

Biological Status of Subcarpathian Settlers in the First Half of the 20th Century

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ABSTRACT The purpose of the paper is (a) to present the characteristics describing opportunity for natural selection in the population of the Subcarpathian settlers in the first half of the 20th century and (b) to assess the secular trend in body height in this immigrant group living in isolation from the surrounding Slavic population. The research material comes from the historical data stored in the archives of the Institute of Anthropology in Poznań. Examination records refer to 229 males and 233 females and contain anthropometric measurements and biodemographic information. The subjects were analyzed in five cohorts. The index of opportunity for natural selection was calculated using Crow's formula (1958). The cohort analysis revealed a fairly high fluctuation and high Im values. A strong secular trend in body height manifested as an increase of the mean height between the extreme cohorts, was observed in women. In male cohorts we noted fluctuations in the mean height, however, no directional trend was observed. No correlation was demonstrated between the number of siblings that had died in the studied families and the mean body height in the cohorts. This result corroborates the thesis that the reproductive potential and growth potential of a population are realized independently and are determined by different sets of modifying factors.

INTRODUCTION

Natural selection is the function of fertility and survivals differentials and one of the evolutionary factors, which brings about a change in the gene pool of a population. This influences 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 (Babu et al. 1995; Chanu and Varte 2009; Dhgarani et al. 2003; Johnston and Kensinger 1971; Lakshmi et al. 2002; Kotal and Sengupta 2003; Sengupta and Begum 1998).

Crow (1958) proposed the index of total selection which assumes that the reproductive differentials are due to genotypic differences and fitness is completely heritable. The index sets an upper limit for the potential action of natural selection. Anthropological analyses based on historical materials seem to be a significant completion of the knowledge on human populations living in various historical periods (Luna and Moral 1990; Ivanov et al. 1997; Johansen 1999; Nowak and Piontek 2008). From this source we can obtain valuable data referring to specific and unique human groups (for example, populations colonizing new areas) or groups whose

living conditions were different from average, in the historical period under study (Varte and Varte 2006; Raju and Prakash 2009; Nowak et al. 2009; Das and Sikdar 2010).

The objective of the paper is to present the characteristics describing the opportunity for natural selection (Crow 1958) in the population of German individuals who arrived to the Subcarpathian region (*Polish*: Podkarpacie) in the first half of the 20th century and to attempt to describe the secular trend in body height in this population.

MATERIAL AND METHODS

The research material is based on the data collected by Franciszek Wokroj in 1939 in the villages of Brygidyn, Oleksice Nowe and Kalinów. Franciszek Wokroj examined anthropometrically 229 men and 233 women and collected data on the number of children in families that had finished reproduction and on the number of children in these families who had died before the age of 14. The purpose of this research was to collect material that would make it possible to estimate differences in anthropological structure and biodemographic data between the German settlers and the native population in the area (Wokroj 1954).

The data were collected in a manner enabling their reuse in order to illustrate the opportunity for natural selection and the secular trend in body height in a unique and isolated population.

The data used in this paper referred to individuals belonging to three successive generations, and they could be analyzed in five birth cohorts for individuals born in the years 1850-1879; 1880-1890; 1891-1900; 1901-1910; and 1911-1920 (Table 1).

Table 1: The size of the sample in subdivision into cohorts and places of residence of the subjects

Cohorts (years)	Locality			Totality
	Brygidyn	Oleksice Nowe	Kalinów	
1850-1879	35	1	-	36
1880-1890	53	3	-	56
1891-1900	83	26	4	113
1901-1910	95	33	29	157
1911-1920	58	20	22	100
Totality	324	83	55	462

The index of opportunity for natural selection was calculated using Crow's formula (1958).

The mean values of body height of individuals under study are presented in order to find a correlation between this trait and child mortality in the family, using Spearman's rank correlation. An attempt was also made to describe the secular trend in body height in individual cohorts.

