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# IMPACT OF COVID-19 PANDEMIC ON SELECTED CAUSES OF DEATH IN EU REGIONS

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**Purpose:** The main objective of the study is to learn about the impact of the COVID-19 pandemic on the trends of selected causes of death in EU regions. The second objective is to learn about the variation in mortality from heart disease and cancer and from accidents in EU regions.

**Design/methodology/approach**: To examine the impact of the pandemic on mortality, the average rates of change in mortality before and after the pandemic in all EU regions were counted. The linear ordering method was also used to rank EU regions in terms of mortality from ischemic heart disease and cancer and accidents, thus examining the variation in terms of the aforementioned indicators across EU regions.

**Findings:** The analyses show that 90% of the regions experienced an increase in the total death rate after the pandemic, so it can be argued that indeed the COVID-19 pandemic had a significant impact on mortality in EU regions. The study also shows that there is a high similarity in deaths from heart disease and cancer in regions within EU countries. In the case of deaths due to accidents, there is much greater variation within countries.

**Research limitations/implications**: Further research should focus on analyzing similarities in the development of EU regions. The research can be expanded to analyze coefficients related to the economic development of the regions.

**Social implications:** By learning which regions are best able to cope with the effects of a pandemic, regions that are coping less well can draw some patterns to better handle similar situations in the future. In the era of globalization, similar cases may occur more and more frequently, so it is important to have appropriate strategies prepared and to implement them immediately.

**Originality/value:** While countries are often compared with each other, regions are much less often. The article shows the changes that are taking place precisely in the regions of EU countries. Of course, many decisions are made at the national level, however, also at the level of the regions many important decisions can be made, thanks to which some regions develop better and others less well.

Keywords: EU country regions, Hellwig linear ordering method, average rate of change, mortality.

Category of the paper: empirical research.

# 1. Introduction

Globalization brings many benefits, but it also brings risks. In December 2019, the first reports of a new disease emerged. A cluster of patients with severe pneumonia was detected in the city of Wuhan, China. The World Health Organization was informed on December 31, 2019, when 44 cases were detected, and on January 9, 2020, information that the disease was caused by a new coronavirus similar to SARS-CoV circulated the world (Duszynski et al., 2020, p. 12). The ease of human travel has caused the coronavirus to spread around the world at a rapid pace.

The COVID-19 pandemic in Poland lasted from March 2020 to May 2022, causing 6.5 million cases and 119,000 deaths. There were also more than 200,000 excess deaths in Poland during this period compared to the average in recent years (Płonka-Syroka, 2023, p. 27). Also in the rest of Europe, more than 2 million people died from the pandemic (PAP, 2022). In the literature, we can find articles on the impact of the COVID-19 pandemic on the global economy (Jędrzejowska, Wróbel, 2021), individual countries (Rangachev, Marinov, Mladenov, 2022; Bogos et al., 2021; Parkitny, Parkitna, 2024) or selected regions (Budner-Iwanicka, Legutko, 2021; Hacoğliu-Hoke, Känzig, Surico, 2021).

The purpose of this article is to examine the changes that have occurred in the pattern of deaths due to the COVID-19 pandemic in all regions of the EU. The analysis includes the total number of deaths, deaths from accidents, from traffic accidents, from cancer and from ischemic heart disease. Deaths, especially excess deaths, can have serious consequences for the economies of individual EU regions, which is why it is so important to monitor them.

The article examines the changes that have occurred in mortality in the 5 categories adopted by Eurostat in all regions in the NUTS 2 division of the EU. Population deaths were divided according to the 5 categories:

- death due to transport accidents,
- death due to accidents,
- death due to ischaemic heart diseases,
- death due to cancer,
- all causes of death.

The research hypotheses also included:

- mortality in regions of individual EU countries for individual causes is similar to each other,
- in regions from "richer" countries (northwestern Europe) mortality from individual causes is lower than in "poorer" regions (southeastern Europe),
- the authorities of the regions taking care of their residents strive to reduce the listed causes of death, however, the pandemic may have changed the trend of the number of deaths,

• in regions from the countries of Central and Eastern Europe "chasing" the countries of Western Europe, the number of deaths from the listed causes is falling at a faster rate.

