

# Comparative analysis of current health expenditure and mortality from COVID-19 by countries

*Análisis comparativo del gasto corriente sanitario y la mortalidad por COVID-19 por países*

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Received/Recibido: 06/28/2020 Accepted/Aceptado: 07/15/2020 Published/Publicado: 09/09/2020

DOI: 10.5281/zenodo.4266533

## Abstract

The research aimed to conduct a comparative assessment of mortality rates from COVID-19 and health expenditure in countries, where the COVID-19 had been found, in order to establish the correlation between these two indicators.

**Materials and methods.** Data about current health expenditure per capita have been taken from the Data World Bank from the World Health Organization Global Health Expenditure Database. Worldwide mortality data of coronavirus have been used from Johns Hopkins University and medicine Coronavirus resource center where actual data of incidence and fatal cases are presented.

**Results.** The results of the analysis have shown: among countries with a low level of health expenditures per capita the smallest share has corresponded to the countries with a high COVID-19 fatality rate – less than 20% (22 countries). Assessment of the volume of expenditures of these 22 countries indicates: 2 of them (9%) have had health expenditures per capita higher 2000\$ (Italy and Spain), 4 of them (18%) – from 1000\$ to 2000\$, and 4 countries have had health expenditures per capita less 200 \$.

**Conclusions.** The results of our comparative study of health expenditures to COVID-19 case-fatality convincingly show that the absence of a direct correlation between the volume of health expenditure of the country and the COVID-19 fatality index.

**Keywords:** COVID-19, pandemic, health expenditure, comparative analysis.

## Resumen

El objetivo de la investigación fue realizar una evaluación comparativa de las tasas de mortalidad por COVID-19 y el gasto en salud en los países donde se presenta el COVID-19, para establecer la correlación entre estos dos indicadores.

**Materiales y métodos.** Los datos sobre el gasto actual en salud per cápita se han tomado del Banco Mundial de Datos de la base de datos de gastos mundiales en salud de la Organización Mundial de la Salud. Los datos mundiales de mortalidad por coronavirus se han utilizado los de la Universidad Johns Hopkins y el Centro de Recursos De Medicina Coronavirus, donde se presentan datos reales de incidencia y casos fatales.

**Resultados.** Los resultados del análisis han demostrado que, entre los países con un bajo nivel de gasto en salud per cápita, la proporción más pequeña corresponde a los países con una alta tasa de mortalidad de COVID-19, menos del 20% (22 países). Se ha obtenido una evaluación del volumen de gastos de estos 22 países: 2 de ellos (9%) han tenido gastos de salud per cápita superiores a 2000 \$ (Italia y España), 4 de ellos (18%) - de 1000 \$ a 2000 \$, y 4 países han tenido gastos de salud per cápita menos 200 \$.

**Conclusiones.** Los resultados de nuestro estudio comparativo de gastos en salud para la letalidad de COVID-19 demuestran de manera convincente la ausencia de correlación directa entre el volumen de gasto en salud del país y el índice de letalidad de COVID-19.

**Palabras clave:** COVID-19, pandemia, gasto en salud, análisis comparativo.

## Introduction

Over the past few decades, a large number of people have been affected by the 3 epidemics caused by coronavirus family (SARS-2003, MERS-2012, and COVID-2019) in the world. A novel coronavirus spillover event, with its epicenter in Wuhan, People's Republic of China, has emerged as a public health emergency of international concern. This began as an outbreak in December 2019<sup>1</sup>. Nevertheless, there is a substantial genetic dissimilarity between pathogens of the three previous epidemics, in particular, MERS with COVID-19. In the previous epidemics, initial hotspots of diseases were the Middle East, Saudi Arabia (MERS), and China and animal to human and then human to human transmissions of pathogens were reported in other countries<sup>2-5</sup>.

