İLERİ MÜHENDİSLİK ÇALIŞMALARI VE TEKNOLOJİLERİ DERGİSİ

# Data Analysis of the Factors Related with Covid-19 Death Ratios: Cases in Spain, Italy, UK, Germany and Portugal

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## Abstract

Severe Acute Respiratory Syndrome Coronavirus- 2 (COVID-19) pandemic has been created worldwide chaos and also great pressure on the health systems of countries at the same time. While some countries are able to cope with the pandemic successfully, on the other hand, some countries have taken insufficient measures to prevent the spread of the pandemic. In this study, the data of some European Union Region countries, which had distressful days with this pandemic, have been used and analyzed. The main purpose of this study is to argue the effect of some factors causing different death ratios such as sugar consumption, vaccination of TBC, and air pollution, between Italy, Spain and United Kingdom which have been suffering from this crisis severely and Germany and Portugal which have been exhibited relatively better conditions than others and expected to get normalized quickly during this pandemic. General evaluation of the factors that can increase the effect of the pandemic is discussed among the focused group countries.

**Keywords:** Covid-19, Sugar consumption, TBC vaccine, Air pollution.

# Covid-19 Kaynaklı Ölüm Oranlarının Seçili Faktörlerle İlgisine Yönelik Data Analizi: İspanya, İtalya, Birleşik Krallık, Almanya ve Portekiz Örnekleri

## Özet

Şiddetli Akut Solunum Sendromu Koronavirüs-2 (COVID-19) salgını dünya çapında bir kaos yaratırken aynı zamanda ülkelerin sağlık sistemleri üzerinde de büyük bir baskı yaratmıştır. Bazı ülkeler pandemiyle başarılı bir şekilde başa çıkarken, diğer taraftan bazı ülkeler pandeminin yayılmasını önlemede yetersiz kalmıştır. Bu çalışmada, pandemi sürecinde sıkıntılı günler geçiren bazı Avrupa Birliği Bölgesi ülkelerinin verileri kullanılmış ve analiz edilmiştir. Bu çalışmanın temel amacı, bu krizden ciddi şekilde etkilenen İtalya, İspanya ve Birleşik Krallık ile diğerlerine nispeten daha iyi bir durum sergileyen ve hızla normale dönmesi beklenen Almanya ve Portekiz arasında şeker tüketimi, TBC aşısı, hava kirliliği gibi farklı ölüm oranlarına neden olan bazı faktörlerin etkisini tartışmaktır. Pandeminin etkisini artırabilecek faktörlerin genel değerlendirmesi, odak grup ülkeleri arasında karşılaştırmalar yapılarak tartışılmaktadır.

**Anahtar Kelimeler:** Covid-19, Şeker tüketimi, TBC aşısı, Hava kirliliği.

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## 1. INTRODUCTION

Since ancient times, it had been faced with many virutic or bacterial diseases which are invisible enemies of humanity such as plague, Spanish Flu, SARS (Severe acute respiratory syndrome) MERS (Middle East Respiratory Syndrome), Ebola pandemics causing massive deaths. Nowadays, humanity is in trouble with another invisible enemy called COVID-19 and struggling global scale. In the future, as long as the humanity continues to harm the nature and pillage the wildlife, it seems that such zoonotic pandemics will follow on.

COVID-19, which causes lethal effects, especially in the elderly and people with chronic disease, has been identified as the same family and zoonotic with SARS and MERS viruses (Wang et all. 2020). As known, this pandemic started at Wuhan region in China in the last days of December 2019 also deaths were reported at the end of 2019. The virus, which had spreading rate that increased as exponentially globally, spread to almost the whole world (Fig. 1 and Fig. 2).

Some countries ignored this pandemic at first and their health system reached maximum capacity rapidly and they became inadequate to provide even basic health care services. However, some countries took precautions like “social distancing, isolation, curfew etc.” and targeted “Controlled spreading” which means spreading the number of infected people in time and not putting pressure on their health system.

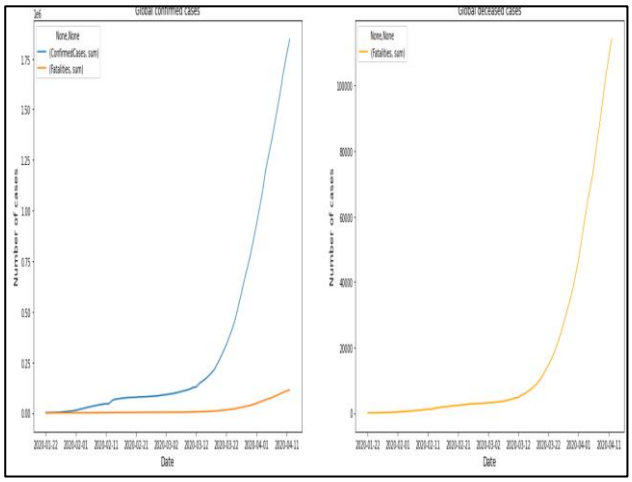


**Figure 1.** Global Confirmed cases and fatalities (Until 14.04.2020)

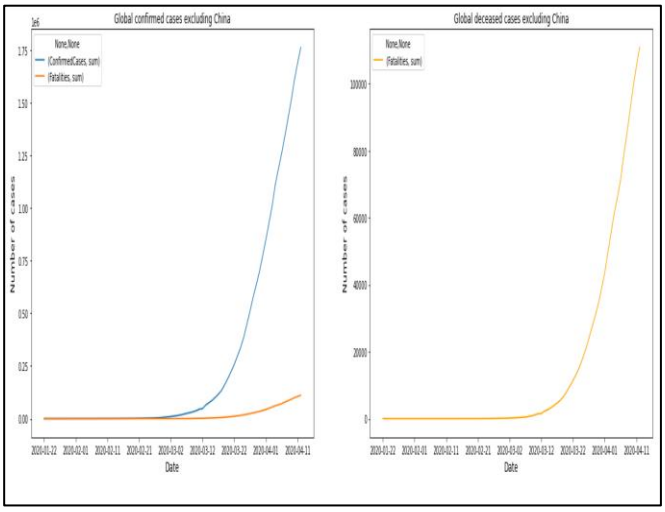


**Figure 2.** Global Confirmed cases and fatalities excluded China (Until 14.04.2020)

Italy, Spain and United Kingdom announced much more cases and deaths than other European region countries. Day by day their numbers are increasing. Also, in the three countries, the ratio of mortality to the confirmed cases is constantly increasing due to the pressure on the health care systems. However, in countries such as Germany and Portugal, although the number of cases has been increased, mortality rates and spreading rates remain stable.

With the COVID-19 epidemic, the number of cases and cases and intensive care unit needs are increased. Therefore, the suppression of health systems occurred to great concerns about the health system capacities of European countries and the effective response for patients, who needs treatment, ability. Europe has become a new epicenter with the United States. The mortality rate, which is 4% in China, is 13% in Italy and 11% in Spain (Ceylan, 2020).

In this study, in addition to precautions taken by countries, it has been tried to analyze whether there is a relationship between the death resulted by COVID-19 in terms of vaccine calendars, air pollution and sugar consumption.

## 2. SPREADING PROCESS OF COVID-19 PANDEMIC IN FOCUSED COUNTRIES

### 2.1. The Short History of Covid-19 Pandemic in Italy

After announcing this outbreak as “Pandemic”, the first official cases were seen in Italy with the positive tests of 2 tourists coming from China on 31 st January 2020. This date has been confirmed by Italian government as the starting date of the spread of the virus all around the country. After this case, as the global scale, the disease factor spread, throughout the country with exponential velocity and almost in one and half months, nearly two hundred thousand people were infected.

On 31 st of January 2020 Italian government firstly suspended all flights from China and a few weeks later, all domestic and international flights were suspended to prevent spreading. After, the first day of March, the government made some regulations regarding the social life such as social distancing, isolation and quarantine.

By April 15, Italy had conducted about 1,117,400 tests for the virus. Due to the limited numbers of tests performed, the real number of infected people in Italy, as in other countries, is estimated to be higher than the official count (Lau etc. 2020).

Recent days with the isolation and quarantine, the situation is getting quite better than before. One of the most important scale for normalization is “recovery rate vs date rate”. This rate is decreased positively in Italy (Fig. 3).

