**Title:** A normalized mortality rate showed the diverse severity of Covid-19 in the world

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**Abstract**

Covid-19 has given a halt to all the activities in the world. Europe was most affected followed by the United States of America. Spain and Belgium were found to be at the highest risk of Covid-19 followed by Italy, France, and the United Kingdom. The Covid-19 cases were on the rise in the United States of America and India but with a lower mortality rate. Japan was least affected in comparison to other countries. A normalized method was used to see the mortality of Covid-19 in comparison to other diseases. The deaths occurred by Cardiovascular diseases, cancer, and respiratory diseases were more in number than the Covid-19 caused deaths in the 45 days period where most of the Covid-19 deaths had taken place. The Covid-19 severity was found to be diverse in the world as well as within Europe. This diversity could be a result of the increased number of diagnostic tests or subsidizing other preexisting diseases to count the Covid-19 positive death under Covid-19 or the accuracy of the diagnostic test performed to detect Covid-19. Normalization based on total death counts could be performed to compare the Covid-19 mortality with other diseases to know the real severity of Covid-19.

**Keywords:** Covid-19, Mortality rate, Cancer, Cardiovascular disease

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## Introduction

Covid-19 has touched a two million mark causing more than 100,000 deaths worldwide in just over three months. It was started in China and spread all over the world[1,2]. Europe and the United States of America (USA) were the worst affected by Covid-19 infection. Italy, Spain, France, and the United Kingdom (UK) together and the USA alone have lost more than 70,000 and 25,000 lives in less than two months. It was on increase in Europe and the USA as well as in other parts of the world. The severity of Covid-19 was different in different countries[3,4]. It seemed to be more lethal in Europe with the highest death reported[5].

There was a different and blurred opinion worldwide on the behavior and severity of Covid-19. Most of the countries were under lockdown to stop the transmission of SARS-Cov-2. We did not know much about Covid-19 how it affected a diseased body in different condition and why mortality rate differed in different countries and region

Two different mortality rate calculation method was used to see the severity of Covid-19. In the first method, the mortality rate was calculated based on total positive Covid-19 cases to see the severity of Covid-19 in different countries. In the second method, a normalized mortality rate was used based on 45 days period to see the severity of Covid-19 in comparison to other diseases.

## Materials and Methods

Two different datasets were used for this study. As the first dataset, Covid-19 data was downloaded from the Covid-19 dashboard set up by WHO. Covid-19 data was updated till 16$^{th}$ April 2020. Deaths caused by Covid-19 was calculated for 45 days period from 3$^{rd}$ March to 16$^{th}$ April 2020. As the second dataset, Global Health Estimate (GHE) 2016 summary table which was released in March 2018 by Department of information, Evidence, and Research, World Health

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Organization (WHO), Geneva, Switzerland was downloaded from the WHO website. GHE code – 0, 380, 610, 800, 1100, 1170, and 1270 which contain data for all causes, respiratory infectious diseases, malignant neoplasms, diabetes mellitus, cardiovascular diseases, non-communicable respiratory diseases, and kidney diseases respectively were used for this study.

The mortality rate of Covid-19 was calculated in two ways. As the first method mortality rate was calculated by dividing the total deaths caused by Covid-19 by the total number of positive Covid-19 cases per 1000. This method was used to see the death rate of Covid-19 among positive Covid-19 people. Only those countries were included in the first part of the study where Covid-19 positive cases exceeded 10,000. The second method was based on the total number of deaths caused by Covid-19 and other diseases in 45 days period to compare the severity of Covid-19 with other diseases. The mortality rate caused by different diseases and reasons were converted into deaths per one and half month (45 days). The downloaded data was in the unit of mortality per 1,00,000 population. The given mortality rate was divided by 1,00,000 and then multiplied by the population of that country which gave the number of deaths by various causes per year. It further divided by 9, which gave an average death occurred per one and a half months for the respective country. Covid-19 caused deaths for the period of 45 days ($3^{rd}$ March – $16^{th}$ April 2020) was compared with the deaths caused by cardiovascular diseases, cancer, non-communicable respiratory diseases, respiratory infectious diseases, diabetes mellitus, and kidney diseases in 45 days period. All the countries who have reported more than 100 deaths by Covid-19 were included at the preliminary label. Only those countries were included for the final and second part of the study where high completeness and quality of cause of death assignment was available (according to WHO norms). All the calculations performed, and graphs were drawn in R version 3.6.2 and Microsoft Excel[6,7].