Severe acute respiratory syndrome coronavirus (SARS-CoV)-2, a novel coronavirus from the same family as SARS-CoV and Middle East respiratory syndrome coronavirus, has spread worldwide leading the World Health Organization to declare a pandemic. The disease caused by SARS-CoV-2, coronavirus disease 2019 (COVID-19), presents flu-like symptoms that can become serious in high-risk individuals<sup>13</sup>.

Coronavirus disease 2019 (COVID-19) is a newly emerged disease that has become a global public health concern as it rapidly spread around the world. The etiologic agent responsible for this disease has been named as severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses as it shows similar genomic features to that of SARS-CoV which caused a pandemic in 2002.

In February 2020, the World Health Organization (WHO), worked with an international network of statisticians and mathematical modelers to estimate key epidemiologic parameters of COVID-19, such as the incubation period (the time between infection and symptom onset), case fatality ratio (CFR, the proportion of cases that die), and the serial interval (the time between symptom onset of a primary and secondary case). These values were published in the Situation Report-30 and were considered preliminary and parameters were updated as more information become available. Future modeling can support decision-making but needs to be combined with rigorous data collection and comprehensive analysis of the situation<sup>6-9</sup>.

Worldwide, the COVID-19 pandemic is causing significant loss of life, disrupting livelihoods, and threatening recent health advances and progress toward global development goals, according to the WHO World Health Statistics 2020<sup>10</sup>.

Given the significance of the problem WHO has developed technical guidelines on COVID-19<sup>11</sup>:

1. WHO interim guidance for laboratory testing
2. WHO interim guidance for laboratory biosafety related to COVID-19 virus
3. Molecular assays to diagnose COVID-19 virus
4. WHO reference laboratories providing confirmatory testing

for COVID-19

5. Guidance for laboratories shipping specimens to WHO reference laboratories that provide confirmatory testing for COVID-19 virus
6. Laboratory Assessment Tool for laboratories implementing COVID-19 testing
7. Scientific brief: Advice on the use of point-of-care immunodiagnostic tests for COVID-19.

The epidemic of COVID-19 has caused public health crises. In the coming weeks and months, viral tests for the presence of COVID-19 infection as well as serological tests for antibodies and to measure the prevalence of the disease are crucial. Governments, businesses and households will rely on the data of these tests when deciding on the path ahead. However, local test data is not currently available to the public, and there is no comprehensive set of this data in one place<sup>12</sup>.

The number of COVID-19 cases has risen substantially in the world compared to SARS and MERS, and it would probably take longer to halve the disease cases; meaning that control measures would have to be in place for a longer period. WHO has announced that the Coronavirus epidemic is progressively increasing in three countries, including Italy, South Korea, and Iran. The shared string that links these three countries is the pandemic of MERS in 2013, which was transmitted through close human-to-human contacts. Some studies were carried out to review different epidemiological and clinical aspects of the new emerging disease along with specific measures by countries at the community level<sup>14-25,35</sup>.

The economic effects of COVID-19 around the world have been described on The World Economic Forum COVID Action Platform<sup>26</sup>. Confirmed cases of the COVID-19 coronavirus have topped 4 million globally. Businesses are coping with lost revenue and disrupted supply chains as factory shutdowns and quarantine measures spread across the globe, restricting movement and commerce. Unemployment is skyrocketing, while policymakers across countries race to implement fiscal and monetary measures to alleviate the financial burden on citizens and shore up economies under severe strain.

In the US, the unemployment rate in April climbed to 14.7% - a post-war record - as more than 20 million Americans lost their jobs. The news comes after the US Commerce Department reported a rapid decline in the gross domestic product (GDP) in the first three months of the year on 29 April. GDP dropped by 4.8% in the first quarter of 2020 - the sharpest contraction since the global financial crisis of 2007-2009 - bringing to an end the longest economic expansion in US history.

