Mortality in the populations of Danzig and the District of Danzig (*Regierungsbezirk Danzig*) in the second half of the nineteenth century

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Abstract

The study concerning the populations of: the city of Danzig, Kartuzy County and the whole District of Danzig (*Regierungsbezirk Danzig*) has been based on demographic data from German yearbooks published in the second half of the nineteenth century and at the beginning of the twentieth century. The research has covered the period between 1855 and 1879 for the city of Danzig and between 1860 and 1869 for the District of Danzig.

For selected years some demographic measures, such as: death rates, infant death rates, natural increase, and population dynamics rates have been estimated. At the same time, seasonal fluctuations in mortality within a year and the most important cultural and biological causes for death have been disscussed. Moreover, life tables for the whole District of Danzig have been built. (The authors employed two methods: firstly – Halley's proposal, assuming at first a stationary type of population and then a model stable in regard to formerly calculated natural increase; secondly – a technique based on probability of death). Finally, the opportunity for natural selection through differential mortality has been estimated (Crow index I_m, potential gross reproduction rate R_{pot}, biological state index I_{bs}).

The results of the own research have been compared to attainable data concerning other regions of Poland under partition.

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Introduction

Researchers investigating the past of man, even the past so recent (taking into account the history of our species) as the previous century, face a particularly difficult task. They attempt to present at least fairly objective demographic data, having to depend on dispersed, often unreliable and uncomplete historical sources. Unfortunately, such are the demographic records concerning nineteenth-century Poland under partition.

Particular regions of the Polish territory under partition were described in numerous studies of historical demography – conducted on a large scale as well as on smaller one (e.g. BOROWSKI [1967, 1969]; GIEYSZTOROWA [1976]; JANCZAK [1987, 1994]; KĘDELSKI [1980]; PIASECKI [1990] and many others), while only rarely was their biological past recon-

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structed (mainly: HENNEBERG [1977a, b; 1978]; PUCH [1989, 1993]; partly PIASE-CKI [1990]). Former Poland's northern regions, which in the nineteenth century belonged to the part annexed by Prussia, were subjects of only few demographic researches (e.g. KLOTZKE [1980], LABU-DA 1993]). Such a situation calls for further investigation of that territory, aimed not only at providing traditional demographic measures, but also at disscussing various biological issues concerning the populations of that time and population genetics.

This study is an attempt to assess demographic dynamics and biological dynamics of such a large administrative region as the District of Danzig in selected years of the second half of the nineteenth century.

Material and methods

Due to the partitions of Poland, which took place in 1772, 1793, and 1795, the Polish state ceased to exist and its territories were annexed by the neighbouring powers. By the decision of the partitioning powers, and then by the Treaty of Vienna (1815), the District of Danzig was incorporated into West Prussia and divided into eight and afterwards into nine counties, including the urban county of Danzig (Fig. 1). That division proved to be very stable, which was important for the reliability of demographic records [LABUDA 1993].

Having access to collective information about the numbers of people, births, and deaths in the whole District of Danzig, we have managed to separate a similar type of data both for Kartuzy

Fig. 1. District of Danzig (*Regierungsbezirk Danzig*) in the second half of the nineteenth century

County, which – with some reservations – can be treated as representative for the rural areas, and for Danzig, the capital of the whole district and a big seaport with flourishing commerce. The research has covered selected years of the seventh decade of the nineteenth century, but for some demographic measures we were able to extend the limits by several or dozen or so years. Precisely speaking, we had access to data concerning the years from 1855 to 1879 for the city of Danzig, and from 1860 to 1869 in the case of the District of Danzig. The latter period is very interesting for the researcher, since in Poland, demographic material (i.e. statistical data and parish registers elsewhere treated as an important source of information about births, deaths and marriages in past centuries) dated back to the years before 1874 is rather scarce. In 1874 the Prussian authorities created Register Offices on the Polish territory annexed by that country; more precisely:

in 1873 civil marriages were made obligatory and in 1875 the Act of 6th February created registration districts [KLOTZKE 1980, BIERNAT 1992].

The selection of the above-mentioned period for study resulted from accessibility of German statistical and historiographic sources concerning the second half of the previous century, on the basis of which our own estimations and calculations have been made [ASCHKEWITZ 1940; *Topographisch-Statistische Handbuch...* 1869; *Preussische Statistik...* 1870; WALLENBERG 1880]. Comparative material containing data from other regions of Poland under Prussian rule as well as the parts of Poland annected by Russia and Austria have been choosen with regard to the same period of time [BOROWSKI 1967, 1969; GIEYSZTOROWA 1976; HENNEBERG 1977 a, 1978; JANCZAK 1987; PUCH 1989, 1993].