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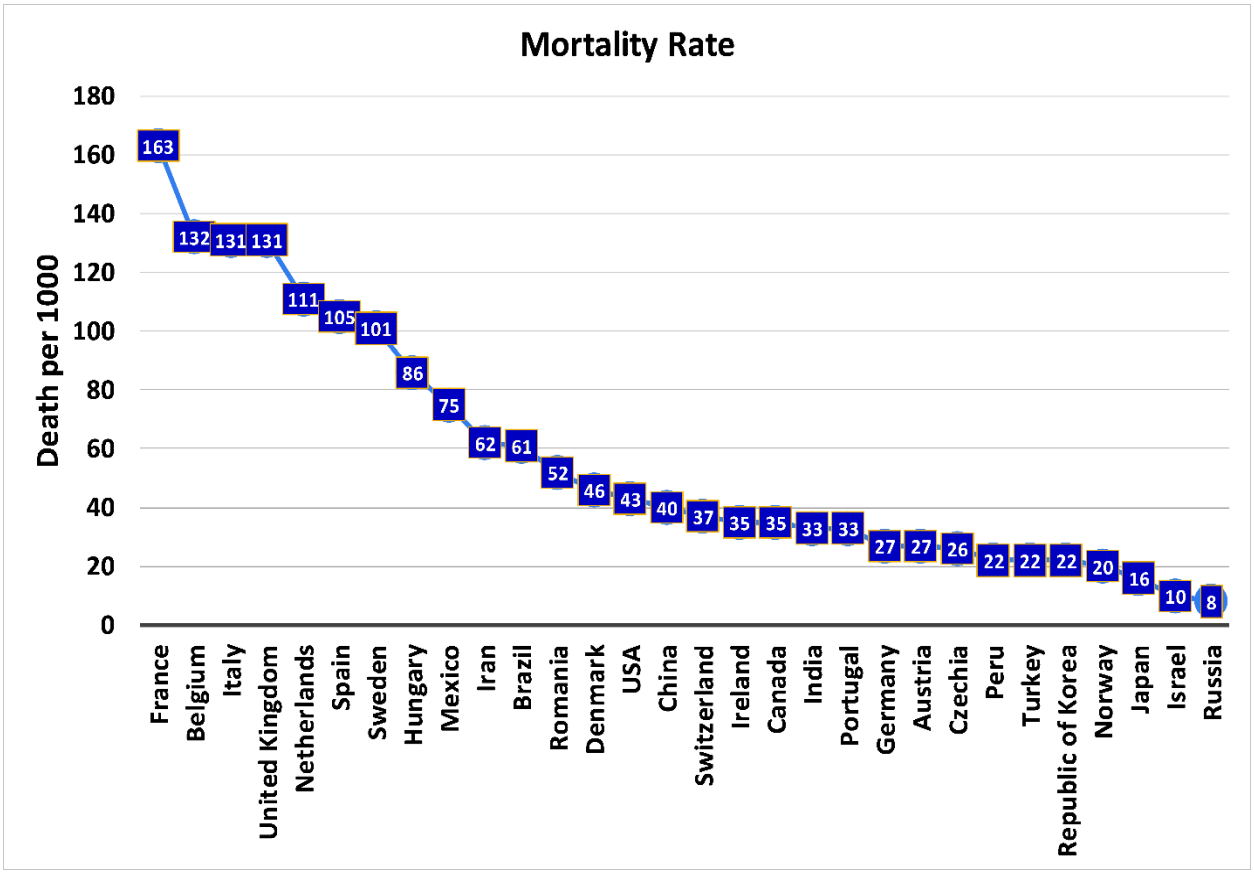
## Results