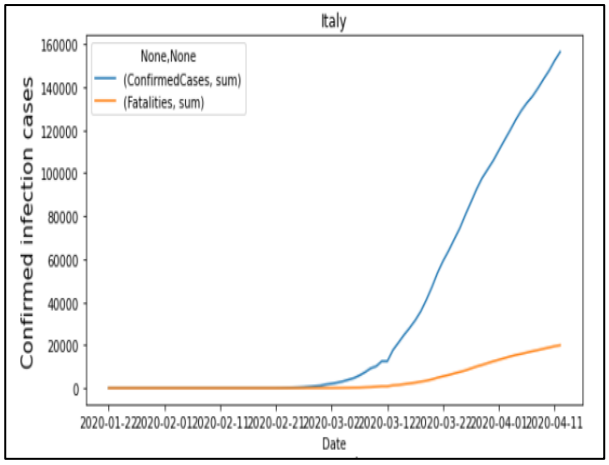


**Figure 3.** Total Confirmed cases and fatalities in Italy (Until 14.04.2020)

Confirmed cases and daily deaths decrease with precautions (curfew, quarantine etc.) taken by the government (Fig. 4-5). While the death rate decreases due to the decrease in the number of cases and the pressure on the health system, the recovery rates increase (Fig. 6).

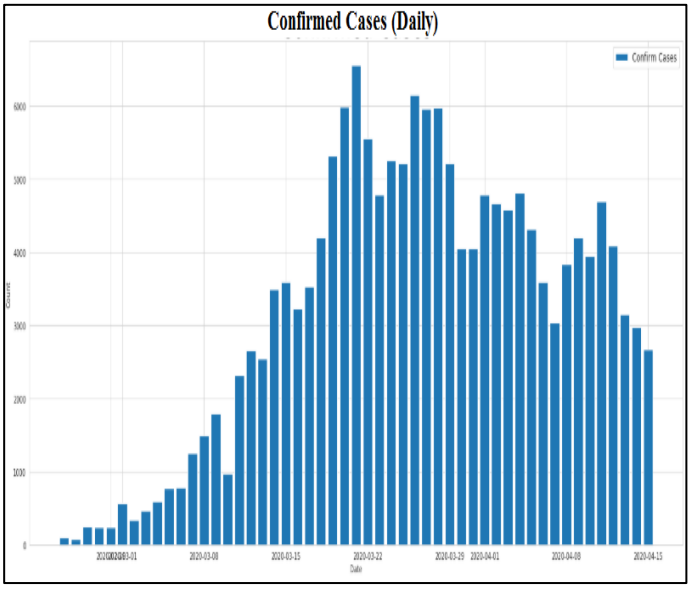


**Figure 4.** Confirmed cases day by day Italy (Until 15.04.2020)

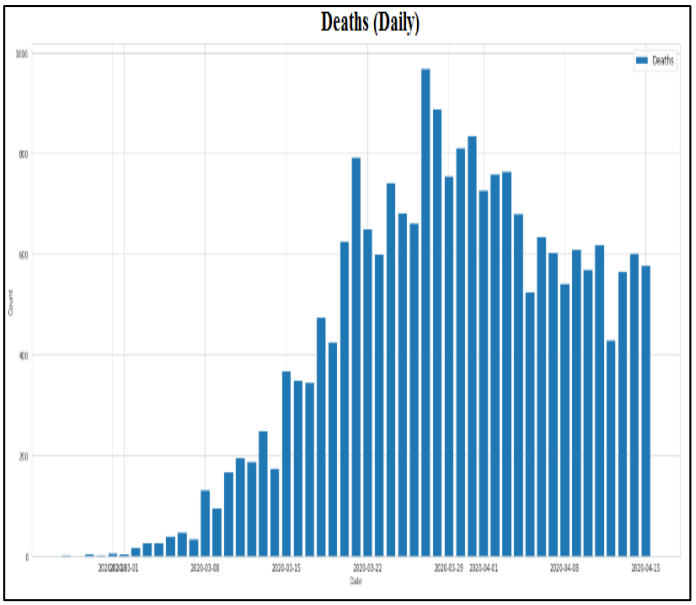


**Figure 5.** Deaths day by day Italy (Until 15.04.2020)

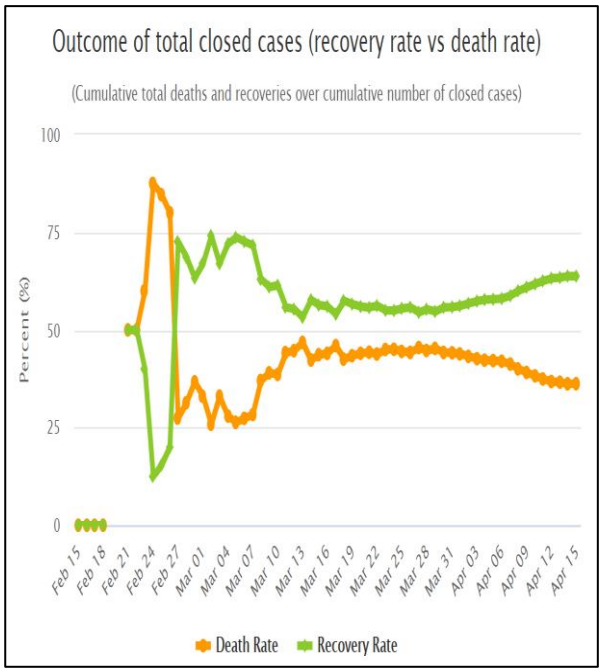


**Figure 6.** Recovery rate vs. death rate in Italy (Worldometers, 2020)

### 2.2. The Short History of Covid-19 Pandemic in Spain

Spain is one of the countries which have been affected much more from COVID-19 pandemic. The first case was confirmed on 31st of January 2020, with the test result of a German tourist in Canary Islands. On 14th of March 2020 national lockdown was announced and still continues.

Between 26 st of February- 13th of March 2020 period was recorded as the fastest spreading period in the country. During this period, almost 120.000 people attended to "International Women's Day" celebration in Madrid. In addition, various gatherings, events and organizations made a lot of people infected. After this period, death numbers and confirmed cases decreased constantly. Until the mid of April, almost more than 10.000 confirmed cases and more than 900 deaths reported daily. The country declared state of emergency until 26 April 2020.

It was stated that confirmed cases, infected numbers and deaths periodically decreased in Spain which is one of the countries with the highest number of cases and the most affected by the Covid 19 epidemic in Europe until the mid of April. Until 16 April 2020, there have been 182,816 confirmed cases and 19,130 deaths in Spain (Fig. 7).

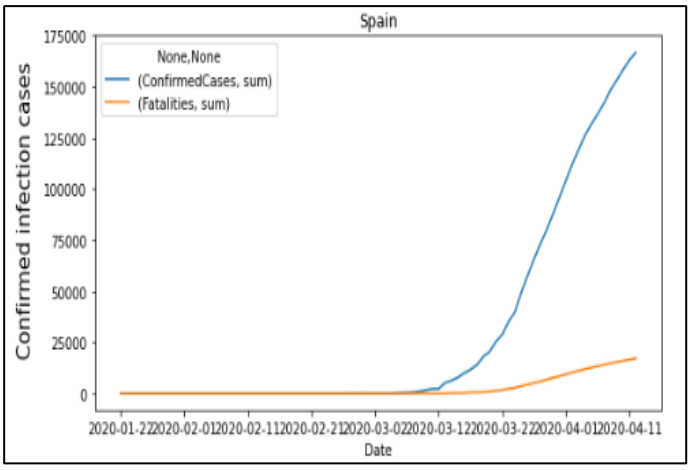


**Figure 7.** Confirmed cases and fatalities in Spain (Until 15.04.2020)

Daily new cases and deaths are still at high numbers. Spain has an irregular daily cases and deaths chart. This situation also suppresses the recovery rate-death rate chart, which shows that countries are on the right direction in the COVID-19 struggle (Fig. 8, Fig. 9 and Fig. 10).

