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Risk factors influencing COVID-19 mortality rate in OECD countries

A cross-sectional study

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Summary

The coronavirus disease (COVID-19) has spread globally; however, the COVID-19 mortality rate varies largely across countries. The purpose of this study was to investigate the factors affecting mortality and increase in mortality rate by time trends in 30 member countries of the Organization for Economic Co-operation and Development (OECD). These countries have different national health and medical characteristics in terms of health care use, health equipment, health resource, health risk, and health status at different time points. The results revealed that the lower 25% of countries had an increase in the mortality rate of 27.21% which was higher than the upper 25% of countries' increase in the mortality rate of 20.51%. Therefore, the affected countries should strengthen their medical infrastructure to prepare for such large-scale outbreaks in the future. It is imperative to reduce the health inequality between population groups and achieve health equity, regardless of the income gap, rather than vaccination of specific countries. This will require the management of non-communicable diseases, a solid health insurance system, a stable supply of medical supplies, and strengthening the competency of health care workers.

Abbreviations: ANOVA = analysis of variance, COVID-19 = Coronavirus disease-19, CT exams = computed tomography, DTP = child vaccination, GDP = Gross Domestic Product, GNI = Gross National Income, HIV = human immunodeficiency virus, KCDC = Korea Centers for Disease Control and Prevention, MRI = magnetic resonance imaging, OECD = Organization for Economic Co-operation and Development, SARS-CoV-2 = respiratory syndrome coronavirus 2, TB = tuberculosis, WHO = World Health Organization.

Keywords: COVID-19, mortality, OECD, public health

1. Introduction

As of January 2020, the Coronavirus disease-19 (COVID-19) has spread to almost every country in the world.[1] The first COVID-19-related pneumonia patient was reported in Wuhan City, Hubei Province, China in December 2019, and the disease has spread widely to other countries since January 2020.[2] The World Health Organization (WHO) declared the rapidly spreading outbreak, a pandemic, on March 11, 2020, highlighting the seriousness of the disease.[3]

On March 11, 2020, WHO declared the COVID-19 pandemic a global pandemic.[4] As of December 23, 2021, 276,436,619 confirmed cases and 5,374,744 deaths have been reported in 221 countries and territories due to the proliferation of a new variant, Omicron.[5] However, the mortality rate varies greatly across countries according to time trends.

The mortality rate of new infectious diseases and medical resources are related, that is, there is an increase in the rate of mortality in areas with limited medical resources. Therefore, studying this relationship can provide significant insights regarding time and methods to prepare for the outbreak of a new infectious disease in an area with limited resources.[6] Particularly, the inability of existing health care systems to manage COVID-19

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in large populations, the high prevalence of complications in some countries, and the inability to deal with health and economy raise concerns regarding the pandemic.[7,8] For example, in some countries in East Asia, such as Vietnam, Thailand, and the Philippines, the initial increase in reported cases has not come down even after the drastic increase in mortality rate. It is necessary to test strategies, starting with measures, access to health care, and population age structure.[9] The transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) owing to the dense living environment and large households, poor water hygiene and personal hygiene, high prevalence of noncommunicable diseases because of low health care capacity, and increased mortality rates in low-and middle-income countries have led to the spread of COVID-19.[10] Especially, "social distancing," the most effective means to prevent the spread of SARS-CoV-2, cannot be maintained in over-crowded conditions. Moreover, the use of personal hand sanitizers and preservation of water hygiene is not feasible in the above-mentioned low- and middle-income countries.[11] Moreover, health care facilities in these countries are overcrowded with patients who require human immunodeficiency virus (HIV), tuberculosis (TB), malaria, and surgical treatments, making it difficult to accommodate COVID-19 patients.[11]

There is a difference in mortality rate caused by new infectious diseases as per health resources.[12] The Chinese government announced in 2019 that the difficulty in the delivery of medicines, medical personnel, diagnostic test equipment, etc. to the epicenter of the outbreak increased the mortality rate. The Chinese government ordered the prompt delivery of medicines and diagnostic testing equipment and immediately mobilized medical personnel in China to build medical facilities at the epicenter of the outbreak.[12]

In July 2020, the United States reported a COVID-19 mortality rate of 24%.[13] Blumenthal et al.[14] reported that these figures reflect the irrationality of the public health system in the United States and the undermining of health care insurance coverage. Owing to the pandemic, more than 20 million people lost their jobs and 40% of them worried that they or their spouses would not receive benefits from health insurance to self-quarantine or get adequate treatment.[14]

The purpose of this study was to investigate the factors affecting mortality and increase in mortality rate by time trends in 30 member countries of the Organization for Economic Co-operation and Development (OECD). By classifying each factor that affects the increase in mortality rate according to the time trend of each country, the top 25% of countries and the bottom 25% of countries corresponding to each factor were divided and the mortality rate of each country was compared.

Through this comparison of the increase in mortality rate in OECD countries, the factors that affect the COVID-19 mortality rate were compared and analyzed through multidisciplinary approaches which included medical infrastructure, health care economics, medical health policy, and primary care prevention.