RESULTS

Data needed for the calculation of the Crow's index and its values in subdivision into birth cohorts are shown in Table 2.

Table 2: Basic data characterizing opportunity for natural selection through differential mortality and differential fertility and Crow index values in subdivision into birth cohorts

Cohorts	P_d	P_s	I_m	V_f	X^2	I_f	I
1850-1879	0.37	0.63	0.59	8.03	86.12	0.15	0.74
1880-1890	0.23	0.77	0.3	7.27	56.85	0.17	0.47
1891-1900	0.27	0.73	0.37	12.42	81.82	0.21	0.58
1901-1910	0.33	0.67	0.5	14.63	76.74	0.29	0.79
1911-1920	0.26	0.74	0.35	8.97	67.73	0.18	0.53

P_d – fraction of offspring dying before reaching the age of reproductive maturity

P_s – fraction of offspring reaching reproductive maturity ($P_s = 1 - P_d$)

I_m – index of opportunity for natural selection through differential mortality

V_f – variance of number of offspring in a complete family

X^2 – square of the mean number of offspring in a complete family

I_f – index of opportunity for natural selection through differential fertility

I – Crow's index value

Crow's index values are close to mean values for agricultural populations living at the turn of the 20th century in Central Europe.

However, cohort analysis revealed fairly high fluctuation of the values of index of total opportunity for natural selection and high values of the index of opportunity for selection through differential child mortality (I_m). For the whole period under study the value of the Crow's index of the total opportunity for natural selection was 0.64 and it did not differ significantly between both sexes.

A strong secular trend in height was observed in women (4.0 cm difference between extreme cohorts). In men only irregular fluctuations in mean height within the range from 163.6 cm to 166.7 cm were observed (Fig. 1). The mean body height of the examined men was 165.2 cm, while the mean height of women was 154.9 cm.

The decrease in the value of the Crow's index of the total opportunity for natural selection was mainly due to the decline in the value of I_m index.

Figures 2 and 3 show interrelations between the mean body height of the studied individuals and the mean number of children in the family that had died before reaching 14 years of age. However, Spearman's rank correlation test failed to show a statistically significant correlation between these two variables.

DISCUSSION

The high post natal mortality in human groups may be due to poor medical facilities available to them due to their low socio-economic condition. The incidence of child mortality greatly depends upon social status, the higher the social status, the lower the incidence of mortality (Singh 1974). Also, an inverse relationship has been found between various indices (I_m and I_f) and social categories in the studies of selection potential (Kapoor et al. 2003). The total I is