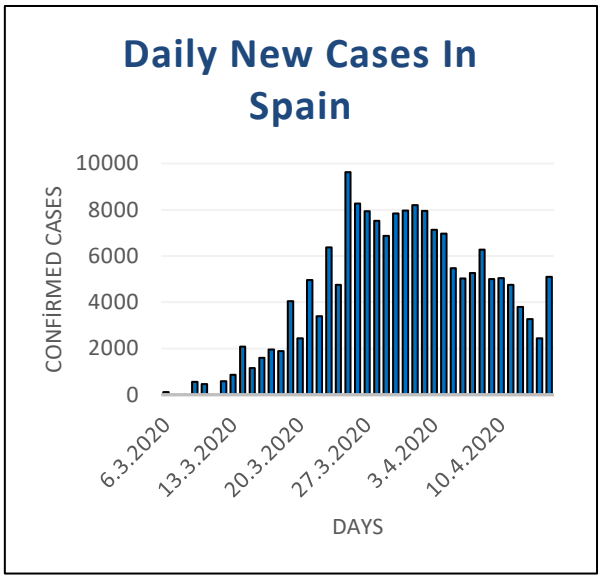


**Figure 8.** Confirmed daily cases in Spain (Until 15.04.2020)

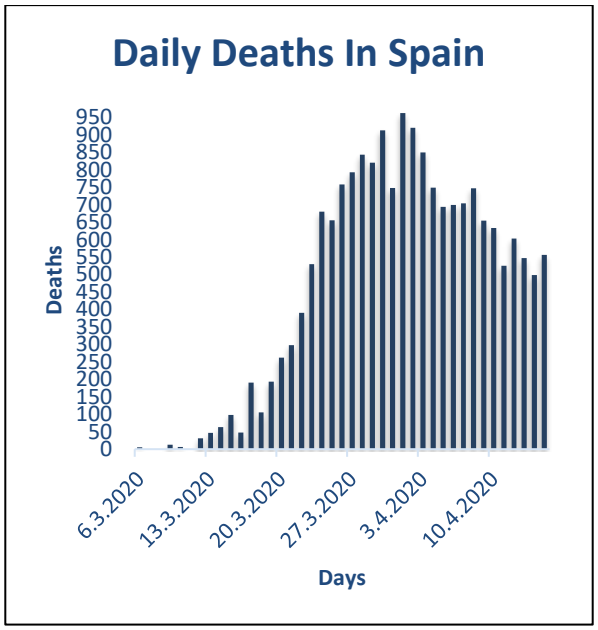


**Figure 9.** Daily Deaths in Spain (Until 15.04.2020)

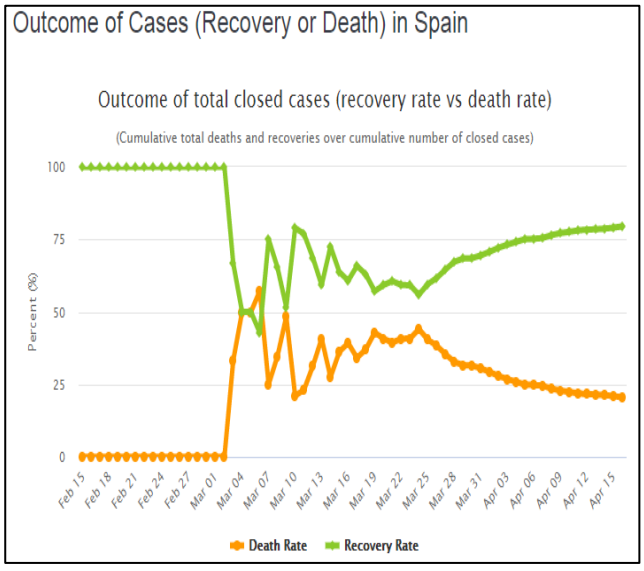


**Figure 10.** Recovery rate vs. death rate in Spain (Worldometers, 2020)

### 2.3. The Short History of Covid-19 Pandemic in United Kingdom (UK)

In UK, first confirmed case was identified last week of January, transmission was announced in February and the number of confirmed cases increased rapidly in March. When novel coronavirus outbreak was announced as "Pandemic" by World Health Organization, British Government did not take this situation seriously and tried "Herd Immunity". However, with the acceleration of transmission of the virus, almost more than 100.000 people were infected in a really short time and this situation was threatened UK Health Care System because of the inadequate capacity of hospitals and as a result the mortality rate increased around the Kingdom.

Because of the rapid increase of confirmed cases and deaths, the government made some legal arrangements regarding domestic and international flights, closure of schools and universities, imposing travel restrictions and cancelation of organizations which people can join collectively and brought rules about social distancing and self-isolation. On 18 March 2020, British government announced "Lockdown" across the country. Also, mid of March, Crown Prince Charles and late March UK Prime Minister Boris Johnson tested positive for the virus. In April 5$^{th}$, the Prime Minister hospitalized and needed intensive care due to the disease. Boris Johnson left hospital on 12 April 2020.

Mid of April, UK has had almost more than 100.000 confirmed cases and 13.000 deaths (Fig. 11). The number of cases and deaths continue to increase in UK, whose massive outbreak cannot be controlled down (Fig. 12).

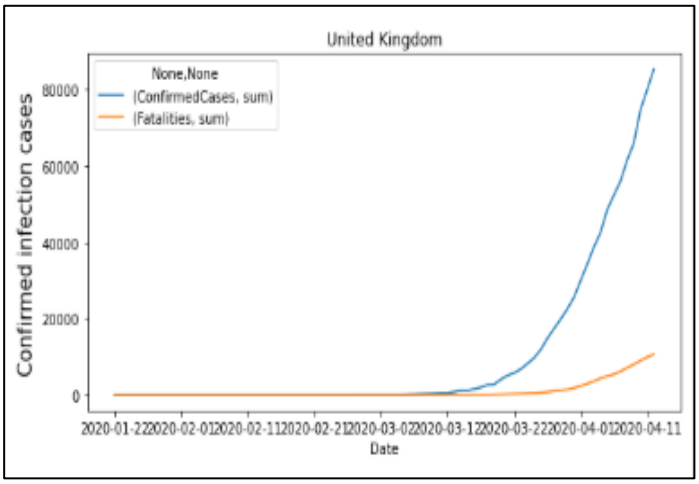


**Figure 11.** Total Confirmed cases and fatalities in UK (Until 14.04.2020)

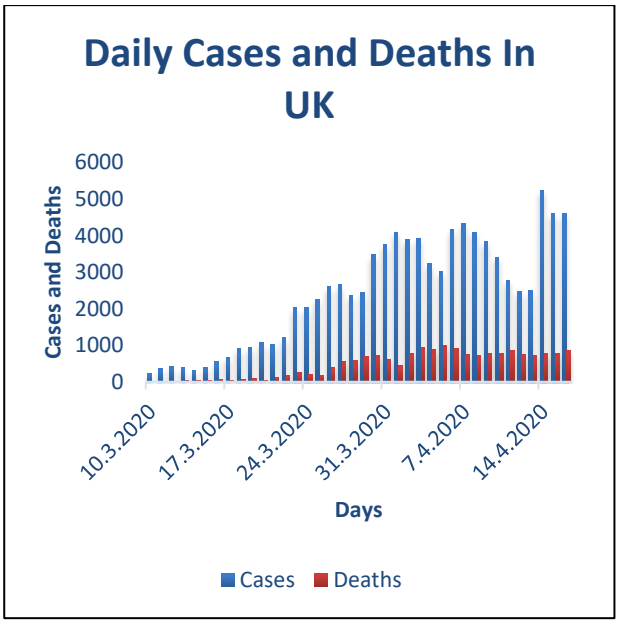


**Figure 12.** Daily confirmed cases and deaths in UK (Until 16.04.2020)

### 2.4. The Short History of Covid-19 Pandemic in Germany

COVID-19 Pandemic reached to Germany 27 January 2020 that confirmed first case Bavaria, Munich. Germany is one of the most successful countries in Europe that can control the pandemic. Transmission of disease is getting under control day by day with cooperation of the government policies and Robert Koch Institute (RKI). RKI created Pandemic Master Plan which is about precautions and upper level surveillance and test applications as much as possible.

According to RKI plan which started in February, prohibiting travels, closure of schools- kinder gardens and institutes, closing of borders to five neighborhood countries, cancellation of all flights, social distancing-isolation and solid quarantine protocols were regulated and done. By these means, German government moved one step ahead and announced "National Curfew" on 22 March 2020.

Despite the increasing number of cases, Germany seems to be the most successful crisis coordinator among European countries with its low mortality rate and less pressure of the health system. With almost 2 million tests are done in a short time (20629 tests per 1 million people) Germany has the highest test numbers in Europe. Thus, early diagnosis and quarantine procedures of infected people are provided (Fig. 13 and Fig. 14). Within those countries, Germany has one of the best recovery rate- death rate numbers in Europe (Fig. 15).

With the advantage of Prime Minister Angelina Merkel who is a scientist, Germany, which combines scientific data with German discipline, is one of the countries that can overcome this pandemic with minimum damage compared to the other European Countries.

