New Mexico Press.
- Sudhakar, G., V. Padma and B.V. Babu, 1998. Opportunity for natural selection in Koppala Velama caste of West Godavari district, Andhra Pradesh. South Asian Anthropologist, 19: 107-109.
- Ulizzi, L., San Martini A. and Terranato, L., 1979. Changes of Selection Opportunities with a changing environmental regional heterogeneity in Italy. Annals of Human Genetics, 43:137-141. United Nations Demographic Year Book, 1977.
- Watson, J.E, R.S. Kirby, K.J. Kelleher and R.H. Bradley, 1996. Effects of poverty on home environment: An analysis of three-year outcome data for low birth weight premature infants. Journal of Pediatric Psychology, 21:419-431.



This document was created with the Win2PDF "print to PDF" printer available at <http://www.win2pdf.com>

This version of Win2PDF 10 is for evaluation and non-commercial use only.

This page will not be added after purchasing Win2PDF.

<http://www.win2pdf.com/purchase/>