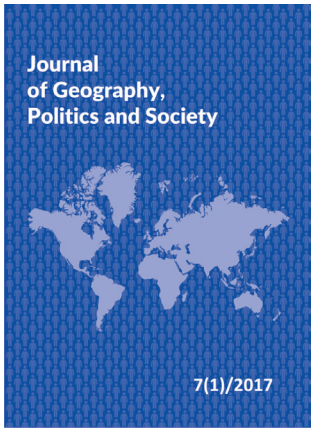

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UNEXPLAINED, SIGNIFICANT DISPARITIES IN THE INCIDENCE OF LUNG CANCER IN MEN AND BREAST CANCER AMONG NEIGHBOURING POPULATIONS OF THE POMORSKIE VOIVODESHIP

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Abstract
Significant, unexplained disparities in the incidence of lung cancer in men and breast cancer among some neighbouring populations of the Pomorskie voivodeship poviats were revealed. They were not found for lung cancer in women. Examinations were conducted on data from the Pomeranian Cancer Registry. A hypothesis was put forward that the observed accumulation of certain surnames in certain poviats argues for the repetitive occurrence of certain features of the genotype in populations inhabiting these areas, which may have an influence on the emergence of certain cancers and play a role in the emergence of the above mentioned disparities.

Key words
lung cancer, breast cancer, medical geography, local health disparities, Pomorskie voivodeship.

1. Introduction

Where we live has an influence on our health and life span. The differences concern continents, and also countries, which is understandable due to racial, civilization and climatic dissimilarities. The incidence rate of various kinds of cancer is different among ethnically and racially diversified citizens of the USA, and the differences can even rise to four times (prostate cancer, AfroAmericans 255.5 vs Native American Indians from Alaska 68.2) (National…, 1975–2004).

The standardized incidence rate for malignant cancers in Polish voivodeships also varies. For example, in 2010 it was between 302.5 (men) and 249.3 (women) in the Pomeranian voivodeship and 208.6 in men and 175.9 in women in the Podlaskie voivodeship (Didkowska, Wojciechowska, 2015). The authors of this information suggest that inadequate reporting of the cases in the voivodeships where the rate is low is the reason for the differences. However, this is contradicted by relatively low standardized coefficients of morbidity in the Podkarpackie voivodeship, for which they estimate the completeness of registration at 100%.

There are also reports about differences between poviats within the same voivodeship, which seems

especially intriguing – because what different causes of cancers could be found in people who live in close proximity, in a country that is ethnically uniform and in which everybody has similar access to medical care, and where people do not differ drastically with respect to their social and economic status? But the crude coefficients of incidence of invasive breast cancer in the Świętokrzyskie voivodeship in the years 1999–2012 was between 42.9 (Kielce poviat) and 82.9 (Skarżysko poviat) (Góźdź, Macek (ed.), 2015), and in poviats of the Podkarpackie voivodeship in 2010 it fluctuated between 25.4 (Tarnobrzeg poviat) and 132.9 (Lesko poviat) (Grądalska-Lampart et al., 2013). The authors do not comment on these differences. The weakness of these reports is that the presented data have not been standardized, and the differences have not been verified with the use of statistics.

Low and high incidence rates in a voivodeship cancel one another out and remain unnoticed. This is why the examination of differences between counties can create more premises for further exploration than examining only the voivodeship data. Also, it is easier to spot some other differences that might be connected with the incidence rate of cancer in small populations rather than in big ones.

2. The aim

The aim of this study was to examine whether the standardized incidence of lung cancer C34 (International…, 2016) and breast cancer (C50) in a long period of time may differ among some neighbouring poviats to a significant degree ($p<0.05$). The problem was examined based on the example of the Pomorskie voivodeship. Fig. 1 presents its division into poviats[1]. It means that the presented study becomes part of analyses having as their object the internal diversification of the demographic, social and health situation of the voivodeship population in its spatial frame (see: Czapliński, Szymańska, 2013; Michalski, 2002a, 2002b, 2012; Michalski et al., 2011; Nowicki, 2012; Ocena…, 2011; Rydz, 2012; Strategia…, 2001; Szmytkowska et al., 2010; Szymańska, 2012; Tarkowski, 2014; Tarkowski et al., 2014a, 2014b; Zagożdżon, Zaborski, 2002; Zaborski, Zagożdżon, 2002).