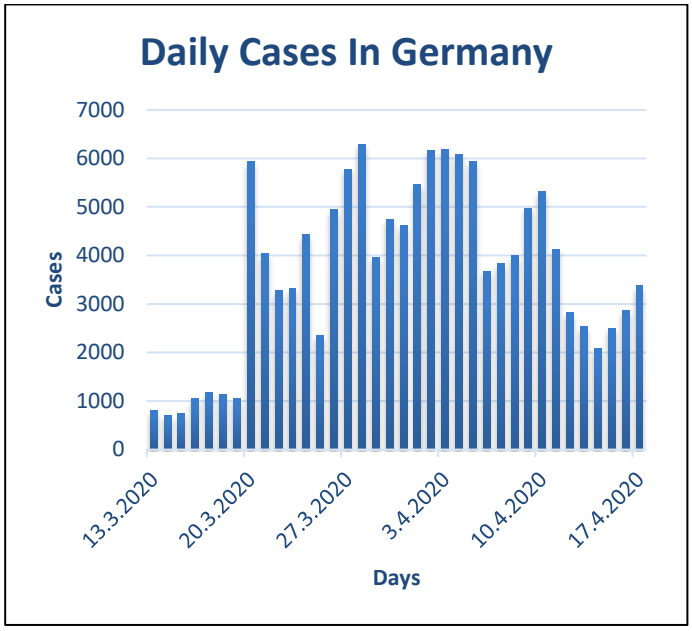


**Figure 13.** Daily confirmed cases and deaths in UK (Until 16.04.2020)

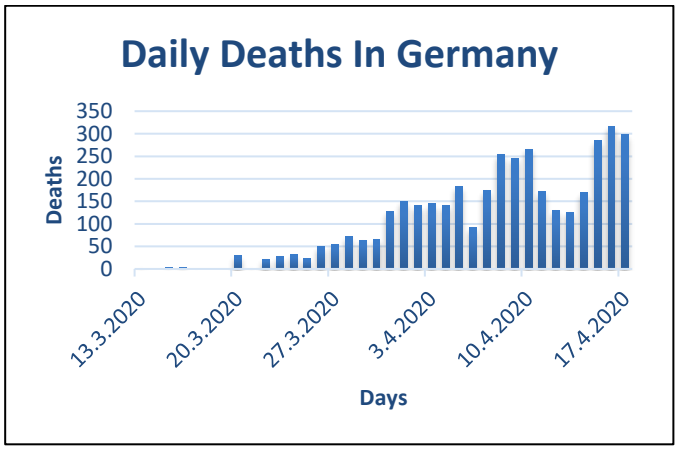


**Figure 14.** Daily confirmed cases and deaths in UK (Until 16.04.2020)

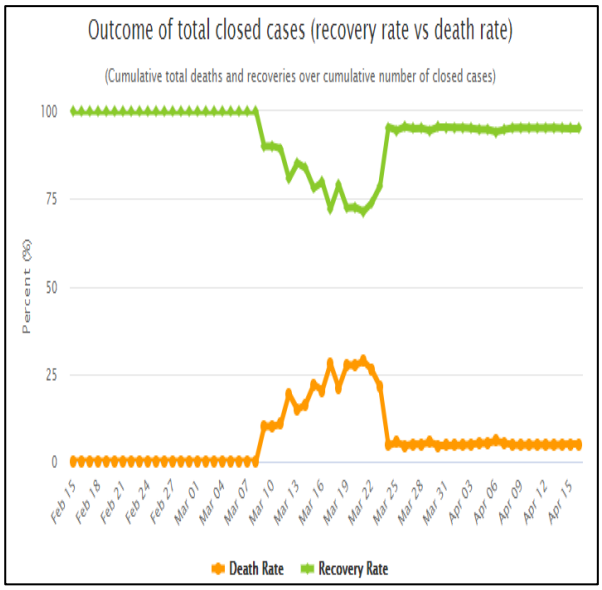


**Figure 15.** Daily confirmed cases and deaths in UK (Until 16.04.2020) (Worldometers, 2020)

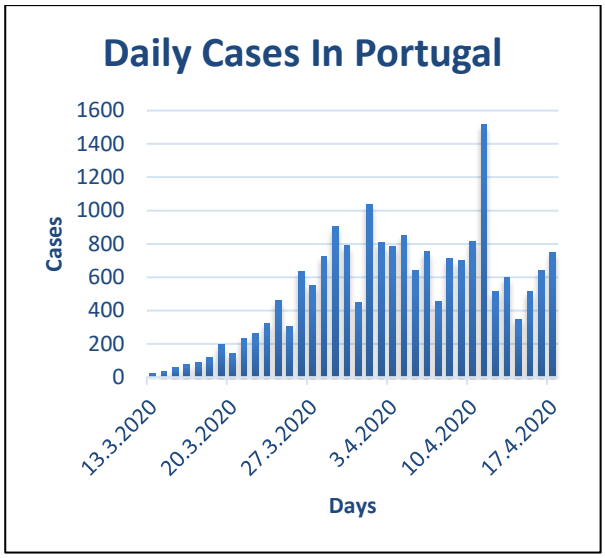


**Figure 16.** Daily confirmed cases in Portugal

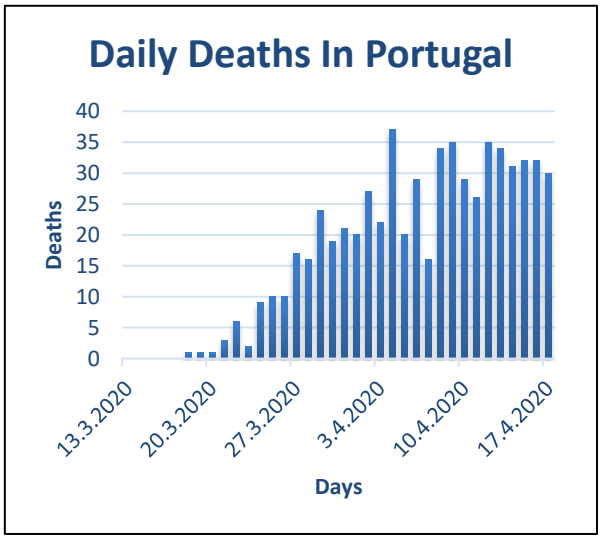


**Figure 17.** Daily deaths in Portugal

### 2.5. The Short History of Covid-19 Pandemic in Portugal

Portugal is one of the smallest countries in Eurasia Region with its high potential tourism destinations and therefore naturally affected from this pandemic like the other European Countries. However, this pandemic reached to Portugal on mid of March. On 24 March, the Portuguese Government admitted that the country could not struggle with COVID-19 any more, as it is widespread, and, on 26 March, the country entered the Mitigation Stage. The health care sites dedicated to fight the disease started including the Portugal Health center groups. Portuguese Government decreed special measures in restricting people movements between municipalities with very few exceptions, closing all airports to civil transportation and increased control in the national borders.

Compared to the population of Portugal, they have a similar profile with Germany. They took precautions early and determined their policies according to this scientific examination and modeling. Their number of tests approached 250.000 in a period of 1 month (21.678 in 1 million people- Third in Europe) and they applied strict quarantine procedures prevailing over the chaos seen in other Mediterranean countries. The number of cases and deaths are lower in Portugal along with Germany. Daily cases and deaths are in a decreasing trend (Fig. 16 and Fig.17).

## 3. COUNTRY BASIS ANALYSIS OF FACTORS THAT CAN INCREASE THE IMPACT OF THE PANDEMIC

### 3.1. Sugar Consumption, Obesity and Diabetes of Focused Countries

After the 2005 sugar reform in Europe, sugar production and consumption were tried to be regulated by introducing certain quotas to the market (El Behri et all, 2008). Although the European Commission, WHO and other health organizations have also tried to prevent excessive consumption of sugar, obesity and diabetes are still one of the most important metabolic disorders that threaten Europe.

Food and beverage consumption with corn-derived fructose plays an important role which increases childhood and youth chronic diseases rapidly in the modern world (Malik, Schulze, Hu, 2006; Korkmaz, 2008; Tam et al., 2006; Moreno and Rodriguez 2007; Ochoa, Moreno-Aliaga, Martinez-Gonzalez, Martinez, Marti, 2007). High fructose intake increases insulin resistance and causes impaired glucose tolerance triggering the development of chronic diseases such as hyperinsulinemia, hypertriglyceridemia and hypertension (İşgüzar et all. 2016).

It can be said that healthy nutritional habits have a positive effect on people's immune systems. However, the conditions of countries' access to food, the welfare level of citizens, and their purchasing power of food in terms of balanced nutrition is different for each country. Also, sugar consumption is another controversial topic. Some studies show that there is a negative relationship between the excessive sugar consumption and the strength of the immune system. According to a study conducted at Warwick Medical School (WMS); high blood sugar levels reduce the sensitivity of special receptors that recognize bacteria and viruses. Rising sugar levels block the receptors that play a role in the immune system, making the body susceptible to bacterial and virutic infections (WMS,20011).

The effects of sugar on human health are examined under 3 main headings. The first suggests that sugar is the main cause of dental caries, and a noticeable decrease in caries incidents were observed with the lower sugar consumption. Secondly, it suggests that the excessive consumption of sugar causes obesity and diabetes in the future, with the storage of sugar as fat in the body. Thirdly, it argues that excessive sugar intake could displace micronutrient-dense foods from the diet, resulting of vitamin and mineral deficiency (Ruxton et all. 1999).

