

# SELECTED HEALTH INDICATORS AND THEIR ECONOMIC DETERMINANTS IN THE COUNTRIES OF THE EUROPEAN UNION

**Elżbieta Sojka**

ORCID 0000-0002-9487-8214

University of Economics in Katowice

Faculty of Economics, Department of Statistical and Mathematical Methods in Economics

ul. 1 Maja 50, 40-287 Katowice, Poland

E-mail: elzbieta.sojka@ue.katowice.pl

**Abstract:** *The aim of the study is to assess the health situation of the European Union countries that are differentiated by their demographic potential and the level of socio-economic development, which is reflected, among others, in the difference in GDP per capita and total expenditures on health care per capita.*

*In the first stage of the study, two measures assessing the health situation of societies, i.e. the average life expectancy - Life Expectancy (LE) and the complex measure, i.e. the years of healthy life - Healthy Life Years (HLY), also referred to as the coefficient of life expectancy without disability, are analysed. Attention is also paid to negative health measures, i.e. mortality rates and related indicators based on the number and causes of deaths. The second part of the study is an attempt to analyse the relationships between macroeconomic quantities and life expectancy with the use of nonlinear demometric models. The survey was carried out for 2016 on the basis of data from international WHO, OECD and Eurostat databases and own case studies.*

*Despite the continuous increase in life expectancy, the differences between individual EU countries are still visible in this respect. The average life expectancy declines with the decrease in GDP per capita and decrease in health care expenditures. In the most economically developed countries of the old Union, the value of GDP per capita was more than several times higher than in Poland, and in Greece, one of the poorest countries of the "old" Union, which suffered the most severe effects of the global crisis - almost by half higher.*

**Key words:** health, mortality, Preston curve, GDP per capita, European Union

**JEL codes:** C100, H510, I100, I180

## 1. Introduction

EU Member States are facing pressure to evolve, modernize and adapt healthcare systems to a constantly changing environment, either due to demographic changes (the effects of an aging population), changing epidemiology (increasing burden of chronic diseases), or new technologies. The arguments for prioritizing health policy are strong in all countries. As the report *Health at a Glance: Europe 2016* shows, deaths due to serious non-communicable diseases across the EU translate into EUR 115 billion of potentially economic loss each year (Masters, 2017).

There is a growing awareness that investing in the health of the population is not only valuable in itself, but also contributes to economic growth. The relationships between public health and economy cannot be underestimated. Better citizens' health leads to higher productivity and lower levels of absenteeism at work or early retirement. Healthier citizens are more likely to invest in lifelong learning (Owen, et al., 2012), (Abelson, 2003). Health and wealth of economies are interrelated and show that better health in society increases the rate of economic growth. For high-income countries, the correlation with life expectancy is lower, although the literature indicates positive relationships between good health and economic development, whereas poor health of the population weakens development opportunities (Mackenbach et al., 2008; Ryc, Skrzypczak, 2011).

Improving the state of health security primarily depends on the condition of the health care system. Underfunded and poorly managed, and thus a weak and unprepared health care system is a critical link in the chain of reactions to health threats, while hampering effective actions in emergency situations. Increasing expenditures on health seems to be an obvious choice. However, health ministries in EU have to deal with persistent budget constraints, fears concerning budget stability and competition for the same resources from other services.

On average, health across the EU is the largest government expenditure after pensions. Currently, an average of EUR 2,797 is spent on health per capita, which translates into 9.9% of GDP. In Luxembourg, Germany, the Netherlands, Ireland, Sweden, Austria and Denmark spending per capita is at least 30% higher than the EU average. Comparative analyses of mortality between European countries (Bobak et al. 2000; Gilmore et al. 2002) show that inequalities in health are much lower in Western European countries and higher in Eastern European countries (in the Czech Republic, Hungary, Poland and the Baltic States ). They indicate that the differences in education and lifestyle, including smoking, alcohol consumption

and an increased risk of obesity due to lack or low physical activity and inadequate diet significantly contribute to these inequalities: (de Gelder et al. 2016).

The aim of the study is to assess the diversity of the health situation of EU countries from the point of view of both positive and negative health measures and to analyse the relationships between life expectancy and selected macroeconomic indicators. Attention is drawn to inequalities in health between the countries of the old Union (EU-15) and new member states that joined the Community in 2004 (10 countries), in 2007 (Bulgaria, Romania) and in 2013 (Croatia). The EU countries differ in their level of development, which is reflected, among others, in differences in the volume of gross domestic product per capita, expenditure on health care both in per capita and relative terms, i.e. in relation to GDP.

