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Intergenerational Changes in the Biological Dynamics of Populations from Southern Poland in the 20th Century

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ABSTRACT The study material contained questionnaires with questions referring to three generations of women living in two geographical regions of Poland, Podbeskidzie (313 families) and Podkarpacie (437 families). By computing fertility rates, we attempted to find out whether there were any regional factors determining the biological dynamics of these populations in the 20th century. We were also looking for an answer to the question whether living conditions specific for functioning in various types of population clusters (such as village, town, and city) had an effect on the fertility and mortality levels in the families of the subjects of the study The dynamic nature of the processes associated with fertility and mortality on the population level was studied with the use of the index of opportunity for natural selection . Populations inhabiting the geographical regions under study were similar in terms of the mean number of children in families that had finished reproduction. The intergenerational comparison revealed a significant decline in the total fertility rate in all subgroups formed by size of population cluster. The analysis of the data for the generations of the subjects' mothers and grandmothers showed a distinct decline in child mortality rate. The increase in the fertility rate in the generation of the subjects' mothers may be explained with improving social care provided by the state at that time.

INTRODUCTION

In societies characterized by a high degree of industrialization and urbanization, by improving socio-economic status of individuals and development of modern medical techniques one can observe a very big decline in infant and child mortality (Henneberg et al. 1978; Zonta et al. 1997; Ulizzi et al. 1998; Astolfi et al. 2000). Most of this kind of research has focused on discussing data on fertility and early life mortality (Penn and Smith 2007; Strassman and Gillespie 2002; Voland and Durban 2002), anthropometric measures (Desai 1995; Hagen et al. 2006; Hagen et al. 2001; Lawson and Mace 2008) and, in some cases, marital and reproductive success (Borgerhoff and Mulder 1998, 2000; Gillespie et al. 2008; Low 1991; Pen and Smith 2007; Mace 1996; Voland and Dunbar 1995).

Throughout the 20th century, the Polish population was undergoing a considerable change progressing in line with the general theory of demographic transition, from the initial stage characterized by high fertility and high mortality through the transition stage, when first mortality and then fertility decline, to the final stage when balance is restored between the level of births and deaths, however, with both of these rates at a low level (Notestein 1945; Okólski 1990; Nietyksza 1995). Thus, in the course of demographic transition a population experiences a shift from traditional to modern reproduction. Traditional reproduction is associated with high and unstable fertility and mortality and a high total fertility rate, with progressive population structure by age and low life expectancy. Modern reproduction, on the other hand, is characterized by elements such as low and fairly stable fertility and mortality rates and low total fertility rate, stationary population structure by age and long life expectancy. What both reproduction types have in common is a relative balance between the number of births and deaths in the population (Pu³aska-Turyna 1990; Iglicka 1993; Stpiczyñski 1994).

Even if child mortality and female fertility differentiation are fairly easy to estimate, correlations between these variables are difficult to capture. The dynamic nature of processes related with fertility and mortality on the population level can be captured with the index of opportunity for natural selection proposed by Crow (1958).

This index is often used in anthropological and genetic research as it can be computed just from the data on the number of children in families that finished reproduction and the data on the number of children who had died in these families before reaching 15 years of age.

Objective of the Study

By computing fertility rates for two geographical regions we attempted to find out whether there were any regional determinants of the biological dynamics of their populations living in the 20th century.

The data were quantified taking into account the urbanization factor and then subdivided within the regions into three categories: village, town, and city, which made it possible to find out whether different living conditions, due to functioning in different types of population clusters, had a visible effect on fertility and mortality levels in the families of the subjects.

MATERIAL AND METHODS

Material used in the study comprised of questionnaires referring to three generations of women from two geographical regions in Poland - Podbeskidzie region (313 families) and Podkarpacie region (437 families). The Podbeskidzie region is a part of the Carpathian Foothills situated along the Beskid Mountains range. The name has never been in official use and is commonly used to denote the area including the Silesian Beskid, Low Beskid, ¯ywiecki Beskid, Makowski Beskid ranges and the Silesian Foothills area. Podkarpacie is not only the name of a geographic region in south-eastern Poland, but also, since January 1st, 1999, a term denoting a unit in the country's administrative division – Podkarpackie Voivodship.

Families from these two regions were subdivided by the size of the population cluster they inhabited. The groups included the following clusters: for Podkarpacie: city - Rzeszów, town - Sanok, and villages - Czarna and Lutowiska; and for Podbeskidzie: city - Bielsko Bia³a, town - ¯ywiec, and villages - Milówka, Szare, and Nieledwia. The questionnaires were the source of data on the total fertility rate and child mortality rate for three generations of women, including the subjects of the study, their mothers and grandmothers, from Podbeskidzie region (313 families) and Podkarpacie region (437 families). Data on the number of children in family, age of the subjects' grandparents and parents, and the number of children who had died in their families before reaching 15 years of age were used to determine opportunity for natural selection by means of Crow's index (1958). We are acquainted with the paper of Johnston and Kensinger (1971), however we decided to use Crow's formula because we do not have at our disposal data concerning prenatal mortality in all generations of the discussed population.