On 15 April, the International Monetary Fund (IMF) warned economies in Asia would see no growth this year, for the first time in 60 years, with the service sector particularly under pressure. National lockdowns across the region have meant airlines, factories, shops, and restaurants have suffered the greatest economic shocks. On 20 March, the United

Kingdom (UK) announced radical fiscal spending measures to counter the economic impact of a worsening crisis. The government said it would pay up to 80% of the wages of employees across the country unable to work, as most businesses shut their doors to help fight the spread of coronavirus. Earlier in the month, the Danish government announced it would help private companies struggling to manage the fallout from the pandemic by covering 75% of employees' salaries if firms agreed not to cut staff. Denmark has announced restrictions on companies that are registered in tax havens from accessing financial aid. Companies applying for state aid will also have to commit to not paying dividends or make share buy-backs this year and next. Poland had already announced restrictions on access to state aid based on whether large firms pay taxes in the country.

The European Union more broadly has implemented fiscal measures to shore up the economy worth more than €3 trillion<sup>26,34</sup>.

Given the acute urgency of the COVID-19 pandemic, the research aimed to conduct a comparative assessment of mortality rates from COVID-19 and health expenditure in countries, where the COVID-19 had been found, to confirm or refute the correlation between these two indicators.

Materials and Methods

Here, we provide an overview of the current health expenditure per capita and fatality cases from COVID-19 by countries.

Data about current health expenditure per capita were taken from Data World Bank from the World Health Organization Global Health Expenditure database, last updated date - 09.04.20<sup>27</sup>. Despite this, we consider it expedient to conduct a comparative analysis, because the main trends and ratios of the analyzed indicators are preserved.

Worldwide mortality data of coronavirus have been used from Johns Hopkins University and Medicine Coronavirus resource center where actual data of incidence and fatal cases are presented. Data on May 17, 2020, have been analyzed<sup>28-32</sup>.

According to WHO, there are current health expenditures per capita for 268 countries all over the world. At the same time, there are 151 countries where COVID-19 incidence has been confirmed. From the 151 countries with COVID-19 cases, 7 countries have been presented into the WHO's Global Health Expenditure database but the indicator it had not been given: Albania, Kosovo, Libya, Montenegro, Somalia, Syria, Yemen; and there were 5 countries with COVID-19 cases that even haven't been presented into the WHO's Global Health Expenditure database: Angola, Burma, Diamond Princess, Iceland, Taiwan. So, comparative analyses of COVID-19 fatal cases and current health expenditures per capita have been conducted for 139 countries.

We have ranged the list of countries by COVID-19 fatal cases from the lowest to the highest, and if the countries had the same rate it was placed at the same rank. So it has been ranged from 1 (the country with the lowest case-fatality) to 78 (the country with the highest case-fatality). The case-fatality indicator shows the number of deaths/per 100 confirmed cases (observed case-fatality ratio). Then using the method of equality of intervals, it was proposed three main groups of countries in terms of mortality among the identified cases and it was assigned the codes **A** - countries with low case-fatality from COVID-19 (1-25 country's number in the range), **B** - countries with average case-fatality from COVID-19 (26-52) and **C** - countries with high case-fatality from COVID-19 (53-78).

The data about current health expenditures per capita have been analyzed by Method of Equal-Appearing Intervals<sup>36</sup>. All 139 countries have been divided into three groups - index **I** countries with high health expenditures per capita (expenditure from 10246.1 to 6837.2 \$), index **II** countries with average health expenditures per capita (from 5904.5 to 3428.3 \$), index **III** countries with low health expenditures per capita (from 3361.6 to 19.4\$).