## 2. Methodology

All data are from the Eurostat website (2024). The first step divides the causes of death into 3 categories:

- health-related,
- related to accidents,
- all causes of death.

For the first two categories, Hellwig's linear ordering method (Hellwig, 1968) was used to order each region from those with the lowest mortality rates to those with the highest. To do this, the variables were normalized, and then the pattern of development was counted, i.e. the region (often fictitious) where all rates were best (in this study, rates were lowest) with which all regions were compared.

The use of Hellwig's linear ordering method involves the fact that we must have complete data, variables for which we do not have complete data must be removed from the analysis. In this method, we can include weights for individual variables, this gives the opportunity to take into account the hierarchy of importance of individual criteria, but it also affects the results of the analysis and can lead to manipulation of the study. For this reason, the study did not assign weights to individual variables, so all variables were assumed to be equally important. Another limitation of Hellwig's linear ordering method is that it does not take into account the relationships between variables, which can also affect the results of the analysis, and finally, the most important thing is the choice of variables themselves, which is always a subjective choice.

By organizing the regions, it is possible to answer the question of whether mortality in the regions of each EU country for particular causes is similar to each other, and whether mortality for particular causes is lower in regions from "richer" countries than in "poorer" regions.

In the next step, the average rate of change of total deaths was counted (Ostasiewicz, Rusnak, Siedlecka, 2001) in 2013-19 and in 2019-21. Comparison of these indicators will help answer the last 2 research hypotheses.

# 3. Deaths in EU regions due to ischemic heart disease or cancer

Heart disease and cancer are common causes of death that all EU countries are trying to combat, among other things, through prevention. To see which regions have the highest mortality rates for the aforementioned diseases, they were ranked using Hellwig's linear ordering method. All EU regions were ranked from those for which death rates from heart disease and cancer are lowest to those for which they are highest. Such an analysis was performed for 2013, 2019 and 2021, so we can see whether there were changes in the order of EU regions. Table 1 shows the 15 regions in which Hellwig's measure of development took the largest values (mortality rates were the smallest), and Table 2 shows the smallest. Table 2 arranges the regions in order from the smallest value of the Hellwig development measure to the largest value.

#### Table 1.

*Regions with the highest values of Hellwig's measure of development (ischemic heart disease and cancer)* 

2013				2019		2021			
Region	Country	Hellwig's measure of develop- ment	Region	Country	Hellwig's measure of develop- ment	Region	Country	Hellwig's measure of develop- ment	
Martini- que	France	1,000	Provincia Autonoma di Trento	Italy	1,000	Sardegna	Italy	0,995	
Guyane	France	0,995	Calabria	Italy	0,883	Centre — Val de Loire	France	0,944	
Kýpros	Cyprus	0,869	Sardegna	Italy	0,876	Calabria	Italy	0,936	
La Réunion	France	0,866	Centre — Val de Loire	France	0,832	Provincia Autonoma di Bolzano/Bozen	Italy	0,913	
Voreio Aigaio	Greece	0,859	Sicilia	Italy	0,825	Aquitaine	France	0,900	
Midi- Pyrénées	France	0,852	Provincia Autonoma di Bolzano/Bozen	Italy	0,824	Sicilia	Italy	0,896	
Comuni- dad de Madrid	Spain	0,845	Friesland	Netherlands	0,799	Pest	Hungary	0,883	
Molise	Italy	0,836	Pest	Hungary	0,795	Sostinės regionas	Lithuania	0,872	
Calabria	Italy	0,835	Basilicata	Italy	0,795	Prov. Limburg	Belgium	0,871	
Basilicata	Italy	0,828	Aragón	Spain	0,795	Haute- Normandie	France	0,866	
Abruzzo	Italy	0,814	Vidurio ir vakarų Lietuvos regionas	Lithuania	0,789	Flevoland	Nether- lands	0,865	
Notio Aigaio	Greece	0,814	Sostinės regionas	Lithuania	0,783	Campania	Italy	0,864	
Centro	Portu- gal	0,807	Tübingen	Germany	0,779	Picardie	France	0,862	
Rhône- Alpes	France	0,806	Prov. Limburg	Belgium	0,779	Friesland	Nether- lands	0,860	
Región de Murcia	Spain	0,800	Aquitaine	France	0,778	Prov. Brabant wallon	Belgium	0,859	

Source: own calculations.

