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International Journal of Current Research
Vol. 7, Issue, 05, pp.15554-15558, May, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

MEASURING OPPORTUNITY FOR NATURAL SELECTION IN TWO ENDOGAMOUS SUB POPULATIONS OF ANDHRA PRADESH, SOUTH INDIA

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ARTICLE INFO

Article History:
Received 28th February, 2015
Received in revised form
20th March, 2015
Accepted 19th April, 2015
Published online 25th May, 2015

Key words:

Index,
Opportunity for Selection,
Caste,
North Coastal Andhra Pradesh.

ABSTRACT

Introduction: Natural selection is one of the important evolutionary factors, which brings about a change in the gene pool of a population. This change is brought about by differential fertility and differential mortality. Differential fertility and mortality are due to difference in genetic fitness of individuals which can be determined in terms of viable offspring produced by the individual. These variables operates singly or jointly to determine the fitness of a particular population in a given environment.

Objectives: The main object of the present work is to study the extent of variation provided for the natural selection to operate through differential mortality and also to find out the factors responsible for the variation in sub groups of Salis caste population according to Crow's formula and the modified method suggested by Johnston and Kensinger and also to compare the present findings with some related findings from other populations of the state.

Materials and Methods: In the present study, A house to house survey was conducted for demographic information on 520 families of the Sali sub populations (PS-I: 265; PS-II: 255).Data on fertility and mortality were collected through the in-depth interview with each married woman using structured schedules. The index of total selection intensity (I) and its mortality and fertility (I_m and I_f) were calculated by using the original formula of Crow's and the modified method suggested by Johnston and Kensinger.

Results: The study was observed that the total index of natural selection using Crow's method is higher in PS-II (Pattusalis) (0.5625) than PS-I (Padmasalis) (0.3626). The index of selection due to fertility component is more than mortality component in both the subgroups. 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 due to better living conditions and proper medical care.

INTRODUCTION

Man is the product of two interdependent courses of evolution - biological and cultural. This complex matrix of culture and gene has made human population survive since, its evolution and to evolve continuously to adapt to the changing environmental regime. Human adaptation is a very significant and extremely fascinating process because it is largely different from other related as well as non-related biological species. However, the species is not completely released from the evolutionary forces and factors, particularly the influences of natural selection. It is well-known that demographic variables such as fertility and mortality are the fundamental events of natural selection, which is one of the major evolutionary forces that bring about changes in the genetic make-up of a population over generations. These variables operates singly or jointly to determine the fitness of a particular population in a given environment. Many studies revealed that fertility and mortality components are directly responsible for the rate and direction of human evolution. Crow (1958) devised the index of total selection which can be computed using the reproductive success of a population. The index assumes that the reproductive differentials are due to genotypic differences and fitness is completely heritable. In reality the effect of genetic component in differential fertility and mortality is rather small and reproductive outcome of an individual or population is the result of the interaction of a variety of sociocultural factors (Crow, 1966). Therefore, the index sets an upper limit for the potential action of natural selection and is renamed as opportunity for natural selection. It has two components, due to differential fertility and differential mortality (Crow, 1972).

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These two components determine the relative fitness of the populations. Later Johnston and Kensinger (1971) extended its scope to include prenatal mortality as the Crow's method takes into consideration only postnatal mortality. Due to modernizing forces, changes in fertility and mortality trends leading to a profound effect on the opportunity for natural selection in human populations. Selection intensity of human populations has been extensively studied throughout the world including India and has noted variation of selection intensity with regards to economic condition (Frisancho *et al.,* 1976; Bharati, 1981; Sikdar, 2012), cultural practices (Sphuler,1962; Livingstone and Sphuler, 1965; Johnston and Kensinger, 1978; Mukhopadhyay, 1982; Sengupta and Begum, 1998), education and social status (Reddy and Chopra, 1990; Kapoor *et al.,* 2003; Das and Sikdar, 2010) and altitudes (Cruz-Coke *et al.,* 1977; Gupta, 1980; Kapoor *et al.,* 2003; Gautam *et al.,* 2009). While other studies suggested variation in selection intensity between migratory and settled groups (Kapoor and Patra, 1998; Sarma, 2013), rural-urban population (Sengupta and Chakravarty, 1998; Dharanipriya *et al.,* 2003; Kar *et al.,* 2007; Sikdar, 2008), and ethnic groups/sub groups of the same population (Roy and Bharati, 1982, Kapoor*et al.,* 2001; Ramesh *et al.,* 2005; Lakshmi *et al.,* 2005). The object of the present work is to study the extent of variation provided for the natural selection to operate through differential mortality and also to find out the factors responsible for the variation in the Sali caste population and also to compare the present findings with some related findings from other populations of the state.