For selected years the following measures have been estimated (in accordance with HOLZER'S [1980] recommendations): death rates, infant death rates, natural increase, and population dynamics rates. We have also assessed seasonal fluctuactions in mortality within a year, calculating relative numbers of deaths for particular months (compare: HENNEBERG, KOZAK [1976]). Furthermore, we have built life tables for the whole District of Danzig, making use of two techniques:

1. classic Halley's method – building the tables first for a stationary type of population and next for a model stable in regard to formerly estimated natural increase [ACSÁDI, NÉMESKERI 1970];

2. method based on probability of death, taking the structure of the living population into account [HOLZER 1980, PRESSAT 1966].

The statistical significance of differences in values of life expectancy of a new-born child (e_0) was evaluated with the use of nomograms and standard-error tables of those values [HENNEBERG, STRZAŁKO 1975]. Finally, in order to assess the opportunity for natural selection through differential mortality in the investigated area, we calculated Crow index I_m [CROW 1958], potential gross reproduction rate R_{pot} [HENNEBERG 1975] and biological state index I_{bs} [HENNEBERG, PIONTEK 1975]. At the same time we conducted the analysis of the most important biological and cultural causes for deaths in the District of Danzig.

Results and discussion

As the title of the study suggests, we have focused mainly on one of the constituents of natural movement, namely – on mortality.

In demography, mortality is commonly measured by so called death rate, which, generally speaking, expresses the ratio of the number of registered deaths to the number of people over a particular period of time. Thus the death rate for any given population shows the real level of total mortality resultant from all affecting it factors. In the District of Danzig (Fig. 2, on the basis of ASCHKEWITZ [1940], *Topografisch-Statistische Handbuch...* [1869]) the death rate between 1860 and 1869 amounted to 33 ‰ and, as the figure shows, was similar to the rates for Wielkopolska, Silesia, and Polish territories under Russian and Austrian rules. Very clear difference can be observed, however, between this rate for Danzig, where it amounted to 39
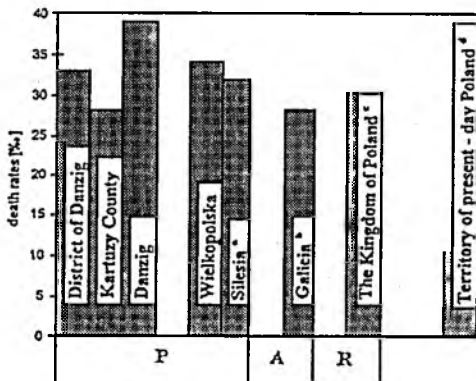
P – Part annexed by Prussia
A – Part annexed by Austria
R – Part annexed by Russia

a – Płużnica Wielka [Puch 1989]
b – Wielkie Drogi [Puch 1989]
c – Gubernias of Augustów, Lublin, Płock, Radom
    and Warsaw [Janczak 1987]
d – Rocznik Statystyczny GUS [1994]

Fig. 2. Death rates between 1860 and 1869 for the terri-
tories formerly under Polish rule

Table 1. Infant deaths on the territories formerly under
Polish rule in the years 1860–1871 (per 1000 live births)

Part annexed by	Region	Number of infant deaths
Prussia	District of Danzig	237
	Danzig	306
	Silesia [a]	223
Austria	Galicia [b]	219
Present-day Poland:	1960[c]	55
	1993[d]	13

a – Płużnica Wielka, approximate value, estimated by
    the authors on the basis of PUCH [1989]
b – Wielkie Drogi, approximate value, as above
c – *Rocznik Statystyczny* [1977] (Polish Main Statistical
    Office)
d – *Rocznik* Statystyczny [1994] (Polish Main Statisti-
    cal Office)

%₀, and for Kartuzy County, where it did not reached the value of 29 ‰.

