Key Indicators and Determinants in the Context of the Financial Aspects of Health Systems in Selected Countries

SOPKO, J., KOČIŠOVÁ, K.

Technical University of Košice, Faculty of Economics, Department of Banking and Investment, Košice, Slovakia

Citation | Sopko, J., Kočišová, K. (2019). Key Indicators and Determinants in the Context of the Financial Aspects of Health Systems in Selected Countries. *Adiktologie, 19*(4), 189–202; doi 10.35198/01-2019-004-0003.

BACKGROUND: An important part of the monitoring of health is the assessment of the financial aspects of the health system. The assessment of health status and quality of life is important both within an individual country and also in international comparison. The level of education and the health status of the population affect a country's development. The development of a country can also be affected by tobacco and alcohol consumption, which, in addition to its harmful health impact in the form of increased mortality, also has economic consequences for the financial level of households. **AIM:** We aim to compare the primary indicators used at the OECD level in the case of health assessment. In our work, we focus on demographic, socio-economic, and financial indicators in the health sector, which we then comment on and evaluate from several points of view. **METHODS:** In our comparative analysis, we focus on the monitoring of health in OECD countries by comparing health spending between 2000 and 2017 and critical health determinants: life expectancy at birth (LE), health-adjusted life expectancy at birth (HALE), the avoidable mortality rate, alcohol and tobacco consumption, etc. We use a two-step cluster analysis for the identification of clusters based on selected indicators. **RESULTS:** In most countries, we can see a decrease in alcohol and tobacco consumption, which is associated with a decrease in preventable and treatable mortality and infant mortality. The average level of health-adjusted life expectancy for OECD countries in 2016 was 71.1 years. The average level of health expenditure per capita for 2017 was 3856.5 US$. We emphasize the fact that the ageing of the population in many OECD countries will be a challenge not only for the countries' health systems but also for their economies as a whole. **CONCLUSIONS:** Healthcare expenditure represents a significant part of the use of national resources. Factors such as ageing populations, obesity, harmful alcohol consumption, and tobacco consumption contribute to an increase in the demand for healthcare services. Increased pressure on the use of resources in the health sector is led by key actors and policymakers to look for efficient pathways for the provision of health services.

Keywords | Health – Expenditure – Health System – Health Sector

Submitted | 15 May 2020 **Accepted |** 25 June 2020

Grant affiliation | This research was supported by the Slovak Scientific Grant Agency as part of the research project VEGA 1/0794/18 "Development of methodological platform for evaluation of efficiency in the financial and non-financial sector".

Corresponding author | Kristína Kočišová, PhD, Technical University of Košice, Faculty of Economics, Department of Banking and Investment, Nemcovej 32, 040 01 Košice, Slovakia **kristina.kocisova@tuke.sk**

1 INTRODUCTION

Healthcare is considered an integral part of the public sector in most countries of the world. The last three decades have brought about constant changes in the field of health. There has been an increased recognition that more attention needs to be paid to this area. The topicality of dealing with financial issues in healthcare and key indicators is determined not only by these changes but also by interest on the part of the population and the professional public, and the very sensitivity of the social and individual value of the population's health. A country's educational level and the adequate health of its population have an impact on the country's development. In most countries, we can still see weak areas and regions with poor healthcare infrastructure, often linked to inefficient funding in the country. Janečková and Hnilicová (2009) state that the performance of the country's health system needs to be assessed comprehensively and coherently related to the whole spectrum of demographic, socio-economic, and political determinants, including globalization processes and changes.

As mentioned by Venkataraman et al. (2019), the consumption of tobacco and alcohol, which are often termed "temptation goods", is one of the foremost avoidable causes of morbidity and mortality in the world. In OECD countries the alcohol consumption in 2017 was nine pure litres per capita aged 15 years and over, and tobacco consumption in 2017 was 18.2% of the population aged 15 years old and over who reported that they are daily smokers (OECD, 2019a). To control or reduce the consumption of these goods, public policies often use taxation as an instrument to make them costlier. Nevertheless, we can see that the consumption of these goods is relatively high. This is of great concern for the poor, who spend a relatively significant part of their incomes on the consumption of these goods. Given a fixed household budget, spending on these goods may divert household economic resources from essential items, such as food, education, and healthcare, which are indispensable components of human development. Besides the economic impact, the consumption of tobacco and alcohol can cause many deadly health problems, such as cancer, vascular disease, including heart attacks, and chronic bronchitis and emphysema.

Several studies suggest that smoking with a high prevalence rate may impose a heavy burden on health systems, which may ultimately result in increasing their health spending (Currie et al., 2009; Inchley et al., 2016). It is important to arrest an addiction to smoking in the part of the population at greatest risk, i.e. young people. Currie et al. (2009) point out that smoking is also expected to be closely linked to an individual's social status and current financial level. Inchley et al. (2016) report that adolescents who smoke are at greater risk of adopting other risky behaviours which are associated with a number of health implications, including addiction, but also reduced lung function and asthma.

In recent years, international bodies (the World Health Organization – WHO, Organisation for Economic Co-operation and Development – OECD, Eurostat) have monitored and evaluated the quality and availability of healthcare in selected countries in their analyses. Health is a unique area of the public sector, as in it more funding does not immediately mean an automatic improvement in the level of efficiency. Several authors have shown that inefficiencies are the main problem in all health systems (Ozcan, 2014; Gavurova et al., 2017; Sopko et al., 2017; Stefko et al., 2018; WHO, 2000, 2009, 2018). The WHO (2000), in its study, showed clear global differences in the effectiveness of health systems.

Six areas of waste of resources in the health system in the US which would ensure efficiency gains if these waste areas were removed or resources were properly allocated in these areas were identified by Berwick and Hackbarth (2012). The individual areas of waste they identified are very important for the US health system, but to some extent, these areas may be found in all types of health systems in OECD countries. These areas include failures in the provision of healthcare, failures in the care activities of several organizations and institutions that ensure the achievement of a large number of healthcare objectives, overtreatment (it represents unnecessary healthcare, which is provided to a greater extent and at greater cost than is appropriate and necessary, possibly involving unnecessary medical interventions or extensive treatment of a condition that only requires the necessary duration of treatment (Emanuel & Fuchs, 2008)), excessive administrative burdens, poor pricing, fraud, and abuse.

Measuring efficiency in the health sector is generally accepted in the literature (Murray & Evans, 2003; Papanicolas & Smith, 2013; Cylus et al., 2016, 2017), from which we can conclude that it is necessary to achieve the highest possible life expectancy or to achieve the highest possible quality of life of the population. Of course, there are other important objectives within the health system, which include reducing health inequalities between regions, protecting citizens against the financial consequences of diseases, and improving healthcare provision. Measuring health efficiency is a challenging objective and leads to two types of risk. On the one hand, policymakers may conclude that identifying and addressing inefficiencies in the health system is impossible and poor health performance has adverse consequences, as mentioned above. Alternatively, if the analysis has identified the need to implement restrictions on expenditure policy, policymakers can implement inefficient and untargeted expenditure reductions that also affect highly efficient areas of the system. The second set of risks may be that policymakers emphasize inadequate and incorrect analyses that abstract information on the implementation of reforms aimed at more or less inefficient practices. Reducing the length of hospital stays can, in some cases, bring added value in terms of more efficient use of financial resources. In other circumstances, however, this may be at the expense of the additional costs associated with outpatient healthcare. Health efficiency and issues related to cost-effectiveness and value for money are significant and frequently-discussed facts in the field of the performance of the health sector. Cost-effectiveness and value for money indicate the extent to which inputs in the form of expenditure and oth-

er resources contribute to achieving the objectives of the health system. The inefficient use of health system resources in OECD countries poses serious problems for several reasons (Cylus et al., 2016):

- a patient undergoing a certain type of treatment may not receive the best possible care because of poor adjustment of the use of resources in the health system;
- over-exploitation of resources may cause treatment to be denied to those patients who would benefit from such treatment if resources were used more efficiently;
- the inefficient use of resources in the health sector can also have a negative impact on other areas of the national economy, e.g. education;
- wasting resources on inefficient healthcare can reduce the willingness of the population to contribute to the financing of health services, which may result in damage to social solidarity, care, and the performance of the health system.

Addressing inefficiencies in the health system is, therefore, of great value. It is a responsibility for policymakers to assure the population that their money is being spent wisely and to reassure patients themselves that their rights to receive justice in the area of healthcare are being treated fairly and consistently. At the same time, the results of efficiency measurements are an important indicator for healthcare providers, including the government itself, insurance companies, and households, which are also interested in learning which areas in the health sector bring added value for money. For state leaders, efficiency is important not only in the health sector but also in the economy as a whole because of the setting of financial stability and long-term financial sustainability. When the measurement of efficiency is adjusted using the right tools, the results of the analysis can determine whether resources are used optimally and, subsequently, to determine exactly which areas of the health system use resources inefficiently (Papanicolas & Smith, 2013). In the health system as a whole, there are a large number of interconnected processes that can be evaluated independently, while at the same time it is possible to determine whether these processes are efficient or inefficient. For this reason, we are looking at a large number of indicators in the health system that may indicate certain types of inefficiencies, but it is very difficult to abstract the overall conclusions of inefficiencies and to offer a comprehensive overview.