MATERIALS AND METHODS

This work is based on a field survey conducted among the Salis. Salis is a 'Telugu Weavers' caste or social group found largely in the state of Andhra Pradesh in India. They are identified by different names in various regions throughout India. Further Salis is divided into two sub populations namely, Padmasalis (PS-I) and Pattusalis (PS-II) scattered all over the city of Visakhapatnam of Andhra Pradesh. A house to house survey was conducted for demographic information on 520 families of the Sali population (PS-I: 265; PS-II: 255) employed in selecting individual households. The entire demographic data were collected through in-depth interview using structured schedule following as far as possible the parameters suggested by the World Health Organization (1964 and 1968) and Mahadevan (1986), which includes data on individual records, fertility, mortality and marriage pattern. Data on fertility and mortality were collected through the in-depth interview with each married woman using structured schedules. The fertility and mortality schedule was completed by filling information on the number of conceptions, number of live births, birth order, age, sex and marital status of each offspring, number of dead children, age at death, causes of death, if any, reproductive wastage like abortions and still births. They were assured that the information will notbe revealed to anyone and not to conceal the information because of its significance in the present work. The information was cross checked with the husband and elders also in the case of joint families.

Data Analysis

Four important measures on fertility were taken into consideration. These includes child woman ratio, mean number of live-births and surviving children to all married women of all ages, completed family size and total fertility rate. For analyzing the data on mortality, three parameters were taken into consideration which includes infant mortality (death before 1 year of life); juvenile (or premature) mortality (death before 15 year of age) and reproductive wastage (abortions and still-births). In the present study, the index of total selection intensity (I) and its mortality and fertility (I_m and I_f) were calculated by using the original formula of Crow's (1958) and the modified method suggested by Johnston and Kensinger (1971). The later took into account of embryonic mortality, but did not analyze post-natal mortality separately. Furthermore, only those mothers who have reached 40 years and above were taken into consideration since fertility declines drastically when a mother reaches 40 years of age. The following formulae are used to calculate the indices. The indices are:

Crow's Index [Taking into account only livebirths]

I : Im + If/Ps
Im : Pd/Ps
Ps : 1/Pd
If : Vf/X2

Where

: Index of total selection intensity
Im : Index of selection due to mortality
Pd : Probability of deaths up to pre-reproductive age
Ps : Probability of survival up to reproductive age
If : Index of selection due to fertility
V : Variance due to fertility
X : Mean number of live births

Johnston and Kensinger's Index [Taking into account all pregnancies]

I : Ime + Imc/Pb + If/Pb x Ps
Ime : Ped/Pb
Pb : 1- Ped
Imc : Pd/Ps
Ps : 1- Pd
If : V/X2

Where

I : Index of total selection
Ime : Index of total selection due to prenatal mortality
Ped : Probability to die before birth
Pb : Probability to survive till birth
Imc : Index of total selection due to post natal mortality
Pd : Probability to die before reaching reproductive age
Ps : Probability to survive till reproductive age
If : Index of total selection due to fertility
V : Variance due to fertility
X : Mean number of children per women
Pd&Ps: Calculated based on prereproductive deaths

RESULTS

The demographic variables for computing indices [Crow's index] of natural selection are presented in Table-1 and 2.

Table 1. Demographic variables for Crow's index among two endogamous sub populations of Salis

Variables and values	Padmasali (PS-I)	Pattusali (PS-II)	Salis (Pooled)
Number of mothers aged 40 years and above	116	90	206
Number of pregnancies	633	470	1103
Number of live births	583	432	1015
Proportion of survivors up to birth (Pb)	0.1046	0.1852	0.1389
Proportion of surviving (Ps)	0.8954	0.8149	0.8611
Mean No. of live births per mother aged 40+ years(X)	5.0568	4.8000	4.9230
Variance of live births (Vf)	5.5600	6.2930	5.8510
Index of mortality (Vf/Xs^2)	0.2458	0.2731	0.2410
Index for natural selection (I=Im+If/Ps)	0.3629	0.5625	0.4411
Fertility component (%)	67.79	59.59	63.43