RESULTS

Populations inhabiting the geographical regions under study were similar in terms of the mean number of children in families that had finished reproduction (complete families). Statistically significant differences were noted only for mothers of the subjects (the second generation under study) living in the villages and the town situated in the Podkarpacie region (Fig.1).

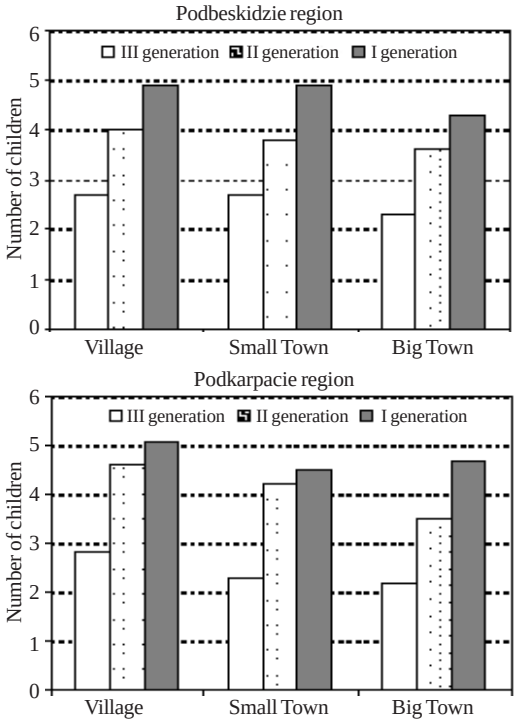

Fig. 1. Mean number of children in three generations of studied women's (I generation – grandmothers of the subjects, II generation – mothers of the subjects, III generation - subjects)

The intergenerational comparison revealed a significant decline in the total fertility rate in all subgroups formed by size of population

cluster. The highest number of children (both in Podbeskidzie and in Podkarpacie region) were born, as expected, in the families of the subjects' grandmothers inhabiting rural areas.

The data on the mean mortality of children under 15 years of age were available only for the generation of grandmothers and mothers of the subjects, as not all of the subjects' children had reached the age of 15 at the time of the study (Fig. 2). Both in Podbeskidzie and in Podkarpacie regions an intergenerational decline in child mortality was revealed. This downward trend in child mortality in the successive generations should be undoubtedly linked with technological and organizational advancement, better access to medical care and general improvement in living conditions.

The above-mentioned data were used to compute Crow's indices (Tables 1 and 2).

The analysis of the data for the generations of the subjects' mothers and grandmothers showed a distinct decline in child mortality rate (I_m), which along with a slightly higher fertility rate determined somewhat higher values of the index of opportunity for natural selection. This trend was observed in all urbanization subcategories and in both geographical regions. It seems that the increase in the fertility rate in the generation of the subjects' mothers may be explained with improving social care provided by the state at that time.

The Podbeskidzie region turned out to be the region with lower biological dynamics in the generation of mothers of the subjects (active in reproduction in the 1960s), in the town category.

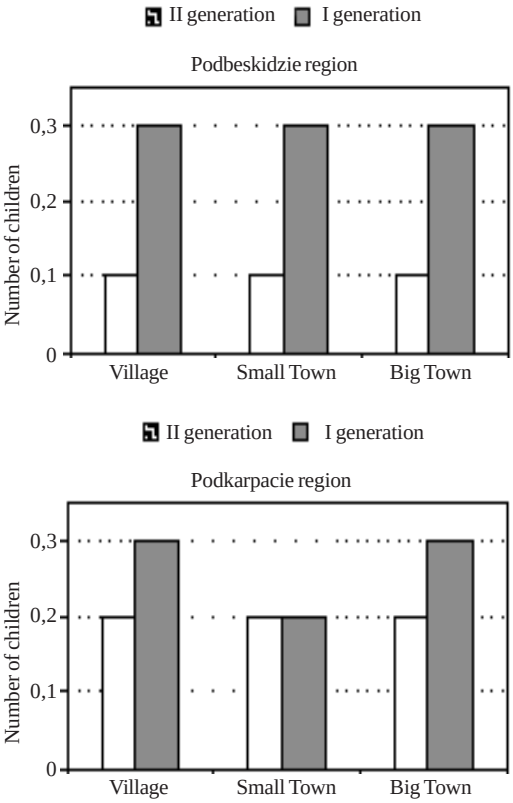

Fig. 2. Mean mortality of children under 15 years of age for the generation of grandmothers and mothers of the subjects

In the generation of the subjects' grandmothers the highest fertility was observed –as expected - in rural areas, while in the generation of the

Table 1: Basic data characterizing opportunity for natural selection through differential mortality and differential fertility and Crow index values in subdivision into level of urbanization (Podbeskidzie region)