Death rate, as has been mentioned above, is a general measure. Its level is significantly influenced by the mortality of children under the age of one year (Tab. 1, on the basis of *Topografisch-Statistische Handbuch...* [1869], WALLENBERG [1880]). In the second half of the nineteenth century infant death rates for the Polish territory under partition amounted to around 220–230‰, which meant that about one fifth or even one fourth of the total number of new-born children died every year before they reached one year of age. Undoubtedly, such high level of infant death rate for the whole District of Danzig resulted from the terrifying value of 306 ‰ for the city of Danzig.

Such high mortality of infants and adults can be blamed on many causes.

Doubtless, the heaviest death toll in the second half of the nineteenth century was taken by epidemics of infectious diseases, which spread rapidly because of very low hygienic standards. Epidemics alarmingly worsened the situation in cities, where population density was far in excess of that in the rural areas. In last decades of the nineteenth century its value exceeded six thousand people per square kilometer in Danzig, while in the villages of Kartuzy County it reached only the level of a few dozen people, for example in Załakowo population density amounted to 42 inhabitants per square kilometer at that time [FRIEDRICH 1895]. Combining that information with the fact that the road system was very poorly developed in comparison to present times [Brandsfäter 1879], one should not be surprised that cities experienced particularly severe outbreaks of epidemics, while the rural areas were much less afflicted. In the year 1866 alone the epidemic of cholera took the lives of 1450 people in Danzig and only 37 people in Kartuzy County, which meant the ratio of twenty five to one (after: *Topogra-*
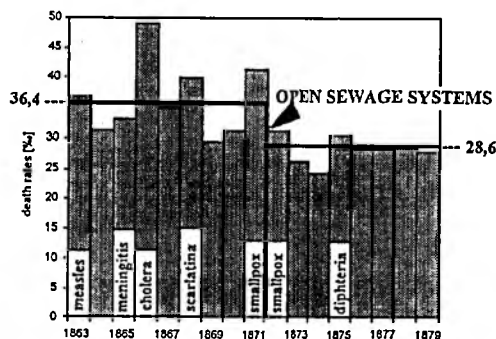
Fig. 3. Factors affecting intensity of death in Danzig be-
tween 1863 and 1879

phisch-Statistische Handbuch... [1869]).

Figure 3 presents the influence of epidemics afflicting the city of Danzig on the death rates in consecutive years of the seventh and eighth decades of the nineteenth century. As the chart shows, the above-mentioned cholera epidemic of 1866 was the most dangerous one and raised the value of death rate up to 50 ‰. But then there was very distinct drop in the mean value of death rate (from 36.4 ‰ down to 28.6 ‰) following the construction in 1872 water-supply and sewerage systems (on the basis of: Wallenberg [1880]).

a – including pregnancy complications
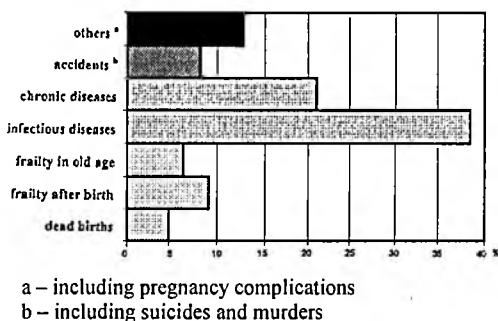b – including suicides and murders

Fig. 4. Death causes in the District of Danzig between 1865 and 1867

Epidemic diseases and low standards of hygiene were not, however, the only

factors shaping mortality in the area covered by our research. Figure 4 shows different causes for death in the District of Danzig. Unquestionably, the most important were, as we have mentioned above, infectious diseases responsible for almost 40% of all deaths, but other causes cannot be omitted (calculations based on data from *Topographisch-Statistische Handbuch...* [1869]). We have kept the terminology used by the German authors who studied that subject in the nineteenth century.