2 DATA AND METHODOLOGY

We aim to compare the basic indicators used at the OECD level in the case of health assessment. In our work, we focus on demographic, socio-economic, and financial indicators in the health sector, which we then comment on and evaluate from several points of view. For this study, the following key data was extracted from OECD.Stat, Eurostat, WHO, and UN DESA statistics between 2000 and 2017. The data for 2018 from the individual databases is incomplete, so in our work we use the data for 2017 within OECD countries. In this paper, we use cluster analysis to classify individual countries according to the level of health status achieved and their current expenditure on health. We use two-step cluster analysis, using a Euclidean distance measure and a predefined number of three clusters (Şchiopu, 2010). The classification of individual countries is also displayed using scatterplots and fitted with a curve that can be marked as a Preston curve (Preston, 2007). The Preston curve points to the relationship between the level of the economy (expressed as gross domestic product per capita) and health status (expressed as life expectancy at birth). In our analysis, we follow the relationship between current expenditure on health per capita and health-adjusted life expectancy at birth during the years 2000, 2008, and 2017. Finally, we refer to the basic forecasts of the population old-age dependency ratio index in selected countries.

Another common feature of the above studies is the difficulty of obtaining the necessary data from databases. It is a significant limiting factor for this study. The inconsistency in the publication and updating of data for the individual indicators within countries partially devalues the results of the analyses. In the absence of data, Grubaugh and Santerre (1994) suggest the possibility of using a smaller sample of countries for comparison and not including countries with missing data in the analysis. Anderson et al. (2000), on the other hand, refer to the possibility of using older data or data closest to the reference year or period for which the analysis is conducted.

3 RESULTS AND DISCUSSION

Life expectancy – LE – expresses how long a person in the average population will live in the absence of changes in mortality tables, i.e. ratios. It is one of the basic indicators for assessing the state of health of a country. In 2000, the WHO published a report monitoring the level of health in the individual Member States. The WHO used the disability-adjusted life years (DALY) indicator to measure the level of health status. This indicator includes the years of life lost as a result of premature death and the years the individual survives in poor health, with the indicator itself indicating the years of life during which the individual is expected to live in a fully-fledged state of health (WHO, 2000; Mathers et al., 2003; Salomon et al., 2003). Reacting to member states' feedback on the WHO indicator, it changed the approach and developed a new Health-Adjusted Life Expectancy indicator. For a deeper analysis of the calculation of the HALE indicator, see Mathers et al. (2003). A comparison of LE or HALE indicators with health expenditure provides an enhanced possibility of simple interpretation of whether a health system achieves good health performance in relation to value for money (Cylus & Pearson, 2016).

Table 1 shows the values for HALE, LE (in total as well as for men and women, at the ages of 60 and 65 respectively), and health expenditure in US$ PPPs for 2017 in OECD member states. The data for the HALE indicator was obtained from the WHO database, and it is available only for 2016. The

	Country	LE	HALE	HALE_female	HALE_male	HALE_60	HALE_f_60	HALE_m_60	LE_female	LE_male	LE_f_65	LE_m_65	Health expenditure (US$ per capita)
AUS	Australia	82.6	73	74.1	71.8	20.4	21.4	19.3	84.6	80.5	22.3	19.7	4790.5
AUT	Austria	81.7	72.4	73.9	70.9	19.3	20.6	17.9	84	79.4	21.5	18.5	5270.2
BEL	Belgium	81.6	71.6	73	70.2	18.8	20.1	17.4	83.9	79.2	21.9	18.5	4832.3
CAN	Canada	82	73.2	74.3	72	20.5	21.6	19.4	84	79.9	22.1	19.3	4811.8
CZE	Czech Republic	79.1	69.3	71.6	67	16.6	18.2	14.9	82	76.1	19.8	16.2	2850.4
DNK	Denmark	81.2	71.8	73	70.7	18.9	19.9	17.8	83.1	79.2	20.8	18.2	5024.5
EST	Estonia	78.2	68.2	71.4	64.6	16.9	18.9	14.3	82.6	73.8	20.8	15.6	2120.5
FIN	Finland	81.7	71.7	73.5	69.8	19	20.4	17.4	84.5	78.9	22.1	18.4	4126.7
FRA	France	82.6	73.4	74.9	71.8	20.6	21.9	19.1	85.6	79.6	23.6	19.6	4930.8
DEU	Germany	81.1	71.6	73	70.2	18.6	19.8	17.3	83.4	78.7	21.2	18.1	5847.7
GRC	Greece	81.4	72	73.6	70.5	18.8	20.1	17.5	83.9	78.8	21.4	18.6	2207.1
HUN	Hungary	75.9	66.8	69.5	64.1	15.1	16.7	13	79.3	72.5	18.4	14.5	1996.4
CHL	Chile	80.2	69.7	71.5	67.9	18	19.3	16.5	83.1	77.4	21.5	17.8	2095.3
ISL	Iceland	82.7	73	73.8	72.3	19.6	20.3	19	84.3	81.1	21.4	19.8	4153.9
IRL	Ireland	82.2	72.1	73.2	71.1	19.2	20.1	18.2	84	80.4	21.4	19	4631.1
ISR	Israel	82.6	72.9	74.1	71.7	19.6	20.5	18.5	84.6	80.6	21.9	19.3	2666.4
ITA	Italy	83	73.2	74.3	72	19.9	21	18.6	85.2	80.8	22.4	19.2	3376.3
JPN	Japan	84.2	74.8	76.9	72.6	20.9	22.9	18.7	87.3	81.1	24.4	19.6	4629.6
LVA	Latvia	74.8	66.2	69.5	62.4	15.8	17.6	13.3	79.7	69.8	19	14.1	1649.3
LTU	Lithuania	75.6	66.1	70	61.9	15.8	17.9	13	80.5	70.7	19.4	14.4	2182.5
LUX	Luxembourg	82.2	72.6	73.7	71.1	19.3	20.5	17.9	84.4	79.9	21.7	18.6	4940.7
MEX	Mexico	75.4	67.7	69.6	65.8	17.1	18	16.2	77.9	72.9	18.7	16.8	1105
NLD	Netherlands	81.8	72.1	72.8	71.3	18.9	19.9	17.8	83.4	80.2	21.2	18.7	5155
NZL	New Zealand	81.9	72.8	73.9	71.8	20.3	21.2	19.4	83.6	80.2	21.7	19.6	3742.2
NOR	Norway	82.7	73	74.3	71.8	19.6	20.7	18.4	84.3	81	21.6	19.3	6063.6
POL	Poland	77.9	68.5	71.7	65.4	16.6	18.4	14.5	81.8	73.9	20.2	15.9	2047.7
PRT	Portugal	81.5	72	74	70	19.4	20.7	17.9	84.6	78.4	22.1	18.3	2758.5
KOR	South Korea	82.7	73	75.1	70.7	19.7	21.4	17.6	85.7	79.7	22.7	18.6	2870.3
SVK	Slovak Republic	77.3	68.3	71.2	65.3	16.3	18	14.2	80.7	73.8	19.1	15.3	2187.8
SVN	Slovenia	81.1	70.5	72.6	68.3	17.6	19	16	84	78.2	21.7	17.6	2801.2
ESP	Spain	83.4	73.8	75.4	72.2	20.3	21.8	18.7	86.1	80.6	23.4	19.3	3224.1
SWE	Sweden	82.5	72.4	73.4	71.5	19.2	20.1	18.2	84.1	80.8	21.5	19.2	5264.4
CHE	Switzerland	83.6	73.5	74.5	72.4	20.1	21.2	19	85.6	81.6	22.8	20	7146.8
TUR	Turkey	78.1	66	67.6	64.4	15.5	16.6	14.4	80.8	75.3	19.2	16	1185.6
GBR	United Kingdom	81.3	71.9	72.9	70.9	19.2	20.1	18.3	83.1	79.5	21.1	18.8	3942.9
USA	United States	78.6	68.5	70.1	66.9	17.9	19	16.7	81.1	76.1	20.6	18.1	10206.5
OECD	OECD Average	80.7	71.1	72.8	69.3	18.6	19.9	17.1	83.4	78.1	21.3	18	3856.5

Table 1 | Health expenditure and life expectancy at birth in 2017 and health-adjusted life expectancy at birth in 2011 in OECD countries
Source: Prepared by authors
Notes: HALE – health-adjusted life expectancy at birth; LE – life expectancy; HALE_60 – health-adjusted life expectancy at 60 (f-female and m-male); LE_65 – life expectancy at 65 years old (f-female and m-male); Health expenditure – current expenditure on health, per capita, US$ purchasing power parities

values are updated every five years. The average values for OECD countries suggest that on average women live longer than men in the case of LE, but also in the case of HALE.