2. Method

2.1. Research using data from Korea Centers for Disease Control and Prevention (KCDC) & OECD

This study used data from the KCDC which records the number of COVID-19 confirmed cases and COVID-19 deaths worldwide.[15,16] We extracted data on COVID-19 mortality in 30 OECD countries from KCDC data. The countries included Australia, Austria, Belgium, Canada, China, Denmark, Estonia, France, Germany, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Lithuania, Luxembourg, Mexico, Norway, Poland, Russia, Slovenia, South Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States. About COVID-19 deaths, the OECD data of countries that had complete information regarding the study variables were taken.[17] For cross-country comparisons, we calculated the increase in COVID-19 mortality compared to the previous day. The average mortality rate for 2 weeks was determined according to the health and medical base of the countries. There were a total of 9 periods (1–9). If data mining started on 11 January 2020 and ended on 14 May 2020, then period 1 was 11 January 2020 to 24 January 2020. Similarly, period 2 was 25 January 2020 to 7 February 2020, period 3 was 8 February 2020 to 21 February 2020, period 4 was 22 February 2020 to 6 March 2020, period 5 was 7 March 2020 to 19 March 2020, period 6 was 20 March 2020 to 2 April 2020, period 7 was 3 April 2020 to 16 April 2020, period 8 was 17 April 2020 to 20 April 2020, and period 9 was 1 May 2020 to 14 May 2020 (Table 1).

2.2. Research using variables in OECD data

The variables in the OECD data we used were mainly indicator groups for health topics.[17] These indicator groups include health care use, health equipment, health resources, health risks, and health status. Health care use indicator group variables include doctors' consultations, computed tomography (CT) exams, magnetic resonance imaging (MRI) exams, Caesarean sections, child vaccination (DTP) rate, influenza vaccination rate (≥65), length of hospital stay, and hospital discharge rates. Health equipment indicator group variables include hospital beds, CT scanners, MRI units, mammography machines, and radiotherapy equipment. Health resources indicator group variables include health spending, pharmaceutical spending, doctors, nurses, and medical graduates (the number of students who have graduated from medical school or similar institutions in a given year excluding dental, public health, and epidemiology graduates), and nursing graduates (the number of nursing students who have graduated in a given year and including those from higher-and lower-level nursing programs). Health risk indicator group variables included daily smokers, alcohol consumption, and overweight or obese population. Health status indicator group variables include life expectancy at birth, life expectancy ≥65 for men, life expectancy ≥65 for women, infant mortality rates, potential years of life lost, death from cancer, and suicide rates. The definition of sub-indicators of each main indicator is shown in Table 2.[17]

2.3. Subindicator quantile distribution

The distribution of the quantile of the indicator shows the countries corresponding to the quartiles (25% each) for each subindicator by using a statistical program. This study shows the increase in mortality rates for countries in the Upper 25% and countries in the Lower 25%.

In the case of Health care use, the trial or duration ratio of each sub-indicator was divided into 4 quantiles. In the case of Health equipment, the number of subindicators possessed was divided into 4 sections of quantiles. In the case of Health resources, each subindicator's spending status or human resource holding status was divided into 4 quantiles. In the case of health risks, the number of populations corresponding to health risk behaviors was divided into 4 sections of quantiles. In the case of the last Health status, life expectancy and prevalence of specific sex and age groups were divided into 4 quantiles.

2.4. Ethics statement and data available

Ethical approval was not required for this study on national-wide public data in accordance with the institutional requirements. Written informed consent for participation was not required for this study in accordance with the institutional requirements.

Table 1

Increase mortality rate & increase number of mortality by Organization for Economic Co-operation and Development (OECD) 30 countries.

