

## ECONOMIC DIMENSION OF CHRONIC DISEASES - ASSESSMENT OF LOST PRODUCTIVITY IN THE BLACK SEA REGION

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**Abstract:** *The subject of the study was to assess the level of lost productivity of human resources in the countries of the Black Sea region determined by poor health. The assumed analysis was carried out by assessing the intensity of the level of premature mortality of people in the working age caused by chronic diseases and its economic effects measured by the value of lost production. The assessment of the cost of lost productivity was based on the human capital method (HCM). The comparison of the value of the lost product in the analyzed group of countries showed large discrepancies resulting both from the differences in the scale of the burden of premature mortality in the working age population and from the adopted valuation of the work unit.*

**Key words:** *lost productivity, labour resources, years of life lost - YLL, Black Sea region*

### Introduction

Currently, in many countries there is an increase in the burden on people of working age with the consequences of chronic diseases. In particular, this phenomenon is characteristic of economies with a high level of development and it is rooted both in the increasing aging process of the society, as well as in the growing scale of the risk of lifestyle-related diseases [5]. In 2019, 2.36 million people aged 15-69 died prematurely in Europe in 2019 due to non-communicable diseases (NCD), and chronic diseases were responsible for over 85% of all deaths in this age group. The intensification of the scale of the occurrence of chronic diseases negatively affects both the level of professional activity of the labour force [6] and contributes to significant economic losses resulting from the lost productivity [10]. The burden of chronic diseases increases with age and it should be expected that people in „late“ working age will be burdened with numerous limitations in activity due to health problems or at worst, premature death [4]. The long-term consequences of the exacerbation of chronic diseases among the working-age population pose a challenge for many countries regarding the need to deal with the problem of reduced productivity of labour resources. However, it should be noted that the incidence and rate of mortality from chronic diseases vary between countries [7].

The aim of the study is to analyse and assess the burden of chronic diseases in the group of people of working age in the countries of the Black Sea region and to attempt to indicate the impact of premature mortality of people of working age on the level of lost productivity of labour resources. The indicated selection of the group of countries in the Black Sea region provides an excellent opportunity to study the phenomenon of chronic disease burden of societies living in similar geographic conditions, but politically, economically and culturally diverse. The assumed analysis was carried out in a time



perspective by assessing the intensity of the level of premature mortality of people in the working age caused by chronic diseases at two time points, i.e. in 2000 and 2019. The assessment of the cost of lost productivity was based on the human capital method (HCM) proposed in the literature, allowing to estimate the level of loss from the perspective of the national economy [9][1].

The main sources of information were the databases of the World Health Organization (WHO) allowing to obtain information on the scale of burden of chronic diseases consequences at the level of individual countries of the studied area, estimated as the number of prematurely lost years of life (the number of potentially productive years of life lost as a result of chronic diseases). For the purposes of the assumed analysis, these data were aggregated for the group of people aged 15-69, considering this age group as potentially productive. The use of international databases made it possible to present the studied phenomenon against the background of the average results observed in this area in the group of highly developed countries.

### **Health and productivity in the concepts of the labour market**

There have been many attempts in the literature to carry out theoretical considerations, as well as empirical verification of the problem of the impact of health on the level of economic activity of people of working age. Poor health assessment is indicated there as one of the key predictors of the phenomenon of premature exit from the labour market or abandonment of seeking employment [13][14]. D.E. Bloom et al. adopting an approach based on endogenous growth models, it indicates the following relationships between poor health and the economy: (1) lowering the health quality of people of working age causes lower labour productivity, (2) shortening the average life time, including healthy life, implies growth the rate of depreciation of skills aggregated in labour resources, (3) increasing the effectiveness of education and stimulating innovative attitudes is more effective in relation to healthy people [3]. The main problem in measuring the effect of health on the lost productivity of human capital turns out to be the multi-directional mechanisms of its operation. In the case of many studies, the problem of the endogeneity of the relationship between health and the economy was emphasized, which did not allow to unequivocally confirm the causal relationship of the positive correlation between the health condition of the inhabitants and the effect measured by the level of economic growth [16]. Two concepts play a dominant role in the literature. On the one hand, there is a causal link between health and economic activity, suggesting that poor health is a consequence of economic inactivity of people of potentially working age [2]. On the other hand, it is argued that poor health may substantially increase the risk of low economic activity in those affected by the consequences of disease [15].