The World Health Organization (WHO) emphasizes that a maximum of 5% of the daily intake of energy should consist of simple sugar, and health problems may begin above this amount (WHO, 2019).

In this part, the nutritional habits and sugar consumption of the 5 countries have been investigated since the pandemic spreading rate may have an effect on this. According to International Diabetes Federation (IDF) 2016 data, sugar intake in adults' ranges from about 16-17% in Spain and in the United Kingdom. Worryingly, sugar intake is much higher among children to nearly 25% in Portugal (de Sabata et.al. 2016). There may be a relationship between immune system disorders and COVID-19 deaths due to the obesity and sugar consumption.

Between focused countries, Germany is the lead on table with high sugar consumption than others. It is clearly seen that they are above the EU average which is around 20 kg / capita. In focused countries, only Portugal has below average consumption value among adults (Table. 1).

**Table 1.** Countries Sugar Consumption in 2018 (Protectivity Insurance, 2019)

| Country | Population | Consumption (metric tonnes) | Consumption (kg /capita) | Consumption (gs) | Teaspoons (4g) |
|---|---|---|---|---|---|
| **Germany** | 82,665,600 | 2,645 | 32 | 32000 | 8 |
| **UK** | 65,648,054 | 2 | 25 | 30465 | 7.618 |
| **Italy** | 60,497,174 | 1,706 | 28 | 28200 | 7,05 |
| **Spain** | 46,549,045 | 1,215 | 26 | 26097 | 6,524 |
| **Portugal** | 10,309,73 | 1,95 | 19 | 18907 | 4,72 |

As known, Spain- Italy and UK have higher mortality rates than other European countries. Especially Spain has almost 429 deaths/ 1M Pop. When the table is analyzed according to COVID 19 mortality rates, Germany's low mortality rate contradicts the relation between sugar consumption and possible COVID-19 deaths.

Having relatively high mortality rates, Italy, Spain and UK are among the countries with high sugar consumption ratios and this cause-effect relationship may have investigated further as a possible field of study. According to OECD data, the country with the highest obesity rate in focused group countries is Portugal (Fig. 18). UK is the second and Germany is the third. Italy has the lowest obesity rate. When COVID 19 related deaths are analyzed, UK, Italy and Spain have higher mortality rates than Portugal and Germany.

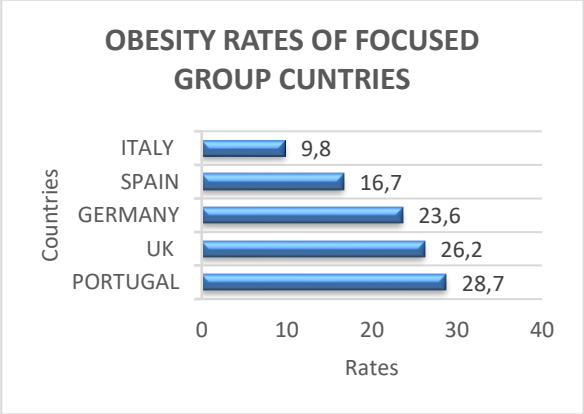


**Figure 18.** Obesity Rates of Focused Group Countries (OECD, 2020)

"Past- Today and Future Projection for Countries" Publication of International Diabetes Federation, suggest that diabetes, which is a chronic disease, is seen in Germany much higher than other focused group countries in 2010 and 2019 (Fig. 19) (IDF, 2020). In the future, it is thought that Germany will take the lead in this matter. In addition, although the diabetes rate of Spain was low in 2010, it is another important conclusion drawn from the data that it increased in 2019 and reached almost the same level with Italy. When the future projection is examined, it is thought that Spain will surpass Italy. UK has followed a stable rate over the years. This rate is not expected to change in the future. Portugal has a low level of diabetes rate despite the intense sugar consumption. This is not expected to undergo a critical change in the coming period.

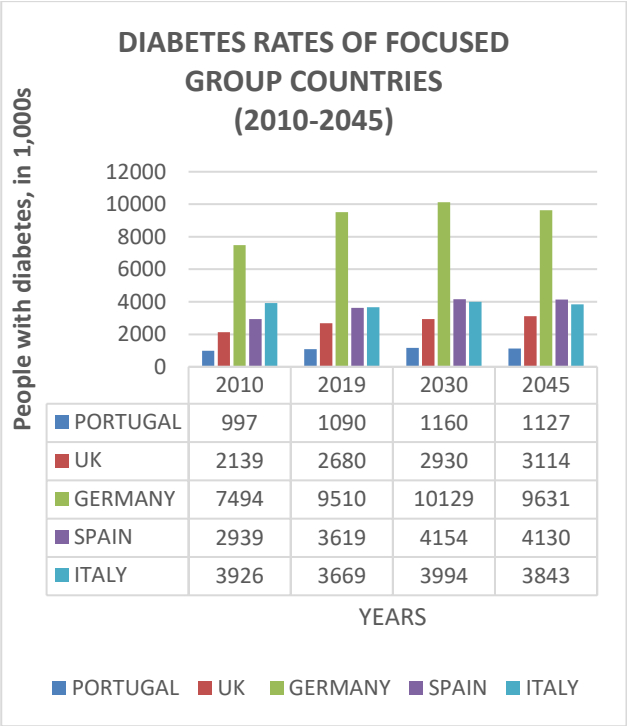


**Figure 19.** Diabetes Rates of Focused Group Countries (IDF, 2020)

### 3.2. Vaccine Calendars of Focused Countries

It is well known that vaccine is very significant as a primary protection of the public health for virutic and bacterial diseases. The immunization with vaccines against preventable infections and other diseases which can be contagious is the best defense mechanism we have. In the past, immunization with vaccines proved its success with smallpox and other success with smallpox and other diseases as such. Thanks to widespread vaccination, Europe and most of the places around the world are pollution- free now.

The application of the vaccines, which cause various discussions around the world, differs from country to country. While some countries necessarily add some vaccines to their vaccine calendars, some countries do not need to.

If considered within the scope of COVID-19, the existed vaccines related to the other viral illnesses and lung diseases may cause some countries to survive from the pandemic process with lesser damage.

Scientists and researchers work on the vaccine for COVID-19 across the world but only a few started first phase trial which indicates producing the safe and effective vaccine may take months, even years.

Looking at the focus group countries, we see an interesting picture. In the focus group, only the UK and Portugal included tuberculosis (TBC) vaccine in their vaccine calendars. As known, TBC is a really dangerous and contagious disease. European Union Recommended Vaccine Calendars are given for focused group (Fig. 20, Fig. 21, Fig. 22, Fig. 23and Fig.24) (European Centre for Disease Prevention and Control (ECDC), 2020).