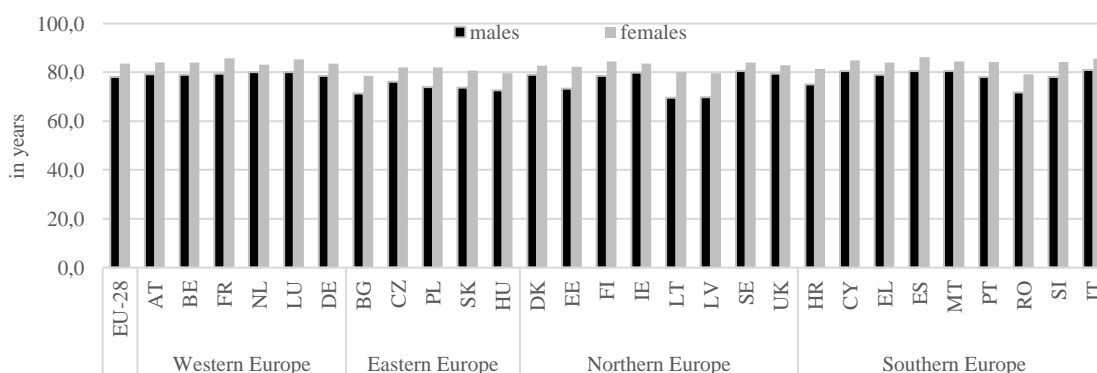
## **2. Methodology and Data**

The study presents some aspects of the health situation of the population of the European Union countries in relation to the level of socio-economic development measured by the GDP *per capita* and the total expenditure on health protection. Presented information, comparisons and analyses were prepared while using data from international WHO, OECD and Eurostat databases as well as own studies. In the first stage, the basic two indicators describing the health condition of societies, including the average life expectancy - *Life Expectancy (LE)*, i.e. the average years of life measured on the basis of statistics on mortality in a given year for a given population, and a complex measure of the years of healthy life - *Healthy Life Years (HLY)*, also referred to as the coefficient of life expectancy without disability were assessed. The first of them refers only to life expectancy, while the second one describes two features of the population being assessed, i.e. life expectancy and quality of life related to health. Both factors are among the basic measures for assessing the health situation of the population in all countries and provide a solid basis for monitoring health as an element affecting productivity and the economy. These indicators give some idea of the health level of the population as a whole. Longer human life is a very positive phenomenon, provided that people are healthy and fit at their old age. Attention was also paid to negative health measures, i.e. mortality rates and related indicators based on the number and causes of deaths. The second part of the study is an attempts to analyse the relationships between selected macroeconomic indicators and life expectancy with the use of nonlinear demometric models. The survey was conducted on the basis of data for 2016.

### 3. Results and Discussion

The movement of healthy lifestyle promotion observed since the beginning of the 1980s, as well as the development of new medical technologies and modern diagnostic methods, has resulted in a clear improvement in life expectancy parameters in the European Union. However, also in this case, a large diversity in the average life expectancy, definitely greater in the subpopulation of men than women, can be observed in individual countries (Figure 1). For most new EU members, life expectancy rates were unfavourable in comparison with the old EU. The smallest differences concerned Cyprus, while the worst situation was observed in Lithuania, Latvia as well as in Romania and Bulgaria. The highest values of the analysed parameter were observed in the countries of Western and Southern Europe and the difference between the extreme values was almost 9 years.

Fig. 1. Average life expectancy at birth in EU-28 countries in 2016



Source: Own case studies based on (www 1).

In four of the EU-13 countries (Lithuania, Latvia, Bulgaria, Romania) the expected life expectancy of men did not exceed 74 years, whereas in the EU-15 countries only in Portugal the value of this parameter for men did not exceed 78.5 years. For women, the differences in life expectancy between the countries of the old Union and its new members were smaller, yet also noticeable. In the old EU member group, only Denmark had the expected life expectancy for women under 83, while in the group of new members the situation was different - women could expect a life expectancy of over 83 years only in three countries (Cyprus, Malta and Slovenia).

In the ranking of 28 countries, Poland is in the 21st place for both sexes. The level of average life expectancy of 78 years for both sexes in Poland was achieved in the countries at a higher level of socio-economic development including France, Sweden, Belgium, Germany or

the Netherlands almost twenty years ago. It is worth noting, however, that the distribution of the analysed parameter in each subpopulation was characterized by moderate left-sided asymmetry, which means that in most EU-28 countries the average life expectancy at birth in 2016 was higher than the EU average.