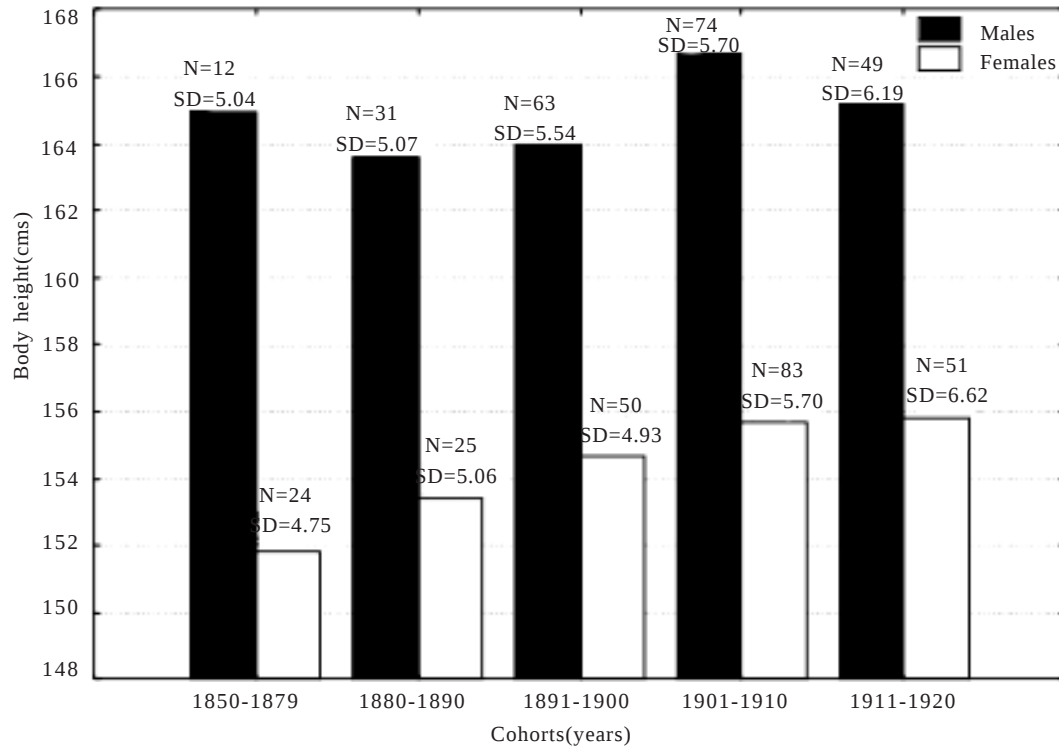


Fig. 1. The secular trend in male and female height



Figs. 2 and 3. Interrelations between the mean body height of the studied individuals and the mean number of children in the family that had died before reaching 14 years of age

a measure of increase in fitness, so it is a measure of the rate of evolution of the population. It is influenced by the socio-economic conditions which include medical facilities. It is well-known that better medical facilities reduce the mortality component. Therefore, increase in medical facilities leads to survival of individuals suffering from various diseases.

The effect of demographic transition on the opportunity for natural selection among the populations of industrialized nations are a reduction in total index, a decline in selection due to reproductive mortality and increase in the fertility index.

The authors compared the Crow's index values with data for a number of local populations. Placing of the population under study and comparative populations (Table 3) in the coordinate system formed by values of differential fertility and mortality rates makes it possible to obtain an unambiguous description of the biological status of the population and to determine the pattern of natural selection it is the closest to (Fig. 4). The comparative populations group was supplemented with the results of one of our recent studies (Nowak et al. 2009) referring to the agricultural population of Podbereżce (Ukraine). On the one hand, it is a population close to the population of German settlers in the Subcarpathian region both geographically and in terms of birth cohorts established, on the other hand, it is a native population, which may be a factor differentiating biological dynamics of the two groups under comparison.

The analysis of the picture in Figure 4 indicates that both the population under study and the population from Podbereżce, close to the studied population according to the original assumption, are significantly distant from

technologically developed populations. In both groups high I_m values could result from high incidence of tuberculosis and difficult climate and environmental conditions. It can be stated that in terms of opportunity for natural selection the studied group of German settlers fits within the range of mean values characteristic of rural populations. In these populations traditional norms of demographic balance were manifested by relatively higher mortality and at the same time by keeping up the birth rate at a level sufficient to balance the death rate (Spuhler 1976; Ivanow et al. 1997; Bhasin and Nag 2007).

CONCLUSION

The relatively high value of I_m index in the first cohort of individuals may have resulted from the fact that the colonists had settled in areas with difficult environmental (climatic and geographic) conditions. In successive years after the settlement child death rate in the studied population tended to decrease.

In line with the thesis that the share of I_f index in the total opportunity for natural selection tends to grow along with cultural progress, we noted an increase in the value of this variable in the last cohort (grouping individuals born in the years 1880-1910).

In turn the decrease in the value of Crow's index measuring opportunity for natural selection through differential fertility in the cohort of individuals born in the years 1911-1920 may be an effect of the settlers' deteriorating material status due to decreasing financial support from Germany.