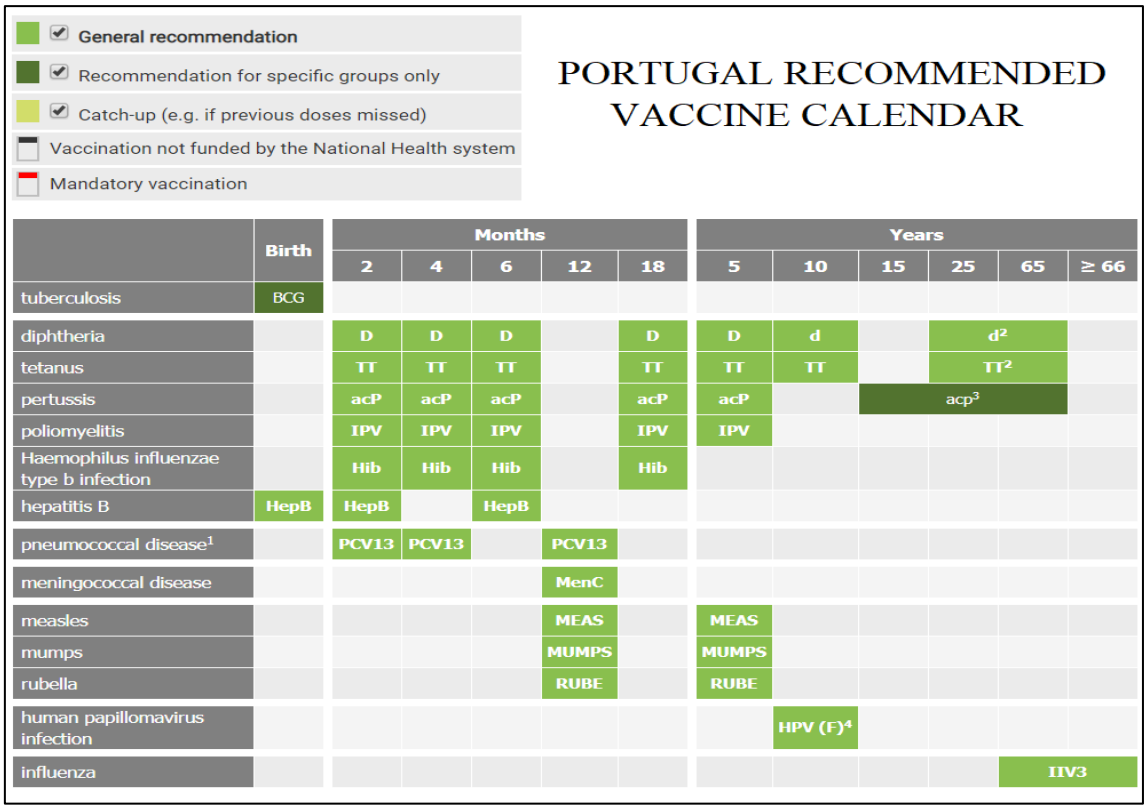


**Figure 20.** Portugal Recommended Vaccine Calendar (ECDC, 2020)

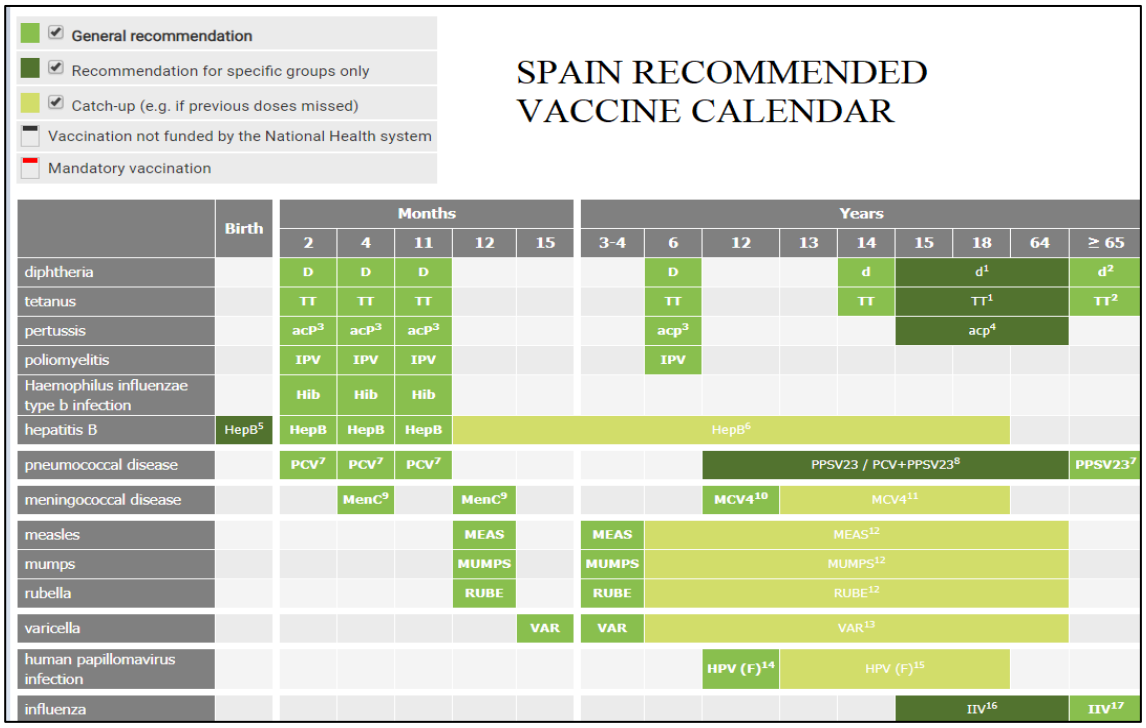


**Figure 21.** Spain Recommended Vaccine Calendar (ECDC, 2020)

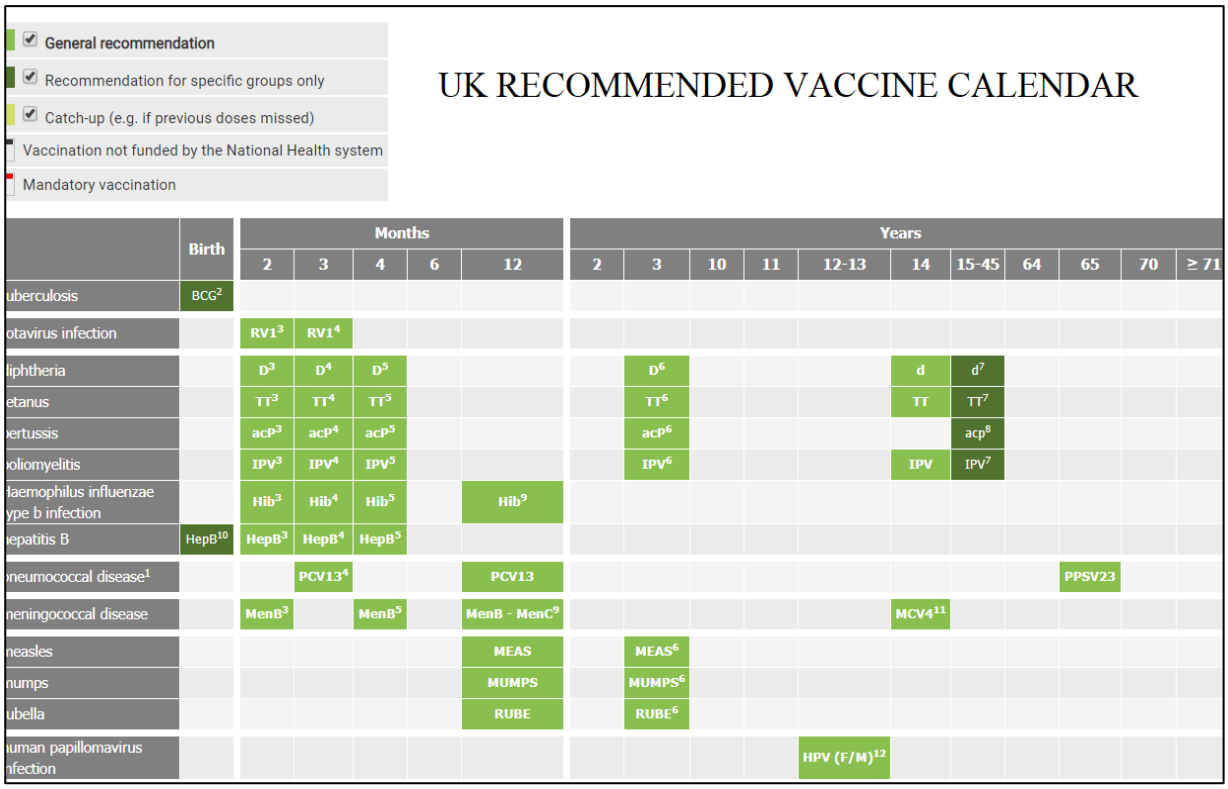


**Figure 22**. UK Recommended Vaccine Calendar (ECDC, 2020)

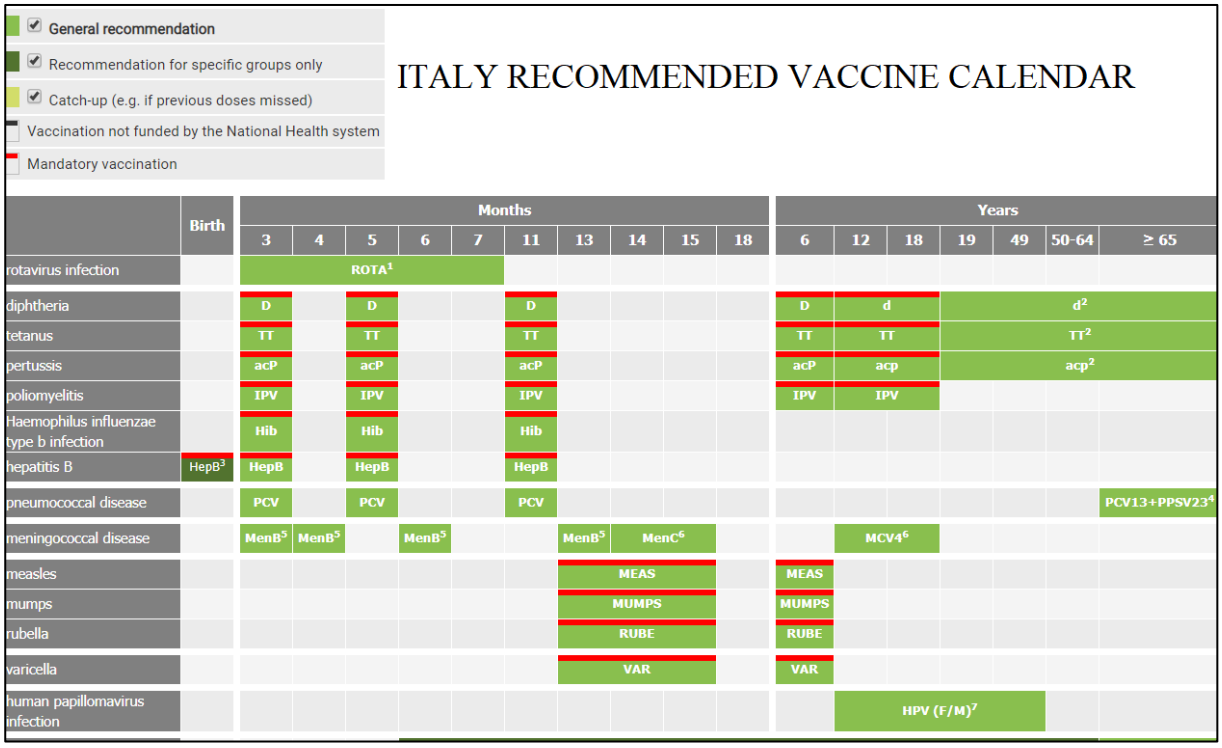


**Figure 23.** Italy Recommended Vaccine Calendar (ECDC, 2020)

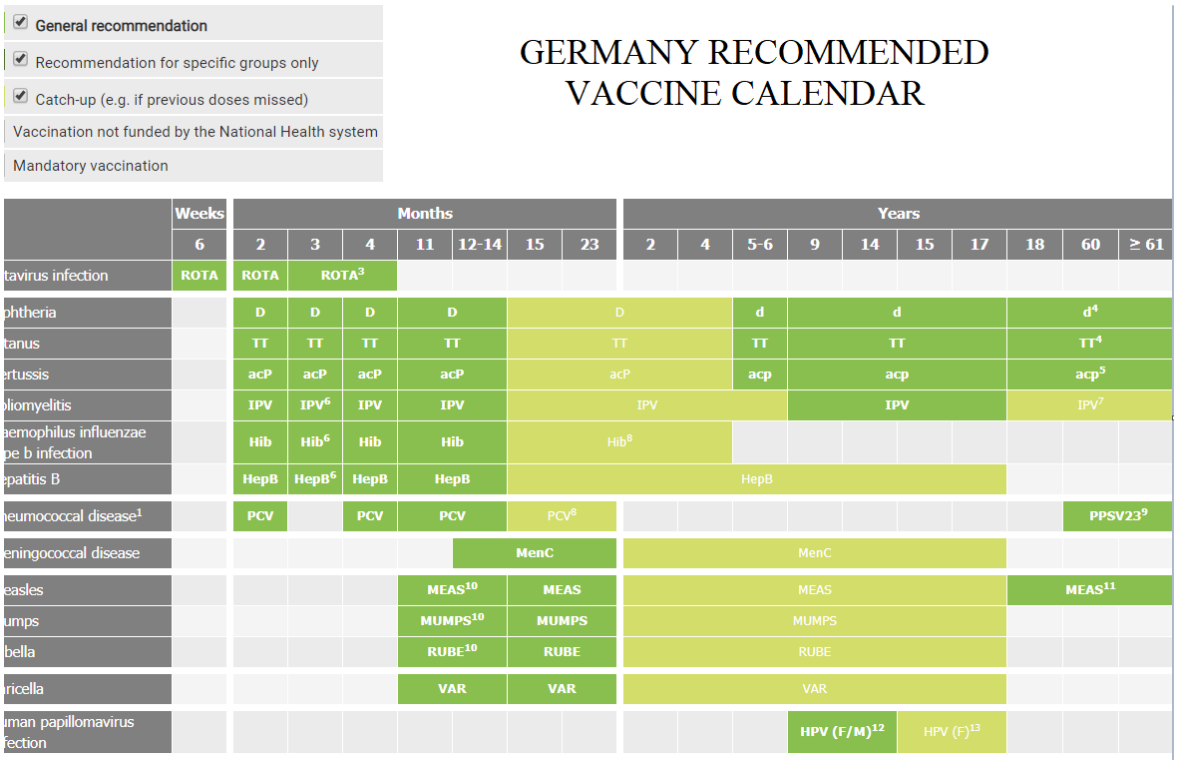


**Figure 24.** Germany Recommended Vaccine Calendar (ECDC, 2020)

In Germany; TBC vaccine is neither mandatory nor recommended and Mass Vaccination was applied between 1961- 1998. The vaccination policy that performed between these years may also be an important data for COVID-19 related deaths which is lesser than other countries. It can be considered that people who have been vaccinated in this period will be more resistant to COVID-19 (Zwerling A. Et.al.: 2011).

Like Germany, TBC vaccine is neither mandatory nor recommended in Italy and Spain. There was no any information about mass vaccination in the past years for Italy. In Spain, Catalonia suspended TBC in 1971 and last TBC policy of Spain performed between 1965 and 1981 (Asociación Española de Vacunología, 2018). Lack of TBC vaccine policy may have triggered high COVID-19 related deaths (Zwerling A. Et.al.: 2011).

In Portugal, National Vaccination Programme has existed since 1965. TBC was given to all newborns in hospitals (Portugal Ministry of Health, 2020).

UK launched the TBC vaccine policy in 1953. Among the focused group countries, UK is the first country to integrate TBC policy into its health system. Until 2005, all school children aged 10-14 and newborns at risk were vaccinated. All children were given a single dose (there is no evidence of an extra protection of the second or more doses). This vaccine policy was terminated in 2005 due to the costs. However, the recommended vaccination schedule of UK still includes the TBC vaccine for new births. The UK, which is on the TBC vaccination schedule as such preventive activity, has been one of the countries most affected by COVID-19 related deaths (NHS, 2016).

Although TBC vaccination is mandatory in UK and Portugal, mortality rates are lower in Portugal than UK. In addition, in Germany, which is not compulsory, low mortality rates are seen in Portugal compared to the other countries. Miller et all (2019) found that countries without a universal TBC vaccination policy (Italy, the Netherlands, USA) are more severely affected than countries with long-standing TBC policies.