Still another issue is the fact that the mortality in the researched period was subject to seasonal fluctuations. Figure 5 presents the distribution of the relative (in proportion to the mean for twelve months) number of deaths within a year. Numbers of deaths in particular months were standarized against numbers of days in those months. The data were smoothed with a consecutive mean for three months with doubled central value. As can be seen in the chart, the shape of the death curve for the District of Danzig differs significantly from those for the nineteenth-century populations of Silesia and Galicia [PUCH 1989], which show clear maximum of mortality in late autumn, winter and early spring. On the other hand no winter maximum can be observed in the curve for the District of Danzig, which suggests, that in that area winters were comparatively mild in the researched period and the mortality caused by such diseases as pneumonia decreased (FRIEDRICH [1895], quoting sources dating back to 1880, presented the following average temperatures for winter months: -2.3° C in the uplands of the District of Danzig and -0.6° C on the coast). The curve illustrating the seasonal fluctuations in mortality for the District
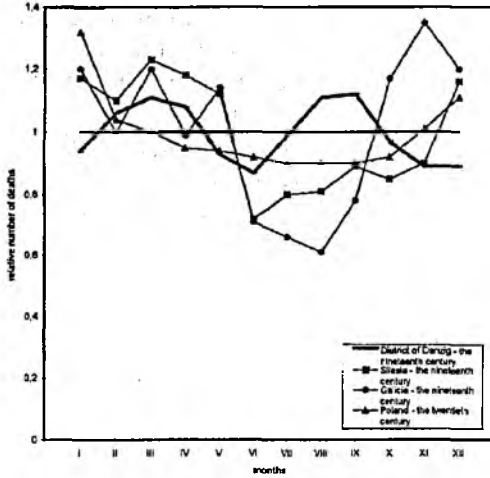
Fig. 5. Annual rhythm of deaths in selected Polish populations in the second half of the nineteenth century and in the twentieth century
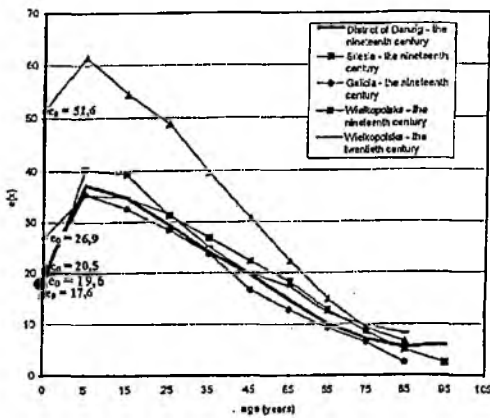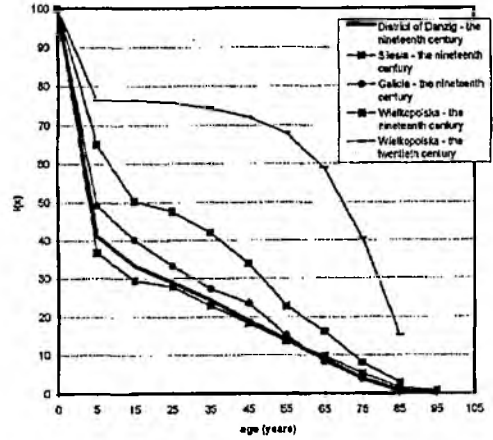

Fig. 7. Curves of survival for the District of Danzig in the second half of the nineteenth century and for selected Polish populations in the second half of the nineteenth century and in the twentieth century (stationary type of population)

Fig. 6. Life expectancy of a person at the age of x years for the District of Danzig in the second half of the nineteenth century and for selected populations in the second half of the nineteenth century and in the twentieth century (stationary type of population)
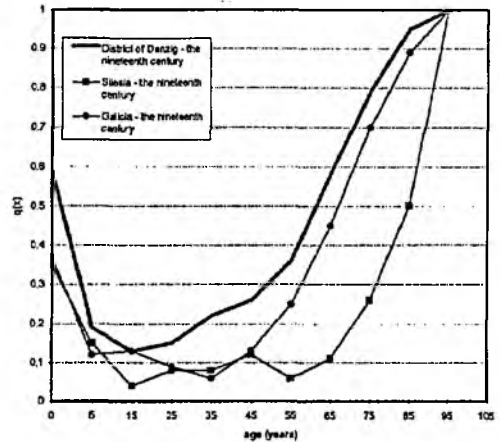

Fig. 8. Probability of death of a person at the age of x years for the District of Danzig in the second half of the nineteenth century and for selected Polish populations in the second half of the nineteenth century and in the twentieth century (stationary type of population)

of Danzig rises slightly in March, following the similar pattern for Silesia and Galicia populations, but it has its second maximum of mortality in summer and early autumn, which was untypical of that period and due, probably, to the above-mentioned epidemic of cholera.