While premature death due to chronic diseases of a working-age person obviously affects the level of their professional activity, the study of the relationship between the level of burden of these diseases in the case of living people and their professional activity of people affected by them requires a broader perspective. Characteristic for highly developed economies, the increase in the burden of the so-called non-communicable diseases, visible especially in the group of older workers, is directly related to the growing scale of chronic diseases and their long-term consequences. This has serious consequences both in terms of labour productivity and employment sustainability, as the expected increase in the number of people with a chronic disease is likely to have a negative impact on the future level of economic activity of people of working age. I.A. Nikolic et al. argue that despite taking

various measures to prevent chronic disease, part of this process should be treated as an inevitable effect of economic growth [11].

The aging process is an important factor in the accumulation of risk of chronic disease. In the case of countries with extensive health care systems, the measures taken may delay the death of chronically ill people by even several dozen years, thus lowering the mortality rate of middle-aged people. Thus, properly applied treatment procedures are able to generate significant short-term benefits, but in the long run only interventions in the early life period have the potential to significantly reduce the consequences of a chronic disease "pandemic" [12]. It is assumed that the so-called 'Causes of causes', or the underlying determinants of chronic diseases, reflect the main forces driving social, economic and cultural change. Processes such as globalization, urbanization, an aging population and general environmental policy are mentioned here. As a consequence, the risk of chronic diseases and their negative effects increases with the scale of risk factor accumulation.

The situation of accumulation of risk factors determining the level of incidence of chronic diseases in the society is visible especially in highly developed countries where, despite very high expenditure on health care, it is not possible to achieve a significant effect of extending the potential life expectancy „in health“ [8]. In the case of the "richest" countries, statistically higher life expectancy corresponds to a lower percentage of healthy life years. For these economies, this means, on the one hand, lower than expected labour potential, and, on the other hand, increasing costs of treating both the growing number of elderly people and the increasing share of people unable to work in the labour force. The reduction in the number of healthy years in total life observed in economies with the highest level of income is an effect of the impact of chronic diseases not only on the risk of premature death, but also on the increase in the number of potential years lived with disability. Estimates by the World Health Organization (WHO) indicate that in the richest countries, chronic diseases are responsible for over 80% of potential years of life lost prematurely due to diseases and injuries, and for over 87% of years lived with disability. Estimated according to the WHO methodology for 2019, the average number of years of healthy life lost as a result of premature death or disability caused by chronic disease in the case of highly developed countries was 241 years per 1 thousand inhabitants, of which 46% of the number of years lost resulted from the statistical time of disability. Taking into account the four categories of countries distinguished according to the World Bank classification according to the level of income achieved, it was the worst result.

### **Consequences of chronic diseases in the perspective of labour markets**

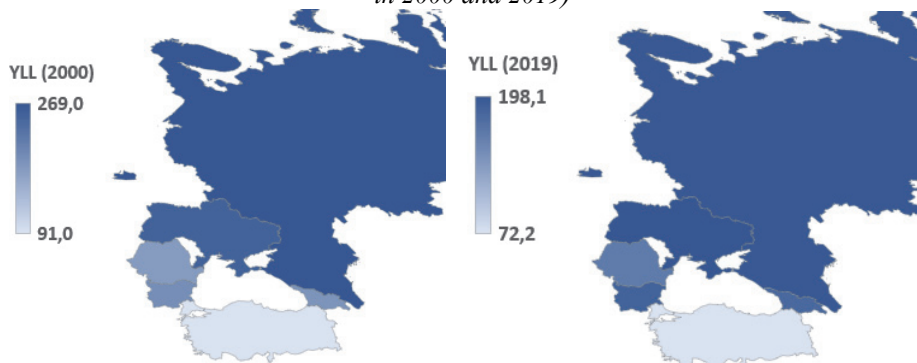
The scale of burdening the economies of the Black Sea countries with the long-term consequences of chronic diseases has been expressed by indicators defining the number of healthy life years lost as a result of premature death or disability (*disability-adjusted life year* - DALY). In the conducted analysis, particular emphasis was placed on the level of prematurely lost years of life (*years of life lost* - YLL). The choice of the analysed variables was made on the basis of a review of the proposed methodology for the assessment of the studied phenomenon presented in the literature. These indicators are intended to illustrate the potentially lost time of effective work of people of working age, at the same time indicating the level of burdening domestic economies with the effects of chronic diseases.