Especially, in Iberian Peninsula, analyze to COVID-19 related mortality rates between Spain and Portugal, the fact that, TBC vaccine is on the calendar in Portugal and the vaccination was applied to masses. In these countries, which have similar geography and physical characteristics, TBC vaccine may have been an advantage

### 3.1.3. Air Pollution of Focused Group

Air pollution, which can be defined as the unfavorable amount and density of foreign substances in the air, negatively affects the health of people, animals and other life forms. Widespread using of low-calorie and high sulfur coals for heating purposes and application of wrong combustion techniques cause air pollution. In addition, high population, mass consumerism and mass production among with the exhaust gases coming out of the motor vehicles whose number is increasing rapidly can be considered as the significant factors of air pollution. Wrong selection of location for the establishment of industrial facilities, ignoring to take necessary measures to protect the environment (no chimney filter, no treatment plant, etc.) and not using appropriate technologies boost the air pollution.

Air pollution causes an increase in respiratory diseases in humans. For example; it is known that it prevents the development and maturation of blood cells, negatively affects the accumulation in the blood and urine, and carbon monoxide (CO) combines with hemoglobin in the blood disrupting oxygen transport. Also, sulfur dioxide (SO2) has sharp, suffocating and irritating effects on the upper respiratory tract. Especially the smoke penetrates from the lungs to the alveolus which has a negative effect.

Air pollution sources;

- Burning fossil fuels in heating, electricity generation, transportation and related sectors
- Solvent use and industrial processes (chemical and mining sectors)
- Disorganized waste management.
- Unconscious agricultural applications (excessive using of pesticides)
- Natural sources: Volcanic eruptions, sea salt spraying, dust storms etc.

Although decrease in the urban population exposed to air pollutants in Europe until 2017 (Fig. 25), increasing industrialization and improper practices in agriculture and other related industrial process still put pressure on the air pollutants data (IEA, 2020). WHO declares that these numbers which are related to urban population exposed to air pollution is much more (Fig. 26) (WHO, 2020).