As has been mentioned, a death rate is a general measure of a mortality level. Since it is strongly influenced by the age structure of population, its cognitive value is limited and therefore some other criteria defining the mortality are necessary. It seems that very useful role can

play here the parameters of life tables. For the purpose of this study we have calculated such parameters for the whole District of Danzig (on the basis of *Topographisch-Statistische Handbuch...* [1869]). The tables have been built in regard to different model situations. Figures 6, 7, and 8 present values of selected parameters of the life tables in the case of a stationary type of population. Among these parameters the best known one is life expectancy e_x (Fig. 6), which synthetizes all factors affecting the level of mortality in any given population. This measure is equivalent to the number of years which a person at the age of x years from the researched population is expected to live in any given mortality conditions. The chart shows, that all curves illustrating values of e_x for consecutive years of life in the compared populations of the second half of the nineteenth century have the similar shape. Different are, however, initial points of those curves, namely, values of life expectancy e_0 for new-born children. In the case of the District of Danzig that measure amounted to mere 19.6 years, value still higher than that for the Silesian population of Płużnica Wielka (17.6 years [PUCH 1989]), but considerably lower than for the rural areas of Wielkopolska (26.9 years [HENNEBERG 1977a]) and Galicia (20,5 years [PUCH 1989]). Obviously, the initial point for the present-day Polish population (between 1952 and 1972 [HENNEBERG 1977a]) is placed much higher, at the value of 51.6 years. The curves of survival and of probability of death confirm high intensity of death in the District of Danzig (in comparison with the other Polish popula-

tions in the second half of the nineteenth century [PUCH 1989, HENNEBERG 1977a], Fig. 7, 8).

Because we had an access to records containing not only numbers of deaths in the investigated populations, but also numbers of births, we were able to estimate the natural increase for the compared areas (Tab. 2, on the basis of *Topografisch-Statistische Hanbuch...* [1869]). Its value reached 11.7 ‰ for the District of Danzig and the similar level for Prussian Silesia. The lowest was, obviously, its value for Galicia, while for the Kingdom of Poland it was high. The natural increases for Kartuzy County and for the city of Danzig differed dramatically, once more comparing the city unfavourably with the rural area.

Table 2. Natural increase on the territories formerly under Polish rule, in selected years of the second half of the nineteenth century [%]

Part annexed by	Region	Natural increase
Prussia	District of Danzig	11,7
	Kartuzy County	20,5
	Danzig	1,1
	Silesia [a]	12,0
Austria	Galicia [b]	9,5
Russia	The Kingdom of Poland [c]	18,2
Present-day Wielkopolska 1960[d]		15,0
1993[e]		2,6

a – years between 1860 and 1870, on the basis of BOROWSKI [1969]

b – years between 1860 and 1879, on the basis of GIEYSZTOROWA [1976]

c – Gubernias of Augustów, Lublin, Plock, Radom, Warsaw (without city of Warsaw) – the estimation by the authors on the basis of JANCZAK [1987]

d – *Rocznik Statystyczny* [1977] (Polish Main Statistical Office)

e – *Rocznik* Statystyczny [1994] (Polish Main Statistical Office)

The latter fact has manifested itself also in population dynamics rates, which provide information about the relation between two components of a natural increase, i.e. births and deaths (Tab. 3, on the basis of *Topografisch-Statistische Handbuch...* [1869]). As it turned out, that rate was the lowest for the city of Danzig. It amounted there to one, which meant that within a year only one child was born per each deceased person.

Table 3. Demographic dynamics rates on the territories formerly under Polish rule between 1860 and 1869

Part annexed by	Region	Demographic dynamics rate
Prussia	District of Danzig	1,4
	Kartuzy County	1,6
	Danzig	1,0
Russia	The Kingdom of Poland [a]	1,6
Present-day Poland: 1960[b]		3,0
1993[c]		1,3

a – Gubernias of: Augustów, Lublin, Radom, Warsaw (without city of Warsaw), estimation by authors on the basis of JANCZAK [1987]

b – on the basis of *Rocznik Statystyczny* [1977] (Polish Main Statistical Office)

c – on the basis of *Rocznik Statystyczny* [1994] (Polish Main Statistical Office)

Having estimated the natural increase for the District of Danzig (11.7 ‰), we made use of that value in order to estimate parameters of another life table, in this case with the assumption of stable – in regard to that index – model of population. Thus obtained parameters were considerably improved in comparison to those characterizing the stationary type of population (fig. 9, 10, 11). In particular, life expectancy of new-born children exceeded 28 years, so the difference between results was statistically significant.

