**Introduction**

Year 2020 was undoubtedly dominated by the pandemic caused by the new SARS-CoV-2 coronavirus. The pandemic has created many challenges for governments, enterprises and society globally. All countries in the world have been affected by the illness. Some of them have been hit harder than the others. As a healthcare worker who works in the hospital, I had great interest in all information about development of this disease, and I was especially concerned about situation in Europe.

**Problem description**

In every country in the world governments had to make difficult decision how to save public health from COVID illness. Were they successful? Which EU countries were hit the most with Covid cases and deaths? Did high numbers of hospital beds and healthcare workers helped in keeping low number of patient’s deaths? Is there any correlation between countries with low GDP and higher number of COVID cases? Did school closures and restriction of movement make any difference keeping the low number of cased? Were population with higher median age in worse situation through out the year of pandemic?

There are a lot of questions and I would like to find answers for some of them.

**Project Scope:**

The scope of “Covid cases in Europe” Project is to identify patterns, common elements among European Union countries with high and low number of Covid new cases and new deaths. This project will target health system elements, selected demographic, economical characteristics and internal countries policies.

In project scope:

* Project will target only current European Union countries.
* Project will target period of time between 2020-01-03 and 2021-05-03.
* Project will target only the following elements of demographics characteristics**:**
* GDP, median age.
* Project will target only the following elements of healthcare system characteristics**:**
  + hospital beds, nurses and midwives, physicians per 1000 population.
* Project will target only two specified internal restrictions:
  + School closures, internal movement restrictions.

**Dataset sources:**

* **COVID cases and deaths dataset:**

Dataset have been provided by World Health Organization website (https…) in .csv file type. Original dataset contains number of new cases, cumulative cases, and new deaths and cumulative deaths. Dataset has a minimum amount of missing data and contains worldwide daily data. In my project I use number of new cases and deaths.

* **Economical and demographic datasets**:
* Economical dataset of “GDP” , “population” and “population density” have been sourced from the website <https://data.worldbank.org/indicator/> and imported as .csv files.
* Demographic data of “Median Age” has been scrapped from the website to show ability to find different HTML components, to use Beautifull soup module and to import elements into .csv file for data analysis.
* **Healthcare dataset**:

Healthcare dataset of “Hospital beds”, “Nurses and Midwives” and “Physicians” have been sourced from the website <https://data.worldbank.org/indicator/> and imported as .csv files.

* **Internal policies dataset**:

Healthcare dataset of “Schools closures” and “internal movement restrictions” have been sourced from the website <https://ourworldindata.org/policy-responses-covid> and imported as .csv files.

**Datasets overview:**

* **COVID cases and deaths dataset:**

Issues: Negative values ---

Findings:

**Economical dataset** :

|  |  |  |  |
| --- | --- | --- | --- |
| **count** | **Population** | **GDP per capita (USD)** | **Density per m sq.** |
| **mean** | 16,574,520 | 35,299 | 182 |
| **std** | 22,282,340 | 23,217 | 288 |
| **min** | 502,653 | 9,828 | 18 |
| **25%** | 3,427,172 | 19,424 | 71 |
| **50%** | 8,877,067 | 27,858 | 107 |
| **75%** | 14,408,450 | 47,614 | 141 |
| **max** | 83,132,800 | 114,705 | 1,514 |

Top 8 richest country in Europe produces higher GDP per capita than other 19 countires.

**Healthcare dataset:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Physicians\* | Nurses\* | hospital\_beds\* |
| mean | 3.586241 | 8.461981 | 4.998148 |
| std | 0.842889 | 3.247767 | 1.711239 |
| min | 1.9509 | 3.5534 | 2.21 |
| 25% | 3.0343 | 5.9515 | 3.335 |
| 50% | 3.4664 | 7.9665 | 4.69 |
| 75% | 4.01465 | 10.90885 | 6.59 |
| max | 5.4036 | 15.5735 | 8 |