France showed the highest mortality rate ( Covid-19 caused deaths out of Covid-19 positive cases per 1000) at 163 which was followed by Belgium, Italy, and the UK at 132,131, and 131 respectively (Figure1). The mortality rate in the USA, China, and India was at 43, 40, and 33 respectively (Figure1). Germany, the Republic of Korea, Japan, Israel, and Russia were at the bottom place with a mortality rate at 27, 22, 16, 10, and 8 respectively (Figure1).

**Figure-1: Mortality Rate of Covid-19**




Mortality rate of Covid-19 was calculated as deaths caused by Covid-19 per 1000 Covid-19 affected people; UK: The United Kingdom; USA: The United States of America

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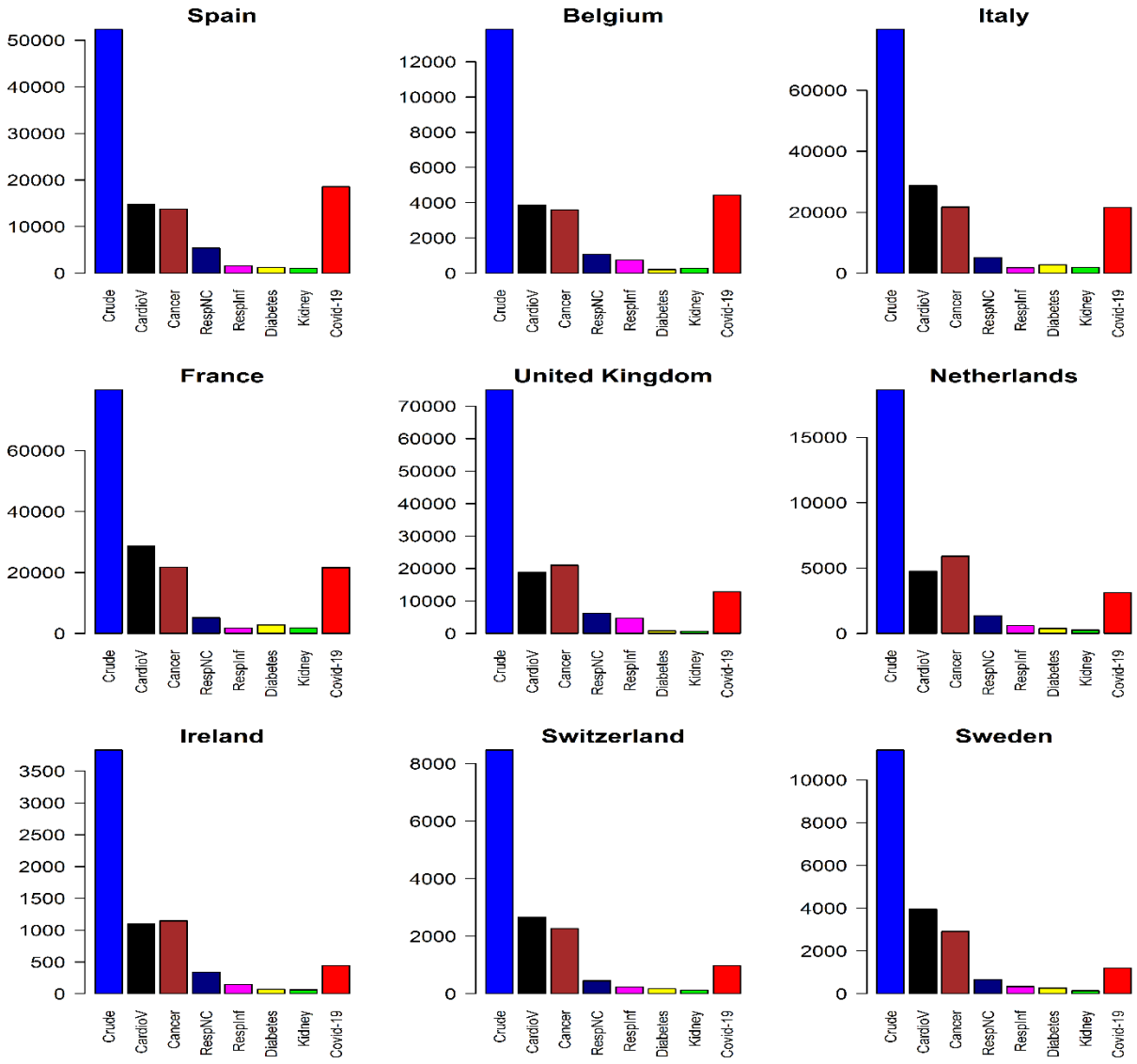
**Figure-2: Deaths Caused by Covid-19 and Other Diseases (High risk group)**