In the case of the group of countries in the Black Sea region, the so-called non-communicable diseases, including serious chronic diseases, in 2019 were responsible for 87.8% of the burden expressed by the number of prematurely lost health years (YLD - *years lost to disability*) and for 84.7% of the burden resulting from premature death (YLL -

years of life lost). In relation to the inhabitants of the studied area aged 15-69, it represented, respectively, 32.3 million years of life in limited health and 35.5 million years of life lost as a result of premature death.

The studies conducted in the field of existing differences in the burden of chronic diseases occurring between the Black Sea region countries indicate that both the incidence of chronic diseases and the mortality rate associated with them differ significantly in individual countries. Data from the World Health Organization indicate that it is the mortality rate associated with chronic diseases that is the main cause of variation in healthy life expectancy between economies. In the group of the Black Sea region countries, a high level of differentiation of this indicator is also characteristic. In relation to the analyzed economies, in 2000 the YLL index per 1 thousand people aged 15-69 ranged from 91.0 (Turkey) to 269.0 (Russian Federation) prematurely lost years of life due to chronic diseases. Despite the significant decrease in the mortality rate in this age group, observed in all countries of the Black Sea region, this indicator in 2019 was still characterized by a significant spread, ranging from 72.2 (Turkey) to 198.1 (Ukraine) (Fig. 1).

**Figure 1.** The distribution of the parameters years of life lost (YLL) due to chronic diseases, per 1 thousand population aged 15-69 (countries of the Black Sea region, in 2000 and 2019)



Source: own study based on [WHO data, <https://www.who.int/data/gho/data/>]

A characteristic feature of the burden of chronic diseases in the countries of the Black Sea region is the visible accumulation of unfavourable effects of this phenomenon in Russia and Ukraine. These countries, compared to the rest of the region's economies, are characterized by a particularly high level of premature mortality from chronic diseases resulting in a significant loss of potentially productive years of life. Despite the positive tendencies of decreasing the YLL index per 1000 of persons in working age (15-69) observed in the analysed period of 2000-2019, these countries remain the area's most prone to premature death of people aged 15-69 (Table 1).

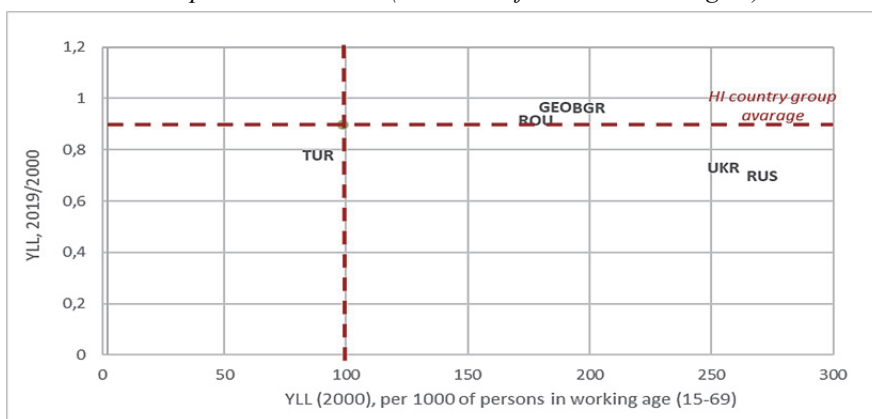
**Table 1. The number of years of life lost (YLL) due to chronic diseases, per 1 thousand persons aged 50-69 (countries of the Black Sea region, in 2000 and 2019)**

Country Name/Country Code		YLL per 1000 of persons in working age		Change 2000-2019		Rankings	
		2000	2019	YLL	in %	2000	2019
Bulgaria	BGR	193,9	186,9	-7,0	-3,6%	3	3
Georgia	GEO	186,8	180,8	-6,0	-3,2%	4	4
Romania	ROU	177,7	163,0	-14,8	-8,3%	5	5
Russian Federation	RUS	269,0	196,1	-72,9	-27,1%	1	2
Turkey	TUR	91,0	72,2	-18,8	-20,7%	6	6
Ukraine	UKR	252,7	198,1	-54,6	-21,6%	2	1

Source: own study based on [WHO data, <https://www.who.int/data/gho/data/>]