The selected parameters of life tables presented so far have been estimated in
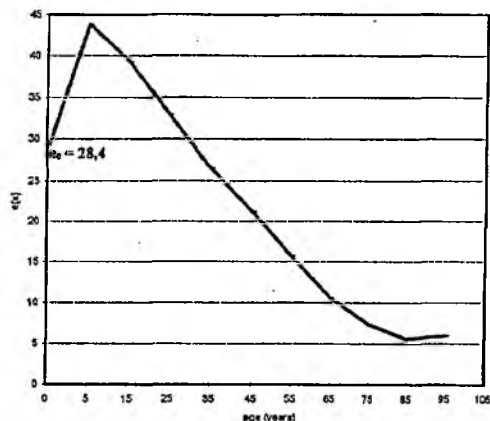

Fig. 9. Life expectancy of a person at the age of x years for the District of Danzig in the second half of the nineteenth century (stable model of population, r = 11,7)

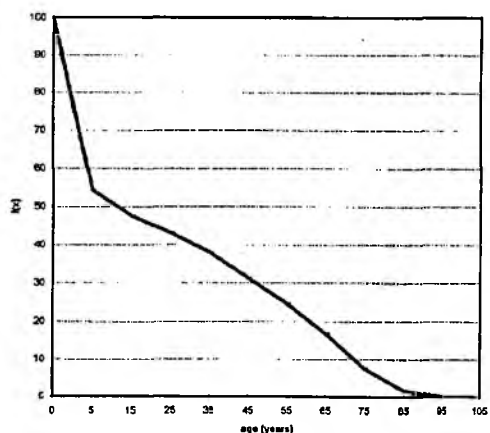
Fig. 10. Curve of survival for the District of Danzig in the second half of the nineteenth century (stable model of population, r = 11,7)

accordance with the technique implemented in anthropology by ACSÁDI and NÉMESKERI [1970] and based on classical Halley's proposal, a method much criticized by demographers. However, in this research we were able to employ still another method for the District of Danzig, because of the fact that the records concerning the population census of 1867 had survived [*Topographisch-*
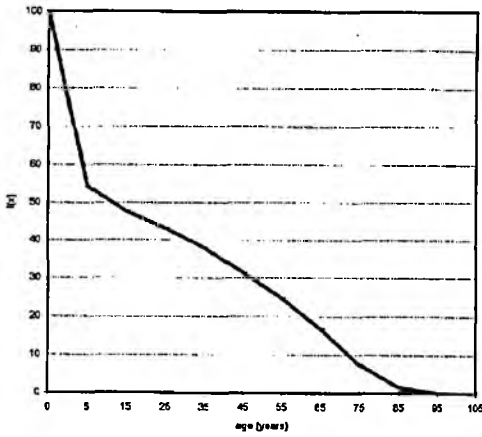
Fig. 11. Probability of death of a person at the age of x years for the District of Danzig in the second half of the nineteenth century (stable model of population, r = 11,7)
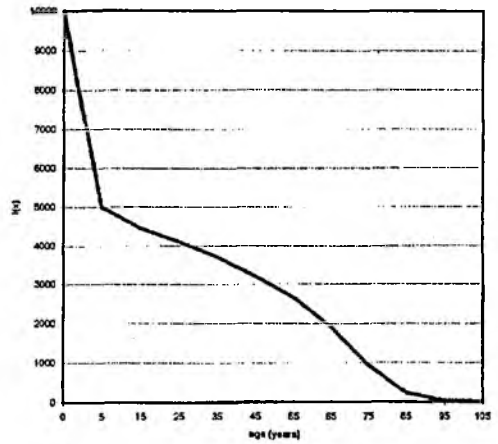

Fig. 13. Curve of survival for the District of Danzig in the second half of the nineteenth century (stationary type of population; structure of living population taken into account)
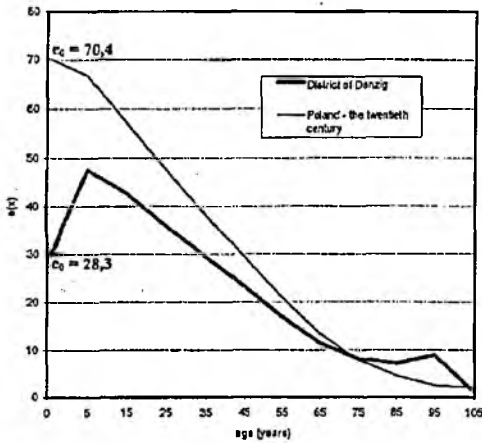