The differences between countries with regard to life expectancy at birth and health-adjusted life expectancy are significant. The differences are due to the methodology, which

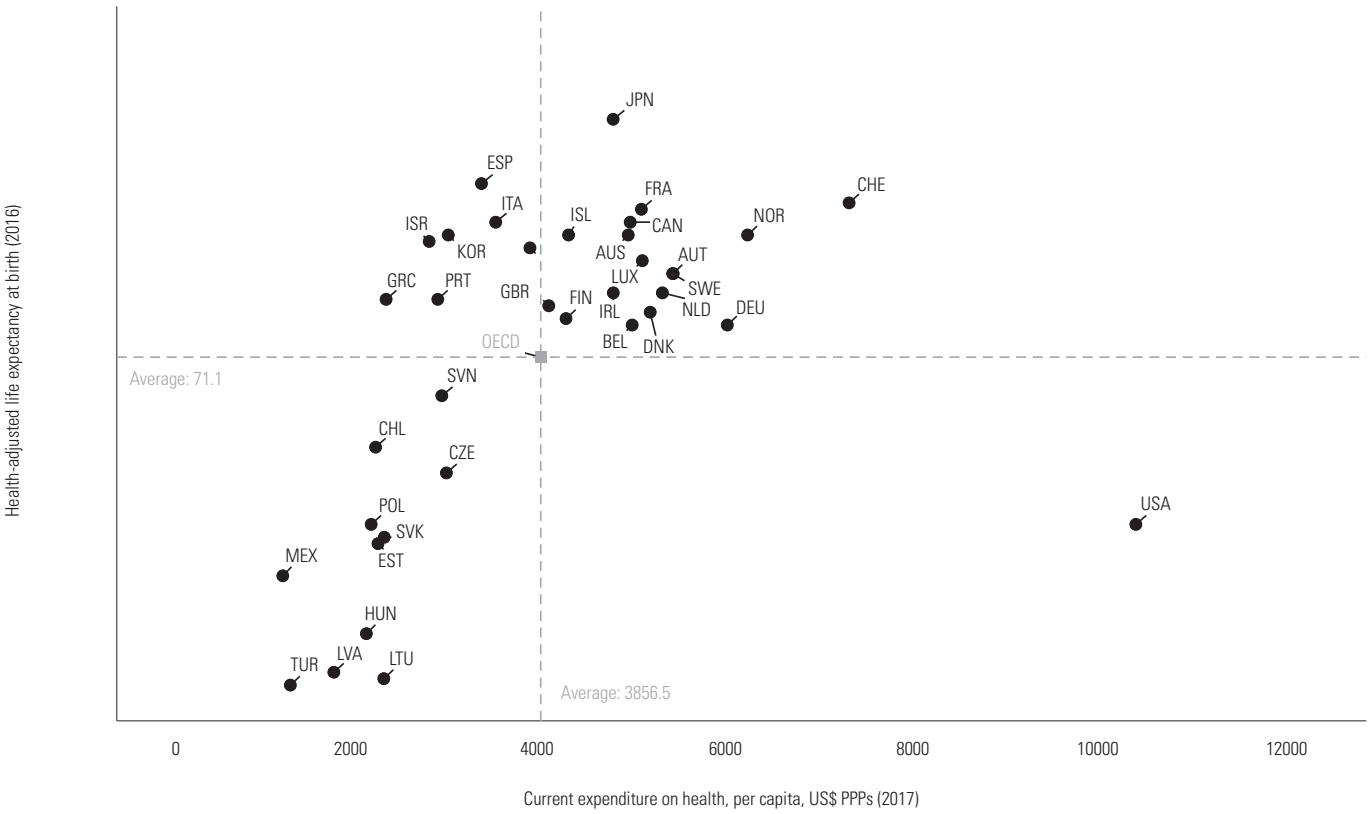

Figure 1 | Health expenditure and Health-adjusted life expectancy at birth
Source: Prepared by authors

is further analysed by Mathers et al. (2003). In 2016, the average HALE score for OECD countries for women was at the level of 72.8 years and for men it was 69.3 years. In the case of life expectancy at birth, women live five years longer on average (LE_female: 83.4 years; LE_male: 78.1 years). More than half of the OECD countries achieve higher HALE and LE values than the OECD average. Japan and Switzerland reach the highest values for both indicators (LE: 84.2 and 83.6 years; HALE: 74.8 and 73.5 years). Conversely, at the opposite end of the spectrum we find Latvia and Mexico (LE: 74.8 and 75.4 years; HALE 66.2 and 67.7 years). The Slovak Republic, along with the other countries of the Visegrad Group, ranks below the OECD average.

In general, as health expenditure increases, we might expect an increase in life expectancy and health-adjusted life expectancy at birth. *Figure 1* compares the HALE indicator with health spending in individual OECD countries. The average level of health-adjusted life expectancy for OECD countries in 2016 was 71.1 years. The average level of health expenditure per capita for 2017 was 3856.5 US$. The OECD countries can thus be divided into four groups. The first group is made up of countries which are below the average HALE level and also have the highest share of health expenditure per capita. This group includes only the USA in comparison to OECD countries which have reached the level of the HALE indicator of 68.5 years; the expenditure there is 10,206.5 US$ per capita. The second group consists of JPN, GBR, ISL, FIN, AUS, LUX, IRL, BEL, DNK, NLD, DEU, SWE, AUT, CAN, FRA, NOR, and CHE. This group of countries achieves HALE levels higher than the OECD average, but at the same time, these countries have, on average, higher health expenditure per capita than the OECD average. There are also considerable differences between the countries in this group.

The level of health expenditure per capita for 2017 in Ireland is similar to that in Japan (4631.1 US$ vs. 4629.6 US$), but on average Japanese people live in health for 2.7 years longer than the Irish population (74.8 vs. 72.1). The third group consists of ESP, ITA, NZL, KOR, ISR, PRT, and GRC. On average, these countries have lower health expenditure per capita but achieve higher HALE levels than the OECD average. The fourth group of countries consists of SVN, CHL, CZE, POL, SVK, EST, MEX, HUN, TUR, LVA, and LTU. These countries have low HALE levels and health expenditure in these countries is below the OECD average. The open question is whether individual countries are allocating health expenditure effectively in order to improve the quality of life of the population. In interpreting these results, we agree with caution that we cannot generalize the results. Cylus and Pearson (2016) also warn that we cannot determine whether, for example, in the case of Switzerland, the health system is more efficient than in the case of the USA, as we cannot say that Switzerland achieves HALE at a minimal cost.

In addition to this classification, we use a two-step cluster[1] method in SPSS Statistics for the identification of clusters by using the Euclidean distance and a predefined number of three clusters. *Figure 2* below shows the classification of

1 | For more information please see Şchiopu (2010).

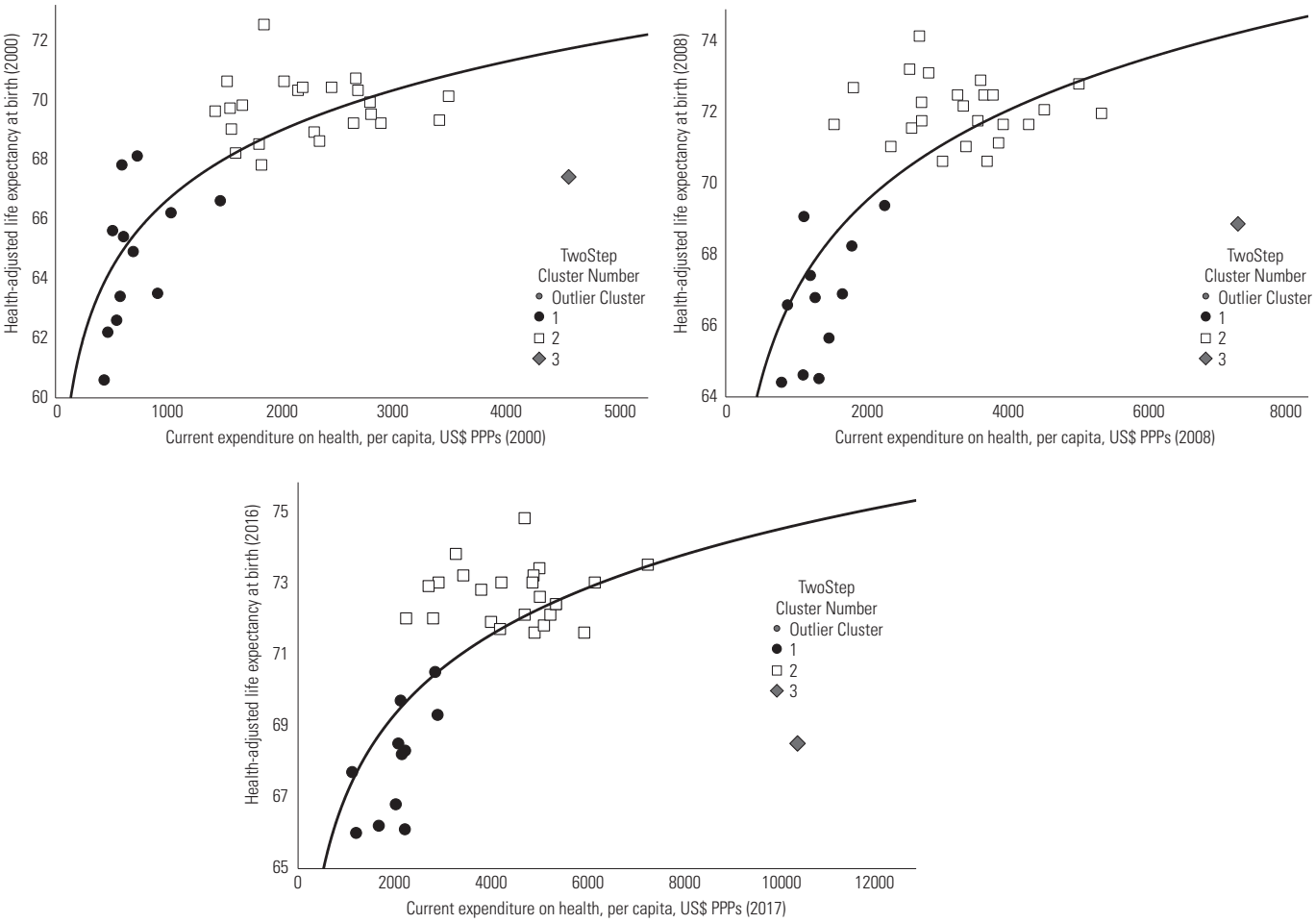

Figure 2 | Two-step cluster analysis and Preston curve
Source: Prepared by authors

countries into clusters based on the current expenditure on health and health-adjusted life expectancy at birth during 2000, 2008, and 2017. The adjusted Preston curve points to the relationship between these variables, and on the basis of its evolution we can say that the curve has shifted over the years, as there has also been an increase in the health status of the population in selected countries. Further information on individual clusters and their basic descriptive statistics can be seen in *Table 2*. The United States represented a separate cluster in each of the reporting periods (Cluster 3). This is most probably because, over the selected periods, the USA had, on average, the highest per capita health expenditure compared to other countries. In 2000, South Korea was included among the countries in Cluster 1. During 2008 and 2017, we can observe the same composition of Cluster 1 and Cluster 2. The average HALE level for the countries in Cluster 1 increased from 64.7 years to 67.9 years between 2000 and 2017. We can see that the countries with a higher level of health spending reached, on average, a higher HALE level between 2000 and 2017.