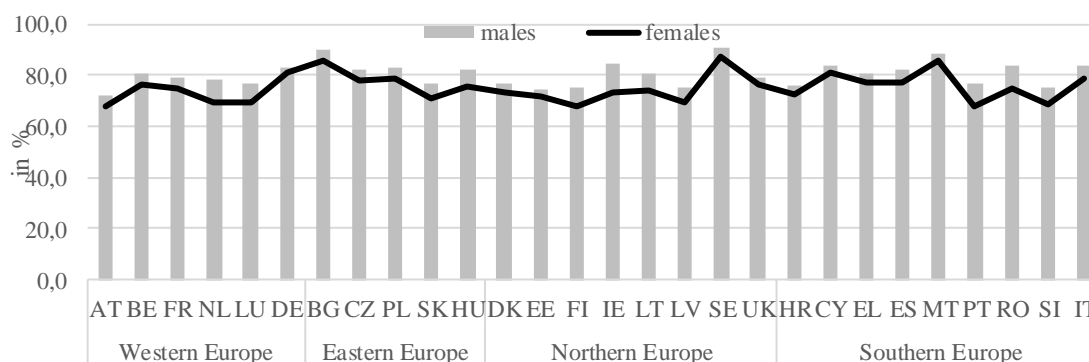
A comparison of the life spans for men and women shows that the greatest differences occur in the countries where residents live short and the smallest in countries with long average life expectancy (Fig. 1). In 2016, this difference was 4 years in the Netherlands, Denmark, Ireland, Sweden, Great Britain and Malta, whereas in Estonia, Latvia and Lithuania from 9 to 11 years. It is well known that the average low life expectancy of men is mainly caused by lifestyle-related conditions, especially the excessive use of stimulants. Research conducted for 15 European countries shows that the risk factors that contribute most to the increase in life expectancy are: smoking (19.8% among men and 18.9% among women), low income (9.7% and 13.4%) and high body weight (7.7% and 11.7%), but there were large differences between countries in terms of analysed risk factors (Mackenbach, et al., 2019).

Long life is currently a desirable value, but only if it is accompanied by good health and if there are no limitations in the performance of daily activities. The fact that a given society is characterized by a high average life expectancy does not mean that it is healthy. Life in health is perceived as life with no diseases that would prevent the normal functioning of a human, and thus independent movement or working, etc. The presence of a medical condition that is treated, even though it requires daily pharmacotherapy (e.g. hypertension) does not qualify an individual as a person who lost their health.

The diversity of countries in terms of the index of life expectancy without disability in the studied subpopulations is slightly higher than in the case of an average life expectancy, but in general the phenomenon of the difference between old and new members of the Union can be observed. Infants in Sweden, Hungary and Malta have a chance to live the longest in good health - 71-73 years, and the shortest in Slovakia - 57 years. The healthy life expectancy of the inhabitants of Poland was 61.3 years for men and 64.6 years for women. This means that women live without disability for 79% and men for 83% of their entire life (Fig. 2). It is worth noting that men in Slovakia can expect a healthy life by 5 years shorter than in Poland with the same average life expectancy for this subpopulation (about 74 years). The analysis of Fig. 2 shows that the problem of loss of health concerns especially women. Although they live longer than men, they also live a greater part of their lives in failing health (limited fitness, the occurrence

of certain chronic diseases or poor self-assessment of health). Hence, for all EU-28 countries, a higher share of healthy life years for men than for women is observed.

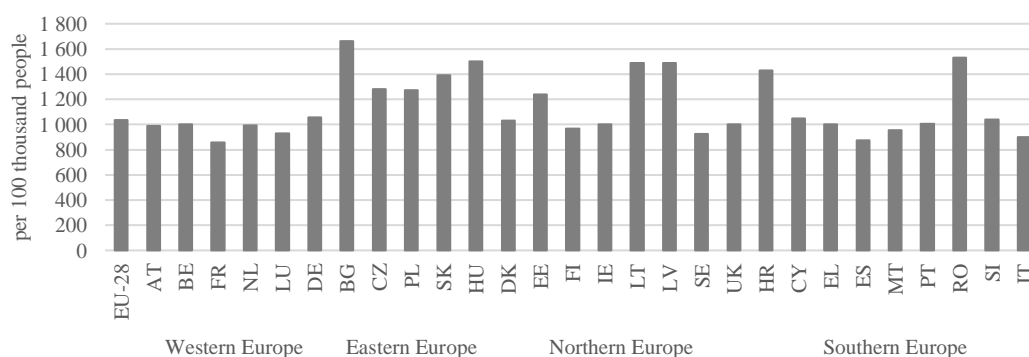
Fig. 2. Healthy life expectancy as a percentage of average life expectancy at birth in EU-28 countries in 2016



Source: Own case study based on (www 1).

Mortality rates and related indicators based on the number and causes of deaths are negative measures of health (Figs. 3 - 5). As Fig. 3 shows, the standardized total death rate took the highest values in the analysed period (over 1,400 deaths per 100,000 population) in such countries as Bulgaria, Croatia, Lithuania, Latvia, Romania and Hungary, whereas the lowest in Italy, Spain and France - around 900 deaths per 100,000 population.

Fig. 3. Standardised total death rate in EU-28 in 2016.