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#### Table 2.

*Regions with the highest Hellwig development index values (ischemic heart disease and cancer)* 

2013				2019		2021		
Region	Country	Hellwig's measure of develop- ment	Region	Country	Hellwig's measure of develop- ment	Region	Country	Hellwig's measure of develop- ment
Észak- Magyaror-szág	Hungary	0,124	Limburg	Nether- lands	0,112	Limburg	Nether- lands	0,130
Közép- Dunántúl	Hungary	0,151	Burgenland	Austria	0,152	Burgenland	Austria	0,148
Észak-Alföld	Hungary	0,152	Gelderland	Nether- lands	0,175	Noord-Brabant	Nether- lands	0,168
Pest	Hungary	0,159	Noord-Brabant	Nether- lands	0,177	Gelderland	Nether- lands	0,185
Dél-Dunántúl	Hungary	0,171	Zuid-Holland	Nether- lands	0,204	Zuid-Holland	Nether- lands	0,231
Vidurio ir vakarų Lietuvos regionas	Lithuania	0,200	Noord-Holland	Nether- lands	0,205	Niederösterreich	Austria	0,233
Dél-Alföld	Hungary	0,213	Niederöster-reich	Austria	0,211	Noord-Holland	Nether- lands	0,237
Nyugat- Dunántúl	Hungary	0,234	Zeeland	Nether- lands	0,269	Zeeland	Nether- lands	0,286
Západné Slovensko	Slovakia	0,248	Norra Mellansverige	Sweden	0,291	Norra Mellansverige	Sweden	0,286
Budapest	Hungary	0,273	Vest	Romania	0,304	Drenthe	Nether- lands	0,332
Severozá-pad	Czech Republic	0,274	Utrecht	Nether- lands	0,314	Utrecht	Nether- lands	0,337
Stredné Slovensko	Slovakia	0,283	Severozápad	Czech Republic	0,318	Sydsverige	Sweden	0,346
Východné Slovensko	Slovakia	0,285	Mellersta Norrland	Sweden	0,327	Severozápad	Czech Republic	0,349
Nord-Vest	Romania	0,294	Drenthe	Nether- lands	0,327	Vest	Romania	0,355
Latvija	Latvia	0,294	Overijssel	Nether- lands	0,343	Overijssel	Nether- lands	0,364

Source: own calculations.

From Tables 1 and 2, we can learn that the regions with the highest and lowest surveyed death rates have changed over the nine years. Of particular note is the Hungarian region of Pest. In 2013 it was ranked 4th in terms of the highest surveyed death rates (the lowest measures of Hellwig development), while in 2019 and 2021 it was ranked 8th and 7th, respectively, among the countries with the highest measure of Hellwig development.

We can also see that among the highest-rated countries in 2013 were the Mediterranean countries and Portugal, while the lowest-rated were the countries of Central and Eastern Europe. In 2019 and 2021, the situation is quite different. Among the worst countries, the Netherlands is by far the leader, with as many as 9 regions from this country in both years (out of 12 regions in total). Among the best regions, there are 6 and 5 regions from Italy and 2 and 4 regions from France, respectively. It can be seen that regions from these countries maintain very high positions throughout the period under review.

Lithuania's regions recorded the largest growth. Lithuania has 2 regions according to the NUTS 2 classification. In 2013, both were among the 20 weakest regions, in 2019 and 2021 they are among the best regions.

Table 3 shows the average positions of the regions for each EU country in 2021.

#### Table 3.

Average regional positions for each EU country (ischemic heart disease and cancer)

	Mean	Standard deviation
Hungary	46,5	23,74
Italy	50,1	44,09
Belgium	58,2	46,85
France	61,3	39,26
Spain	72,7	30,38
Portugal	102	49,87
Germany	116,1	38,16
Poland	126,7	13,71
Finland	138,6	45,13
Greece	147,3	8,90
Bulgaria	152,7	34,51
Slovakia	154	7,73
Sweden	156,6	39,36
Austria	162,3	40,65
Netherlands	166	76,42
Denmark	170,6	12,53
Czech Republic	186,3	9,81
Romania	191,8	4,85

Source: own calculations.