In 2019, in the group of countries in the Black Sea region, the burden of chronic diseases resulting from premature death of a sick person (YLL) was on average at the level of 160.6 prematurely lost years of life per 1 thousand. people aged 15-69, with the average value in the group of EU-27 countries at the level of 94.7, and in the countries with the highest income level (HI group according to the World Bank) - 88.5. Countries of the so-called The „old“ EU (EU-14) managed to reduce the YLL index for chronic diseases to 79.8 prematurely lost life years per 1,000 people aged 15-69. Taking into account the trends observed in high-income economies (HI, EU), it can be concluded that most of the Black Sea countries have a higher level of premature mortality caused by chronic diseases in working age people. In the case of Ukraine and Russia, both in 2000 and 2019 the level of this indicator was over 200% higher than the average for the HI countries group. Only Turkey, in both 2000 and 2019, recorded a better result than the average observed in the group of countries with the highest income. On the other hand, a favourable phenomenon is the decrease in the premature mortality rate in the observed period of 2000-2019 in all countries of the Black Sea region (Fig. 2), with the decrease being the largest in Russia (by 27.1%) and Ukraine (21.6%). However, despite the indicated changes, the distance of the countries with the highest burden in relation to the average group of HI countries has not changed significantly.

**Figure 2. YLL per 1 thousand persons in working age, in 2000 and change in the period 2000-2019 (countries of the Black Sea region)**



Source: own study.

**Estimation of lost productivity - research results**

The proposed estimate of the value of lost productivity as a result of premature death of people burdened with chronic diseases was based on the human capital method (HCM), allowing to estimate the maximum level of lost production as a result of disease and inability to work of employees (Wrona et al., 2011). The human capital method allows to determine the value of potentially lost production or income potentially lost, assuming that a sick worker cannot be replaced due to the lack of free labor resources (full productivity of all labor resources, no unemployment). The application of this approach requires the estimation of the duration of absenteeism and the adoption of a contractual valuation of the value of lost production per a specific unit of working time. For the purposes of the assumed analysis, the estimated annual value of lost production due to absenteeism (VPL) was carried out in accordance with the formula:

$$VPL = YLL \times V_{wy}$$

where: YLL – number of prematurely lost years of healthy life,  $V_{wy}$  - contractual value of the working year.

The choice of variables adopted in the analysis was made on the basis of a review of the proposals for assessing employee productivity presented in the literature, taking into account, at the same time, the availability of aggregated data at the level of national economies. The contractual value of the working year ( $V_{wy}$ ), significantly determining the estimated value of the lost product, was determined using two alternative aggregates: 1) annual value of gross domestic product (GDP) per person employed, 2) annual value added (VA) per worker. The assessment of the scale of lost years of life was based on the available estimates of the World Health Organization. The value of the lost product in relation to individual national economies was estimated annually per 1000 people aged 15-69, which allowed for comparability of results between individual national economies. The detailed results of the performed estimate for the events recorded in the economies of the Black Sea region countries in 2000 and 2019 are presented in Table 2.

**Table 2. Estimation of the value of the lost product**

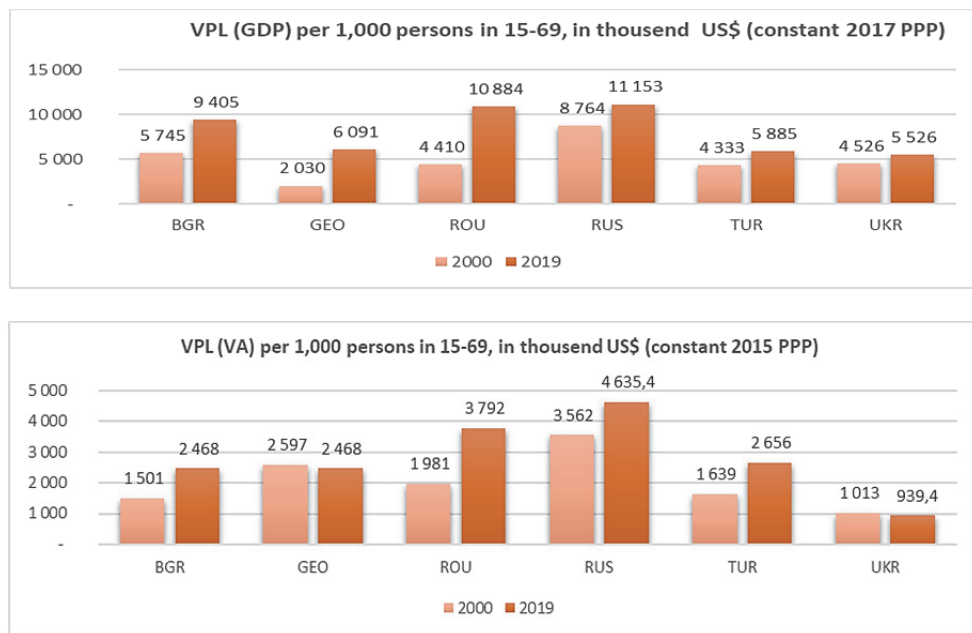
Country Name/Country Code	YLL per 1000 of persons in age 15-69		Contractual value of the working year		Value of production lost per 1000 of persons in working age (15-69)*		
	2000	2019	2000	2019	2000	2019	
GDP per person employed (PPP constant 2017 US\$)							
Bulgaria	BGR	193,9	186,9	29 623	50 327	5 744 590	9 405 486
Georgia	GEO	186,8	180,8	10 868	33 682	2 030 496	6 091 333
Romania	ROU	177,7	163,0	24 812	66 786	4 409 925	10 883 645
Russian Federation	RUS	269,0	196,1	32 581	56 874	8 764 088	11 152 698
Turkey	TUR	91,0	72,2	47 619	81 538	4 333 185	5 885 332
Ukraine	UKR	252,7	198,1	17 909	27 895	4 525 883	5 525 961
Value added per worker (PPP constant 2015 US\$)							
Bulgaria	BGR	193,9	186,9	7 738	13 208	1 500 558	2 468 485
Georgia	GEO	186,8	180,8	13 899	13 650	2 596 607	2 468 498
Romania	ROU	177,7	163,0	11 147	23 272	1 981 181	3 792 450
Russian Federation	RUS	269,0	196,1	13 244	23 639	3 562 403	4 635 443
Turkey	TUR	91,0	72,2	18 014	36 800	1 639 231	2 656 207
Ukraine	UKR	252,7	198,1	4 009	4 742	1 013 092	939 399