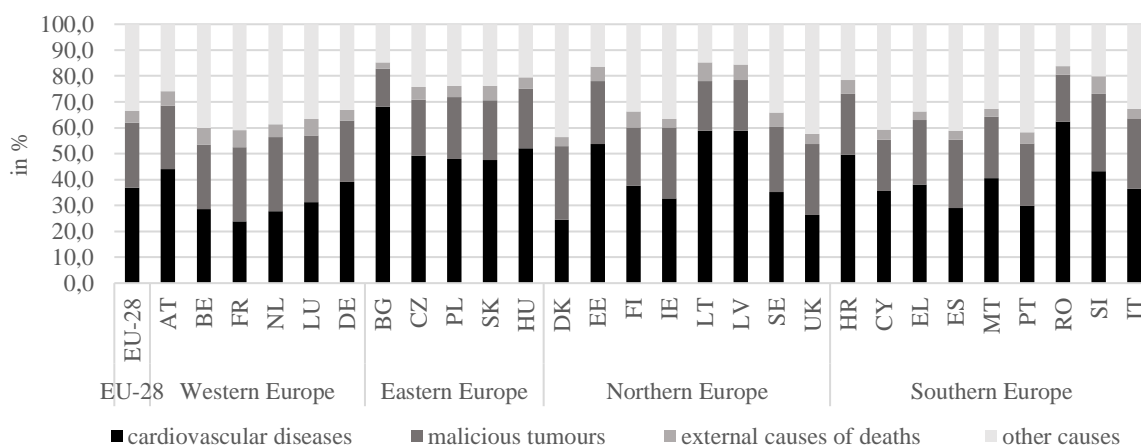


Source: Own case study based on (www 1).

Among the analysed countries, a clear difference in mortality by causes is observed. For several years, cardiovascular disease has invariably remained in the first place in the death statistics of most countries as the major cause (Fig. 4). Deaths from cardiovascular diseases in 2016 represented from 24% of all deaths in Denmark and France, to 68% in Bulgaria. In the

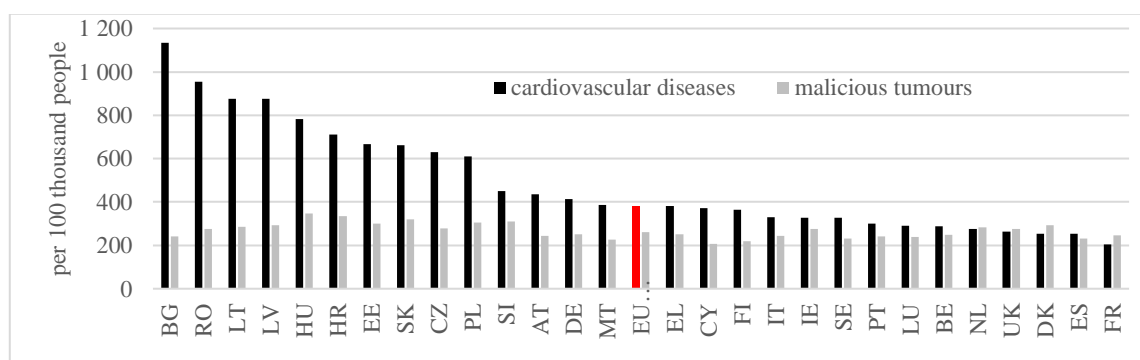
group of new EU members, mortality from cardiovascular disease was at a higher level than in the EU-15 (Fig. 5). The difference in mortality between the country with the highest (Bulgaria) and the lowest (France) value of the rate was as much as 928 deaths per 100,000 population and was twice as high as in 2009 when it was at the level of 429 per 100,000. This means that the distance between the countries of the old and the new Union considerably increased. In Poland and the Czech Republic, death rates from cardiovascular disease were the lowest of all within the former socialist bloc and reached 610 and 630 deaths per 100,000 people respectively. However, the value of the coefficient was still three times higher than the one observed for example for France - 205 per 100,000 people. There are also countries in the EU where the death rate from cardiovascular disease was lower than from malignant tumours. These include: France, the Netherlands, Denmark and Great Britain (Fig. 5).

Fig. 4. Standardized mortality structure by causes in EU-28 in 2016.



Source: Own case study based on (www 1).

Fig. 5. Standardised rates of mortality caused by cardiovascular diseases and malicious tumours (per 100,000 people)



Source: Own case study based on (www 1).