The differences between Clusters 1, 2, and 3 were statistically significant ($p < 0.001$) over the years for both indicators. For further research, it would be interesting to make a comparison between countries without the USA, as this country has above-average health expenditure. We also recommend that the analysis can be carried out among, for example, all the countries in the world, while also including a higher number of indicators.

As mentioned above, the role of the state should be to ensure timely and accessible healthcare. It should be the kind of healthcare that improves the quality of life of the population not only through early diagnosis and treatment of diseases but also by combating or mitigating the manifestations of diseases and targeted prevention. A significant indicator of health status in OECD countries is the avoidable mortality rate (*Table 3*).

The term “amenable” mortality was used until recently, in 2018. The OECD and the European Commission have agreed on a common approach and a common methodology. There are two types of avoidable mortality – treatable (formerly amenable) and preventable mortality (OECD & Eurostat, 2019). In summary, the avoidable mortality rates reflect the number of deaths in a population under the age of 75 per 100,000 inhabitants that can be prevented by early and effective public health and medical interventions. The most frequently avoidable deaths include ischaemic heart disease, cerebrovascular disease, and certain forms of cancer (OECD & Eurostat, 2019; Eurostat, 2019; UN DESA, 2020). Treatable mortality is described as the mor-

	2000					
	Cluster 1		Cluster 2		Cluster 3	
	HALE	HE	HALE	HE	HALE	HE
Min	60.6	431.8	67.8	1417.6	67.4	4557.2
Max	68.1	1463.2	72.5	3490.6	67.4	4557.2
Mean	64.7	710.2	69.7	2245.6	67.4	4557.2
Std. Dev.	2.3	295.1	1.0	603.5	-	-
Countries	CZE, EST, HUN, CHL, LVA, LTU, MEX, POL, KOR, SVK, SVN, TUR		AUS, AUT, BEL, CAN, DNK, FIN, FRA, DEU, GRC, ISL, IRL, ISR, ITA, JPN, LUX, NLD, NZL, NOR, PRT, ESP, SWE, CHE, GBR		USA	
	2008					
	Cluster 1		Cluster 2		Cluster 3	
	HALE	HE	HALE	HE	HALE	HE
Min	64.4	807.1	70.4	1565.4	68.7	7403.1
Max	69.2	2297.5	73.8	5431.1	68.7	7403.1
Mean	66.6	1373.6	71.8	3420.7	68.7	7403.1
Std. Dev.	1.7	433.0	0.8	929.7	-	-
Countries	CZE, EST, HUN, CHL, LVA, LTU, MEX, POL, SVK, SVN, TUR		AUS, AUT, BEL, CAN, DNK, FIN, FRA, DEU, GRC, ISL, IRL, ISR, ITA, JPN, KOR, LUX, NLD, NZL, NOR, PRT, ESP, SWE, CHE, GBR		USA	
	2017					
	Cluster 1		Cluster 2		Cluster 3	
	HALE	HE	HALE	HE	HALE	HE
Min	66.0	1105.0	71.6	2207.1	68.5	10206.5
Max	70.5	2850.4	74.8	7146.8	68.5	10206.5
Mean	67.9	2020.2	72.7	4433.6	68.5	10206.5
Std. Dev.	1.5	551.6	0.8	1181.2	-	-
Countries	CZE, EST, HUN, CHL, LVA, LTU, MEX, POL, SVK, SVN, TUR		AUS, AUT, BEL, CAN, DNK, FIN, FRA, DEU, GRC, ISL, IRL, ISR, ITA, JPN, KOR, LUX, NLD, NZL, NOR, PRT, ESP, SWE, CHE, GBR		USA	

Table 2 | Two-step cluster membership and descriptive statistics
Notes: HALE refers to health-adjusted life expectancy at birth; HE refers to current expenditure on health, per capita, US$ in PPPs
Source: Prepared by authors

tality rate in which death might not have occurred if there were an optimal setting of quality healthcare in the selected country. In the case of preventable mortality, these are deaths that may not result from correct and targeted primary prevention interventions, better public health programmes, healthier lifestyles, favourable conditions and environmental impacts, and screening. The causes of these deaths are mainly cardiovascular, oncological, and pulmonary diseases (OECD & Eurostat, 2019). A significant proportion of preventable deaths are injuries caused by car accidents, alcohol-related diseases and undesirable substances, self-harm, and suicide. Preventable and treatable mortality rates in 2000, 2008, and 2017 can also be seen in *Table 3* below. At the same time, the table shows the infant mortality rates in OECD countries. The most significant declines (53.4%) for preventable mortality and treatable mortality (53.9%) occurred between 2000 and 2017 in South Korea (238 vs. 111 and 102 vs. 47). For 2017, the lowest preventable mortality levels, which are below the OECD average (132.9), are in these four countries: ISR, CHE, JPN, and ITA. The lowest treatable mortality levels, which are below the OECD average (75.2), are in these four countries: ISL, KOR, NOR, and FRA.

Gmeinder et al. (2017) state that, at first glance, it may be apparent that countries are investing minimum resources in prevention, as many measures are characterized as cost-effective. At the same time, we can find a problem with insufficient data as a result of problematic reporting in OECD countries. In the case of health expenditure, it is difficult to determine the correct proportion of expenditure on treatment and prevention, as several effective prevention programmes, such as vaccination, are cheap or several effective programmes are not classified in the health sector. The impact of health spending on reducing the avoidable mortality rate is stronger and more significant than its impact on increasing life expectancy at birth (Heijink, 2015). According to Devaux and Sassi (2015), higher productivity

		Preventable mortality*				Treatable mortality*				Infant mortality**			
	Country	2000	2008	2017	% change 2000–2017	2000	2008	2017	% change 2000–2017	2000	2008	2017	% change 2000–2017
AUS	Australia	136	107	96	-29.4	83	61	49	-41.0	5.2	4.1	3.3	-36.5
AUT	Austria	135	135	116	-14.1	68	68	57	-16.2	4.8	3.7	2.9	-39.6
BEL	Belgium	168	142	119	-29.2	92	70	54	-41.3	4.8	3.8	3.6	-25.0
CAN	Canada	148	127	117	-20.9	86	71	59	-31.4	5.3	5.1	4.5	-15.1
CZE	Czech Republic	232	184	149	-35.8	167	124	95	-43.1	4.1	2.8	2.7	-34.1
DNK	Denmark	196	157	125	-36.2	106	77	59	-44.3	5.3	4	3.8	-28.3
EST	Estonia	368	281	194	-47.3	214	148	103	-51.9	8.4	5	2.3	-72.6
FIN	Finland	176	155	126	-28.4	104	71	58	-44.2	3.8	2.6	2	-47.4
FRA	France	148	121	106	-28.4	72	58	48	-33.3	4.4	3.6	3.9	-11.4
DEU	Germany	162	127	120	-25.9	101	77	66	-34.7	4.4	3.5	3.3	-25.0
GRC	Greece	117	117	113	-3.4	75	75	75	0.0	5.9	2.7	3.5	-40.7
HUN	Hungary	377	306	251	-33.4	210	162	136	-35.2	9.2	5.6	3.5	-62.0
CHL	Chile	190	155	128	-32.6	111	88	78	-29.7	8.9	7.8	7	-21.3
ISL	Iceland	143	97	96	-32.9	76	63	44	-42.1	3	2.5	2.7	-10.0
IRL	Ireland	132	132	107	-18.9	85	85	65	-23.5	6.2	3.4	3	-51.6
ISR	Israel	121	88	72	-40.5	107	77	62	-42.1	5.5	3.8	3.1	-43.6
ITA	Italy	105	105	88	-16.2	62	62	55	-11.3	4.3	3.1	2.7	-37.2
JPN	Japan	137	112	87	-36.5	70	59	51	-27.1	3.2	2.6	1.9	-40.6
LVA	Latvia	379	328	269	-29.0	225	201	157	-30.2	10.3	6.6	4.1	-60.2
LTU	Lithuania	341	365	244	-28.4	180	196	141	-21.7	8.6	5.5	3	-65.1
LUX	Luxembourg	168	110	102	-39.3	85	65	51	-40.0	5.1	1.8	3.2	-37.3
MEX	Mexico	251	228	212	-15.5	163	157	155	-4.9	20.8	15.1	12.1	-41.8
NLD	Netherlands	142	111	101	-28.9	92	67	52	-43.5	5.1	3.8	3.6	-29.4
NZL	New Zealand	157	128	112	-28.7	105	81	66	-37.1	6.3	5	5	-20.6
NOR	Norway	146	116	98	-32.9	88	65	47	-46.6	3.8	2.7	2.3	-39.5
POL	Poland	245	216	169	-31.0	157	127	99	-36.9	8.1	5.6	4	-50.6
PRT	Portugal	124	124	110	-11.3	82	82	69	-15.9	5.5	3.3	2.7	-50.9
KOR	South Korea	238	166	111	-53.4	102	64	47	-53.9	6.2	3.4	2.8	-54.8
SVK	Slovak Republic	277	230	193	-30.3	202	164	129	-36.1	8.6	5.9	4.5	-47.7
SVN	Slovenia	225	175	144	-36.0	113	82	66	-41.6	4.9	2.4	2.1	-57.1
ESP	Spain	142	111	93	-34.5	80	65	53	-33.8	4.4	3.3	2.7	-38.6
SWE	Sweden	125	107	93	-25.6	86	66	51	-40.7	3.4	2.5	2.4	-29.4
CHE	Switzerland	130	103	85	-34.6	70	52	40	-42.9	4.9	4	3.5	-28.6
TUR	Turkey	144	144	145	0.7	110	110	113	2.7	28.4	15.7	9.2	-67.6
GBR	United Kingdom	135	135	119	-11.9	86	86	69	-19.8	5.6	4.6	3.9	-30.4
USA	United States	197	177	175	-11.2	116	96	88	-24.1	6.9	6.6	5.8	-15.9

