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**Index of Opportunity for Natural Selection in
Koplik's Population and its Surroundings**

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Index of Opportunity for Natural Selection in Koplik's Population and its Surroundings

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Abstract

This study is done in Koplik's municipality. Koplik is a small town which is located in the north of Albania. A database is built for 20000 inhabitants of Koplik's Municipality, where the year of birth, the year of marriage and the year of death are included. A total number of 3016 married women were covered under the study. It is observed the mean number of life-births per woman of completed fertility, number of surviving children, number of dead children, age of death, cause of death. This data is used to calculate the index of total selection intensity. It was found, that the values of I , I_f and I_m , calculated according to Crow's formula (1958), were 0.236, 0.297 and 0.0217, respectively. The index of total selection intensity is considered low, but its value shows that natural selection affects the genetical constitution of Koplik's population. The index due to fertility seems to contribute more than the index due to mortality. It was found that the value of the index of total selection intensity for locals was from 0.3 to 0.44 and was considered moderate. This effect is due to the improvement of living conditions and medical care.

Keywords: Fertility, Index of total selection intensity, Koplik, Mortality.

Introduction

Natural selection is the main force of evolution that brings about changes in gene frequencies in population, through differential fertility and mortality, which operate singly or jointly to determine the intensity of selection (Demetrius et al., 2007), and the population's fitness. Darwinian fitness or selective fitness of a population depends on the reproductive efficiency of the members of the population and the offspring's survival (Alfanzo-Sanchez et al., 2004).

Quantity of natural selection includes chances of survival and reproduction of different genotypes. If there is no genetic variation in fitness, there is no differential selection, so there is no significant evolutionary change in the genetic composition of population.

Crow in 1966 devised an index called the Index of Opportunity for Natural Selection, which enables the change in fitness to be measured (Crow, 1958).

Crow's index facilitates the quantitative calculation of selective pressure, if model of population's reproduction is known (Crow, 1958). It refers to the total quantity of selection and consists of two components: the mortality component (I_m) and the fertility component (I_f). It measures the percentage of which fitness will be increased with specific mortality and fertility rates, if they are selective and if the heritage of fitness is total. This index can be considered as the upper limit for potential action of natural selection and is named the total casual index of natural selection (Crow, 1958). This index and the factors that affect it, have been studied by several researchers in different parts of the world, including India.

Practically, the genetic component in differential fertility and mortality, is not the only component, but it is the result of interaction of social and cultural factors, that affect the fertility and mortality of a specific population.

The data about fertility and mortality is analyzed based on parameters WHO. (WHO, 1968; Mahadevan, 1986). According to Khongsdier, the value of Crow index of total selection, if it is <0.340 is considered low, $0.340-0.470$ moderate, $0.470-0.6$ mild, $0.6-0.73$ average, $0.73-0.86$ high, >0.86 very high. The index of total selection intensity is calculated in different populations. In a study made in North India it ranges between 2.258 and 2.250 (Reddy and Chopra, 1990). These values are considered low. This result goes in conformity with several other studies done recently in different parts of India (Kapoor et al., 2003; Dharani et al., 2003; Lakshmi et al., 2005). In all these studies it is observed that the fertility component contributes more to the total index than the mortality component in all the population groups. Low values of selection intensity indicate a low pressure of natural selection in these populations. This may be because of the operation of different factors like sociocultural and economic, the educational system, the health awareness, and the medical facilities among a different group of population in recent years. The low intensity of selection may suggest that population is at the initial stage of demographic transition. In the initial stage of the transitional phase, the index

of total selection declines initially, followed by a rapid decline of the mortality component with a stable fertility component (Sikdar, 2008).

Materials and Methods

The data is taken from the interviews of 20000 inhabitants of Koplik's Municipality and its surroundings. A database is built by using this data, where the year of birth, the year of marriage and the year of death for each person is included, using the registers of civil state offices of Koplik's Municipality. From this database, data is taken for women above 40 years old and their children, the proportion of children's death before 18 years of age, the proportion of survivors, the mean number of life-births per woman of completed fertility and the variance in the number of life-birth.

Data Analysis

Four important parameters are taken into consideration. Those are: the women-child ratio, the average of number of children ever born and have survived and the variance in the number of life-birth for every woman over 40 years old. In our study the index of total selection is calculated by Crow formula (1958). Table 1 shows the parameters that have been used for the calculation of the selection intensity for Koplik's population and Table 2 shows the parameters that have been used for the calculation of the selection intensity for locals.