No correlation was found between the number of children in the family that had died

Table 3: Values of Crow's index components (I_m , I_f) and value of the index (I) for the comparative populations and obtained in authors' own research

Populations-period	I_m	I_f	I	Author
Colonists from Podkarpacie	0.41	0.23	0.64	Own data
Switzerland (20th century)	0.06	1.59	1.65	Spuhler 1963
France (1900)	0.26	0.84	1.10	Jacquard 1974
Great Poland (20th century)	0.05	0.26	0.31	Henneberg 1978
Caceres Province – Spain (1880-1930)	0.99	0.32	1.31	Gonzalez and Prado 1987
Caceres Province – Spain (1950-1983)	0.09	0.29	0.36	Gonzalez and Prado 1987
Basques (1830-1859)	0.81	0.50	1.31	Alfonso-Sánchez et al. 2004
Basques (1950-1990)	0.08	0.59	0.67	Alfonso-Sánchez et al. 2004
Kashubian villages (20th century)	0.11	0.25	0.36	Berdychowski and
Henneberg 1978				
Podbereżce (1850-1918)	0.51	0.18	0.69	Nowak et al. 2009
Podbeskidzie villages (20th century)	0.06	0.25	0.31	Nowak et al. in print

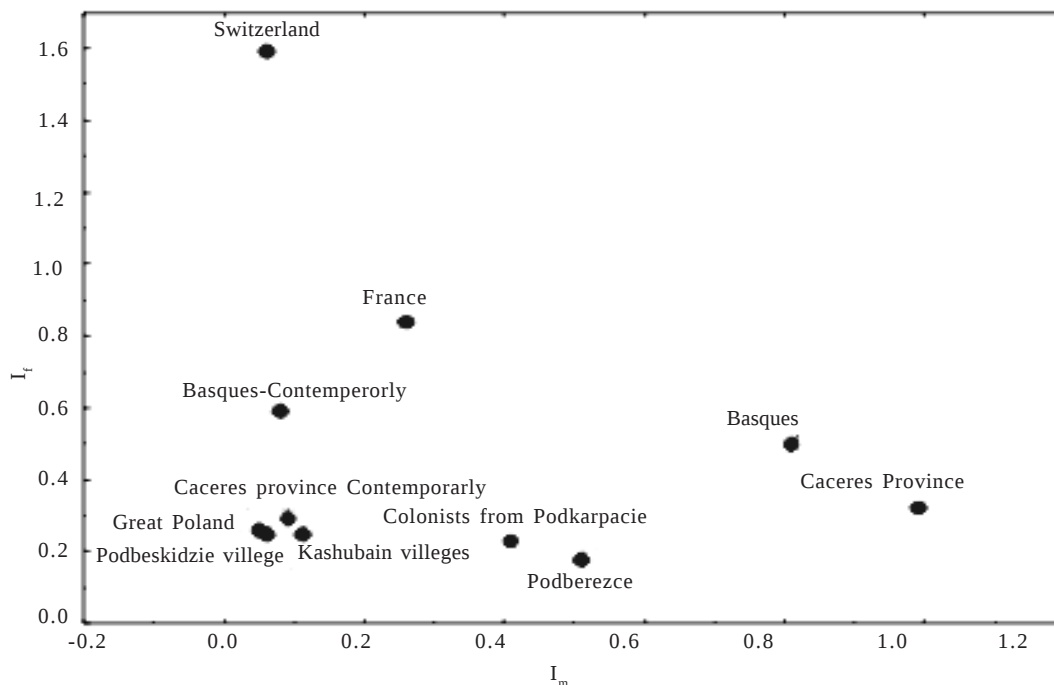


Fig. 4. Distribution of populations with different levels of technological and civilizational development and of population analyzed in the coordinate system formed by I_t and I_m values

before reaching 14 years of age and the mean value of male and female body height in the cohorts. This result corroborates the thesis that the two biological potentials of a population, reproductive potential and growth potential, are realized in a way independently as determined by different sets of modifying factors.

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