Table 3 | Avoidable (preventable and treatable) mortality and infant mortality in 2000, 2008, and 2017
Source: Prepared by authors
Notes: * Deaths per 100,000 population; ** Deaths per 1,000 population

and efficiency, combined with reducing the burden on the social system and reducing the health inequalities of the population, are the greatest benefits associated with quality prevention programmes and public health strategies. These authors also examine the impact of lifestyle risk factors and related chronic illnesses on the labour market. Their conclusions indicate that lifestyle risks such as smoking, obesity, and alcohol consumption associated with chronic diseases have a negative impact on the labour market, but in some areas, the results are mixed. These findings are complemented by the results of the study of Vuik et al. (2019), which indicate that obesity and alcohol consumption in childhood may have a negative impact on future educational outcomes. The main health risks, such as smoking, alco-

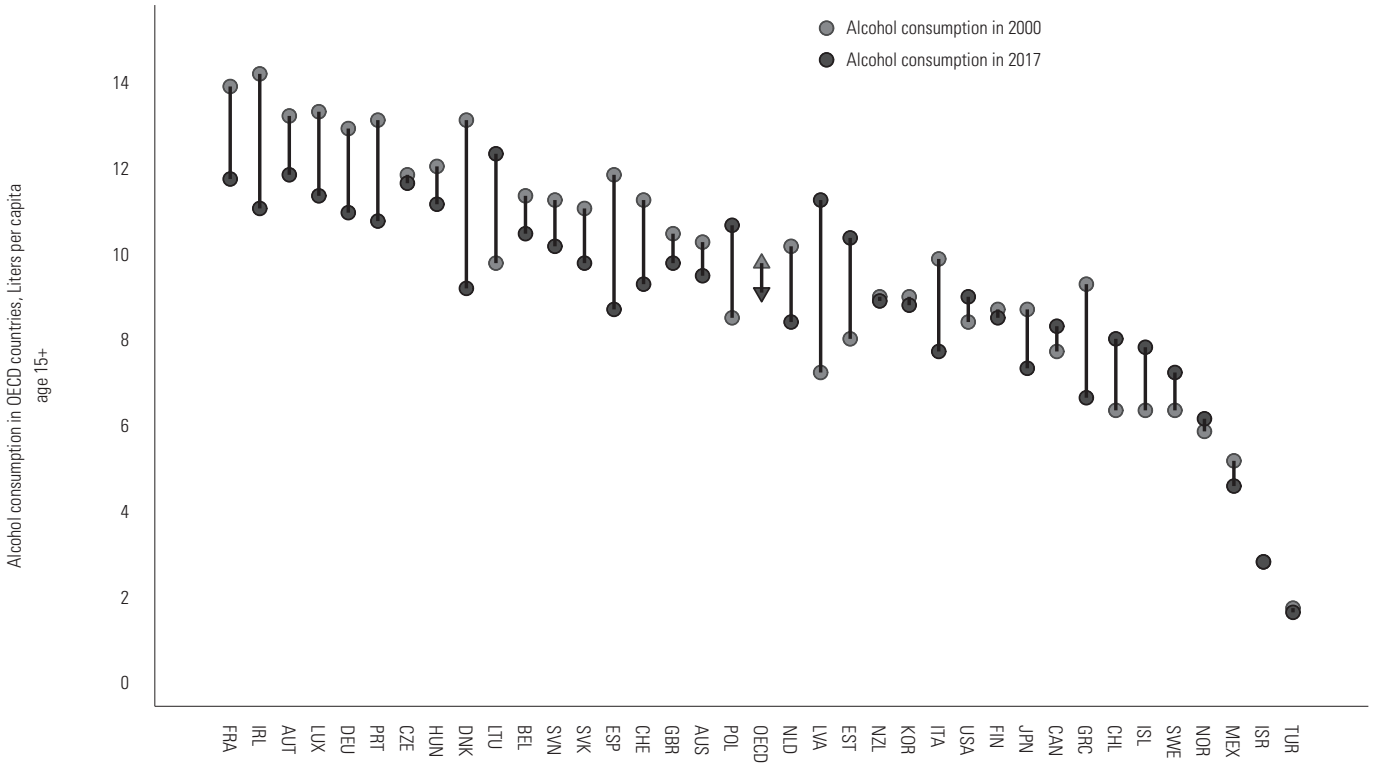

Figure 3 | Alcohol consumption in OECD countries (2000–2017)
Source: Prepared by authors

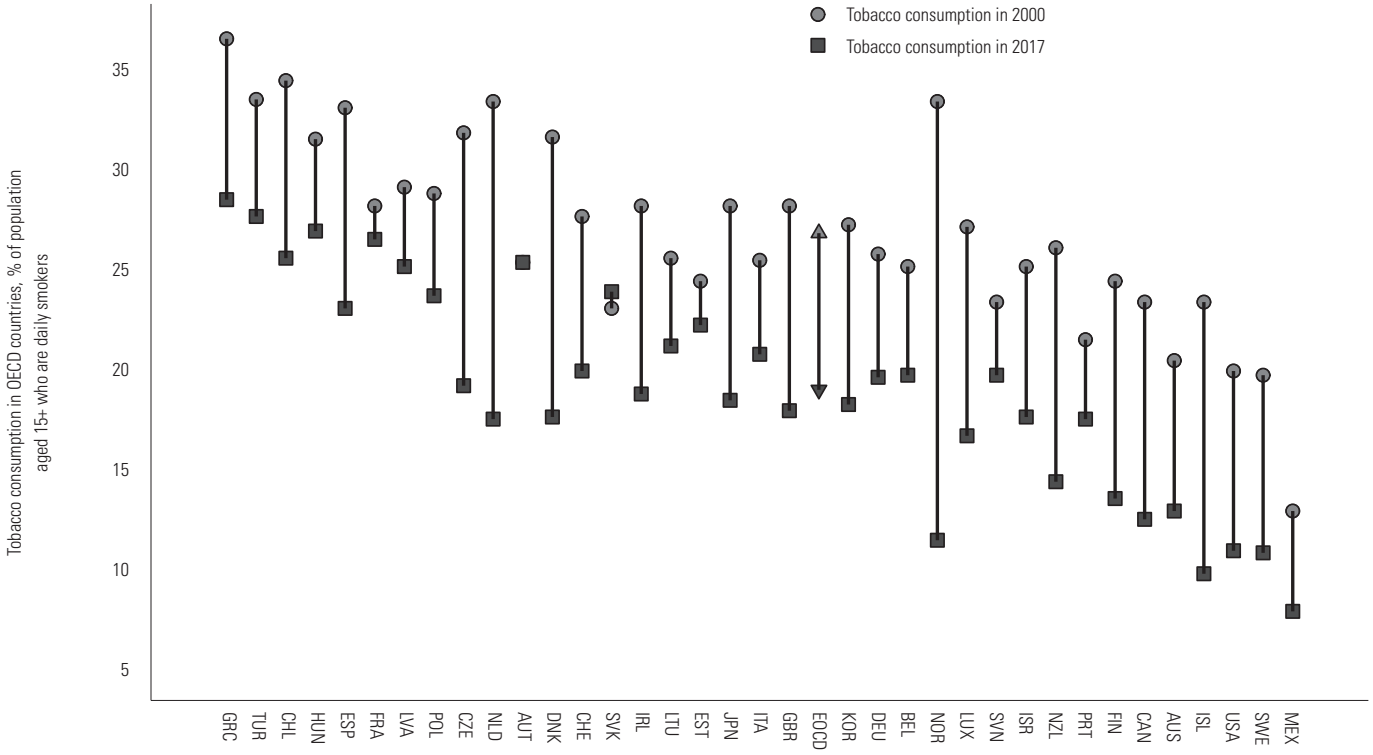

Figure 4 | Tobacco consumption in OECD countries (2000–2017)
Source: Prepared by authors

hol consumption, obesity, air pollution, physical inactivity, hypertension, poor hygiene habits, etc. are also addressed by Mitsakou et al. (2019) and Forouzanfar et al. (2016).