The Pomeranian Voivodeship is situated in the north of Poland on the Baltic Sea. Its area is 18,310 square km. It consists of 20 poviats, including four towns that function on the basis of poviat rights. Gdańsk and Gdynia are seaports for ocean going ships. The voivodeship is inhabited by 2,300,000 people, with 51.3% of the population being women (BDL GUS). The voivodeship has a particularly high incidence of malignant tumours, and the percentage of histopathologically verified cases is high – 96–97% (Didkowska, Wojciechowska, 2015). The completeness of registration of diagnosed tumours is estimated by National Cancer Registry at 100%.

Interestingly, not all of public health parameters here are poor. There is a higher than in the country demographic dynamics coefficient, which in 2014 amounted to 1.22[2] per 1,000 inhabitants and fewer deaths (8.75) per 1,000 inhabitants in the year (less than in Poland), and the air in Gdańsk, the largest accumulation of population[3], belongs to the less polluted in the country (Ochrona…, 2016).

3. Research material and methods

The research material consisted of the information included in the bulletins of the Pomeranian Cancer Registry (Nowaczyk et al. (ed.), 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015) for the period of 2006–2013. For each of the cancers, each poviat and each year they contain the number of new registered cases, the crude rate and the standardized rate. The analysed material, after its standardization, comprises 2,051 cases of women and 4,365 cases of men who would develop lung cancer as well as 4,819 cases of women who would develop breast cancer providing the age structure in populations where they live was standard. It is important to add that new cases and deaths are reported in Poland in the place of residence of a given person and not where he/she was treated or died.

For every kind of examined cancer, every sex, every year and every poviat, the virtual number of new, modified by standardization cases was calculated. It was done by multiplying their absolute number by the coefficient of standardization and dividing by the crude rate (CR, absolute incidence)[4].

[1] Poviats in Poland (NUTS-4) divide into administrative districts (on maps and sketches their names begin with small letter preceded with the small letter p and on cities with poviat's rights (on maps and sketches their names start with the capital letter).

[2] At the same time for Poland it was 1.00

[3] At the end of 2015 it was inhabited by 32.4% of Pomeranian voivodeship population (BDL, GUS).

[4] For example, from information for the poviat of Starogard, where "n" (new cases) in 2007 was 61, the crude rate was 100.99, the standardized incidence coefficient was 87.66, its corrected by standardization virtual number of new cases in 2007 was 52.9. After the adding the numbers of 8 investigated years and rounding the sum to the nearest integral number the sum was 336.