Table 2. Opportunity for natural selection among Salis (Crow's Index)

Population	No	I	Im	If/Ps	Fertility Component%
Padmasali (PS-I)	120	0.3629	0.1168	0.2458	67.79
Pattusali (PS-II)	95	0.5625	0.2263	0.3352	59.59
Salis (Pooled)	215	0.4411	0.1613	0.2798	63.43

Table 3. Opportunity for natural selection among Salis Johnston and Kensinger's Index

Population	No	I	Ime	Imc	If/ PbXPs	Fertility Component%
Padmasali (PS-I)	120	0.4334	0.0856	0.0799	0.2679	61.81
Pattusali (PS-II)	95	0.6086	0.0879	0.1561	0.3646	59.91
Salis (Pooled)	215	0.5859	0.1465	0.1151	0.3209	54.77

The mean live births among two sub populations are 5.0568 (PS-I); 4.8000 (PS-II) respectively. This is well within the range (3.70 to 8.84) reported for Indian populations. The selection intensity index [I] is higher in PS-II (0.5625) than PS-I (0.3629). The pooled Salis shows the value of (o.4411) index. The contribution to the total index of selection due to fertility component is rather higher in both the sub groups (PS-I: 0.2458; PS-II: 0.2731) than the mortality component (PS-I: 0.2692; PS-II: 0.2273). Further the relative contributions of fertility and mortality components to the measure of selection are (PS-I: 67.79%; PS-II: 59.59%) and (PS-I: 32.21%; PS-II: 40.41%) respectively. The pooled Salis shows the value of 36.57%. The table-3 shows the component due to prenatal mortality is low in two sub groups of Salis. The contribution of prenatal mortality, post natal mortality and fertility component to the total selection in two endogamous sub groups are (PS-I: 19.75%; 18.44%; 61.81%; PS-II: 14.44%; 25.64%; 59.91%) respectively. The total selection intensity index (I) value (0.5859) is found in modified method among the Salis.

DISCUSSION

Higher fertility component of Crow's Index suggests that the natural selection is operating through the fertility component rather than the mortality component. However, between sub groups the mortality component is very high in PS-II when compare with the PS-I. The higher contribution of fertility component to the total index among the two subgroups supports the contention that due to better living conditions and proper medical care, there has been a decrease of deaths among offspring, thereby enhancing the fertility component. A similar situation is observed in Rellis (Ramesh, 1992) as well as in most of the other caste population like Kalings, Vysya, Thrivarnika, Madiga I, Madiga III and Mala I from Andhra Pradesh.

Even 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 comparative study has revealed several interesting things. The total index of opportunity for natural selection (Crow's Index) has increased along with decrease in social hierarchy. Considering the components of the index, the mortality component is lower in the upper castes than in the lower castes and tribes. It is also to be noted here that the total index among Indian populations varies from 0.26 to 2.25 (Reddy and Chopra, 1990). The total index exceeding the value of 1 is found among the lower castes and tribal groups only. Among the caste populations of Andhra Pradesh majority castes shows a larger index value of fertility than mortality. The present study also shows the same trend. This may be definitely because of their socio-economic status and the better accessibility of medical facilities of these two sub groups of Salis of urban populations in this area. One interesting study was observed that the changing trend of the components of the index in two different studies among the Brahmins of the same area. Srikumari (1985) reported a higher mortality component (0.1270) and a lower fertility component (0.1801) when compared to the Sitalakshmi (2002) which reported a lower mortality component (0.0396) and a higher fertility component (0.3484). The operation of selection through mortality in the earlier study is shifted to fertility in the later over a period of time. Total index is also slightly increases leading to enhanced fitness of the population. Study of the same population over different periods is of much use to observe this trend. The studies of AryaVysy as (lakshmi *et al.,* 2005) and Vysyas (Rao and Murthy, 1984) exhibit the same trend.