Country	Period 1 (2020.01.11–2020.01.24)	Period 2 (2020.01.25–2020.02.07)	Period 3 (2020.02.08–2020.02.21)	Period 4 (2020.02.22–2020.03.06)	Period 5 (2020.03.07–2020.03.19)	Period 6 (2020.03.20–2020.04.02)	Period 7 (2020.04.03–2020.04.16)	Period 8 (2020.04.17–2020.04.30)	Period 9 (2020.05.01–2020.05.14)
	Increase mortality rate (mortality n*)	Increase mortality rate (mortality n*)	Increase mortality rate (mortality n*)	Increase mortality rate (mortality n*)	Increase mortality rate (mortality n*)	Increase mortality rate (mortality n*)	Increase mortality rate (mortality n*)	Increase mortality rate (mortality n*)	Increase mortality rate (mortality n*)
Australia				21.43(1–3)[#5]	6.67(3–6)	9.44(6–20)	8.49(21–61)	2.49(63–88)	0.70(90–97)
Austria					25.64(1–4)[#7]	31.50(4–146)	7.37(158–393)	2.68(393–580)	0.53(580–624)
Belgium					26.67(3–14)[#15]	38.32(14–828)	12.87(1011–4,440)	3.58(4857–7501)	1.19(7594–8834)
Canada					7.69(1–1)[#16]	78.36(9–105)	18.43(127–1010)	7.74(1048–2996)	4.19(3082–5301)
China	40.27(1–25)	27.16(41–636)	9.51(722–2236)	2.24(2345–3042)	0.50(3070–3245)	0.16(3248–3318)	0.05(3322–3342)	2.57(3342–4633)	0.00(4633–4633)
Denmark					7.69(1–1)[#17]	48.26(4–90)	9.05(104–299)	2.52(309–434)	1.40(443–527)
Estonia						23.81(1–4)[#22]	18.30(5–31)	3.31(35–50)	1.45(50–61)
France			16.67(1–1)[#1]	17.86(1–6)	37.24(6–244)	22.40(327–4087)	11.30(4503–17,176)	2.29(17920–24,087)	0.84(24376–27,074)
Germany					33.05(2–28)[#8]	28.87(44–920)	10.81(1107–3804)	3.56(4052–6405)	1.48(6623–7861)
Hungary					33.33(1–1)[#9]	33.18(1–16)	16.90(20–134)	5.58(4052–6623)	2.61(312–430)
Iceland						7.14(1–2)[#23]	12.93(2–8)	1.57(4052–6,623)	0.00(10–10)
India					11.54(1–3)[#10]	21.87(3–38)	18.82(38–392)	6.55(142–312)	6.47(174–2415)
Ireland					15.38(1–2[#11]	31.84(2–71)	14.06(85–444)	6.98(486–1190)	1.66(1,32–1497)
Israel						41.47(1–21)[#24]	14.53(21–130)	3.35(142–212)	1.53(219–262)
Italy				48.99(1–148)[#4]	26.41(197–2978)	11.26(3405–13,155)	3.63(13,195–21,645)	1.66(22,170–27,682)	0.84(27,967–31,106)
Japan			14.29(1–1)[#2]	20.48(1–6)	14.03(6–31)	4.50(33–57)	6.47(63–136)	8.22(148–415)	3.69(432–687)
Lithuania						18.93(1–7)[#25]	9.93(8–24)	4.26(29–44)	0.93(45–50)
Luxembourg					7.69(1–1)[#18]	29.30(2–23)	8.39(29–69)	1.72(69–89)	0.99(89–102)
Mexico						30.95(1–28)[#26]	19.68(29–332)	11.34(406–1569)	6.85(1859–3926)
Norway					23.08(1–3)[#19]	19.13(3–28)	11.63(32–127)	2.94(130–195)	0.37(202–228)
Poland					12.82(3–5)[#12]	26.12(5–33)	16.34(43–263)	5.99(286–624)	2.33(644–861)
Russia						27.02(2–17)[#27]	19.56(24–198)	11.31(232–972)	6.09(1073–2212)
Slovenia					7.69(1–1)[#13]	26.40(1–12)	11.93(15–56)	2.95(61–86)	1.23(89–102)
South Korea			50(1–1)[#3]	33.78(2–42)	6.20(44–91)	4.56(94–169)	2.20(174–229)	0.51(230–247)	0.37(247–260)
Spain					64.48(5–598)[#20]	21.64(767–9053)	5.29(10,003–18,579)	1.80(19,130–24,275)	0.79(24,275–27,104)
Sweden						62.69(10–180)[#28]	14.79(239–1203)	4.96(1333–2462)	2.47(2462–3460)
Swiss					35.97(1–21)[#14]	23.91(33–378)	7.06(432–973)	2.51(1017–1408)	0.75(1408–1564)
Turkey						63.01(1–277)[#29]	13.05(356–1518)	4.86(1643–3081)	1.80(3081–3952)
UK					59.8(2–60)[#21]	32.44(144–2,352)	13.05(2921–12,868)	4.92(13,729–26,097)	1.73(26,097–33,186)
USA				48.81(1–11)[#6]	21.30(12–118)	30.44(176–4757)	13.69(5850–28,326)	5.30(32,186–60,853)	2.34(62,870–84,059)

Descriptive by Period 1–9

Increase mortality Rate: Its value was interval 2 weeks average mortality rate by Period. And mortality rate calculation formula = (on the day-before day)/before day*100.

*Mortality n: It values were the real number of deaths from COVID-19 and left value was the period start deaths count and the right value was the period end deaths count.

#1 France was start day 2020.02.16/ #2 Japan was start day 2020.02.15/ #3 South Korea was start day 2020.02/ #4 Italy was start day 2020.02.23/ #5 Australia was start day 2020.03.04/ #6 USA was start day 2020.03.01/ #7 Austria was start day 2020.03.15/ #8 Germany was start day 2020.03.10/ #9 Hungary was start day 2020.03.10/ #10 India was start day 2020.03.14/ #11 Ireland was start day 2020.03.14/ #12 Poland was start day 2020.03.16/ #13 Slovenia was start day 2020.03.19/ #14 Swiss was start day 2020.03.08 #15 Belgium was start day 2020.03.14/ #16 Canada was start day 2020.03.12/ #17 Denmark was start day 2020.03.17/ # 18 Luxembourg was start day 2020.0315/ #19 Norway was start day 2020.03.15/ #20 Spain was start day 2020.03.08/ #21 UK was start day 2020.03.08/ #22 Estonia was start day 2020.03.27/ #23 Iceland was start day 2020.03.25/ #24 Israel was start day 2020.0324/ #25 Lithuania was start day 2020.03.25/ #26 Mexico was start day 2020.03.22/ #28 Russia was start day 2020.03.27/ #29 Turkey was start day 2020.03.20.

Table 2

Indicator and subindicator classification and subindicator definition.