X-axis denotes the causes of death; Y-axis denotes the number of deaths in a 45 days period; Crude: Total deaths occurred by all causes; CardioV: Deaths caused by cardiovascular diseases; Cancer: Deaths caused by cancer; RespNC: Deaths caused by non-communicable respiratory diseases; RespInf: Deaths caused by respiratory infectious diseases; Diabetes: Deaths caused by diabetes mellitus; Kidney: Deaths caused by kidney diseases; Covid-19: Deaths caused by Covid-19

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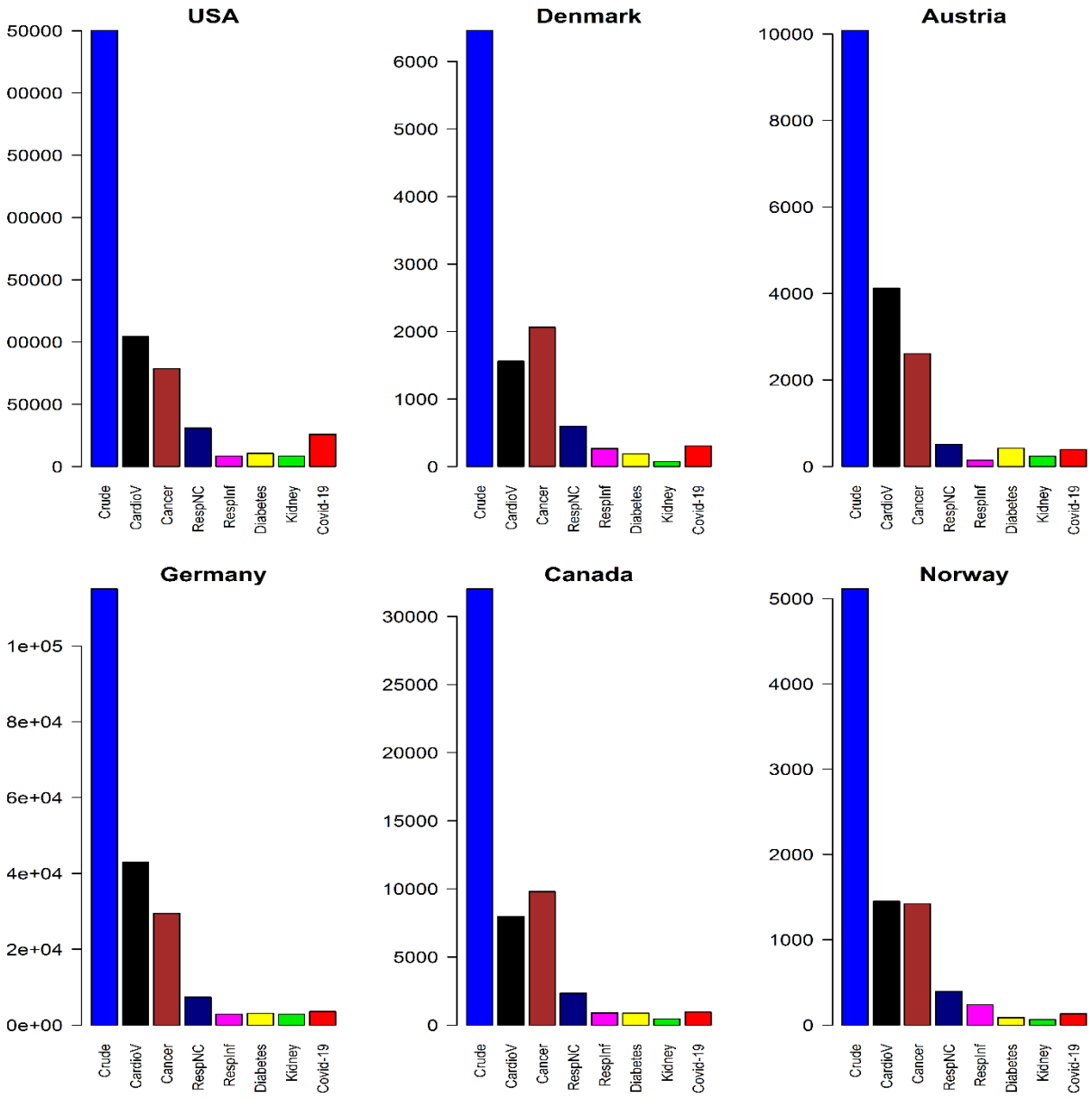
**Figure-3: Deaths Caused by Covid-19 and Other Diseases (Moderate risk group)**




