FERTILITY AND MORTALITY DIFFERENTIALS AMONG THE HIGH AND LOW ALTITUDE MONPA OF ARUNACHAL PRADESH

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Abstract: Any differential in fertility or mortality is natural selection, which helps to measure the fitness of a particular population in a particular environment. The index of total selection intensity (I) measures the maximum potential rate of change, assuming that variations in morality and fertility are genetically determined and fitness is completely heritable. Altitudinal variations in fertility and mortality patterns have been reported in India and other countries by many authors. This study examines fertility and mortality differentials among the high and low-altitude Monpa of Arunachal Pradesh. The index of total selection intensity was much higher among the low-altitude Monpa (Dirang Monpa:1.6094) than that of the high-altitude Monpa (Tawang Monpa: 0.4540). The present study reveals that the environment of the high altitude of Arunachal Pradesh has reduced the fitness of Monpa populations.

Introduction

Spuhler (1973) regarded differential in fertility and mortality in a population as a genetic phenomenon that has been operating in all human populations. The index of opportunity for selection measures the maximum potential rate of change by the selection, where zero indicates no change (Livingston and Spuhler 1965; cf. Sarkar 1997). The method for

computing the index of total selection based on the maximum amount of differential fertility and mortality in a population was formulated by Crow (1958). This was modified by Johnston and Kensinger (1971) to incorporate the embryonic mortality component. Gupta (1980) is of the opinion that the index of total selection intensity measures the maximum potential rate of change, assuming that variations in mortality and fertility are genetically determined and fitness is completely heritable.

Urbanization and industrialization are two main forces responsible for rapid changes in many traditional groups in India. It is well established that differential fertility and mortality vary with some related factors i.e. physical environment, socio-cultural, religious and ethnic etc. Altitudinal variations in fertility and mortality patterns have been reported by, among others, Grahn and Kratchman (1963), Baker and Dutt (1972), Mazess (1975), and Abelson (1976). Such variations concerning Crow's (1958) selection intensity, a composite index involving fertility and mortality parameters, have been reported for an Aymara-speaking population of Chile and the Quechua of Peru (Cruz-Coke et al. 1966, Garruto and Hoff, 1976, Cruz-Coke 1977). Gupta (1980) found that the index of total selection varies between two altitudinal subgroups of the Sherpa. The purpose of the present study is to estimate the intensity of natural selection among high (Tawang Monpa) and low altitude (Dirang Monpa) Monpa of Arunachal Pradesh.

Material and Methods

Information on general demographic and socio-economic variables was collected by visiting two sub-groups of the Monpa namely the Dirang and Tawang Monpa of Arunachal Pradesh. For the sake of the present study, 53 Dirang Monpa and 78 Tawang Monpa mothers who were older than 45 years were selected for the study.

Dirang Monpas are Buddhist by religion and are one of the sub-groups of the Monpa tribe. They inhabit the hilly terrain (1600 m) of the West Kameng district of Arunachal Pradesh. The district experiences moderate to heavy rainfall and in the winter, it experiences severe cold. Dirang Monpa residing in Dirang town and its surrounding areas were selected for the study.

Tawang Monpa is also Buddhist. Like Dirang Monpa they are one of the sub-groups of the Monpa tribe, who are high altitude (3048 m) people. They inhabit the hilly terrain of the Tawang district of Arunachal Pradesh. This district experiences moderate to heavy rainfall and in the winter it experiences frost and snowfall. For the present study, Tawang Monpa residing in Tawang town and its surrounding areas were selected.

The index of opportunity for selection (I) and its fertility and mortality components (I_f and I_m) were calculated following the formulae of Crow (1958) and Johnston and Kensinger (1971).

Results

It is apparent from Table 1 that 78 Dirang Monpa and 53 Tawang Monpa mothers had altogether 373 and 193 pregnancies. The mean of live births per woman is 4.61 among the Dirang Monpa and 3.41 among the Tawang Monpa. The variance of which was 0.2222 and 2.9352 respectively. Whereas, the proportion of premature deaths (those who died before 15 years of age) was found to be 0.6128 among Dirang Monpa and 0.1381 among the Tawang Monpa.