Fig. 12. Life expectancy of a person at the age of x years for the District of Danzig in the second half of the nineteenth century and for Poland in the second half of the twentieth century (stationary type of population; structure of living population taken into account). century
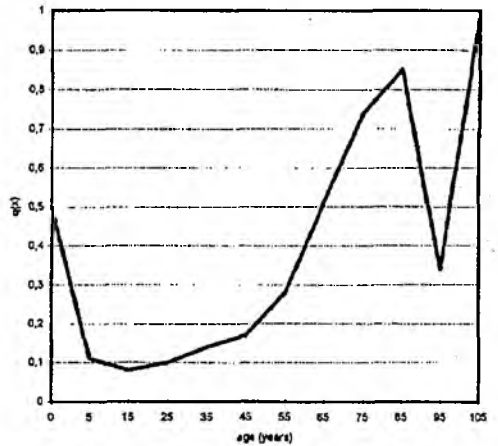

Fig. 14. Probability of death of a person at the age of x years for the District of Danzig in the second half of the nineteenth century (stationary type of population; structure of living population taken into account)

Statistische Handbuch... 1869]. Those data enabled us to build a life table applying the method of probability of death, with the structure of living population taken into account (Fig. 12, 13, 14). The results obtained by the both above-mentioned techniques (for station-ary type of population) differed signifi-cantly. It seems that those achieved in accordance with Acsádi's and Némes-keri's proposal (Fig. 6, 7, 8) may be treated as the minimal values of meas-ures characterizing the District of Dan-zig. At the same time, including the val-

ues of natural increase in our calculations (Fig. 9, 10, 11), we have achieved much more similarity between classic life tables and those built in accordance with probability of death.

Table 4. Measures of the opportunity for natural selection for the territories formerly under Polish rule in selected years of the second half of the nineteenth century (stationary type of population)

Part annexed by	Region	Im	Rpot	Ibs
Prussia	District of Danzig	1,99	0,93	0,31
	Wielkopolska[a]	0,96	0,82	0,42
	Silesia[d]	2,45	0,94	0,25
Austria	Galicia[c]	1,49	0,88	0,30
Present-day Poland[d]		0,11	0,99	0,89

a – parish of Szczepanowo from 1855 to 1874 (according to HENNEBERG [1977a])
b – parish of Płużnica Wlk. (according to PUCH [1989])
c – parish of Wielkie Drogi (according to PUCH [1989])
d – parish of Szczepanowo from 1952 to 1972 (according to HENNEBERG [1977a])

The mortality relations disscussed in this study manifested themselves in the measures of opportunity for natural selection (Tab. 4). Crow index I_m, i.e. the ratio between the number of people dying before they attained puberty and the number of survivors, reached relatively high value. The most surprising, however, was very high level of potential gross reproduction rate R_{pot} and at the same time, very low value of biological state index I_{bs}. R_{pot} provides information about the rate at which natural selection eliminates adults from a given population (and thus from reproduction). The fact that its value for the researched population of the District of Danzig was close to the level for present-day Poland gave evidence that adults of that population almost fully realized their reproductive potential. That was possible thanks to

relatively low level of adult mortality. As we have mentioned above, index I_{bs}, which shows combined effect of the natural selection in the age of prepuberty and puberty, reached alarmingly low value, thus placing the studied population among populations existing in the Bronze Age [PIONTEK 1979]. Its value informed us, that only 31% of all new-born children had the possibility to produce the full number of offspring. Undoubtedly, such situation resulted from extremely high infant mortality in the District of Danzig at that time (67% of all deaths).

Conclusions

1. The study covering selected years of the second half of the nineteenth century in the District of Danzig has proved the existence of the striking distinction between urban and rural areas in life conditions at that time, a distinction unfavourable for the cities. That fact has been confirmed by the values of the demographic measures used in the research, such as: death rates, infant death rates, natural increase and population dynamics rates.

2. Epidemic infectious diseases acted as a significant factor regulating the number of people in the previous century. They were inseparably linked with insufficient medical care, low standards of hygiene and high population density in the urban areas, where the situation was particularly severe.

3. The opportunity for natural selection in the researched period was still very high, as the values of Crow index and biological state index have shown.