Indicator[17]	Subindicator[17]	Definition[17]
Health care use	Doctors' consultations	This indicator presents data on the number of consultations patients have with doctors each year. There are variations across countries in the coverage of different types of consultations, notably in outpatient departments of hospitals. The data come from administrative sources or surveys, depending on the country. This indicator is measured per capita.
	Computed tomography (CT) exams	Computed tomography (CT) exams help physicians diagnose a range of conditions by producing images of internal organs and structures of the body. The indicator is presented as a total and broken down between hospitals and ambulatory care providers. It is measured per 1 000 inhabitants.
	Magnetic resonance imaging (MRI) exams	Magnetic resonance imaging (MRI) exams help physicians diagnose a range of conditions by producing images of internal organs and structures of the body. The indicator is presented as a total and broken down between hospitals and ambulatory care providers. It is measured per 1 000 inhabitants.
	Caesarean sections	This indicator shows the rate of caesarean sections per 1000 live births. This indicator is measured per 1000 live births.
	Child vaccination (DTP) rate	All Organization for Economic Co-operation and Development (OECD) countries have established vaccination programs based on their interpretation of the risks and benefits of each vaccine. This indicator is presented for measles and for diphtheria, tetanus, and pertussis. It is measured as a percentage of children at around age 1.
	Influenza vaccination rate (≥65)	Influenza vaccination rate refers to the number of people aged 65 and older who have received an annual influenza vaccination, divided by the total number of people over 65 years of age. This indicator is measured as a percentage of the population aged 65 and older who have received an annual influenza vaccine. The data come from administrative sources or surveys, depending on the country.
	Length of hospital stay	The average length of stay in hospitals (ALOS) is often used as an indicator of efficiency. The indicator is presented both for all acute care cases and for childbirth without complications.
	Hospital discharge rates	Hospital discharge rates measure the number of patients who leave a hospital after receiving care. This indicator is measured per 100,000 inhabitants.
Health equipment	Hospital beds	This indicator provides a measure of the resources available for delivering services to inpatients in hospitals in terms of the number of beds that are maintained, staffed, and immediately available for use. The indicator is presented as a total for curative care and psychiatric care. It is measured in the number of beds per 1000.
	Computed tomography (CT) scanners	A computed tomography (CT) scanner is an x-ray machine that combines many x-ray images with the aid of a computer to generate cross-sectional views and, if needed, 3-dimensional images of the internal organs and structures of the body. This indicator is measured in the number of equipment per 1,000,000 inhabitants. It is presented as a total and broken down between hospitals (primarily inpatient facilities) and ambulatory care providers (primarily outpatient facilities).
	Magnetic resonance imaging (MRI) units	MRI units help physicians diagnose a range of conditions by producing images of internal organs and structures of the body. This indicator is measured in the number of equipment per 1,000,000 inhabitants. It is presented as a total and broken down between hospitals (primarily inpatient facilities) and ambulatory care providers (primarily outpatient facilities).
	Mammography machines	Most OECD countries have adopted breast cancer screening programs as an effective way for detecting the disease early, using tools such as mammography machines. This indicator shows the number of dedicated mammography machines (those designed exclusively for taking mammograms) available in OECD countries. The indicator is presented as a total and broken down between hospitals (primarily inpatient facilities) and ambulatory care providers (primarily outpatient facilities). It is measured per 1,000,000 inhabitants.
	Radiotherapy equipment	This indicator presents the number of machines used for treatment with x-rays or radionuclide. The indicator is presented as a total and broken down between hospitals (primarily inpatient facilities) and ambulatory care providers (primarily outpatient facilities). It is measured per 1,000,000 inhabitants.
Health resources	Health spending	Health spending measures the final consumption of health care goods and services (i.e. current health expenditure) including personal health care (curative care, rehabilitative care, long-term care, ancillary services, and medical goods) and collective services (prevention and public health services as well as health administration), but excluding spending on investments. This indicator is presented as a total and by type of financing ("Government/compulsory", "Voluntary", "Out-of-pocket") and is measured as a share of Gross Domestic Product (GDP), as a share of total health spending, and in US Dollar per capita (using economy-wide Purchasing power parity).
	Pharmaceutical spending	Pharmaceutical spending covers expenditure on prescription medicines and self-medication often referred to as over-the-counter products. This indicator is measured as a share of total health spending, in US Dollars per capita (using economy-wide Purchasing power parity) and as a share of GDP.
	Doctors	Doctors are defined as "practicing" doctors providing direct care to patients. This indicator is measured per 1000 inhabitants.
	Nurses	Nurses are defined as all the "practicing" nurses providing direct health services to patients, including self-employed nurses. This indicator is measured per 1000 inhabitants.
	Medical graduates	This indicator presents the number of medical graduates each year. This indicator is measured per 100,000 inhabitants.
	Nursing graduates	This indicator presents the number of nursing graduates each year. This indicator is measured per 100,000 inhabitants.
Health risks	Daily smokers	Daily smokers are defined as the population aged 15 years and over who are reporting to smoke every day. This indicator is presented as a total and per gender and is measured as a percentage of the population considered (total, men, or women) aged 15 years and over.
	Alcohol consumption	Alcohol consumption is defined as annual sales of pure alcohol in liters per person aged 15 years and older. This indicator is measured in liters per capita (people aged 15 years and older).
	Overweight or obese	The overweight or obese population is defined as the inhabitants with excessive weight presenting health risks because of the high proportion of body fat. This indicator is presented both for "self-reported" data (estimates of height and weight from population-based health interview surveys) and "measured" data (precise estimates of height and weight from health examinations) and is measured as a percentage of the population aged 15 years and older.

(*Continued*)

Table 2
(Continued)

Indicator[17]	Subindicator[17]	Definition[17]
Health status	Life expectancy at birth	Life expectancy at birth is defined as how long, on average, a newborn can expect to live, if current death rates do not change. This indicator is presented as a total and per gender and is measured in years.
	Life expectancy ≥65 for men	Life expectancy at age 65 years old for men is the average number of years that a person at that age can be expected to live, assuming that age-specific mortality levels remain constant. This indicator is presented by gender and is measured in years.
	Life expectancy ≥65 for women	Life expectancy at age 65 years old for women is the average number of years that a person at that age can be expected to live, assuming that age-specific mortality levels remain constant. This indicator is presented by gender and is measured in years.
	Infant mortality rates	The infant mortality rate is defined as the number of deaths of children under 1 year of age, expressed per 1000 live births. This indicator is measured in terms of deaths per 1000 live births.
	Potential years of life lost	This indicator is a summary measure of premature mortality, providing an explicit way of weighting deaths occurring at younger ages, which may be preventable. This indicator is presented as a total and per gender. It is measured in years lost per 100,000 inhabitants (total), per 100,000 men and per 100,000 women, aged 0–69.
	Death from cancer	This indicator presents data on deaths from cancer. There are more than 100 different types of cancers. This indicator is presented as a total and by gender. Cancer mortality is measured per 100,000 inhabitants (total), 100,000 men, and per 100,000 women.
	Suicide rates	Suicide rates are defined as the deaths deliberately initiated and performed by a person in the full knowledge or expectation of its fatal outcome. This indicator is presented as a total and per gender and is measured in terms of deaths per 100,000 inhabitants (total), per 100,000 men, and per 100,000 women.