X-axis denotes the causes of death; Y-axis denotes the number of deaths in a 45 days period; Crude: Total deaths occurred by all causes; CardioV: Deaths caused by cardiovascular diseases; Cancer: Deaths caused by cancer; RespNC: Deaths caused by non-communicable respiratory diseases; RespInf: Deaths caused by respiratory infectious diseases; Diabetes: Deaths caused by diabetes mellitus; Kidney: Deaths caused by kidney diseases; Covid-19: Deaths caused by Covid-19; USA: The United States of America

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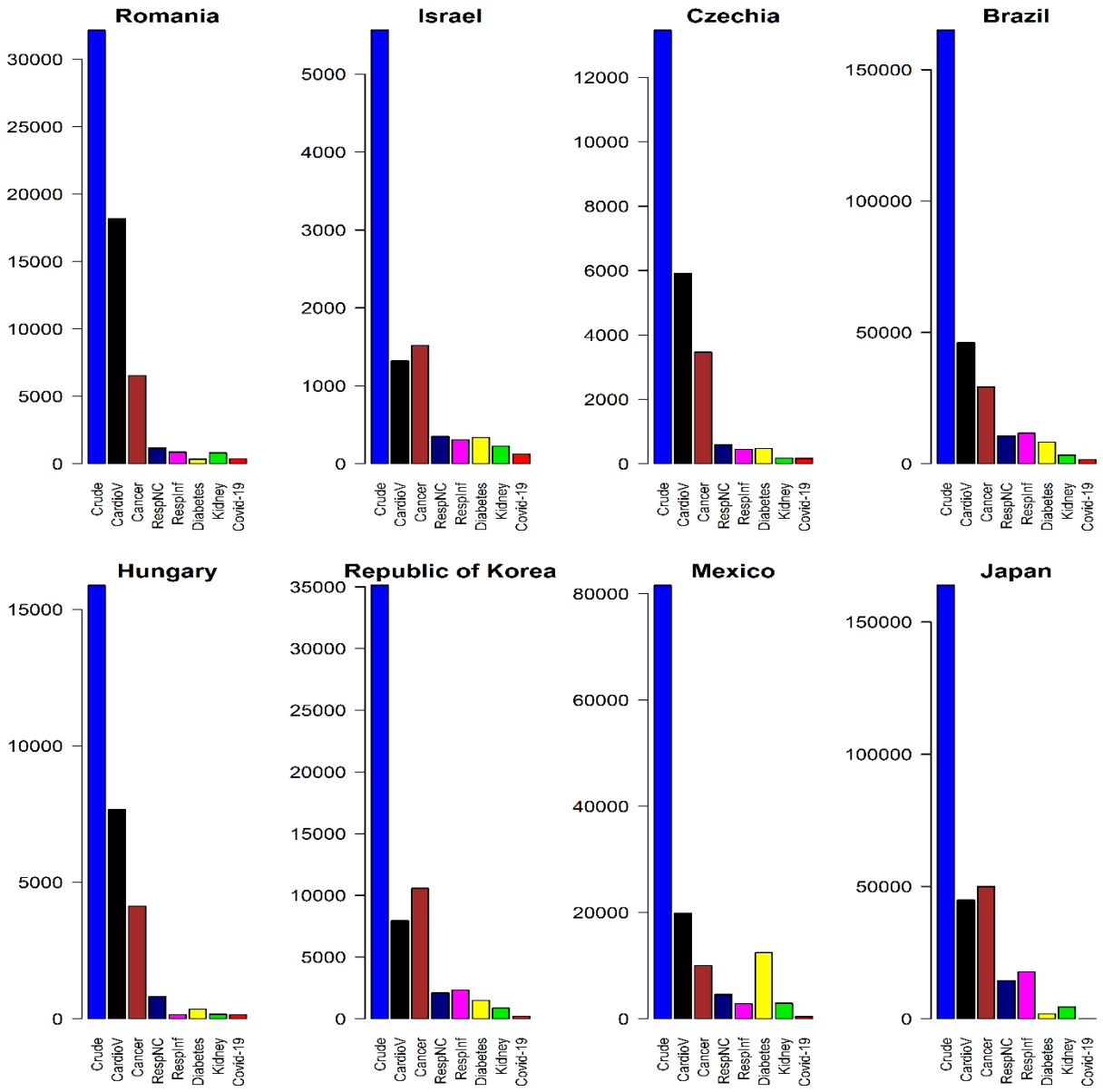
**Figure-4: Deaths Caused by Covid-19 and Other Diseases (Low risk group)**




X-axis denotes the causes of death; Y-axis denotes the number of deaths in a 45 days period; Crude: Total deaths occurred by all causes; CardioV: Deaths caused by cardiovascular diseases; Cancer: Deaths caused by cancer; RespNC: Deaths caused by non-communicable respiratory diseases; RespInf: Deaths caused by respiratory infectious diseases; Diabetes: Deaths caused by diabetes mellitus; Kidney: Deaths caused by kidney diseases; Covid-19: Deaths caused by Covid-19

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Italy, Spain, France, and the UK lost 21595, 18579, 17143, and 12868 lives respectively in 45 days period because of Covid-19. The mortality rate was found highest in Spain followed by Belgium, Italy, and France at 35.53, 32.09, 27.00, and 24.59 percent respectively of the number of deaths taken place from all causes in a 45 days period on an average. These countries were not only on top of Europe but in the world. They were considered as a high risk zone for Covid-19. There was another group of countries that showed a moderate percentage of deaths caused by Covid-19 in comparison to total deaths that occurred by all causes in a month. The USA and Germany with 25871 (7.39 %) and 2915 (3.10 %) deaths led this group by death count. The third and the lowest risk group was led by Brazil followed by Mexico with 1223 (0.93%) and 406 (0.50) deaths by Covid-19 during the 45 days period. Israel led this group with 2.26 % mortality rate while Japan was found at the bottom with 0.08 % mortality rate.