\* World Bank Open Data, <https://data.worldbank.org/>

Source: own study.

The comparison of the value of the lost product in the group of countries in the Black Sea region shows large discrepancies resulting both from the differences in the scale of the burden of premature death of people of working age and from the performed valuation of the value of a unit of lost work. According to the World Bank data, the statistical value of the year of work measured by the level of gross domestic product per employed (constant 2017 PPP US \$) in 2019 ranges between 27,895 (Ukraine) and 81,538 (Turkey). In the case of gross value added per worker (constant 2015 PPP US \$) in 2019, this value ranged between 4,742 (Ukraine) and 36,800 (Turkey). Consequently, depending on the adopted criterion for the valuation of the working time unit, the values of lost productivity estimated for 2019 as a result of premature death of people as a result of chronic diseases are at a very different level. Taking into account the value of the domestic product per employed, the estimated value of lost productivity in the group of countries of the Black Sea region ranges from 5,526.0 thousand US \$ (Ukraine) to US \$ 11,152.7 thousand (Russian Federation) per 1000 people aged 15-69. Taking into account the gross value added per worker, the lost productivity of labour resources in the analysed country group assumed the values from PLN 939.4 thousand US \$ (Ukraine) up to 4,635.4 thousand US \$ (Russian Federation) per 1,000 people aged 15-69. At the same time, it should be noted that in the analysed period of 2000-2019, despite the diagnosed decrease in the mortality of labour resources, the estimated value of lost productivity increased significantly. This increase is particularly evident in the shift to a valuation based on the value of gross domestic product per employed (Fig. 3).

**Figure 3. Estimation of the value of the lost product – selected indicators, countries of the Black Sea region in 2000 and 2019**



Source: own study.



## Conclusions

The conducted analysis of the issue of health restrictions as a determinant of the contemporary labour market shows that in the conditions of the observed demographic changes shaping this market, the problem of burdening labour resources with the consequences of civilization diseases becomes more and more important. The attempt to estimate the value of the lost productivity of labour resources in the economies of the Black Sea countries using the human capital method, proposed in this approach, despite the visible methodological limitations, allowed for the assessment of the loss in the global value of the manufactured product resulting from the analysed process. In relation to the economies of the analysed countries, high inequalities were demonstrated both in the level of risk of premature death of people in working age as a result of chronic diseases and in the economic consequences of this phenomenon. The obtained results, apart from indicating the relationship between health and productivity, constitute the basis for a discussion on the effectiveness of health „interventions“ from the perspective of national economies. This gives both arguments in the discussion on the causes of inequality and the possibility of taking actions to reduce the negative effects of civilization diseases, as well as justifying the need to adopt a perspective in the assessment of health programs that goes beyond the so-called the direct cost of the disease.

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