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) which 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 here the study of Ulizzi *et al.,* 1979 and Terranato *et al.,* 1979; they have investigated the change of selection opportunities with a changing environment of Italy over a century and explained the relevance of socio-economic and cultural changes to the evolution of selective patterns. Majority of tribal populations and low socio-economic caste groups show a larger index value of mortality than fertility. These populations are characterized by a very poor accessibility to medical care, lesser social mobility and inadequate efforts to control of population growth. However, sub groups of Yanadi tribe (Vasulu, 1987) show a greater fertility component than mortality component. This condition is mainly due to better accessibility to public health facility in that area, on account of their distribution in plain areas. The total {I} is a measure of increase in fitness. Therefore it is a measure of the rate of evolution of the population. It is influenced by the socio-economic conditions which include medical facilities. Therefore increase in medical facilities leads to survival of individuals suffering from genetic diseases this will lead to increase of genetic load in the populations. At the same time the diseased persons survive, marry and reproduce. Thus their fitness- measured through fertility performance increases.

Conclusions

Both the sub populations live in an urban environment and the economic status of Padmasalis (PS-I) is better compared to Pattusalis (PS-II). The fertility component is high in both the subgroups. But the contribution of mortality component to the index of natural selection (Crow's Index) is more in PS-II than PS-I, which might be attributed to their low economic status. The same trend was observed in Johnston and Kensinger Index. When the mortality component is split into prenatal and pre-reproductive mortality the later was more in Pattusalis than Padmasalis, once again reflecting the lower standards of living and improper medical care in Pattusalis in comparison to Padmasalis. From an evolutionary point of view, selection plays a major impact in bringing changes in the genetic make-up within the Sali population. It appears that selection is operating with moderate intensity and contributes more through differential fertility than mortality. This trend might be because of better living condition and health-care system among the Salis, which have a positive impact on the lower contribution of mortality for the evolution mechanism through natural selection.

REFERENCES

Bharati, P., 1981. Economic condition and demography among the Mahishyas of Chakpotavillage, Howrah district, West Bengal. *J. Biosoc. Sci.,* 13:345-356.

Crow, J.F., 1958. Some possibilities for measuring selection intensities in man. *Hum. Biol.,* 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: De GJ, Ebling FJG, Henderson IW, (Ed.). *Proceedings of the Fourth International Congress of Human Genetics.*

Cruz-Coke, R., Christoffanini, A.P., Aspillaga, M. and Biancani, F. 1966. Evolutionary forces in human populations in an environmental gradient in *Arica. Chile. Hum. Biol.,* 38:421-438.

Das, F.A. and Sikdar, M. 2010. Opportunity for natural selection among some selected populationgroups of Northeast India. *Indian J. Hum.Genet.,*16:61-66.

DharaniPriya, B., Veerraju, P. and Rao, T.V. 2003. Selection intensity among Kshatriy as anendogamous population of Andhra Pradesh. *Indian J. Hum.Genet.,*9:69-73.

Frisancho, A.R., Klayman, J.E., Matos, J. 1976. Symbiotic relationship of high fertility, high childhood mortality and socioeconomic status in an urban Peruvian population. *Hum. Biol.,* 48:101-111.

Gautam, R.K., Kapoor, A.K. and Kshatriya, G. K. 2009. Natural selection among Kinnaura of the Himalayan highland: A comparative analysis with other Indian and Himalayan populations. *Indian J. Hum. Genet.,* 15:125-136.

Geneva: WHO; 1964. WHO. Research in Population Genetics of Primitive Groups. WHO Technical Report Series No. 279.

Geneva: WHO; 1968. WHO. Research in Human Population Genetics. WHO Technical Report Series No. 387.

Gupta, R. 1980. Selection intensity in the Sherpas.*Curr.Anthropol.,* 21:136-137.

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 Ward. R.H. 1976.The genetic consequences of changing reproductive behaviour. *J. Hum.Evol.,*5:139-54.

Johnston, F. E. and Kensinger, K.M. 1978. Fertility and mortality differentials and their implications for micro evolutionary change among the Cashinahua.*Hum. Biol.,* 43:356-364.

Johnston, F.E. and Kensinger, K.M. 1971. Fertility and mortality differentials and their implications for micro-evolutionary change among Cashinahua. *Hum. Biol.,* 43:356-64.

Kapoor, A.K., Kaur, J., Trivedi, K. and Sinha, R. 2001. Role of selection in demographic fluctuations among the various caste groups of Kerala, India. *Int. J. Sci. Emerg. Tech.,* 3:82- 88.

Kapoor, A.K., Kshatriya, G.K. and Kapoor, S. 2003. Fertility and mortality differentials among thepopulation groups of the Himalayas. *Hum. Biol.,* 75:729-747.