Podbeskidzie village	$P_{(d)}$	$P_{(s)}$	$I_{(m)}$	$V_{(f)}$	x^2	$I_{(f)}$	$1/P_{(s)}$	I
I generation	0.061	0.939	0.065	6.1	24.01	0.254	1.065	0.336
II generation	0.037	0.963	0.038	4.7	16	0.294	1.038	0.343
III generation				1.5	7.29	0.206		
Podbeskidzie small town	$P_{(d)}$	$P_{(s)}$	$I_{(m)}$	$V_{(f)}$	x^2	$I_{(f)}$	$1/P_{(s)}$	I
I generation	0.06	0.94	0.064	5.3	24.01	0.221	1.064	0.299
II generation	0.037	0.963	0.038	2.9	14.44	0.201	1.038	0.247
III generation				1.3	7.29	0.178		
Podbeskidzie big town	$P_{(d)}$	$P_{(s)}$	$I_{(m)}$	$V_{(f)}$	x^2	$I_{(f)}$	$1/P_{(s)}$	I
I generation	0.063	0.937	0.067	4.5	18.49	0.243	1.067	0.327
II generation	0.045	0.955	0.047	4.9	12.96	0.378	1.047	0.443
III generation				1.2	5.29	0.227		

Table 2: Basic data characterizing opportunity for natural selection through differential mortality and differential fertility and Crow index values in subdivision into level of urbanization (Podkarpacie region)

Podkarpacie village	$P_{(d)}$	$P_{(s)}$	$I_{(m)}$	$V_{(f)}$	x^2	$I_{(f)}$	$1/P_{(s)}$	I
I generation	0.059	0.941	0.063	6.5	26.01	0.250	1.063	0.328
II generation	0.047	0.953	0.049	5.4	21.16	0.255	1.049	0.317
III generation				1.6	7.84	0.204		
Podkarpacie small town	$P_{(d)}$	$P_{(s)}$	$I_{(m)}$	$V_{(f)}$	x^2	$I_{(f)}$	$1/P_{(s)}$	I
I generation	0.38	0.962	0.040	4.7	20.25	0.232	1.040	0.281
II generation	0.039	0.961	0.041	5.2	17.64	0.295	1.041	0.347
III generation				1.1	5.29	0.208		
Podkarpacie big town	$P_{(d)}$	$P_{(s)}$	$I_{(m)}$	$V_{(f)}$	x^2	$I_{(f)}$	$1/P_{(s)}$	I
I generation	0.067	0.933	0.072	5.2	22.09	0.235	1.072	0.324
II generation	0.045	0.955	0.047	4.1	12.25	0.335	1.047	0.398
III generation				1	4.84	0.207		

subjects' mothers, active in terms of reproduction in the period of socialist economy, fertility rates tended to grow along with the growing level of the region's urbanization an the resulting improvement of social and economic conditions.

DISCUSSION AND CONCLUSION

The changes we observed in the values of the Crow's index components for the three generations of women seem to correlate strongly with socio-economic and cultural changes. First of all, we noted a significant decline in the value of the Crow's index of opportunity for natural selection through child mortality ($I_{m)}$, resulting from decreasing infant and child mortality.

It is stressed in literature that the downward trend in mortality observed in early stages of demographic transition is a crucial factor explaining changes in differential fertility in a population (Stinson 1982; Chandran 1989; Zamorski 1993; Feeney 1994; Mace 1998). The costs of high parental fertility to individual offspring have been found to be less pronounced in relatively wealthy strata in both contemporary and preindustrial European populations (Gillespie et al. 2008). Following demographic transition, modern fertility is dramatically reduced in comparison to many traditional populations (Nettle and Pollet 2008). Evolutionary demographers are split on the extend to which modern fertility represents maladaptation to novel environmental conditions, where cultural evolution is driving low fertility (Barlow and Burley 1980; Newson et al. 2005), or due to perceived or real high costs of parental investment (Kaplan et al. 2002; Mace 2008).

This point of view derives from the transition theory according to which a decline in a population's fertility must be an effect of decline in mortality (Teitelbaum 1975; Mason 1997). In the pre-industrial period characterized by high mortality (in particular among infants), there were no reasons for the broadening of the spectrum of birth control measures in order to maintain the population size in balance (Wilson et al. 1988; Wood 1990; Nietyksza 1995). Urbanization and modernization of societies reduced the factors causing postnatal and infant mortality and generated the model of life in which "investment" in children is an element blocking further enlargement of the family.

The biggest changes in the studied population took place in the reproduction pattern. Over a relatively short period of time (3 generations of women) an average size of family decreased from 5.1 to 2.8 children in the rural areas of Podkarpacie region and from 4.9 to 2.7 in the rural settlements of Podbeskidzie region. In the "town" and "city" categories the declines were as follows: Podkarpacie (4.5-2.3 and 4.7-2.2, respectively); Podbeskidzie (4.9-2.7 and 4.3-2.3, respectively).

In Poland, the decline in birth and death rates started initially in western part of the country as early as at the late 19th century, however the final departure from the traditional reproduction pattern took place only in the first decade of the 20th century (Okólski 1988). No regional variation was observed in the populations

under study in the values of differential fertility rate. Both for the Podkarpacie and for Podbeskidzie region this rate's values were similar in successive generations.

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