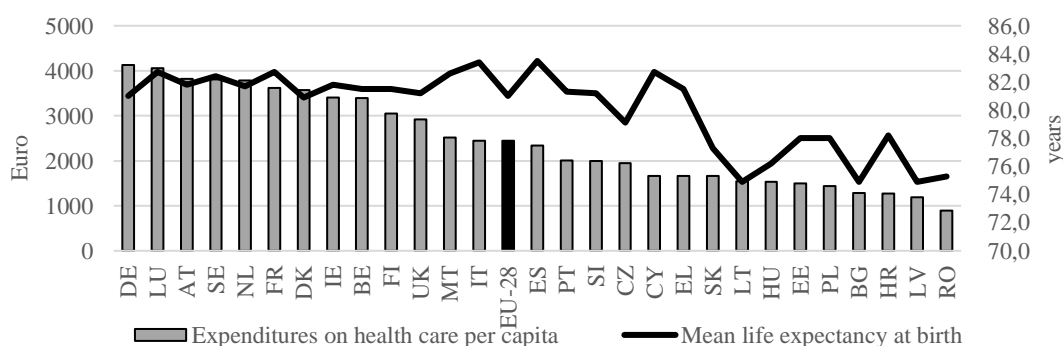
In the case of malignant neoplasms, the spatial diversity of the mortality rate was definitely smaller than in the case of cardiovascular diseases (Fig. 5). The most favourable values in this respect occurred in Finland (219/100 thousand) and Cyprus (207/100 thousand), whereas the highest - in Hungary (350 deaths per 100 thousand), in Poland, Slovenia, Slovakia and Croatia (from 300 to 340 per 100,000 people).

The highest share of deaths caused by external causes among the causes of total deaths was recorded in Lithuania (7.3%; 110/100 thousand) and Slovenia (7%; 73/100 thousand), whereas the lowest in Bulgaria (2.4%; 41/100 thousand) – Fig. 4. The author's research shows that these two countries: Lithuania and Slovenia also have the highest death rates due to suicide in the EU (31 and 21 deaths per 100,000 population, respectively). In addition, in many countries of the new Union, deaths caused by external causes, mainly road accidents, are increasing due to the rapid development of the automotive industry and the lack of adequate road infrastructure.

### 3.1. Life expectancy and macroeconomic variables

It is commonly known that there is a relationship between economic development of a country and indicators of the health situation of the society. Together with the development of a country economy, the share of expenditure on health in GDP increases and the amount of the expenditure per capita grows. This enables better health care and thus significantly affects the state of health of the society (Ryć, Skrzypczak, 2011).

Fig. 6. Average life expectancy at birth and the level of expenditures on health care *per capita* in EU-28 in 2016



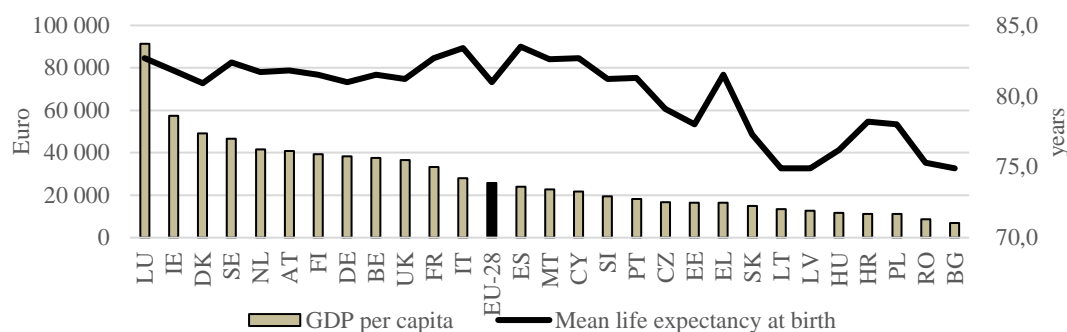
Source: Own case study based on (www 1).

This part of the study examines the relationship between basic macroeconomic variables and average life expectancy (Figures 6, 7). In the case of the former, GDP per capita and the level of total expenditure on health care *per capita* (in Euro according to PPS) were taken into



account. The size of GDP reflects the country's economic potential and the level of income of the society, while total expenditure on health care includes expenditure incurred both in the public and private sectors on all material and human resources that are involved in responding to health-related needs.

Fig. 7. Average life expectancy at birth and GDP *per capita* level in the EU-28 in 2016



Source: Own case study based on (www 1).

The analysis of the above figures allows to state clearly that with the decrease in GDP per capita and the decrease in expenditure on health care, the average life expectancy declines. In the most economically developed countries of the old Union, the value of GDP per capita was more than several times higher than in Poland, and in Greece - one of the poorest countries of the "old" Union, which suffered the most severe effects of the global crisis - almost by half higher. In terms of GDP *per capita* Poland was only in 26th place in the ranking of the member countries. In this respect, it was overtaken by countries that joined the EU structures together with Poland, i.e. the Czech Republic, Estonia, Slovakia, Lithuania, Latvia and Hungary. In 2016, GDP *per capita* in Poland amounted to EUR 11 100 (according to PPS), which constituted 67% of the GDP of the Czech Republic and Estonia expressed in the same way, and 74% of Slovakia's GDP. Bulgaria with a GDP value of EUR 6800 / inhabitant was at the end of the list.