Table 3 shows countries with at least 3 regions. The average can give us an idea of what the situation is in terms of mortality from heart disease and cancer in each EU country. The standard deviation, as a measure of variability, tells us how different the individual positions of the regions are from the average for the country. It can be seen that in 2021 Hungary, Italy and Belgium were ranked No. 1, with Denmark, the Czech Republic and Romania in last place. It can be seen that the largest variation of individual regions is in the Netherlands, while for many countries the variation is small, indicating the significant influence of the state and the systemic solutions adopted in each country to counter the studied mortality in each region. The worst situation is in the last 3 countries because the averages indicate very high mortality rates compared to EU countries, and the low value of the standard deviation shows that this bad situation applies to all regions in these countries. In the Netherlands, the situation is also bad, but the high value of the standard deviation shows that some regions are doing much better than others. There are 2 regions from the Netherlands in the top 15, and as many as 9 in the last 15.

### 4. Deaths in EU regions due to accidents

In addition to mortality due to ischemic heart disease and cancer, this study examined mortality due to accidents. Deaths from traffic accidents and deaths from accidents in general were taken into account. As in the case of mortality from diseases, the regions were also ranked by counting the Hellwig measure of development. Tables 4 and 5 show the regions for which the development measure took the largest and smallest values.

### Table 4.

Regions with the highest values of Hellwig's measure of development (accidents)

2013			2019			2021		
Region	Country	Hellwig's measure of develop- ment	Region	Country	Hellwig's measure of develop- ment	Region	Country	Hellwig's measure of develop- ment
Comunidad de Madrid	Spain	0,9772	Centre — Val de Loire	France	0,949	Centre — Val de Loire	France	0,944
Ciudad de Ceuta	Spain	0,9505	Lorraine	France	0,931	Región de Murcia	Spain	0,891
Bremen	Germany	0,9494	Notio Aigaio	Greece	0,922	Hannover	Germany	0,888
Düsseldorf	Germany	0,9106	Pays de la Loire	France	0,905	Wien	Austria	0,872
Arnsberg	Germany	0,9088	Bretagne	France	0,902	Nord-Pas de Calais	France	0,867
Canarias	Spain	0,8924	Bremen	Germany	0,895	Notio Aigaio	Greece	0,867
Köln	Germany	0,8913	Región de Murcia	Spain	0,875	Champagne- Ardenne	France	0,863
Berlin	Germany	0,8911	Warmińsko- mazurskie	Poland	0,869	Attiki	Greece	0,861
Schleswig- Holstein	Germany	0,8838	Attiki	Greece	0,868	Pays de la Loire	France	0,859
Comunitat Valenciana	Spain	0,8822	Düsseldorf	Germany	0,868	Bretagne	France	0,854
País Vasco	Spain	0,8802	Alsace	France	0,861	Basse- Normandie	France	0,854
Saarland	Germany	0,8740	Wien	Austria	0,860	Alsace	France	0,853
Detmold	Germany	0,8666	Nord-Pas de Calais	France	0,860	Warmińsko- mazurskie	Poland	0,852
Andalucía	Spain	0,8654	Voreio Aigaio	Greece	0,859	Ile de France	France	0,850
Münster	Germany	0,8630	Hovedstaden	Denmark	0,857	Münster	Germany	0,846

Source: own calculations.

#### Table 5.

Regions with the lowest values of Hellwig's measure of development (accidents)