Figures 3 and *4* above compare alcohol and tobacco consumption, respectively, in OECD countries between 2000 and 2017. Alcohol consumption is defined as the annual consumption

of pure alcohol in litres, per capita and aged 15 years old and over. Tobacco consumption (see *Figure 4*) is defined as the percentage of the population aged 15 years old and over who report that they are daily smokers (OECD, 2019b). In 2017, the average alcohol consumption for OECD countries was 9 litres. The average alcohol consumption in OECD countries decreased by an average of 0.7 litres compared to 2000. Compared to 2000, the average alcohol consumption increased in CAN, EST, CHL, ISL, LTU, LVA, NOR, POL, SWE, and USA. The highest increase was seen in LVA, from 7.1 litres to 11.2 litres. The countries with the highest alcohol consumption in 2017 (more than 11.5 litres) include AUT, CZE, FRA, and LTU. On

		Physicians aged 55 and more, % of total physicians *			Physicians, Density per 1,000 population **		
	Country	**2000**	**2008**	**2017**	**2000**	**2008**	**2017**
AUS	Australia	23.1	24.1	26.0	2.5	3.0	3.7
AUT	Austria	15.8	20.6	29.7	3.9	4.6	5.2
BEL	Belgium	24.1	35.8	44.6	2.8	2.9	3.1
CAN	Canada	23.5	29.7	33.3	2.0	2.2	2.7
CZE	Czech Republic	20.7	29.9	37.2	3.4	3.6	3.6
DNK	Denmark	21.8	31.1	32.5	2.9	3.6	4.0
EST	Estonia	35.6	37.3	45.9	3.1	3.3	3.5
FIN	Finland	14.5	22.3	26.7	2.5	2.7	3.2
FRA	France	15.6	36.6	45.1	3.0	3.1	3.2
DEU	Germany	31.8	37.5	44.7	3.3	3.5	4.3
GRC	Greece	24.2	24.2	29.3	4.4	5.7	6.1
HUN	Hungary	25.5	39.0	43.3	2.7	3.1	3.3
CHL	Chile	22.8	22.8	28.3	1.7	1.9	2.5
ISL	Iceland	27.6	35.3	42.9	3.4	3.6	3.9
IRL	Ireland	20.2	20.3	22.5	2.8	2.8	3.1
ISR	Israel	29.7	42.8	49.9	3.5	3.4	3.1
ITA	Italy	18.9	35.4	55.1	3.4	3.8	4.0
JPN	Japan	27.6	30.2	36.8	1.9	2.2	2.4
LVA	Latvia	31.5	36.3	47.6	2.9	3.2	3.2
LTU	Lithuania	29.9	36.3	39.2	3.6	3.9	4.6
LUX	Luxembourg	24.7	29.0	43.4	2.2	2.7	3.0
MEX	Mexico	18.7	18.7	26.1	1.6	1.9	2.4
NLD	Netherlands	13.7	22.2	25.5	3.4	3.5	3.6
NZL	New Zealand	16.3	19.8	27.6	2.2	2.5	3.3
NOR	Norway	22.8	26.1	25.0	3.4	4.0	4.7
POL	Poland	0.0	0.0	0.0	2.2	2.2	2.4
PRT	Portugal	0.0	0.0	0.0	3.1	3.6	5.0
KOR	South Korea	13.1	13.1	19.4	1.3	1.9	2.3
SVK	Slovak Republic	19.0	29.5	36.0	3.4	3.4	3.4
SVN	Slovenia	0.0	24.6	29.5	2.2	2.4	3.1
ESP	Spain	12.0	18.8	34.1	3.1	3.5	3.9
SWE	Sweden	21.2	31.9	33.8	3.1	3.7	4.1
CHE	Switzerland	19.4	28.3	35.5	3.8	3.8	4.3
TUR	Turkey	9.6	13.1	17.9	1.3	1.6	1.9
GBR	United Kingdom	11.1	13.6	13.8	2.0	2.6	2.8
USA	United States	25.9	31.0	37.0	2.3	2.4	2.6
OECD	OECD Average				2.8	3.1	3.5

Table 4 | Statistics on physicians (2000–2017)
Notes: * In the case of Poland, Portugal, and Slovenia some data is not available; ** the data for Greece, Portugal, and Chile refers to all physicians who are licensed to practice. The data for Iceland, the Slovak Republic, France, Canada, and Turkey refers to professionally active physicians (practising physicians working in the health sector as educators, managers, researchers, etc.) The data for other countries refer to practising physicians (physicians providing care directly to patients).
Source: Prepared by authors

average, the Slovak Republic reduced its alcohol consumption by 1.3 litres (from 11 litres to 9.7 litres) compared to 2000.

The proportion of people aged 15 years and over who are daily smokers increased between 2000 and 2017 only in SVK (22.1% vs. 22.9%). The average value for tobacco consumption in 2017 was 18.2% in OECD countries. In AUT, BEL, CZE, EST, FRA, DEU, GRC, HUN, CHL, ITA, LVA, LTU, POL, SVK, SVN, ESP, CHE, and TUR the tobacco consumption in 2017 was higher than the OECD average. The health consequences of tobacco consumption are an increased risk of cancer, heart attack, stroke, and cardiovascular disease. Alcohol and tobacco consumption account for the largest proportion of disability-adjusted life years in several OECD countries (Forouzanfar et al., 2016).

Ono et al. (2013) state in a study on health workforce planning that the objective of planning is to strike a balance between supply and demand across different levels and categories of health professions, not only in the short term but also in the long term. Planning is important in terms of time-effectiveness, but also cost-effectiveness, linked to the training of new physicians and health professionals. Future projections showed a high degree of uncertainty provided by what are termed pension and migration patterns, particularly given the approaching retirement age of several physicians. This problem, discussed in this study, is also highlighted in *Table 4*. Between 2000 and 2017, the proportion of physicians aged 55 and over increased rapidly in BEL (from 24.1% to 44.6%), FRA (from 15.1% to 45.1%) and ITA (from 18.9% to 55.1%). Currently, more than 40% of all the physicians aged 55 and over are in BEL, EST, FRA, DEU, HUN, ISL, ISR, ITA, LVA and LUX. These findings will be a major healthcare challenge for many OECD countries over the next ten years. Most of these physicians who have reached retirement age are more than likely to continue their work. However, in the future, the pension reforms in a number of countries in recent years, mainly linked to the extension of retirement age, will have a significant impact on the need to replace these physicians. Most OECD countries indicate a shortage of medical practitioners, particularly in the smaller regions of each country. The highest proportion of physicians per 1,000 inhabitants in 2017 is in GRC (6.1 physicians). However, this indicator may be overestimated as the data for GRC includes all physicians licensed to practice their activities. Thus, this sample may also include those physicians who are no longer engaged in this activity for various reasons. The average number of physicians in OECD countries in 2017 was 3.5. The average number of physicians in SVK for 2017 was 3.4, which is just below the OECD average, whereas in CZE, the number of physicians was 3.6, which is just above the OECD average.

We believe that the above-mentioned facts will be one of the main topics for health policy actors globally in the coming years. The ageing of the population will, on the one hand, lead to higher health expenditure within a given country in the future, but on the other hand, there is an opportunity for these countries to improve their state of health and reduce the level of avoidable mortality (De Mooij & Tang, 2003). In this respect, the old-age dependency ratio is a significant indicator.

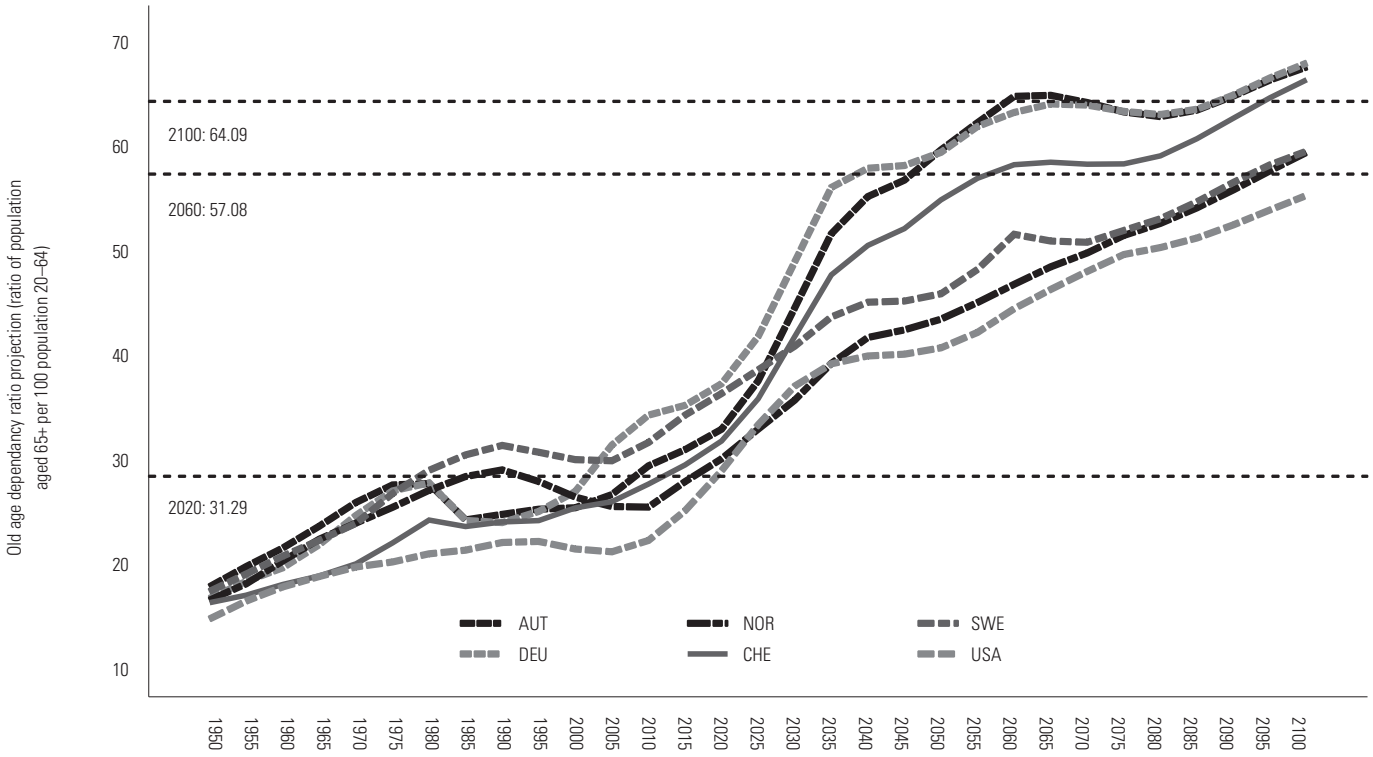

Figure 5 | Old-age dependency ratio projection for selected OECD countries
Source: Prepared by authors