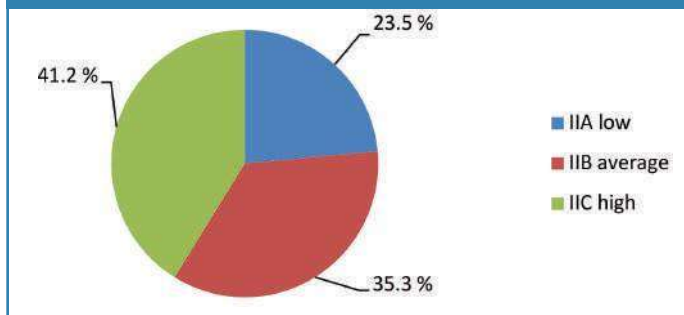
Accumulation both of indicators allowed to propose a consolidated "cost-fatality" index. If there is an indirect correlation between the volume of health expenditures and COVID-19 fatal cases, consolidated "expenditure - fatality" index will show the lowest fatality in countries with high health expenditures per capita (IA) and the highest fatality in countries with low health expenditures per capita (IIIC).

Table 1. Results of complex comparative analyzes of health expenditure per capita and COVID-19 fatality in countries with high (I) and average (II) health expenditures level

| Current health expenditures per capita, \$, 2017 | Range number by health expenditures per capita (of 139) | Country Name   | Range number by Case-Fatality (of 78) | Confirmed cases | Deaths | Case-Fatality In % | Consolidated "expenditure-fatality" index |
|--|---|----------------|---------------------------------------|-----------------|--------|--------------------|---|
| 10246.13867                                      | 1   | United States  | 49                                    | 1.508.308       | 90.347 | 6.0                | IB  |
| 9956.259766                                      | 2   | Switzerland    | 51                                    | 30.597          | 1.886  | 6.2                | IB  |
| 7936.375   | 3   | Norway         | 23                                    | 8.257           | 233    | 2.8                | IA  |
| 5904.583984                                      | 4   | Sweden         | 70                                    | 30.377          | 3.698  | 12.2               | IIC                                       |
| 5800.151367                                      | 5   | Denmark        | 42                                    | 11.166          | 548    | 4.9                | IIB                                       |
| 5782.628418                                      | 6   | Luxembourg     | 22                                    | 3.947           | 107    | 2.7                | IIA                                       |
| 5331.817871                                      | 7   | Australia      | 13                                    | 7.068           | 99     | 1.4                | IIA                                       |
| 5033.452148                                      | 8   | Germany        | 39                                    | 176.551         | 8.003  | 4.5                | IIB                                       |
| 4976.862305                                      | 9   | Ireland        | 53                                    | 24.2            | 1.547  | 6.4                | IIC                                       |
| 4939.875488                                      | 10  | Austria        | 32                                    | 16.269          | 629    | 3.9                | IIB                                       |
| 4911.44043                                       | 11  | Netherlands    | 71                                    | 44.341          | 5.713  | 12.9               | IIC                                       |
| 4754.947754                                      | 12  | Canada         | 59                                    | 79.411          | 5.96   | 7.5                | IIC                                       |
| 4507.356445                                      | 13  | Belgium        | 76                                    | 55.559          | 9.08   | 16.3               | IIC                                       |
| 4379.727051                                      | 14  | France         | 75                                    | 180.051         | 28.242 | 15.7               | IIC                                       |
| 4205.742676                                      | 15  | Finland        | 41                                    | 6.38            | 300    | 4.7                | IIB                                       |
| 4168.986328                                      | 16  | Japan          | 40                                    | 16.305          | 749    | 4.6                | IIB                                       |
| 4040.700021                                      | 17  | Algeria        | 56                                    | 761             | 51     | 6.7                | IIC                                       |
| 3937.221924                                      | 18  | New Zealand    | 13                                    | 1.499           | 21     | 1.4                | IIA                                       |
| 3858.674316                                      | 19  | United Kingdom | 73                                    | 247.709         | 34.876 | 14.1               | IIC                                       |

As shown in Table 1, in groups I and II - from 19 countries – where the highest health expenditures per capita, a high level of fatality was registered in most of them- 7 countries - 41,2% (IC index), the lowest was in the group of countries - 4 countries only- with low fatality rates (figure1).