	2013		2019			2021		
Region	Country	Hellwig's measure of develop- ment	Region	Country	Hellwig's measure of develop- ment	Region	Country	Hellwig's measure of develop- ment
Prov. Namur	Belgium	0,187	Prov. Luxembourg	Belgium	0,217	Övre Norrland	Sweden	0,109
Sostinės regionas	Lithuania	0,194	Overijssel	Nether- lands	0,225	Stredné Slovensko	Slovakia	0,226
Guyane	France	0,214	Övre Norrland	Sweden	0,225	Západné Slovensko	Slovakia	0,230
Prov. Luxembourg (BE)	Belgium	0,227	Západné Slovensko	Slovakia	0,257	Etelä-Suomi	finlandia	0,336
Vidurio ir vakarų Lietuvos regionas	Lithuania	0,261	Sardegna	Italy	0,263	Calabria	Italy	0,347
Vest	Romania	0,262	Veneto	Italy	0,292	Overijssel	Nether- lands	0,363
Nord-Est	Romania	0,387	Etelä-Suomi	Finland	0,308	Prov. Luxembourg (BE)	Belgium	0,366
Sud-Est	Romania	0,397	Stredné Slovensko	Slovakia	0,323	Länsi-Suomi	Finland	0,367
Latvija	Latvia	0,401	Limburg	Nether- lands	0,328	Veneto	Italy	0,400

Sud-Vest Oltenia	Romania	0,416	Prov. Namur	Belgium	0,357	Sardegna	Italy	0,408
Lubuskie	Poland	0,419	Länsi-Suomi	Finland	0,362	Gelderland	Nether- lands	0,419
Kujawsko- pomorskie	Poland	0,432	Drenthe	Nether- lands	0,380	Drenthe	Nether- lands	0,419
Prov. Hainaut	Belgium	0,437	Gelderland	Nether- lands	0,385	Mellersta Norrland	Sweden	0,420
Prov. Liège	Belgium	0,443	Calabria	Italy	0,418	Nord-Vest	Romania	0,461
Wielkopolskie	Poland	0,447	Zuid-Holland	Nether- lands	0,420	Prov. Namur	Belgium	0,464

Cont. table 5.

Source: own calculations.

If we look at Table 4, in 2013 the highest values of Hellwig's measure of development were in regions of 2 countries, Spain and Germany. In subsequent years, the ranking changed and there were more and more regions from France and Greece. The top 15 also included 1 region from Poland - the Warmian-Masurian Voivodeship.

In contrast, the regions with the most accidents in 2013 were Belgium, Romania and Poland. It also included both regions from Lithuania and Latvia. The final places of the classification also saw changes in subsequent years. Several regions from the Netherlands, Italy, Slovakia and Finland appeared. Country averages and standard deviations in 2021 are shown in Table 6.

#### Table 6.

	Mean	Standard deviation
Greece	37,8	38,82
Denmark	39,8	12,06
Hungary	68,8	19,10
Germany	74,1	39,37
France	74,6	61,04
Spain	83,7	50,43
Bulgaria	102	43,88
Portugal	106,3	42,11
Italy	126,3	56,30
Poland	132,1	54,77
Belgium	135,3	53,99
Sweden	144,1	70,29
Austria	145,1	53,44
Czech Republik	149,9	37,06
Netherlands	151,1	56,25
Finland	164,8	47,10
Romania	183,4	14,57
Slovakia	192	25,52

Average regional positions for each EU country (accidents)

Source: own calculations.

In 2021, 2 countries by far lead the way in terms of the lowest death rates from accidents, both traffic and overall. Greece ranked first, followed by Denmark. If we look at the standard deviations, they are much higher than for deaths from heart disease and cancer. Only in three countries is the standard deviation value below 20. This shows that in the case of death from accidents, the regions in each country are much more diverse than in the case of death from heart disease and cancer. It seems that in this case the geographic location of the region is more important.

### 5. Deaths in EU regions, and the COVID-19 pandemic

If we look at the average rate of change of total deaths of residents of EU regions (Table 7) from 2019 to 2021, and the average rate of change of total deaths from 2013 to 2019, we find that out of 239 districts, as many as 219 were higher in the later period. Undoubtedly, this was influenced by the outbreak of the COVID-19 pandemic. However, in 20 regions there was a decrease in the average rate of deaths.

It should be noted that the number of deaths decreased (on average) from year to year in most regions between 2013 and 2019. Only in 7 regions it increased: in 4 regions in France, 2 in Portugal and 1 in Greece. Between 2019 and 2021, the number of deaths has already increased (on average) in 182 regions. The regions where the average death rate decreased are in 7 countries: Denmark 3, Germany 8, Greece 2, Spain 2, France 1, Portugal 3, Finland 1. Denmark is particularly noteworthy, it is here in 3 out of 5 counties that the average rate of deaths further decreased during the pandemic period, and in all counties the number of deaths steadily decreased throughout the period studied. This was still the case in Ireland, Luxembourg and Finland. In these 4 countries, the average rate of change in both 2013-1019 and 2019-2021 was below 1, so on average, the number of total deaths declined from year to year.