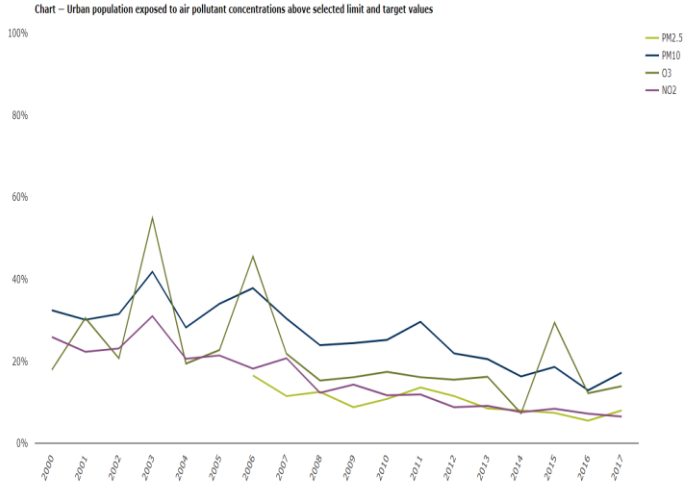


**Figure 25.** Urban population exposed to air pollutant concentrations

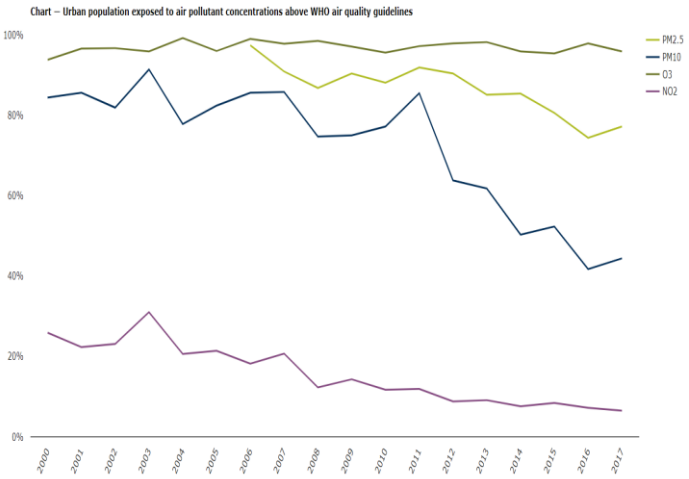


**Figure 26.** Urban population exposed to air pollutant concentrations above WHO air quality guidelines

Considering the air pollution data at the end of 2018 (Fig. 27), it is seen that Italy, one of the focus group countries, is the most polluted of all. It is a remarkable detail that Germany has an average level in the list due to the heavy industry and it is below Italy. The other countries such as Spain and UK do not have a high value. The best air quality country of the focus group is Portugal (WHO, 2020).

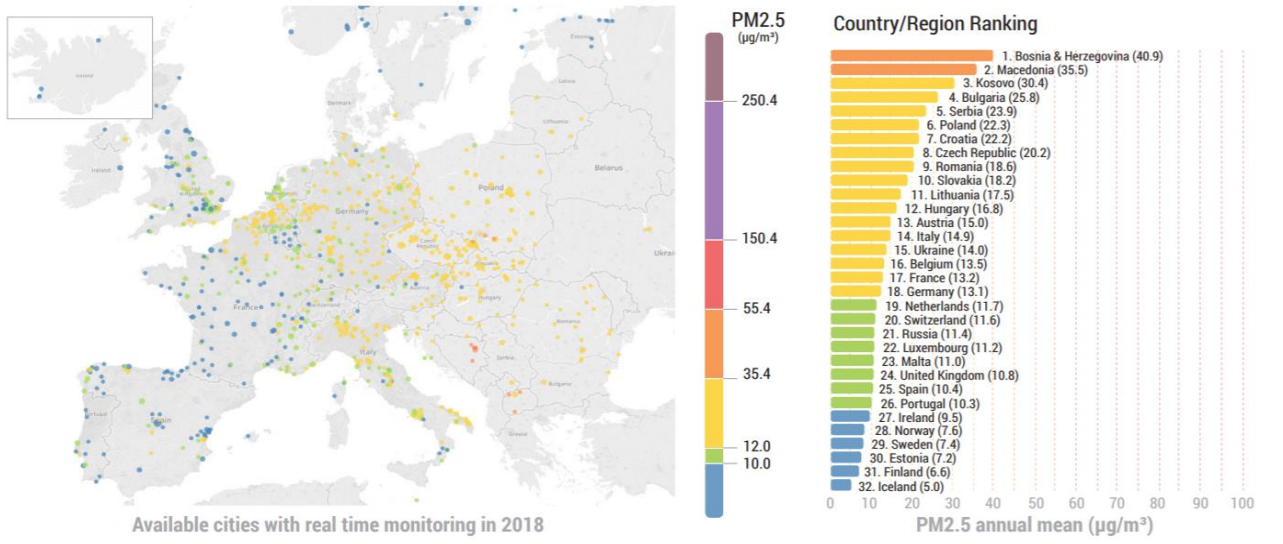


**Figure 27.** Air pollution monitoring of Europe (WHO, 2020)

As is well known, many European countries have declared a lockdown to stop the spread of COVID-19. Therefore, activities that cause daily air pollution have stopped and there has been a noticeable change in air quality in Europe.

## 4. DISCUSSION

The COVID-19 outbreak, which started from China and spread all over the world and declared as Pandemic by WHO, affected the whole world and over two million people were infected. As a result, it has reached a death rate of nearly two hundred thousand people.

As the direction of the pandemic graph begins to normalize in some countries day by day, high cases and mortality rates continue in the countries examined within the scope of the study such as UK, Spain and Italy. However, in Germany and Portugal, which are the other focused countries of the study, although the number of cases increased, it is observed that these countries may enter normalization processes in a shorter period of time. The mortality rate is lower in these countries comparing with the others.

In this study, which factors might cause mortality rate difference among focused group countries is investigated and selected factors include sugar consumption, vaccine calendars and air pollution.

Germany has a lower mortality rate than other countries during the pandemic, although it has more sugar consumption than other countries. On the other hand, UK, Spain and Italy faced higher mortality rates, even though they had less consumption value than Germany. Portugal, which draws a similar epidemic curve with Germany, is in opposition to Germany in terms of sugar consumption.

Also, vaccination calendars of focused group countries are examined. This study particularly dwells on the vaccination of TBC which is a dangerous lung disease and found out that it is only in the calendar of the UK and Portugal among other focused group countries.

Although there is not a great difference between vaccines for other viral diseases in vaccine calendars, this subject is also an issue that needs to be investigated further. One of the reasons for the huge difference at COVID-19 related mortality rates between Spain and Portugal which are both in the Iberian Peninsula can be explained with the TBC vaccine which is in Portugal's vaccination calendar and the country suffer less COVID-19 related deaths.

Although Germany does not have the TBC vaccine in its calendar, it seems to be the country with the lowest mortality rate with Portugal when compared with the other focused group countries. When the TBC vaccine and COVID-19 related deaths are examined, this parameter should be evaluated definitely.

Along with Italy and Spain, UK is one of the countries with the highest mortality rate in the focused group, although the TBC vaccine is on the calendar and the existing negative situation contrasts between the relationship between TBC vaccine and COVID-19 related deaths.

In terms of air pollution, Italy has the dirtiest air than other focused group countries. This may cause to have higher mortality rates in Italy during the COVID-19 outbreak. UK and Spain have average air pollution rates. Despite Germany's heavy and developed industry, it is cleaner than Italy. Portugal with its low air pollution and low death ratios of COVID-19 can prove the significance of good air quality on our endurance to the virus.

## 5. CONCLUSION

Having less sugar consumption and less air pollution, Portugal exhibits less mortality rates during this pandemic which proves that there could be a possible relationship between these variables with the death ratios of COVID-19. It should not be overlooked, however, that Germany, having high sugar consumptions and moderate air pollution, gives lower mortality rate values when compared with the other focused group EU countries. Sugar intake of UK, Italy and Spain should not be underestimated since those countries also have numbers above standards. Nevertheless, more detailed analysis regarding the relationship between sugar consumption and COVID-19 deaths will be essential in the future.

Portugal, included the vaccination of TBC in their vaccine calendar and suffers less COVID-19 related deaths when compared with Spain. It is noteworthy that both being Iberian Peninsula countries, the two country exhibit different death ratios of COVID-19. More detailed research should be done to understand the relationship between COVID-19 deaths and TBC Vaccine.

Not having TBC vaccine in its calendar, Germany is one of the lowest mortality rates in the focused countries. Therefore, the effectiveness of TBC vaccine is concerned for COVID-19, this parameter should be evaluated separately.

Most particularly, Italy and then UK and Spain have high air pollution rates which is accordance with the high COVID-19 death ratios. In this regard, as a study subject it can be investigated by associating with the deaths from COVID-19 in future studies.

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