Comparisons of expenditure on health are not good for patients. The analysis of Fig. 6 shows that there is a gap between old and new members of the European Union. The most favourable result was recorded for Germany (€ 4,129 per person) and Luxembourg (€ 4053), whereas for eight countries (Austria, Sweden, the Netherlands, France, Denmark, Ireland, Belgium, Finland) the expenditure was in the range of 3000 - 4000 Euro per 1 inhabitant (according to PPS). There are also considerable differences in the case of new members. Expenditures *per capita* in the Czech Republic and Slovenia were about 40% higher than in Poland, which is a continuation of the relationship from 2000. On the other hand, in Romania

their level did not exceed € 900 per capita. Comparing Poland with its western neighbours sets a strategic goal for the central administration, because in the analysed period, for example Germany spent on health 287%, Austrians, Swedes and Dutchmen - 260%, French and Danes - 250% of the level of Polish expenditure on health *per capita*. Considering that modern, technologically and technically highly advanced medical procedures are expensive, it means that the availability of these services in countries with low health care expenditure is not only limited, but also extended in time.

Resources allocated to health can also be referred to the welfare of a given country and presented in relation to the gross domestic product. In 2016, a total of 6.5% of GDP was allocated to health in Poland (both from public and private sources). Again, this is one of the lowest rates not only among EU-28 countries but also among OECD countries. However, it should be remembered that the low share of health expenditure in GDP does not always mean small funds allocated for this purpose. An example here is Luxembourg, a small rich country, which, similarly to Poland, allocates 6.2% of GDP to health, although the amount per person is as much as € 4052 according to PPS (three times more than in Poland). However, the low share of expenditure in GDP in less prosperous countries is a problem because it indicates not only low health financing, but also the failure of health care needs in relation to other needs in the race for limited resources of a given country. However, it should be remembered that the problem of limited resources (including human resources) and unlimited needs are one of the main dilemmas faced by Polish healthcare. Therefore, even high amounts allocated to health will not allow to meet all health-related needs of the population. Higher expenses not always translate into better health of the population. The United States, which spends the most on health<sup>1</sup> could be an example here, as the health situation of the society is relatively weak there for such highly developed country. Therefore, societies, especially the rich ones, where health expenditure is already high, have to consider to what level should funds for treatment, that is health care be increased; or whether they should only try to make better use of them, and allocate additional funds for other purposes related to prevention and health promotion, i.e. the goals that can bring greater health and social benefits.

The statistics indeed show a certain relationship between the country's wealth measured by *GDP per capita* and the amount of financial resources for health, i.e. the wealthier the

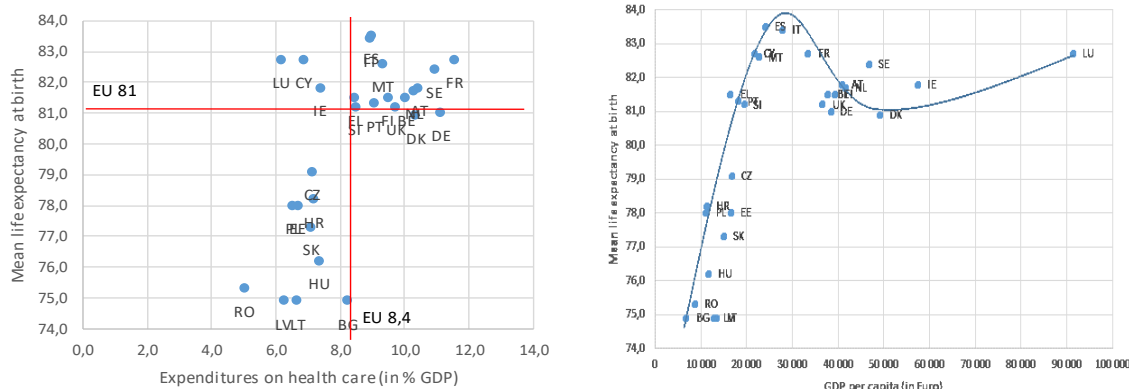
---

<sup>1</sup> It is estimated that in 2016 the United States was significantly ahead of all other OECD countries, spending the equivalent of USD 9,892 PPP per capita. This level of health expenditure is almost two and a half times higher than the average in 35 OECD countries (USD 4 003) and 25% above the level in Switzerland. The United States spends almost 80% more than Germany, and more than twice as much on healthcare per person than Canada, France and Japan. See (OECD, 2017), (www 4), (www 5).

---

country, the higher the level of health care expenditure per capita (the rank correlation coefficient was 0.85 for data of 2016). On the other hand, the higher the country's share of health care expenditure in GDP, the higher the average life expectancy (Fig. 8).

Fig. 8. Relationship between expenditure on health care and average life expectancy in EU-28 countries in 2016 (left graph) and Preston curve (right graph)



Source: Own case study based on (www 1), (www 7).