4. Life tables built by two methods: firstly – classic, based on Halley's proposal [ACSÁDI, NÉMESKERI 1970], secondly – based on probability of death [HOLZER 1980, PRESSAT 1966] had different values of parameters. The technique taking into account the structure of living population provided more reliable results. That fact became particularly apparent in more probable value of life expectancy of new-born children, which for the District of Danzig amounted to 28.3 years. The reliability of that result was further confirmed by the value of death rate. The reciprocal of this value is equal to the life expectancy of the newborn (with the assumption of stationary type of population [PRESSAT 1966]). The value of e_0 for the District of Danzig calculated as the reciprocal of the death rate amounted to 32 years.

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Streszczenie

Wykorzystano dane demograficzne dotyczące ludności Gdańska, powiatu kartuskiego oraz całej rejencji gdańskiej, opublikowane w niemieckich rocznikach statystycznych z II połowy XIX i początków XX wieku. Badaniami objęto lata 1855 do 1879 w przypadku miasta Gdańsk i 1860 do 1869 w przypadku rejencji gdańskiej.

Dla wybranych lat oszacowano surowe współczynniki zgonów, współczynniki zgonów niemowląt, przyrostu naturalnego oraz dynamiki demograficznej. Oceniono sezonowość zgonów w ciągu roku, a także najważniejsze biologiczne i kulturowe przyczyny zgonów. Dla całej rejencji gdańskiej zbudowano tablice wymieralności (dwoma metodami: Halley'a – przy założeniu zastojowego stanu populacji oraz ustabilizowanego ze względu na wartość oszacowanego wcześniej współczynnika przyrostu naturalnego, a także według prawdopodobieństw zgonów). Oszacowano ponadto sposobność do działania selekcji naturalnej przez zróżnicowaną wymieralność (wskaźnik Crowa Im, potencjalny współczynnik reprodukcji brutto Rpot, wskaźnik stanu biologicznego Ibs).

Wyniki własne odniesiono do dostępnych danych z innych regionów zaboru pruskiego oraz pozostałych zaborów.

Uzyskane rezultaty podsumować można następująco:

1. Na przykładzie rejencji gdańskiej z wybranych lat II połowy XIX wieku wykazano istnienie w tym czasie rozwarstwienia miasto-wieś na niekorzyść miasta. Potwierdzają to zastosowane w pracy mierniki demograficzne takie jak: współczynniki zgonów (rys. 2), umieralności niemowląt (tab. 1), przyrostu naturalnego (tab. 2) i dynamiki demograficznej (tab. 3).

2. Znaczącym regulatorem liczby ludności w minionym stuleciu były epidemicznie występujące choroby zakaźne (rys. 3, 4), nierozerwalnie związane z niedostateczną opieką medyczną, niskim poziomem higieny i dużą gęstością zaludnienia w ośrodkach miejskich, gdzie sytuacja wyglądała szczególnie dramatycznie. Odnotowana w 1866 roku w rejencji gdańskiej epidemia cholery znalazła odbicie w krzywej sezonowości zgonów dla tego okresu (lata 1865–1867, rys. 5).

3. Sposobność do działania selekcji naturalnej w badanym okresie była nadal bardzo wysoka. Świadczą o tym wartości współczynnika Crowa i wskaźnika stanu biologicznego populacji (tab. 4).

4. Dwie metody budowania tablic trwania życia zastosowane w pracy: klasyczna, oparta na wskazaniach Halley'a (Acsadi, Nemeskeri [1970], rys. 6, 7, 8) oraz bazująca na prawdopodobieństwach zgonu (Holzer [1980], Pressat [1966], rys. 12, 13, 14) dały różne wyniki. Metoda uwzględniająca strukturę ludności żyjącej dostarczyła wyników rzetelniejszych. Uwidoczniło się to szczególnie w bardziej prawdopodobnej wartości przeciętnego dalszego trwania życia noworodka, która wynosiła w rejencji gdańskiej 28,3 roku. Za wiarygodnością tego wyniku przemawia dodatkowo wartość surowego współczynnika zgonów, którego odwrotność odpowiada przeciętnemu trwaniu życia nowonarodzonych (przy założeniu zastojowej populacji, Pressat [1966]). Wartość e₀ wyliczona właśnie jako odwrotność tego współczynnika wynosi dla rejencji 32 lata. Wprowadzenie do obliczeń informacji o przyroście naturalnym znacznie upodobniło tablicę klasyczną do zbudowanej metodą prawdopodobieństw zgonów (rys. 9, 10, 11).