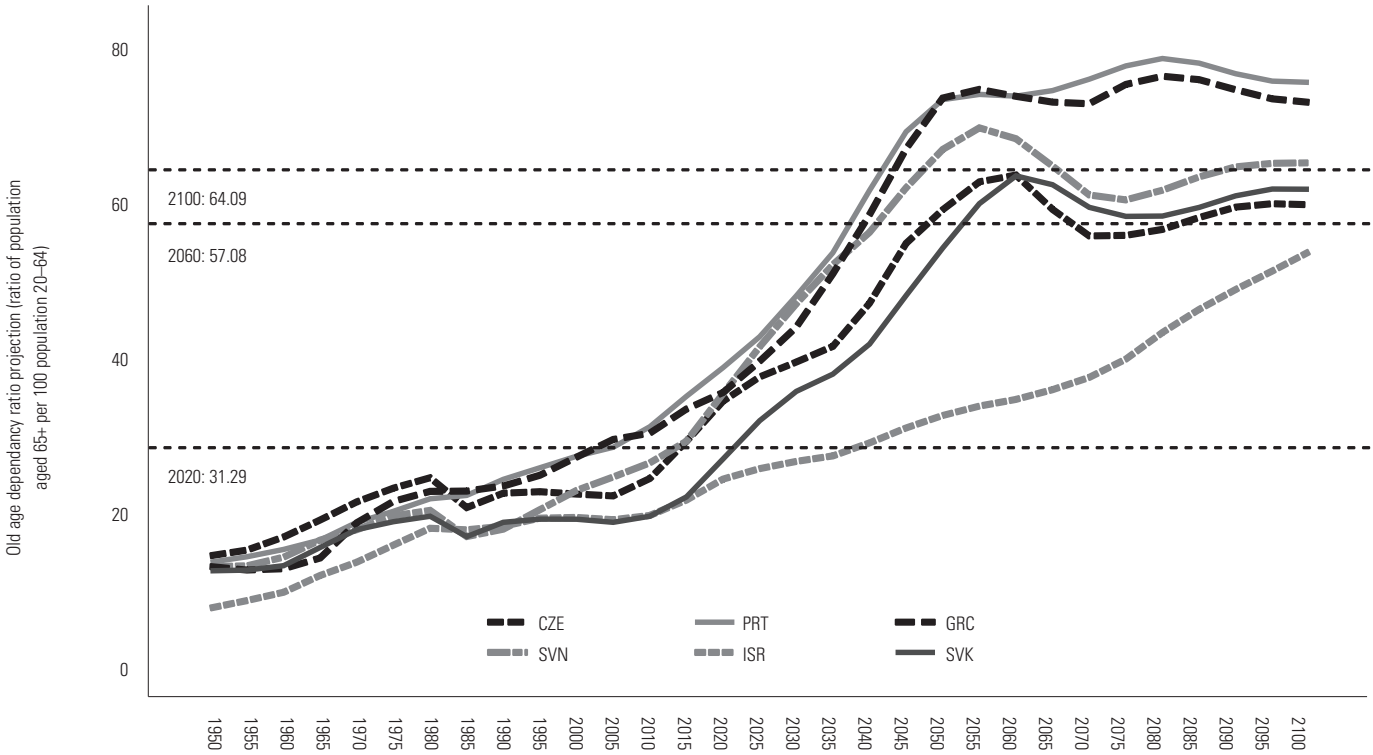

Figure 6 | Old-age dependency ratio projection for selected OECD countries
Source: Prepared by authors

In our case, the old-age dependency ratio is the ratio between the economically inactive population aged 65 and over and the number of persons aged between 20 and 64. This indicator is calculated per 100 inhabitants between economically active (working) age 20 and 64. *Figures 5* and *6* below highlight the old-age dependency ratio in selected OECD countries according to the UN DESA medium-case scenario until 2100.

In 2015, on average, there were almost 28 people aged 65 and over per 100 members of the population aged 20–64 in OECD countries. It is estimated that this ratio will more than double to 57.08 people by 2060, while it is projected to grow until 2100 to reach 64.09 people on average in OECD countries. Among the countries listed in *Figure 5,* the old-age dependency index will be the highest in Germany (67.8), Austria (67.4), and Switzerland (66.2) in 2100. A sharp increase in this index can be expected between 2020 and 2060.

Figure 6 comprises the countries CZE, ISR, PRT, GRC, SVN, and SVK. The development of the index will be very similar in GRC, SVN, and SVK. A sharp increase in the proportion of the older population can also be expected between 2020 and 2060. The average median age for OECD countries will increase by almost nine years by 2100, according to UN DESA (2019; 2020). The impact of ageing has several potentially significant effects on a country's economy, with a significant impact of ageing on pension systems (Oliveira Martins et al., 2005; Martin, 2018). The European Commission (2018) draws attention to the demographic changes the society can expect in the coming years. The ageing report emphasizes the importance of the economic age dependency index of the older generation aged 65 and over in relation to the economically active population. The ECB (2019) highlights the fiscal impact of the ageing of the population in EU countries within the framework of the projection of several scenarios. Ageing-related expenditure as a percentage of GDP is projected by the ECB (2019) to increase by 2.2 percentage points between 2016 and 2040 (from 26.0% of GDP to 28.2% of GDP). At the same time, it is pointed out that increasing ageing-related expenditure in EU countries may create fiscal problems for many countries which are already experiencing problems with high levels of public debt. More than half of the euro area countries have a higher public debt-to-GDP ratio than the reference value (60% of GDP). The problem of fiscal developments in countries with high public debt-to-GDP ratios (Italy, Portugal, Belgium) will also increase with rising ageing-related expenditure in these countries until 2040 (ECB, 2019).

4 CONCLUSIONS

Healthcare reforms in the context of ageing populations pose challenges for all OECD countries. These countries should seek to improve the age structure of the population through their policies, whether with the reforms mentioned above or by measures and policies to influence the fertility rate. In addition to these areas in the health sector, there is a need to focus on the consolidation of public expenditure, which is supported by the fact that more than half of the euro area countries have public debt above 60% of GDP.

Similarly, labour market measures could increase labour productivity and shift labour to higher value-added areas (OECD, 2018). Loichinger et al. (2014) use simulations of the economic dependency index, which, in addition to the demographic structure of the population, is extended to include economic behaviour and labour market activity. According to these authors, we can expect a high increase in the proportion of the older population in the economically active population in the coming years if current mortality tables remain unchanged. For policymakers, this is an opportunity to prepare and respond appropriately to these negative scenarios through well-defined health and social policies, which, in a way, can minimize the social impact of an ageing population.

Healthcare expenditure represents a significant part of the use of national resources. Factors such as ageing populations, obesity, and harmful alcohol and tobacco consumption contribute to an increase in demand for sustainable healthcare. Smoking and tobacco use are one of the most common causes of preventable diseases (Inchley et al., 2016). The findings of a number of studies investigating the risk behaviour of young people point to the need to develop prevention policies and programmes in the field of smoking and alcohol abuse that will reflect not only the risk factors of health but also the social determinants of the individual (Currie et al., 2009; Devaux & Sassi, 2015; Inchley et al., 2016). Alcohol consumption among the young population in several European countries is alarming. Currie et al. (2009) and Inchley et al. (2016) state that young people can see alcohol as a way of satisfying their own needs and at the same time helping them to adapt better to society. However, we must add that alcohol has a number of negative consequences for the life of an individual, but also for society. The hazardous drinking of alcohol is associated with adverse psychological and social consequences for the individual's health and can also lead to various problems. Alcohol abuse is often also associated with smoking and illicit drug use, which in the future may have an impact on unfavourable health outcomes. The impact of the community and society on individuals at a young age has a significant impact on their risky behaviour.

Increased pressure on the use of resources in the health sector is led by key actors and policymakers to look for efficient pathways for the provision of health services. Improving efficiency in this area, even in small measures, can bring about significant savings in financial resources. Efficient measures can be used as a tool for planning and evaluating health policies. For all governments in OECD countries, cost-effective healthcare should be an essential objective. However, it should be stressed that, in the case of an analysis of the effectiveness of the provision of health services, a comparison with the analysis of efficiency in other areas and sectors is highly complicated, in particular, as a result of the nature of health processes and health services, as well as the determinants of healthcare.

Authors´ contributions: KK and JS designed the study. JS and KK performed the statistical analysis and together participated in the interpretation of the data. JS drew up the original draft of the manuscript. KK conducted the literature review and summarized related work. KK supervised the formal analysis, statistical analysis, editing, and visualization of the manuscript. All the authors have read and agreed to the published version of the manuscript.