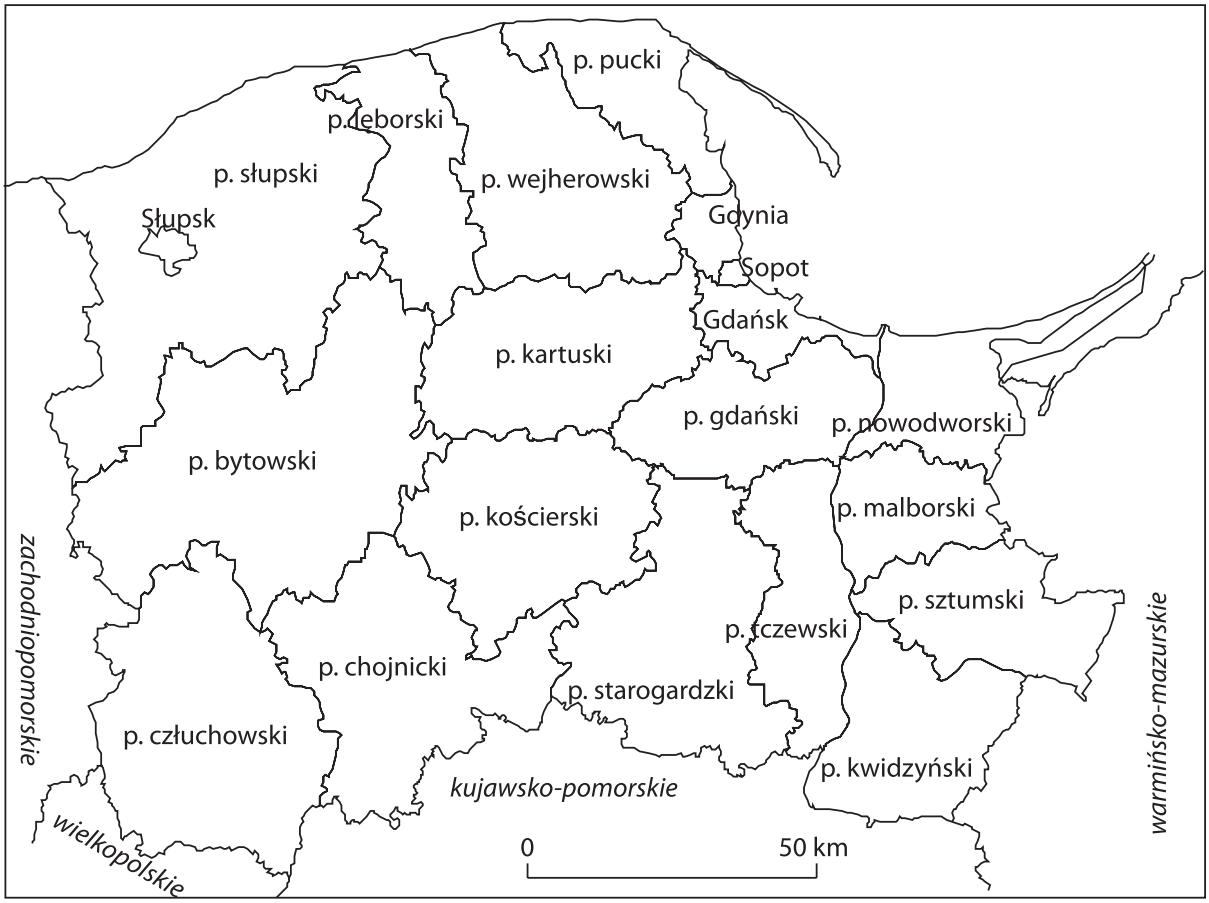


Fig. 1. Administrative division of the Pomorskie voivodship into poviats in 2016

Source: Own study based on GUS.

The number of residents of a given sex was averaged for the study period. The numbers of cases corrected with standardization were related to the numbers of residents of the same sex. They were then compared with other poviats using the principle "each with each" with the use of the Chi-square test. To avoid errors resulting from synchronous testing of the so-called "family of hypothesis", the Bonferoni adjustment was applied (Abdi, 2007) by multiplying the primarily obtained levels of significance by the number of possible comparisons, which in this study is 190.

To check whether the reports of new cases are adequate, their numbers and numbers of deaths were tested with the correlation coefficient.

4. Results

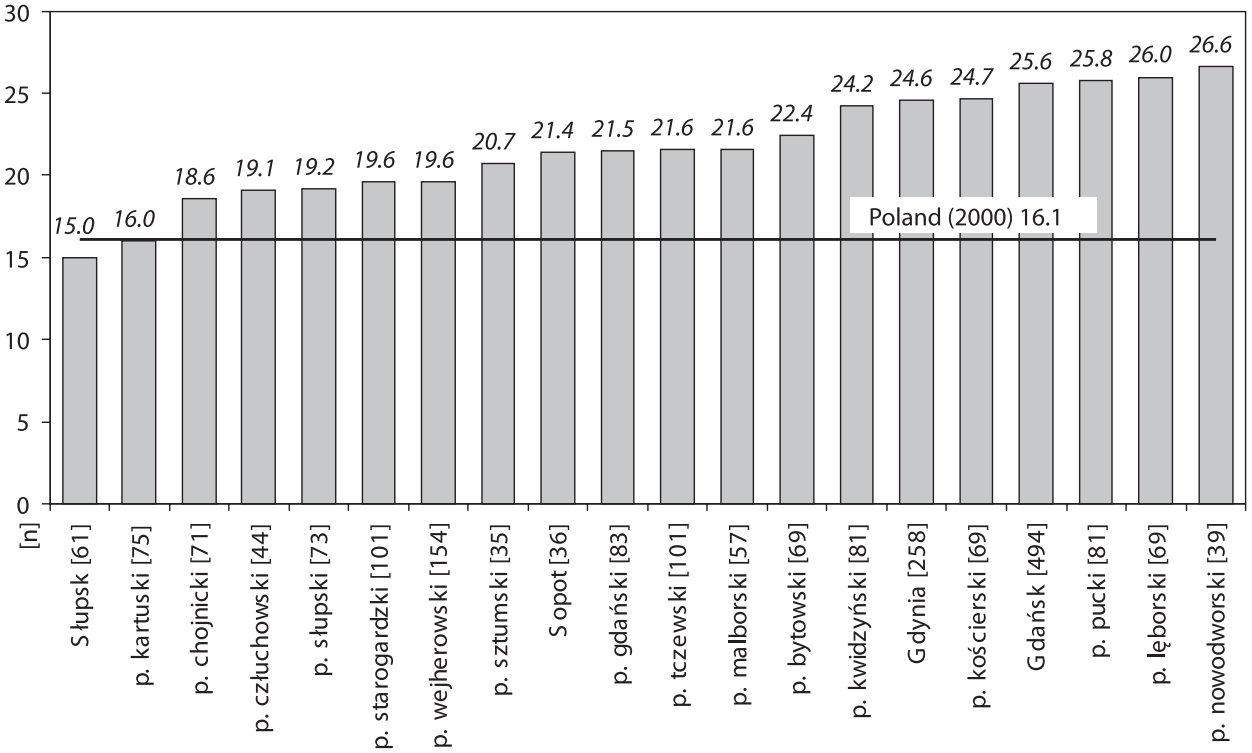
Figures 2–4 present the standardized incidence of the given cancer in Pomeranian poviats and numbers of new standardized cases in an 8-year period of observation. Numbers of new cases and deaths for each of both tested cancers have shown a high degree of correlation ($r \geq 0.994$), which seems to be proof of adequate reporting. Table 1 presents the summary of results tending to prove the thesis of this study.