2.5. Statistical analysis

We used the open-source statistical software R version 3.6.2 for all statistical analyses. To understand COVID-19 mortality and the increase in mortality rate by country, a descriptive analysis was conducted for periods 1 to 9. Another analysis was also conducted by viewpoint, which is the total number of deaths in 8 weeks, 2 weeks apart by country. To understand the increase in COVID-19 mortality rate by country and viewpoints 1–4, we used R packages "meta," "d-meta," functions "meta-mean," "subgroup-analysis-mixed effects," and meta-analysis of variance (ANOVA) subgroup analysis. We used meta-ANOVA subgroup analysis to split variables into the indicator groups, including health care use, health equipment, health resources, health risks, and health status, and variables split upper 25% and lower 25% by 30 countries' infra status variables. Originally, a meta-analysis combines multiple studies and concludes. However, we used a meta-analysis for this study, considering each country as 1 case for this study. The 2-week average increase in mortality was calculated as the mean value and standard deviation from the daily increase in mortality rate, and the n value was population by country.

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3. Results

3.1. Increase mortality rate and increase number of mortality by OECD 30 countries (periods 1 to 9)

Period 1 (11 January 2020 to 24 January 2020) showed an increase in the mortality rate of 40.27% (mortality=1 to 25) in China.

Period 2 (25 January 2020 to 7 February 2020) showed an increase in the mortality rate of 27.16% (mortality=41 to 636) in China.

Period 3 (8 February 2020 to 21 February 2020) showed an increase in mortality rate of 9.51% (mortality=722 to 2236) in China, 16.67% (mortality=1 to 1) in France, 14.29% (mortality=1 to 1) in Japan, and 50.00% (mortality=1 to 1) in South Korea.

Period 4 (22 February 2020 to 6 March 2020) showed an increase in mortality rate of 2.24% (mortality=2345 to 3042) in China, 17.86% (mortality=1 to 6) in France, 20.48% (mortality=1 to 6) in Japan, 33.78% (mortality=2 to 42) in South Korea, 48.99% (mortality=1 to 148) in Italy, 21.43% (mortality=1 to 3) in Australia, and 48.81% (mortality=1 to 11) in the United States.

Period 5 (7 March 2020 to 19 March 2020) showed an increase in mortality rate of 0.50% (mortality=3070 to 3245) in China, 37.24% (mortality=6 to 244) in France, 14.03% (mortality=6 to 31) in Japan, 6.20% (mortality=44 to 91) in South Korea, 26.41% (mortality=197 to 2978) in Italy, 6.67% (mortality=3 to 6) in Australia, 21.30% (mortality=12 to 118) in the United States, 25.64% (mortality=1 to 4) in Austria, 33.05% (mortality=2 to 28) in Germany, 33.33% (mortality=1 to 1) in Hungary, 11.54% (mortality=1 to 3) in India, 15.38% (mortality=1 to 2) in Ireland, 12.82% (mortality=3 to 5) in Poland, 7.69% (mortality=1 to 1) in Slovenia, 35.97% (mortality=1 to 21) in Switzerland, 26.67% (mortality=3 to 14) in Belgium, 7.69% (mortality=1 to 1) in Canada, 7.69% (mortality=1 to 1) in Denmark, 7.69% (mortality=1 to 1) in Luxembourg, 23.08% (mortality=1 to 3) in Norway, 64.48% (mortality=5 to 598) in Spain, and 59.8% (mortality=2 to 60) in the United Kingdom.

Period 6 (20 March 2020 to 2 April 2020) showed an increase in mortality rate of 0.16% (mortality=3248 to 3318) in China, 22.40% (mortality=327 to 4087) in France, 4.50% (mortality=33 to 57) in Japan, 4.56% (mortality=94 to 169) in South Korea, 11.26% (mortality=3405 to 13,155) in Italy, 9.44% (mortality=6 to 20) in Australia, 30.44% (mortality=176 to

4757) in the United States, 31.50% (mortality=4 to 146) in Austria, 28.87% (mortality=44 to 920) in Germany, 33.18% (mortality=1 to 16) in Hungary, 21.87% (mortality=3 to 38) in India, 31.84% (mortality=2 to 71) in Ireland, 26.12% (mortality=5 to 33) in Poland, 26.40% (mortality=1 to 12) in Slovenia, 23.91% (mortality=33 to 378) in Switzerland, 38.32% (mortality=14 to 828) in Belgium, 78.36% (mortality=9 to 105) in Canada, 48.26% (mortality=4 to 90) in Denmark, 29.30% (mortality=2 to 23) in Luxembourg, 19.13% (mortality=3 to 28) in Norway, 21.64% (mortality=767 to 9053) in Spain, 32.44% (mortality=144 to 2,352) in the United Kingdom, 23.81% (mortality=1 to 4) in Estonia, 7.14% (mortality=1 to 2) in Iceland, 41.47% (mortality=1 to 21) in Israel, 18.93% (mortality=1 to 7) in Lithuania, 30.95% (mortality=1 to 28) in Mexico, 27.02% (mortality=12 to 17) in Russia, 62.69% (mortality=10 to 180) in Sweden, and 63.01% (mortality=1 to 277) in Turkey.