#### Table 7.

Region	Number of regions	Number of region average rate of ch 1 in ye	ns in which the ange was above ears	Number of regions where the average rate of change in 2019-21 was higher than in 2013 19	
		2013-2019	2019-2021	was inglief than in 2013-19	
Belgium	10	0	10	10	
Bulgaria	6	0	6	6	
Czech Republic	8	0	8	8	
Denmark	5	0	0	2	
Germany	38	0	19	30	
Estonia	1	0	1	1	
Ireland	3	0	0	3	
Greece	13	1	11	11	
Spain	19	0	15	17	
France	27	4	22	26	
Croatia	1	0	1	1	
Italy	21	0	21	21	
Cyprus	1	0	1	1	
Latvia	1	0	1	1	
Lithuania	2	0	2	2	
Luxembourg	1	0	0	1	
Hungary	8	0	8	8	
Malta	1	0	1	1	
Netherlands	12	0	10	12	
Austria	9	0	9	9	
Poland	17	0	17	17	
Portugal	7	2	4	4	
Romania	8	0	8	8	
Slovenia	2	0	2	2	

Increase/decrease in average rate of change of total deaths in EU regions

Cont. table 7.

Slovakia	4	0	4	4	
Finland	5	0	0	1	
Sweden	8	0	1	8	
Source: over calculations					

Source: own calculations.

Table 8 shows that 215 regions out of 239 (90%) saw an increase in the average rate of change of deaths in the surveyed regions in 2019-2021 compared to 2013-2019. On this basis, it can be argued that indeed the COVID-19 pandemic caused an increase in excess deaths, which undoubtedly translates into economic growth in the EU.

### 6. Conclusions

Referring to the research hypotheses, we can conclude that in the case of mortality due to ischemic heart disease and cancer in many countries, we can see little variation within a country. However, this does not apply to all countries. In the Netherlands, the variation is very large. For deaths due to traffic accidents and accidents in general, we see much greater variation. Only in the case of 3 countries, Denmark, Hungary and Romania, the standard deviation of the places of each region in the ranking is less than 20.

When we look at the regional rankings we can see that in 2013 the highest mortality from heart disease or cancer was in the regions of Central and Eastern Europe, however, the top countries were not from Northern Europe, but rather from the Mediterranean basin, which may suggest that diet has a huge impact on the above statistics. In the following years, the situation improved dramatically in the countries of Central and Eastern Europe, to the point that in 2021 mortality from heart disease or cancer was lowest in regions from Hungary. Regions from France, Belgium and Italy also ranked very high. On the other hand, if we compare mortality due to accidents, here the regions of Central and Eastern European countries fare even worse. It should be noted that looking through the prism of countries, in both rankings in 2021, regions from Romania ranked last, while Hungary ranked 1st and 3rd, respectively. In summary, while back in 2013 we could indeed see a division between the "old EU" countries and the new EU members, over the years this division is blurring.

Answering the question of whether the COVID-19 pandemic has changed the trends of the overall number of deaths in each region, the answer is definitely yes. In most regions of the EU countries in 2013-2019 the trend was downward, while in 2019-2021 it was already upward. However, there are countries in which total mortality declined in all regions in both periods studied. Such a situation provides an opportunity for the authorities of regions where the situation is worse to look at the decisions and actions taken in recent years by the authorities of regions where the situation is best. The different cities and region of the EU countries are cooperating with each other, knowledge of which of them are dealing with particular problems

best can be used to cooperate even more closely to solve problems that are influenced by the lower level authorities and to prepare an appropriate action strategy for similar situations like the COVID-19 pandemic.

The analysis could be extended to regions outside Europe. Such a comparison would also provide an answer to the question of how European regions coped with the effects of Pandemic COVID-19 compared to regions from other continents.

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