5. Conclusions, proposals, discussion

In discussion with persons interested in cancer incidence one gets an impression that they consider the possibility of differences in adjacent populations to be improbable and rather due to local negligence in reporting. It was shown in this study that the differences really exist.

What has been noted in raw material between data from 2006 and 2013 is a significant growth in the number of new cases of lung cancer in women (up to 37%), of breast cancer (up to 55%) and a slight drop (5–7%) in lung cancer in men. As the situation is so dynamic, it forces researchers of the presented phenomenon to compare case numbers from the same time period.

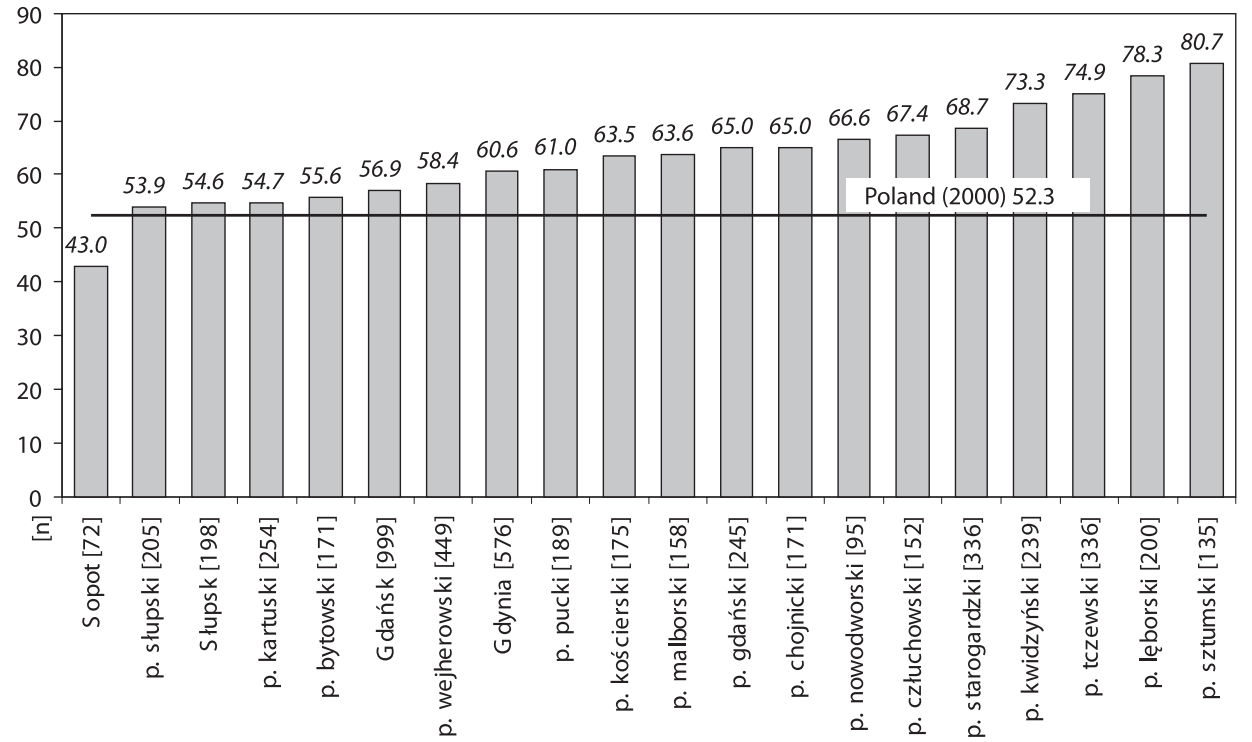
What should be the next step with findings presented in this paper? Looking for other common or



[n] = anticipated numbers of new cases in the period 2006-2013 which would occur if the population in a given poviat had the same age structure as the population accepted as standard.