Kapoor, A.K., Patra, P.K. 1998. Selection intensity in high altitude tribe of Central Himalayas.*Ind.Anthropol.,*28:81-87.

Kar, S., Mozumdar, A. and Roy, S.K. 2007. Comparison of demographic characters between Bengali and Meitei

population groups of Cachar district, Assam. In: Sharma, A. N. (Ed.) *Trends in Anthropological DemographySarup and Sons Publishers,* New Delhi. p 40-61.

Lakshmi, N., Rao, T.V. and Veerraju, P. 2005. Opportunity for natural selection among three endogamous subpopulations of Andhra Pradesh. *Ind. J. Hum.Genet.,*11:39-43.

Livingstone, F.B. and Spuhear, J.N. 1964. Cultural determinants in natural selection. In: UNESCO *expert meeting on the biological aspects of race*. Paris: France.

Mahadevan, K. 1986. Fertility and Mortality: Theory, Methodology and Empirical Issues. *Sage Publications.,* New Delhi.

Mukhopadhyay, B. 1982. Selection Intensity in the Lepchas of Kalimpong, West Bengal.*Curr.Anthropol.,* 23:577-578.

Ramesh, M. 1992. A Genetic Study of the Rellis. Ph.D. Thesis.Visakhapatnam: Andhra University (un published).

Ramesh, M., SubbaRao, I. and Veerraju, P. 2005. Opportunity for natural selection in four endogamous sub populations of Andhra Pradesh, *Ind. J. Multi. Res., Vol. 1* (2): 187-182.

Rao, V.V. and Murty, J.S. 1984. Selection intensities and inbreeding among some caste groups of Andhra Pradesh, India. *Soc. Biol.,* 31:114-9.

Reddy, B.M. and Chopra, V.P. 1990. Opportunity for natural selection among the Indian populations. *Am. J. Phys. Anthropol.,* 83:281-296.

Roy, S.K. and Bharati, P. 1982. Selection intensity: inter and intra-group variation. *J. Ind. Anthropol. Soc.,* 17:283-286.

Sarma, M. 2013. Measuring opportunity for natural selection: adaptation among twolinguistically cognate tribes inhabiting two eco-situations of North-East India. *Ind.J. Hum.Genet.,*19:159-164.

Sengupta, S. and Begum, S. 1998. Index of opportunity for natural selection among the Sayed Muslim of Assam. *Hum. Ecol.,* 9:95-97.

Sengupta, S. and Chakravarty, K. 1998. Selection Intensity in the Ahom of Assam. *Hum. Ecol.,* 9:83-85.

Sikdar, M. 2008. Influence of socio-economic transition on genetic structure: A case study inupper Assam, India. *Ann. Hum. Biol.,* 35:112-120.

Sikdar, M. 2012. Socioeconomic covariates and their impact on the opportunity for natural selection in a riparian tribe of Northeast India*. Anthropol. Anz.,* 69:273-287.

Sita, L.D. 2002. A Study on Genetic Demography of Brahmins with Social Reference to Temporal Trends in Consanguinity and Consequences. Ph. D. Thesis. Visakhapatnam, Andhra University (un published).

Spuhler, J.N. 1963. The scope for natural selection in man.In: Genetic Selection in Man. Schull WJ, (Ed.). Ann Arbor: University of Michigan Press.

Spuhler, J.N. 1962. Empirical studies on quantitative Human Genetics. In*: Proceedings of UN/WHO seminar on the use of Vital and Health statistics for Genetic and Radiation studies.* NY, USA.

Spuhler, J.N. 1976. The maximum opportunity for natural selection in some human populations. In: Demographic Anthropology: Quantitative Approaches. Zubro EBS,(Ed.). Albuquerque: University of New Mexico Press.

Sri Kumari, C.R. 1985. A study of natural selection and genetic adaptation among the four endogamous sub-populations of Andhra Pradesh, Ph.D. thesis, Andhra University (Unpublished).

Terranato, L., Ulizzi, L. and Sanmartini, A. 1979. The effects of demographic transition on the opportunity for selection, changes during the last century in Italy, *Ann. Hum. Genet.,* 43:

Ulizzi, L., Sanmartini, A. and Terranato, L. 1979. Changes iin selection opportunities with changing environment, regional heterogeneity in Italy. *Ann. Hum. Genet.,* 43: 137-141.

Vasulu, T. S. 1987. Cited from Reddy and Chopra, 1990.

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