Countries where the share of expenditure on health is the highest and exceeds 10% of GDP (France, Sweden, Austria, the Netherlands, Germany, Denmark, Belgium) can boast higher values of life expectancy at birth, far exceeding the EU average of 81 years (fig 8). The expected life expectancy, however, does not change linearly with the change in expenditure on health care. From the perspective of average life expectancy, at a low level of expenditure, their effectiveness is relatively high, and at high level it decreases. A similar relationship can be observed between the average life expectancy at birth and the level of GDP per capita (Fig. 8).

The average life expectancy is better in countries with higher GDP per capita. It seems that this overall relationship appears to be independent of the population size. However, at higher levels of development, the relationship between income and life expectancy is decreasing. For example, Luxembourg is richer than other EU Member States, but life expectancy is higher in other countries, e.g. Spain or Italy. Thus, Preston's curve<sup>2</sup> suggests that income is one of the determinants of health inequalities between countries, but higher GDP per capita is by no means a sufficient (or even necessary) condition for improving population

<sup>2</sup> Preston's curve indicates that, on average, people born in richer countries can expect a longer life than people born in poor countries. However, the relationship between income and life expectancy is flattening. This means that with a low level of per capita income, a further increase in income is associated with a large increase in life expectancy, but with high levels of income, a rise in income has a small related change in life expectancy. In other words, if the relationship is interpreted as cause and effect, then income decreases in terms of life expectancy (Schultz, 2008). See also (Preston, 1975).

health. It is more and more often stated that the prosperity appearing at certain stages of socio-economic development poses a threat to society, expressed by the intensification of civilization diseases, which in consequence lead to shortening of life (www 2).

In the case of strong and statistically significant relationships between the studied variables, there is a validity for the construction of regression models. The logarithmic function proved to be the function best-matching the real data for modelled relationships. Structural parameters of the models and parameters of the stochastic structure were determined by the method of least squares, and the results of the estimation are presented below.

$$Y = 3.5022 \ln X_1 + 45.885 \quad Su = 1.8449; \quad Vz = 2.3\%; \quad R^2 = 0.5873 \quad (1)$$

(0.5593)      (5.6324)

$$Y = 4.8004 \ln X_2 + 43.037 \quad Su = 1.8665; \quad Vz = 2.33\%; \quad R^2 = 0.5775 \quad (2)$$

(0.8058)      (6.2229)

where: Y - average life expectancy;  $X_1$  - GDP *per capita*;  $X_2$  - expenditure on health care *per capita*; Su - residual standard deviation; Vz - random variation coefficient;  $R^2$  - determination coefficient.

Both explanatory variables are statistically significant (at  $\alpha = 0.05$ ) and the best match was obtained in the case of model (1), in which almost 59% of changes in average life expectancy were explained by changes in GDP *per capita*<sup>3</sup>. Considering the results of model estimation (2) with a minimum health expenditure *per capita* of € 896, the average life expectancy (the theoretical value of the endogenous variable) is about 75.7 years.

Summing up, the overall relationship between economic development and health is relatively complicated. Economic development alone does not directly lead to a reduction in health differences. Appropriate policy and greater involvement in social benefit programs are necessary. The translation of GDP *per capita* into the state of citizens' health and health equality largely depends on appropriate policies aimed at reduction of disparities and improvement of overall health through the optimal use of available resources. It is also worth noting that due to factors such as diet, some member states have more favourable health indicators than more economically developed areas of the Community (e.g. France, Spain, Italy or Cyprus).

#### 4. Conclusions

The state of health of the population is shaped under the conditions and standard of living, access to health care services, including prevention, treatment and rehabilitation, as well as

---

<sup>3</sup> In the case of analyzes conducted by the author for 2009, the coefficient of determination was over 0.72. (Sojka, 2014).

security in various areas of social and economic life. Not only life expectancy in general, but healthy and unhealthy life expectancy is important for the assessment of the ability of individual generations to work.

The performed analyses indicate a clear disproportion between old and new members of the European Union, both when comparing indicators determining the health condition of societies and macroeconomic indicators that are an important determinant of the health condition of the population. The reasons for this situation can be found in socio-economic, political and historical differences. Certainly, one of the most important reasons concerns the amount of total expenditure on health care which is significantly lower in the countries of the former Eastern Bloc (from 5.4% to 7.4% of GDP), while in other countries these expenditures definitely exceed 9% of GDP. As the research shows, macroeconomic variable such as expenditure on health protection *per capita* and GDP *per capita* are important determinants of the health situation of European Union countries.

The demographic situation of the population, especially the structure of the population by age is undoubtedly one of the crucial factors shaping the health situation of the population. The percentage of the elderly people has been increasing rapidly in the last several years (Sojka, 2013). In the entire European Union, the percentage of people aged over 65 increased by 4.1 percentage points (from 15.6% in 2000 to 19.7 in 2018). The increase in the percentage of people at retirement age is a challenge for the social policy of states, because there is a need to build special programs providing access to specialist social and health services, conducive to healthy aging and those that will make the lives of older people socially and economically useful.