Fig. 2. The mean year standardized incidence of lung cancer (C34) in women (per 100,000 women) in the Pomorskie voivodeship poviats in the period of 2006–2013

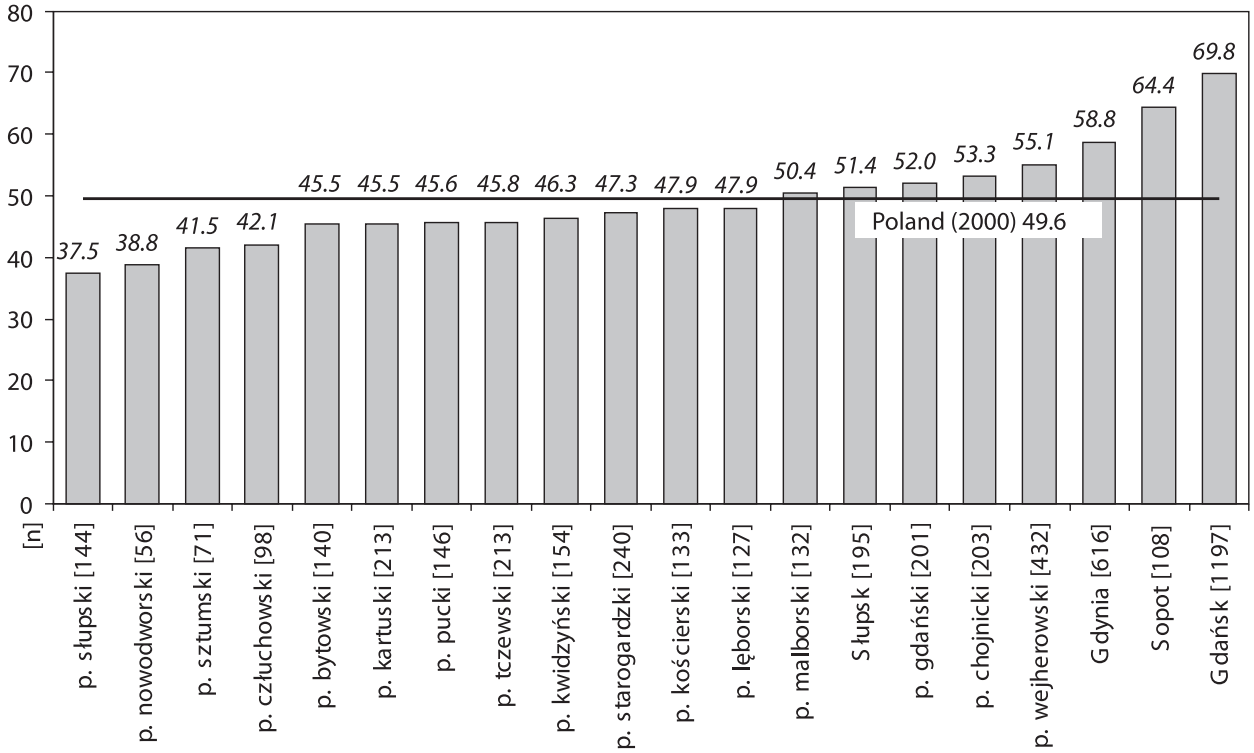
Source: Own study based on the Pomerania Cancer Register (Nowaczyk et al. (ed.), 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015).



[n] = anticipated numbers of new cases in the period 2006-2013 which would occur if the population in a given poviat had the same age structure as the population accepted as standard.

Fig. 3. The mean year standardized incidence of lung cancer (C34) in men (per 100,000 men) in the Pomorskie voivodeship poviats in the period of 2006–2013

Source: Own study based on the Pomerania Cancer Register (Nowaczyk et al. (ed.), 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015).



[n] = anticipated numbers of new cases in the period 2006-2013 which would occur if the population in a given poviat had the same age structure as the population accepted as standard.

Fig. 4. The mean year standardized incidence of breast cancer (C50) in women (per 100,000 women) in the Pomorskie voivodeship poviats in the period of 2006–2013

Source: Own study based on the Pomerania Cancer Register (Nowaczyk et al. (ed.), 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015).