\* per 1000 population

Top 3 counties with highest number of physicians, nurses and hospital beds per 1000 population:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **TOP 3 Highest** | | | **TOP 3 Lowest** | | |
| **Physicians** | **Nurses** | **Hospital beds** | **Physicians** | **Nurses** | **Hospital beds** |
| 1. Greece | 1. Ireland | 1. Germany | 1. Cyprus | 1. Greece | 1. Sweden |
| 2. Austria | 2. Finland | 2. Bulgaria | 2. Romania | 2. Latvia | 2.Denmark |
| 3. Portugal | 3. Germany | 3. Austria | 3. Poland | 3. Bulgaria | 3. Spain |

**Outliers Number of physicians to GDP per Capita:**

I have noticed that countries with low GDP per Capita like Greece , Lithuania , Portugal have proportionally higher number of physicians comparing to Romania, Poland , Bulgaria seems to be one of the poorest countries with higher number of

2.Ratio (counties with strictest lockdown) had less number of cases .

**Country restrictions dataset:**

School closures restrictions have been divided into 4 levels, where 0 –“No measures”, 1-“ Recommended”, 2- “Required only at some levels” and 3- “Required”.

Italy (261 days), Germany (205 days), Romania (201) were among countries with highest number of closed schools.

In this part of my project I would like find out how all European union counties have managed Covid in analysed period of time by comparing total number of Covid cases and deaths per 10,000 population with countries own characteristics.

**Total Covid cases vs GDP.**

Fist of all I wanted to check if there is correlation between number of cases in each country and their GDP per capita. In this investigation I haven’t noticed any obvious visual correlations. The only thing that is noticeable is 4 out of 5 the richest counties (highest GDP per capita, please see Economical Dataset analysis) Ireland, Denmark, Finland has the total lowest number of COVID cases. ~~After making more research I have come across on the article that confirm this observation .Countries with much higher GDP per capita are the ones that have the highest share of employees working from home in Europe.~~

<https://cdn.statcdn.com/Infographic/images/normal/20743.jpeg>

**Total Covid deaths vs Median Age.**

In this pair of features you can notice not definite but noticeable relation. Number of Covid deaths is slightly falling as falling the median age of population in the country. Countries with higher median age experienced higher number of Covid cases in total.

**Total Covid deaths vs Number of days in the highest school closure restriction.**

On this chart I can see counties with number of days higher than average closed schools which have experienced high number of deaths ( Czechia , Slovenia, Slovakia). On the other side of chart there are countries like Latvia, Germany, Ireland, Greece, Malta with also high number of school closed days but less than average deaths. I will look into those counties in final chart, as those group of countries might have more things in common.

**Number of Nursing staff vs Severity in restrictions with normalized data.**

On this chart there is visible relation between number of nursing staff and number of days in school/ internal movement lockdown. You can see that countries with high level of staffing have experienced lower level of restriction as number of nurses is falling countries implemented longer and more server lockdown. There is one more intresting fact that I have noticed that when I taking into account GDP per capita , wealthy countries Ireland, Germany , Finland , Luxemburg have high number of staff.

**Total Covid deaths vs Number of days in the highest internal movement and school closure restriction with normalized data.**

In this chart I compared new number of deaths with number of days in both internal movement restriction and school closures. Again the worst situation can be observed in eastern European countries even though they had longer /higher level of restrictions. On the other hand we have Finland , Denmark, Malta, Estonia. Even though they had no restrictions they had low number of deaths. Ireland , German and Greece kept their restriction for longer and that helped them to keep number of deaths lower than average in EU.

**Daily Covid cases vs. school closures and movement restrictions.**

I am continuing analysing impact of policies on course of Covid cases through out the whole period of pandemic. Covid was a new disease , so as precaution all European countries closed schools and restricted internal movements , even though there was a very low number of new Covid cases. Europe have started extreme lockdown. This can be observe between March 2020 and May 2020 . As we were learning more about Covid and reporting low number of cases, all EU started ceasing on restrictions. You can see that particularly between July-Sept 2020. The next turning point happened in October/November 2020 , Covid cases started dramatically increase. Countries decided to introduce lockdowns again, however in less strict conditions. Prolonged period of lockdown at the start of pandemic , probably has put counties in economic trouble and also politicians started to encounter society resistance on severe lockdown. From January 2021 up to the current date the number of cases remained quite high with higher level of restrictions. Only in April /May 2021 countries have dropped restrictions as they strongly think that implementation of vaccination against Covid will suppress the disease.