Period 7 (3 April 2020 to 16 April 2020) showed an increase in mortality rate of 0.05% (mortality=3322 to 3342) in China, 11.30% (mortality=4503 to 17,176) in France, 6.47 (mortality=63 to 136) in Japan, 2.20% (mortality=174 to 229) in South Korea, 3.63% (mortality=13,195 to 21,645) in Italy, 8.49% (mortality=21 to 61) in Australia, 13.69% (mortality=5850 to 28,326) in the United States, 7.37% (mortality=158 to 393) in Austria, 10.81% (mortality=1107 to 3804) in Germany, 16.90% (mortality=20 to 134) in Hungary, 18.82% (mortality=38 to 392) in India, 14.06% (mortality=85 to 444) in Ireland, 16.34% (mortality=43 to 263) in Poland, 11.93% (mortality=15 to 56) in Slovenia, 7.06% (mortality=432 to 973) in Switzerland, 12.87% (mortality=1011 to 4440) in Belgium, 18.43% (mortality=127 to 1010) in Canada, 9.05% (mortality=104 to 299) in Denmark, 8.39% (mortality=29 to 69) in Luxembourg, 11.63% (mortality=32 to 127) in Norway, 5.29% (mortality=10,003 to 18,579) in Spain, 13.05% (mortality=2921 to 12,868) in the United Kingdom, 18.30% (mortality=5 to 31) in Estonia, 12.93% (mortality=2 to 8) in Iceland, 14.53%(mortality=21 to 130) in Israel, 9.93% (mortality=8 to 24) in Lithuania, 19.68% (mortality=29 to 332) in Mexico, 19.56% (mortality=24 to 198) in Russia, 14.79% (mortality=239 to 1203) in Sweden, and 13.05% (mortality=356 to 1518) in Turkey.

Period 8 (17 April 2020 to 30 April 2020) showed an increase in mortality rate of 2.57% (mortality=3342 to 4633) in China, 2.29% (mortality=17,920 to 24,087) in France, 8.22% (mortality=148 to 415) in Japan, 0.51% (mortality=230 to 247) in South Korea, 1.66% (mortality=22,170 to 27,682) in Italy, 2.49% (mortality=63 to 88) in Australia, 5.30% (mortality=32,186 to 60,853) in the United States, 2.68% (mortality=393 to 580) in Austria, 3.56% (mortality=4052 to 6405) in Germany, 5.58% (mortality=4052 to 6623) in Hungary, 6.55% (mortality=142 to 312) in India, 6.98% (mortality=486 to 1190) in Ireland, 5.99% (mortality=286 to 624) in Poland, 2.95% (mortality=61 to 86) in Slovenia, 2.51% (mortality=1017 to 1408) in Switzerland, 3.58% (mortality=4857 to 7501) in Belgium, 7.74% (mortality=1,048 to 2,996) in Canada, 2.52% (mortality=309 to 434) in Denmark, 1.72% (mortality=69 to 89) in Luxembourg, 2.94% (mortality=130 to 195) in Norway, 1.80% (mortality=19,130 to 24,275) in Spain, 4.92% (mortality=13,729 to 26,097) in the United Kingdom, 3.31% (mortality=35 to 50) in Estonia, 1.57% (mortality=4052 to 6623) in Iceland, 4.26% (mortality=29 to 44) in Lithuania, 11.34% (mortality=406 to 1569) in Mexico, 11.31% (mortality=232 to 972) in Russia, 3.35% (mortality=142 to 212) in Israel, 4.96% (mortality=1333 to 2462) in Sweden, and 4.86% (mortality=1643 to 3081) in Turkey.

Period 9 (1 May 2020 to 14 May 2020) showed an increase in mortality rate of 0.00% (mortality=4633 to 4633) in China, 0.84% (mortality=24,376 to 27,074) in France, 3.69% (mortality=432 to 687) in Japan, 0.37% (mortality=247 to 260) in South Korea, 0.84% (mortality=27,967 to 31,106) in Italy, 0.70% (mortality=90 to 97) in Australia, 2.34% (mortality=62,870 to 84,059) in the United States, 0.53% (mortality=580 to 624) in Austria, 1.48% (mortality=6623 to 7861) in Germany, 2.61% (mortality=312 to 430) in Hungary, 6.47% (mortality=1074 to 2415) in India, 1.66% (mortality=1232 to 1497) in Ireland, 2.33% (mortality=644 to 861) in Poland, 1.23% (mortality=89 to 102) in Slovenia, 0.75% (mortality=1408 to 1564) in Switzerland, 1.19% (mortality=7594 to 8834) in Belgium, 4.19% (mortality=3082 to 5301) in Canada, 1.40% (mortality=443 to 527) in Denmark, 0.99% (mortality=89 to 102) in Luxembourg, 0.37% (mortality=202 to 228) in Norway, 1.53% (mortality=219 to 262) in Israel, 0.79% (mortality=24,275 to 27,104) in Spain, 1.73% (mortality=26,097 to 33,186) in the United Kingdom, 1.45% (mortality=50 to 61) in Estonia, 0.00% (mortality=10 to 10) in Iceland, 0.93% (mortality=45 to 50) in Lithuania, 6.85% (mortality=1859 to 3926) in Mexico, 6.09% (mortality=1073 to 2212) in Russia, 2.47% (mortality=2462 to 3460) in Sweden, and 1.80% (mortality=3081 to 3952) in Turkey (Table 1).

3.2. Increase in Mortality Rate According to Health Care Use (Upper 25% and Lower 25%) by 30 OECD Countries (Viewpoints 1 to 4) (Table 3)

3.2.1, Doctors' consultations in health care use. Countries that fall in the upper 25% with regard to the indicator of doctors' consultations include Australia, Germany, Hungary, Japan, Lithuania, Russia, South Korea, and Turkey. The lower 25% of countries include China, Denmark, India, Mexico, Norway, Sweden, and Switzerland. By viewpoint 2, the lower 25% of countries had an increase in the mortality rate of 27.21% and the upper 25% had an increase in the mortality rate of 20.51%. It is significant (P = .023).