Declaration of interest: No conflict of interest.

Grant affiliation: This research was supported by the Slovak Scientific Grant Agency as part of the research project VEGA 1/0794/18 "Development of methodological platform for evaluation of efficiency in the financial and non-financial sector".

REFERENCES

Anderson, G. F., Hurst, J., Hussey, P. S., & Jee-Hughes, M. (2000). Health Spending And Outcomes: Trends In OECD Countries, 1960-1998: Do Americans get more from their health care system for the larger share of wealth they spend on health?. *Health Affairs*, *19*(3), 150–157.

Berwick, D. M., & Hackbarth, A. D. (2012). Eliminating waste in US health care. *Jama*, *307*(14), 1513–1516.

Currie, C., Zanotti, C., Morgan, A., Currie, D., De Looze, M., Roberts, C., ... & Barnekow, V. (2009). Social determinants of health and well-being among young people. *Health Behaviour in School-aged Children (HBSC) study: international report from the 2009/2010 survey*, (No. 6). 271.

Cylus, J., & Pearson, M. (2016). Cross-national efficiency comparisons of health systems, subsectors and disease areas. *Health System Efficiency*, 139–166.

Cylus, J., Papanicolas, I., & Smith, P. C. (2017). Using data envelopment analysis to address the challenges of comparing health system efficiency. *Global Policy*, *8*, 60–68.

Cylus, J., Papanicolas, I. & Smith, P. C., eds. (2016). Health system efficiency: how to make measurement matter for policy and management. *Health Policy Series, No. 46. European Observatory on Health Systems and Policies*, Brussels, Belgium.

De Mooij, R., & Tang, P. (2003). *Four futures of Europe*. The Hague: CPB Netherlands Bureau for Economic Policy Analysis.

Devaux, M. & Sassi, F. (2015). "The Labour Market Impacts of Obesity, Smoking, Alcohol Use and Related Chronic Diseases", *OECD Health Working Papers*, No. 86, OECD Publishing, Paris, https://doi.org/10.1787/5jrqcn5fpv0v-en.

ECB (2019). Annual Report 2018. European Central Bank. Frankfurt am Main. Available at: https://www.ecb.europa.eu/pub/pdf/annrep/ar2018~d08cb4c623.en.pdf?d4db50437f47e3bf9914e1381b1a2cde

Emanuel, E. J., & Fuchs, V. R. (2008). The perfect storm of overutilization. *Jama*, *299*(23), 2789–2791.

European Commission (2018). The 2018 ageing report: Economic and budgetary projections for the EU member states (2016–2070). Available at: https://ec.europa.eu/info/sites/info/files/economy-finance/ip079_en.pdf

Eurostat (2019). Preventable and treatable mortality statistics. Available at: https://ec.europa.eu/eurostat/statistics-explained/pdfscache/79429.pdf

Forouzanfar, M. H., Afshin, A., Alexander, L. T., Anderson, H. R., Bhutta, Z. A., Biryukov, S., ... & Cohen, A. J. (2016). Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and

metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The Lancet*, *388*(10053), 1659–1724.

Gavurova, B., Kocisova, K., & Sopko, J. (2017). An analysis of health spending: Trends in selected countries. *International Journal of Applied Business and Economic Research*, *15*(9), 1–12.

Gmeinder, M., Morgan, D., & Mueller, M. (2017). "How much do OECD countries spend on prevention?", *OECD Health Working Papers*, No. 101, OECD Publishing, Paris, https://doi.org/10.1787/f19e803c-en.

Grubaugh, S. G., & Santerre, R. E. (1994). Comparing the performance of health care systems: an alternative approach. *Southern Economic Journal*, 1030–1042.

Heijink, R. (2015). Comparative efficiency of health systems, corrected for selected lifestyle factors. *Funded by the European Commission and carried out by the Dutch National Institute for Public Health and the Environment (RIVM)*.

Inchley, J., Currie, D., Young, T., Samdal, O., Torsheim, T., Augustson, L., ... & Barnekow, V. (2016). Growing up unequal: gender and socio-economic differences in young people's health and well-being. *Health Behaviour in School-aged Children (HBSC) study: international report from the 2013/2014 survey* (No. 7). World Health Organization.

Janečková, H., & Hnilicová, H. (2009). *Úvod do veřejného zdravotnictví* [An Introduction to Public Health]. 1st ed. Prague: Portál. 296 pp.

Loichinger, E., Hammer, B., Prskawetz, A., Freiberger, M., & Sambt, J. (2014). *Economic dependency ratios: Present situation and future scenarios* (No. 02/2014). ECON WPS-Vienna University of Technology Working Papers in Economic Theory and Policy.

Martin, J. P. (2018). Live longer, work longer: The changing nature of the labour market for older workers in OECD countries. [IZA Discussion Paper 11510/2018.] Bonn: Institute of Labor Economics.

Mathers, C. D., Murray, C. J., & Salomon, J. A. (2003). Methods for measuring healthy life expectancy. In *Health systems performance assessment: debates, methods and empiricism*, 437–470. World Health Organization, Geneva.

Mitsakou, C., Dimitroulopoulou, S., Heaviside, C., Katsouyanni, K., Samoli, E., Rodopoulou, S., ... & Borrell, C. (2019). Environmental public health risks in European metropolitan areas within the EURO-HEALTHY project. *Science of The Total Environment*, *658*, 1630–1639.

Murray, C. J., & Evans, D. B. (Eds.). (2003). *Health systems performance assessment: debates, methods and empiricism*. World Health Organization.

OECD & Eurostat (2019). *Avoidable mortality: OECD/Eurostat lists of preventable and treatable causes of death (2019 version)*. Available at: https://www.oecd.org/health/health-systems/Avoidable-mortality-2019-Joint-OECD-Eurostat-List-preventable-treatable-causes-of-death.pdf.

OECD (2018). *OECD Pensions Outlook 2018*, OECD Publishing, Paris, https://doi.org/10.1787/pens_outlook-2018-en.

OECD (2019a), *Health at a Glance 2019: OECD Indicators*, OECD Publishing, Paris, https://doi.org/10.1787/4dd50c09-en.

OECD (2019b). Health Statistics 2019 – Definitions, Sources and Methods: Non-medical determinants of health. Available at: http://stats.oecd.org/wbos/fileview2.aspx?IDFile=17d36de2-b4ae-409a-9968-a27c7f2857e4.

Oliveira Martins, J., Gonand, F., Antolin, P., de la Maisonneuve, C., & Yoo, K. Y. (2005), "The Impact of Ageing on Demand, Factor Markets and Growth", *OECD Economics Department Working Papers*, No. 420, OECD Publishing, Paris, https://doi.org/10.1787/545827207132.

Ono, T., Lafortune, G. & Schoenstein, M. (2013). "Health Workforce Planning in OECD Countries: A Review of 26 Projection Models from 18 Countries", *OECD Health Working Papers*, No. 62, OECD Publishing, Paris, https://dx.doi.org/10.1787/5k44t787zcwb-en.

Ozcan, Y. A. (2014). *Health care benchmarking and performance evaluation*. 2nd Edition. Springer US.

Papanicolas, I., & Smith, P. (2013). *Health system performance comparison: an agenda for policy, information and research: an agenda for policy, information and research*. McGraw-Hill Education (UK).

Preston, S. H. (2007). The changing relation between mortality and level of economic development. *International Journal of Epidemiology*, *36*(3), 484–490.

Salomon, J. A., Mathers, C. D., Chatterji, S., Sadana, R., Ustun, T. B., & Murray, C. J. (2003). Quantifying individual levels of health: definitions, concepts and measurement issues. *Health Systems Performance Assessment: Debate, Methods, and Empiricism*, 301–18.

Şchiopu, D. (2010). Applying twostep cluster analysis for identifying bank customers' profile. *Buletinul*, *62*(3), 66–75.

Sopko, J., Gavurová, B., & Kočišová, K. (2017). The Government Expenditure Efficiency in OECD Countries with DEA Approach. *European Financial Systems*, 303–325.

Stefko, R., Gavurova, B., & Kocisova, K. (2018). Healthcare efficiency assessment using DEA analysis in the Slovak Republic. *Health Economics Review*, *8*(1), 6.

United Nations, Department of Economic and Social Affairs, Population Division (2020). *World Mortality 2019* (ST/ESA/SER.A/437). Available at: https://www.un.org/en/development/desa/population/publications/pdf/mortality/WMR2019/World_Mortality_2019.pdf.

United Nations, Department of Economic and Social Affairs, Population Division (2019). *World Mortality 2019: Data Booklet* (ST/ ESA/SER.A/436).

Venkataraman, S., Anbazhagan, S., & Anbazhagan, S. (2019). Expenditure on health care, tobacco, and alcohol: Evidence from household surveys in rural Puducherry. *Journal of Family Medicine and Primary Care*, *8*(3), 909–913.

Vuik, S., Devaux, M., & Cecchini, M. (2019). "Exploring the causal relation between obesity and alcohol use, and educational outcomes", *OECD Health Working Papers*, No. 109, OECD Publishing, Paris, https://doi.org/10.1787/7bcd4669-en.

World Health Organization (2000). The world health report 2000: health systems: improving performance. World Health Organization.

World Health Organization (2009). *Global health risks: mortality and burden of disease attributable to selected major risks*. Geneva: World Health Organization.

World Health Organization (2018). *World health statistics 2018: monitoring health for the SDGs sustainable development goals*. World Health Organization.