Table 1. *Parameters Used in Calculating Selection Intensity for Koplik's Population*

Parameters	Frequency
Number of mothers age 40 year and above	3016
Number of live birth	11153
Number of surviving children	10916
Number of deaths before 18	237
Proportion of survivors to birth – Ps	0.979
Proportion of child death –Pd	0.02125
Mean number of live-birth per mother aged 40+	3.619
Variance of number of live-birth – Vf	2.746

Table 2. Parameters Used in Calculating Selection Intensity for Locals

Parameters		Number of mothers age 40 year and above	Number of live birth	Number of surviving children	Number of deaths before 18	Proportion of survivors to birth – Ps	Proportion of child death -Pd	Mean number of live-birth per mother aged 40+	Variance of number of live-birth – Vf
The tribes	Mehaj	423	1436	1401	35	0.979	0.0244	3.29	3.0956
	Culaj	120	429	416	13	0.969	0.0303	3.464	3.38
	Bajram	94	343	321	22	0.9362	0.0638	3.416	3.036
	Ramçaj	50	162	161	1	0.9938	0.0062	3.22	2.262
	Rrustemaj	66	221	217	4	0.9819	0.0181	3.288	3.38
	Smakaj	59	209	207	2	0.99	0.00957	3.507	3.33
	Lulaj	72	248	245	3	0.9889	0.0121	3.406	3.358
	Zaraj	78	266	262	4	0.985	0.015	3.359	2.369
	Hasmujaj	70	227	222	5	0.978	0.022	3.171	3.298
	Selgjekaj	45	146	142	4	0.9726	0.0274	3.156	2.81

Only women over 40 years old are taken into consideration. They are women who have finished their cycle of fertility (Das and Ghosh, 1988). The index of total selection is divided in two well known components: The index of selection due to fertility and the index of selection due to mortality. The index of total selection is calculated by Crow formula:

$$I = I_m + (I_f/P_s)$$

I-Index of total selection's intensity

Im-Index of selection due to mortality

If-Index of selection due to fertility

Ps -Proportion of survivors

Index of selection due to mortality

$$I_m = P_d/P_s$$

Pd-Proportion of children's death before 18 years of age

Ps=1-Pd is proportion of survivors

Index of selection due to fertility

$$I_f = V_f / (\bar{x})^2$$

Vf is the variance in the number of life-birth due to fertility

\bar{x} is the mean number of life-births per woman of completed fertility

Results and Discussion

Table 3. *Index of Selection due to Mortality, Index of Selection due to Fertility and Index of Total Selection According to Crow (1958), for Koplík's Population*

Im	If	If/Ps	I
0.0217	0.2097	0.2142	0.236

The values of Im, If and I are calculated based in Crow formula (1958) and are respectively 0.0217, 0.2097, 0.236 (Table 3). The value of index of total selection, equals to 0.236 is considered low. It indicates that natural selection affects the genetic variation of Koplík population. It contributes more through differential fertility, than differential mortality. Table 4 below shows the values of Im, If, If/Ps and I for locals of Koplík.

Table 4. *The Values of Im, If, If/Ps and I for Locals of Koplík*

Tribe	Im	If	If/Ps	I
Mehaj	0.02498	0.2862	0.2933	0.318
Culaj	0.03127	0.2815	0.29	0.321
Bajramaj	0.0681	0.26	0.278	0.346
Ramçaj	0.00624	0.2182	0.22	0.226
Rrustemi	0.0184	0.3125	0.3183	0.337
Smakaj	0.0097	0.271	0.2737	0.283
Lulaj	0.01224	0.2895	0.2927	0.3
Hasmujaj	0.0225	0.328	0.3354	0.358
Selgjekaj	0.0282	0.2821	0.29	0.32

Comparing the index of selection due to mortality of the locals of Koplík with all inhabitants of the municipality, it is noticed that this index is lower for the locals. On the other hand, the index of selection due to fertility is higher. Index of total selection is low for all inhabitants and moderate for locals, without any significant change among tribes. This shows that selection has acted more in locals, than in all population.

Conclusions

The value of index of total selection, equals to 0.236, indicates that natural selection affects the genetic variation of Koplík population. This value is considered low. It shows low pressure of natural selection in this population. It contributes more through differential fertility, than differential mortality. So,

Koplik's population has evolved more through fertility than mortality mechanism. That may be happened due to better living conditions, better health care, that brought about a positive impact in reduction of mortality contribution in evolution population's mechanism. The index of selection of differential fertility, 0.21 was also low, even though this population was characterized by high fertility, because the variance in the number of life-birth is low. This low value of index of total selection may suggest that Koplik's population is at the initial stage of demographic transition.

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