Tab. 1. Results of comparisons important for the thesis tested in this study

Cancer	tested populations	significance level
Lung cancer in women	standardized incidence in p. Nowy Dwór Gdański vs city of Słupsk	p>0.05, the difference not significant
Lung cancer in men	standardized incidence in p. Słupsk vs p. Lębork	p<0.029, the difference is significant (adjacent poviats)
	standardized incidence in p. Słupsk vs p. Tczew	p<0.04, the difference is significant
	standardized incidence in p. Kartuzy vs. p. Tczew	p<0.026, the difference is significant
Breast cancer	standardized incidence in p. Słupsk vs city of Gdańsk	p< 0.000004, the difference highly significant
	standardized incidence in city of Sopot vs p. Słupsk	p<0.006, the difference highly significant
	standardized incidence in p. Słupsk vs city of Gdynia	p<0.00038, the difference highly significant
	standardized incidence in p. Słupsk vs p. Wejherowo	p<0.023, the difference is significant

Source: Own study.

absent features in populations where a given cancer was especially frequent or not. It would be reasonable to check whether the frequency of smoking, particularly in poviats with high incidence of lung cancer, does not correlate one with another. The role of smoking, dominant among cancerogenes, was probably the reason for rather small disparities in lung cancer found in this study.

One has to observe whether the differences in the incidence of breast cancer shown in city of Gdańsk, Sopot and Gdynia continue. If yes, populations with higher incidence should be submitted to screening procedures helping early diagnosis.

As we know, one of the agents playing a role in cancer development is genetics. Poland is a country with relatively low mobility of its residents, especially its older generations and those in its pre-1939 areas. People reproduce and die not far from the place where they were born. This may explain the endemicity of LCHAD, a rare genetic disease that occurs in the world at 1:153,000 people, and which is 10 times more frequent in Kashubia. The carriers of the

mutated gene c.1528.G>C, which is responsible for LCHAD, were found in 22 of 862 samples examined in the Kartuzy poviat, while in its neighbouring poviats Wejherowo and Kościerzyna the number was significantly lower (1/154 and 6/1030) (Piekutowska-Abramczuk et al., 2010). One may presume that similar differences in appearance of some genetic arrangements resulting in promoting or defending against malignancy may occur.

Another sign of the low mobility of Poles is extremely frequent occurrence of certain surnames in certain areas and their absence in other part of the country. The portal "Mapa nazwisk. Podział nazwisk w Polsce. Moi krewni.pl" (The map of surnames/The distribution of surnames in Poland/My relatives), which was created on the basis of K. Rymut's dictionary (Rymut, 2003) of surnames used in Poland at the beginning of the 21st century), informs us, for example, that at the time when the portal was being created, there were 601 persons with the surname Ceynowa in Poland, and 421 of them lived in the poviat of Puck (70%), while and in the next as to the frequency city of Gdańsk and poviat of Wejherowo only 6-7%. Contrariwise, the surname Stenka appears 1,778 times in Poland, 29.6% of them in poviat Wejherowo and less than 2% in the Puck poviat[5].

The DNA testing of people who have the same surnames in England conducted by King and Jobling (2009) from Leicester University shows that about 25% of them had common ancestors. This grew to more than one third in people whose names were extremely rare. Obviously, common ancestors mean, to some extent, common genes. King and Jobling (2009) consider surnames as markers of kindred. People in England have had surnames for about 700 years; today the surname Brown is more or less the 25th generation of the founder of the name.

Both in England and Poland the surname is inherited from the father, and chromosome Y is scanty with genes unrelated to sex. Still, the phenomenon of high frequency of the same surnames in certain areas allows us to assume that there are numerous blood relationships among the population that lives there and that it is true irrespective of the sex. This allows us to assume that the so-called inbreeding (the term used in zootechnics) concerns to some extent Polish populations.

[5] The problem does not concern only Pomerania. In 2000, 1,748 persons with the surname Legierski lived in Poland, and one third of them in the Cieszyn poviat, while in Koniakow, one of the poviat's villages 13.15% of the inhabitants carried the surname Legierski, whereas in the adjacent village (Jaworzynka) only 2.6%. One may meet Legierskis in other 60 Polish poviats and in the remaining 220 there are none at all (Rymut, 2003). Interest in the problem of a connection between a surname and over-normal frequency of some genes among theirs carriers is growing and finds some practical application in forensic medicine. It is hard to say whether it could bring any benefits in screening in oncology.

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