## References

- Abelson, P. (2003): *The value of life and health for public policy*, "Economic Record", Vol 79, pp. 2-13, DOI: <https://doi.org/10.1111/1475-4932.00087>.
- Bobak M., Pikhert H., Rose R. et al. (2000), *Socioeconomic factors, material inequalities, and perceived control in self-rated health: cross-sectional data from seven post-communist countries*, „Social Science & Medicine, Vol 51, pp. 1343-1350.
- De Gelder R., Menvielle G., Costa G., Kovacs K., Martikainen P., Strand B.H., Mackenbach J.P. (2016): *Long-term trends of inequalities in mortality in 6 European countries*, "International Journal of Public Health", Vol. 62, pp. 127-141, (DOI: 10.1007/s00038-016-0922-9).
- Gilmore ABC, McKee M, Rose R. (2002), *Determinants of and inequalities in self-perceived health in Ukraine*, „Social Science & Medicine, Vol 55, pp. 2177-2188.
- Mackenbach J. P., Valverde J. Bopp M. et al., (2019): *Determinants of inequalities in life expectancy: an international comparative study of eight risk factors*, "Lancet Public Health", Vol. 4, pp. e529 – e537.

- Mackenbach JP, Stirbu I, Roskam AJ, Schaap MM, Menvielle G, Leinsalu M, et al. (2008): *Socioeconomic inequalities in health in 22 European countries*, "New England Journal of Medicine", 358 (23) (2008), pp. 2468-2481.
- Masters R., Anwar E., Collins B., et al (2017), *Return on investment of public health interventions: a systematic review*, "Journal of Epidemiology & Community Health" (DOI: 10.1136/jech-2016-208141) Vol. 71, pp. 827-834 Published: AUG.
- Niżankowski R. (2000): *Jaki system specjalizacji lekarskich?*, "Zdrowie i Zarządzanie" 2 (5), pp. 20-21.
- OECD (2017), *Health expenditure per capita*, (in:), Health at a Glance 2017. OECD Indicators, OECD Publishing, Paris, (DOI: [https://doi.org/10.1787/health\\_glance-2017-44-e](https://doi.org/10.1787/health_glance-2017-44-e)).
- Owen L., Morgan A., Fischer A., et al. (2012): *The costeffectiveness of public health interventions*, "J Public Health" No. 34, pp. 37-45. DOI: <https://doi.org/10.1093/pubmed/fdr075>.
- Preston S.H. (1975): *The changing relation between mortality and level of economic development*, „Population Studies”, 29(2).
- Ryć K., Skrzypczak Z. (ed.) (2011): *Ochrona zdrowia na świecie*, Wolters Kluwer Polska, Warszawa, p. 25.
- Schultz T. P. (2008): *Podręcznik ekonomii rozwoju*, 4, Elsevier, p. 3406.
- Sojka, E. (2014): *Health condition of ageing populations of the European Union*, (in:), D. Szymańska, and J. Biegańska (ed.), "Bulletin of Geography. Socio-economic Series", No. 23, Toruń: Nicolaus Copernicus University Press, 2014, DOI: <http://dx.doi.org/10.2478/bog-2014-0009> pp. 135-148, pp. 135-148.
- Sojka, E. (2013): *Sex-age Structure of the Population in the European Union and Economic Growth*, (in:), *И.А. Родионова*, (ed.), *Rynek труда i zaniatost naseleniya w naczale XXI* (in:),:Europa, Polska, Rosija, Rosyjskij Universitet Družby Narodow, [Рынок труда и занятость населения в начале XXI в.: Европа, Польша, Россия,] Moskwa 2013, pp. 72-86.
- Zybała A. (red.) (2009): *Wyzwania w systemie ochrony zdrowia – zasoby ludzkie i zasoby organizacyjne w centralnych instytucjach*, Krajowa Szkoła Administracji Publicznej, Warszawa, p. 11.

#### Online sources

- (www 1) <http://ec.europa.eu/eurostat/data/database> (downloaded 14.05.2019).
- (www 2) [ec.europa.eu/social/BlobServlet?docId=6265&langId=pl](http://ec.europa.eu/social/BlobServlet?docId=6265&langId=pl), *Zmniejszanie nierówności zdrowotnych w Unii Europejskiej [Reducing health inequalities in the European Union]*, European Commission 2011 (downloaded 12. 11. 2012).
- (www 3) <https://izp.wnz.cm.uj.edu.pl/pl/blog/ile-i-z-jakich-zrodel-wydajemy-na-zdrowie-w-polsce/> (downloaded 13.09.2019).
- (www 4) [https://stats.oecd.org/index.aspx?DataSetCode=HEALTH\\_STAT](https://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT) OECD Health Statistics 2017 (downloaded 12.09.2019).
- (www 5) <https://apps.who.int/nha/database/Select/Indicators/en> WHO Global Health Expenditure Database (downloaded 12.09.2019).