3.2.2. CT exams in health care use. In the CT exam, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

3.2.3. MRI exams in health care use. In the MRI exam, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

3.2.4. Caesarean sections. In Caesarean sections, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

3.2.5. Child vaccination (DTP) rate. In the Child vaccination rate, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

3.2.6. Influenza vaccination rate (≥65 years) in health care use. Countries that fall in the upper 25% with regard to the influenza vaccination rate (≥65 years) include Australia, Belgium, Canada, Israel, Mexico, South Korea, and the United Kingdom. The lower 25% of countries include China, Estonia, India, Lithuania, Poland, Russia, Slovenia, and Turkey. From viewpoint 2, the upper 25% of countries had an increase in the mortality rate of 28.78%, and the lower 25% of countries had an increase in the mortality rate of 20.13%. It is significant (P = .005).

3.2.7. Length of hospital stay. In length of hospital stay, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

3.2.8. Hospital discharge rates. In Hospital discharge rates, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

Table 3

Increase in mortality rate according to health care use during viewpoint.

Variable	Viewpoint 1		Viewpoint 2		Viewpoint 3		Viewpoint 4	
	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]
Doctor's consultations								
Upper 25%	32.66	23.58, 41.74	20.51	15.45, 25.56	9.72	7.06, 12.38	4.44	2.95, 5.93
Lower 25%	24.92	9.96, 39.89	27.21	24.40, 30.20	14.08	7.30, 20.86	4.08	1.90, 6.27
Between groups *P*	.612		.023		.241		.583	
CT exams								
Upper 25%	26.72	12.68, 40.76	23.55	18.78, 28.31	14.45	4.97, 23.94	6.43	3.34, 9.51
Lower 25%	28.71	15.58, 41.83	28.20	25.42, 30.99	11.96	8.51, 15.41	4.51	2.58, 6.44
Between groups *P*	.936		.098		.628		.235	
MRI exams								
Upper 25%	18.00	9.94, 26.05	24.64	20.55, 28.73	15.04	6.54, 23.53	6.25	2.92, 9.58
Lower 25%	31.98	20.75, 43.20	26.54	22.92, 30.16	11.25	8.52, 13.99	4.41	3.21, 5.60
Between groups *P*	.176		.496		.406		.209	
Caesarean sections								
Upper 25%	35.74	23.92, 47.56	26.72	19.65, 33.78	10.23	7.63, 12.83	6.25	2.92, 9.58
Lower 25%	24.40	11.63, 37.16	20.31	17.34, 23.29	13.87	7.86, 19.88	4.41	3.21, 5.60
Between groups *P*	.338		.102		.275		.209	
Child vaccination (DTP) rate								
Upper 25%	30.59	17.74, 43.44	27.90	22.75, 33.04	10.18	7.89, 12.47	3.39	2.42, 4.36
Lower 25%	22.13	12.49, 31.76	23.24	21.65, 24.83	9.15	3.82, 14.49	3.87	1.66, 6.08
Between groups *P*	.302		.090		.728		.697	
Influenza vaccination rate (≥65 y)								
Upper 25%	32.07	19.69, 44.44	28.78	25.03, 32.54	13.14	4.40, 21.88	5.38	3.51, 7.25
Lower 25%	25.68	12.85, 38.51	20.13	15.49, 24.78	10.05	6.62, 13.47	3.50	2.11, 4.89
Between groups *P*	.337		.005		.518		.152	
Length of hospital stay								
Upper 25%	24.75	14.64, 34.87	30.42	26.15, 34.68	15.26	12.65, 17.87	7.24	5.01, 9.46
Lower 25%	31.67	19.66, 43.68	24.79	21.00, 28.59	11.77	7.04, 16.50	4.10	2.90,.30
Between groups *P*	.269		.053		.205		.097	
Hospital discharge rates								
Upper 25%	25.41	19.39, 31.43	23.69	19.25, 28.13	13.85	11.60, 16.09	6.22	3.44, 8.99
Lower 25%	32.37	19.07, 45.67	28.47	25.67, 31.27	11.18	7.87, 14.50	4.82	3.11, 6.52
Between groups *P*	.351		.074		.192		.400	

Meta-analysis of variance (ANOVA) subgroup analysis by viewpoint 1–4. Viewpoint 1–4: 8 weeks from the time of mortality in each country. Between groups *P*: Difference between groups *P*-value.
CI = confidence interval, CT = computed tomography, MRI = magnetic resonance imaging.

3.3. Increase in mortality rate according to health equipment (upper 25% and lower 25%) by 30 OECD countries (viewpoints 1 to 4) (Table 4)

3.3.1. Hospital Beds in Health Equipment. Countries that fall in the upper 25% with regard to hospital beds include Austria, Germany, Hungary, Japan, Lithuania, Poland, Russia, and South Korea. The lower 25% of countries include Canada, Denmark, India, Mexico, Sweden, Turkey, and the United Kingdom. By viewpoint 2, the lower 25% of countries had an increase in the mortality rate of 33.52% and the upper 25% had an increase in the mortality rate of 25.30%. It is significant (P = .007).

3.3.2. CT scanners in health equipment. There was no significant difference in mortality rates according to the status of CT scanner possession among countries by quartile.