**Figure 1. Distribution of countries with a high and an average level of health expenditures per capita by COVID-19 fatality rate**

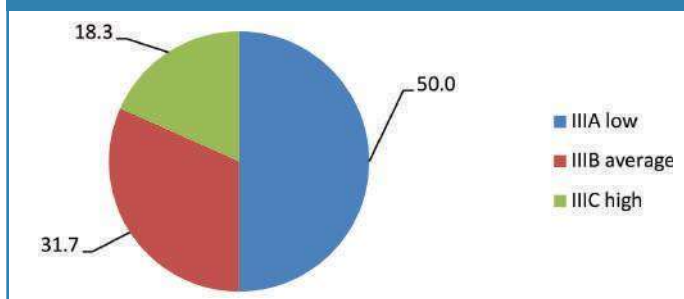


Among the countries with a higher level of health expenditures per capita (group I) such as the US, Switzerland, and Norway, the first two had Consolidated “expenditure- fatality” index IB and only Norway in the third place of the group I had had Index IA. Significant meaning is the absence of high fatality in the group.

Countries with average health expenditure per capita (group II) and low case-fatality (index – II\_A) from COVID-19 were 3 countries: Luxembourg, Australia, and New Zealand. It should be noted; New Zealand presented a rank of 17th - the penultimate place - in group II by health expenditure. Among the average level of health expenditures countries, there were 8 (50% of the II group) with II C index that is, those that are characterized by the highest COVID-19 fatality level: Andorra, Belgium, Canada, France, Ireland, Netherlands, Sweden, and United Kingdom.

The most numerous group (III group) includes 120 countries with health expenditures per capita less than 3428.3 \$. The structural analyses by fatality cases are shown in figure 2.

**Figure 2. Distribution of countries with a low level of health expenditures per capita by COVID-19 fatality rate**



The half, 60 countries of the group, have been assigned index III A – the lowest COVID-19 fatality rate. Thus, Qatar has the lowest Case-Fatality index – 0% (15 deaths of 33 969 confirmed cases). It is fair to say - health expenditures per capita in Qatar were almost 1650 \$ (2017), which is adequate com-

pared to countries with health expenditures per capita less 200\$, Ukraine (177\$), Moldova (191). Russian Federation’s health expenditures per capita consisted of a few more of 585 \$ (61st place in the range of health expenditures per capita of 139 countries). Fortunately, the Russian Federation and Ukraine, both, showed an index IIIA – low COVID-19 fatality rate.

Finally, among countries with a low level of health expenditures per capita the smallest share corresponded to the countries with a high COVID-19 fatality rate – less than 20% (22 countries). Assessment of the volume of expenditures of these 22 countries showed: 2 of them (9%) have health expenditures per capita higher 2000\$ (Italy and Spain), 4 of them (18%) – from 1000\$ to 2000\$, and 4 countries had health expenditures per capita less 200 \$.

## Conclusion

At the time of this study, the priority goals of the WHO in the fight against COVID-19 were:

- Limit human-to-human transmission including reducing secondary infections among close contacts and health care workers, preventing transmission amplification events, and preventing further international spread from China. This can be achieved through a combination of public health measures, such as rapid identification, diagnosis and management of the cases, identification and follow up of the contacts, infection prevention and control in health care settings, implementation of health measures for travelers, awareness-raising in the population and risk communication;
- Identify, isolate and care for patients early, including providing optimized care for infected patients;
- Identify and reduce transmission from the animal source;
- Address crucial unknowns regarding clinical severity, the extent of transmission and infection, treatment options, and accelerate the development of diagnostics, therapeutics, and vaccines;
- Communicate critical risk and event information to all communities and counter misinformation;
- Minimize social and economic impact through multisectoral partnerships<sup>13</sup>.

The results of our comparative study of health expenditures to COVID-19 case-fatality indicate the absence of a direct correlation between the volume of health expenditure of the country and the COVID-19 fatality index.

This study should take into consideration the time of study – relatively short term of COVID-19 pandemic and different periods of epidemic duration in different countries; the different magnitude of testing against COVID-19 by countries; the different levels of transparency and completeness of data by countries.

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