Deaths recorded under Covid-19 overtook Cancer and Cardiovascular diseases caused deaths in Spain and Belgium (Figure2). In Italy, Covid-19 caused deaths were below the cardiovascular diseases caused deaths but almost equal to cancer caused deaths (Figure2). The deaths caused by Covid-19 in France, the United Kingdom, the Netherlands, Ireland, Switzerland, and Sweden were behind cancer and cardiovascular diseases caused deaths but higher than respiratory infectious diseases, non-communicable respiratory diseases, diabetes, and kidney diseases (Figure2). The USA, Denmark, Austria, Germany, Canada, and Norway were found to be in moderate risk by Covid-19 where the mortality rate of Covid-19 was lesser than cancer, cardiovascular diseases, and non-communicable respiratory diseases but found competing with respiratory infectious diseases, diabetes mellitus, and kidney diseases caused deaths (Figure3). The mortality rate of Covid-19 in Israel, Czechia, Brazil, Hungary, the Republic of Korea, Mexico, and Japan were least in comparison to cardiovascular diseases, cancer, non-communicable respiratory

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diseases, communicable infectious diseases, diabetes mellitus, and kidney diseases (Figure4). The mortality rate of Covid-19 in Hungary was higher than the diabetes mellitus but lower than other diseases (Figure4).

**Discussion**

The result divided the Covid-19 affected countries into three risk groups. The highest risk group was having nine countries and all of them were from Europe. The USA and Canada fell under a moderate risk group of countries with four European countries. The third and the low risk group contained countries from Europe, Asia, and each from North and South America.

The result showed that Covid-19 severity in terms of Covid-19 positive cases as well as in comparison to other diseases was diverse in the world. Although it started in China, China and its neighboring countries were not at high risk in comparison to the European countries. The severity of Covid-19 was also diverse within Europe. Spain and Belgium were at the highest risk while Germany and Russia were at a moderate risk while Romania and Hungary were at low risk.

There was different opinion on the incubation period of SARS-Cov-2[8]. It was reported as 5 days to 14 days of incubation period[9,10]. In this study, the mortality rate of Covid-19 in comparison to other diseases was calculated based on 45 days period. This period could have 9 cycles of incubation period with the least incubation period or 3 cycles of incubation period at high incubation period.

If we look at the latest reports on Covid-19 than it was found that a diseased condition or a person with cancer, cardiovascular, respiratory diseases or other diseases were at higher risk of Covid-19 infection[11-13]. It was also reported that Covid-19 increased the severity of preexisting diseases[14-16]. Three months was very little time (since Covid-19 birth) to know a disease

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completely. It might be possible that Covid-19 made the preexisting diseases more severe, but the deaths caused by these conditions were counted under Covid-19 ignoring the preexisting diseases. Government policies by different nations also seemed to play a role in the diversity of Covid-19 throughout the world. If we look at Europe than Germany and Italy as the neighboring country showed a different spectrum of Covid-19 severity. China, India, and the USA as a large population have shown less mortality by Covid-19 in terms of percentage. Overall, Covid-19 caused deaths were not the highest in number during the 45 days period where most of the deaths had occurred worldwide but behind the cardiovascular and cancer caused deaths on an average in high risk group countries except Spain and Belgium. Other European countries in high and moderate risk groups showed Covid-19 caused deaths as par with respiratory diseases, diabetes mellitus, and kidney diseases. Asian and other countries inside and outside Europe were at low risk. European countries featured in each group that showed the diversity of severity of Covid-19 in Europe. The deaths occurred by Cardiovascular diseases, Cancer, respiratory diseases, diabetes mellitus, and kidney diseases were more in number than Covid-19 caused deaths during the 45 days period on an average. It showed that Covid-19 was not same in each country and region and a greater number of people could die by other diseases if other diseases were neglected.

The diversity of Covid-19 severity in the world led us to rethink certain practices. The number of diagnostic tests for Covid-19 has increased which might lead to more positive Covid-19 cases. The reason behind deaths counted under Covid-19 might be because of preexisting diseases which became severe with Covid-19. We might need a better diagnostic kit that could differentiate Covid-19 with other similar symptomatic diseases.

**Ethical approval:** This study did not require ethical approval

**Conflict of interest:** None

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