Table 1: Variables of the index of total selection intensity

Variables	Dirang Monpa	Tawang Monpa
Total number of mothers aged 45 years and above	78	53
Number of reported pregnancies	373	193
Number of live births	359	181
Proportion of premature deaths (P_d)	0.6128	0.1381
Proportion of embryonic deaths (P_{ed})	0.0375	0.0622
Proportion of survivors up to birth (P_s)	0.3872	0.8619
Mean number of live births per woman aged 45 years and above	4.61	3.41
Variance in the number of live births (V_f)	0.2222	2.9352

In Table 2 the indices of selection intensity calculated according to Crow ('58) and Johnston and Kensinger ('71) were presented for the two Monpa groups. It reveals that the component of mortality (I_m: 1.5826) was higher than the component of fertility (I_f: 0.0104) among the Dirang Monpa. While a reverse trend was perceptible among the Tawang Monpa (I_m: 0.1602; I_f: 0.2532). The embryonic mortality component (I_{me}) was lower than that of the fertility component among the Tawang Monpa, while among the Dirang Monpa, a reverse trend was perceptible. The index of total selection (I) calculated according to Johnston and

Table 2: Indices of selection intensity

Population	Calculated according to Crow's (1958) formula			Calculated according to Johnston and Kensinger's (1971) formula			
Vatriables	I_m	I_f	I	I_{me}	I_m	I_f	I
Dirang Monpa	1.5826	0.0104	1.6094	0.0390	1.5826	0.0104	1.7111
Tawang Monpa	0.1602	0.2532	0.4540	0.0663	0.1602	0.2532	0.5503

Kensinger ('71) was comparatively higher than that calculated according to Crow ('58), this is due to the inclusion of embryonic deaths in the earlier one. This was true for both the Monpa groups.

It reveals from Table 3 that the fertility component was higher and the mortality component lower among the Sherpa of Upper Khumbu but a reverse trend was perceptible among their lower counterpart (Kalimpong Sherpa). This is unlike the situation among the high-altitude populations of Latin America. Among the Aymara-speaking highlanders (Cruz-Coke et al. 1966) fertility component was found to be higher and the mortality component lower. But among the Nunoa of Quechua (Garruto and Hoff 1976) a different trend was perceptible. The fertility component was higher than the mortality component among the Monpa highlanders (Tawang Monpa). But the lowland Monpa (Dirang Monpa) show an opposite trend. The index of total selection intensity was much higher among the Dirang Monpa (1.6094) than that of the Tawang Monpa (0.4540).

Table 3: Selection intensity and its components among other populations

Population	Altitude	Demographic measures					Source
		$\bar{x}$	V_f	I_f	I_m	I	
Sherpa							
Upper Khumbhu	High	4.530	6.150	0.300	0.152	0.498	Gupta, 1980
Kalimpong	Low	7.440	9.560	0.173	0.206	0.415	
Aymara							
Huallatire	High	7.30	9.89	0.185	1.178	1.581	Cruz-Coke et al., 1966
Belen	Medium	5.82	6.95	0.205	0.360	0.638	
Arica	Low	4.34	8.53	0.453	0.146	0.665	
Quechua							
Nunoa	High	6.7	9.0	0.200	0.522	0.827	Garruto and Hoff, 1976
Monpa							
Tawang Monpa	High	4.61	2.9352	0.2532	0.1602	0.4540	Present study
Dirang Monpa	Low	4.61	0.2222	0.0104	1.5826	1.6094	Present study

Discussion

Gupta (1980) found that in both Sherpa subgroups (Upper Khumbu and Kalimpong) the index of total selection was closer to the bottom of the range (0.6-3.7) reported by Spuhler

(1962) among ten tribal populations. Among the highlanders of Latin America (Cruz-Coke et al. 1966, Garruto and Hoff 1976, Cruz-Coke 1977) selection operates mainly through mortality (i.e., I_m is higher than I_f).

Gupta's study (1980) reveals that selection operates with higher intensity in the Upper Khumbu Sherpa than in the Kalimpong Sherpa, but the difference between the two is smaller than in the case of similar subgroups among the Aymara-speaking populations in Chile (Cruz-Coke et al. 1966). In turn, among the study population Monpa, selection is operating with higher intensity among the highland Monpa (Tawang Monpa) than that the lowland Monpa (Dirang Monpa).

To interpret I in terms of Darwinian fitness Gupta (1980) said "It may be suggested that high altitude environment has not reduced the fitness of the Upper Khumbu Sherpa to the extent that it has reduced that of the Aymara in comparison with their low-altitude counterparts". However, the findings of the present study do not corroborate these findings. It is apparent from the present study that selection intensity in terms of Darwinian fitness, the rigorous environment of the high altitude of Arunachal Pradesh has reduced the fitness of Monpa populations.

Conclusion

Though India has had a strong tradition of studies on the opportunity of natural selection the same is very limited among the populations living in different altitudes. To mention a few Gupta (1980) conducted a study among the Sherpa of Upper Khumbu, Nepal (high altitude) and Kalimpong (low altitude). In this study fertility and mortality differentials have been examined among the Monpa residing in high (Tawang Monpa) and low altitude (Dirang Monpa) of Arunachal Pradesh. It is found that the opportunity of natural selection related to Darwinian fitness, and the rigorous environment of the high altitude of Arunachal Pradesh has reduced the fitness of Monpa populations.

Acknowledgements

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