3.3.3. MRI units in health equipment. There was no significant difference in mortality rates according to the status of MRI unit possession among countries by quartile

3.3.4. Mammography machine in health equipment. There was no significant difference in mortality rates according to the status of Mammography machine possession among countries by quartile

3.3.5 Radiotherapy equipment in health equipment. There was no significant difference in mortality rates according to the status of radiotherapy equipment possession among countries by quartile

3.4. Increase in Mortality Rate According to Health Resources (Upper 25% and Lower 25%) by 30 OECD Countries (Viewpoints 1 to 4) (Table 5)

3.4.1 Health spending in health resources. Countries that fall in the upper 25% with regard to health spending include Austria, Denmark, Germany, Luxembourg, Norway, Sweden, and Switzerland. The lower 25% of countries include China, Estonia, Hungary, India, Mexico, Poland, Russia, and Turkey. By viewpoint 2, the upper 25% had an increase in the mortality rate of 31.39%, and the lower 25% had an increase in the mortality rate of 22.19%. It is significant (P = .002).

3.4.2. Pharmaceutical spending in health resources. Countries that fall in the upper 25% with regard to pharmaceutical spending include Australia, Belgium, Canada, Germany, Japan, South Korea, and Switzerland. The lower 25% of countries include China, Denmark, Estonia, India, Israel, Mexico, Poland, and Turkey. By viewpoint 2, the upper 25% country had an increase in the mortality rate of 30.36%, and the lower 25% of countries had an increase in the mortality rate of 23.10%. It is significant (P = .038).

3.4.3. Number of doctors in health resources. Countries that fall in the upper 25% with regard to the number of doctors include Austria, Denmark, Germany, Lithuania, Norway, Russia, Sweden, and Switzerland. The lower 25% of countries include China, India, Japan, Mexico, Poland, South Korea, Turkey, and the United States.

Table 4

Increase in mortality rate according to health equipment during viewpoint.

	Viewpoint 1		Viewpoint 2		Viewpoint 3		Viewpoint 4	
Variable	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]
Hospital beds								
Upper 25%	26.88	19.44, 34.33	25.30	20.60, 30.01	10.90	8.69, 13.11	4.24	3.29, 5.18
Lower 25%	27.91	14.61, 41.21	33.52	24.19, 29.41	15.10	7.19, 23.01	5.05	2.64, 7.45
Between groups *P*	.600		.007		.316		.212	
CT scanners								
Upper 25%	24.45	13.98, 34.92	24.50	19.49, 29.52	11.08	2.30, 19.86	4.35	3.51, 5.19
Lower 25%	30.37	16.29, 44.45	29.72	26.67, 32.76	13.61	9.80, 17.43	4.70	2.65, 6.76
Between groups *P*	.751		.082		.604		.642	
MRI units								
Upper 25%	35.03	24.04, 49.50	25.54	22.70, 28.38	10.88	3.42, 18.34	3.46	2.45, 4.46
Lower 25%	28.84	17.56, 31.97	28.46	25.48, 31.45	12.86	8.82, 16.90	4.40	2.35, 6.45
Between groups *P*	.409		.163		.406		.769	
Mammography machine								
Upper 25%	29.14	15.93, 42.35	29.16	22.47, 35.86	13.03	4.80, 21.26	4.86	4.09, 5.64
Lower 25%	27.41	15.34, 39.48	23.95	21.09, 26.81	14.45	11.27, 17.64	5.98	4.03, 7.93
Between groups *P*	.646		.161		.751		.997	
Radiotherapy equipment								
Upper 25%	16.15	6.08, 26.21	29.16	22.47, 35.86	11.86	2.11, 21.60	4.52	2.89, 6.16
Lower 25%	26.17	14.66, 37.67	23.95	21.09, 26.81	15.41	12.18, 18.64	6.78	4.65, 8.91
Between groups *P*	.563		.161		.497		.742	

Meta-analysis of variance (ANOVA) subgroup analysis by viewpoint 1–4. Viewpoint 1–4: 8 weeks from the time of mortality in each country. Between groups *P*: Difference between groups *P* value.
CI = confidence interval, CT = computed tomography, MRI = magnetic resonance imaging.

Table 5

Increase in mortality rate according to health resources during viewpoint.

	Viewpoint 1		Viewpoint 2		Viewpoint 3		Viewpoint 4	
Variable	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]
Health spending								
Upper 25%	22.34	12.21, 32.48	31.39	27.39, 35.40	10.90	8.69, 13.11	2.99	2.43, 3.56
Lower 25%	30.39	18.19, 42.59	22.19	17.97, 26.42	15.10	7.19, 23.01	4.57	3.16, 5.99
Between groups *P*	.600		.002		.316		.913	
Pharmaceutical spending								
Upper 25%	27.00	16.66, 37.34	30.36	25.29, 35.43	13.66	5.07, 22.25	4.98	4.16, 5.81
Lower 25%	28.93	15.94, 41.92	23.10	22.43, 27.46	9.58	5.93, 13.22	3.62	2.25, 4.99
Between groups *P*	.926		.038		.391		.183	
Doctors								
Upper 25%	24.58	19.25, 29.91	29.01	24.27, 33.75	9.54	8.09, 10.99	3.27	2.00, 4.55
Lower 25%	31.82	18.72, 44.92	22.91	18364, 27.18	13.94	8.37, 19.52	4.64	3.17, 6.11
Between groups *P*	.174		.061		.134		.025	
Nurses								
Upper 25%	21.18	14.36, 28.00	21.79	16.73, 26.84	11.68	2.55, 20.81	4.35	3.10, 5.61
Lower 25%	36.10	22.74, 49.47	20.31	16.00, 24.62	9.11	5.69, 12.52	3.53	2.24, 4.82
Between groups *P*	.146		.664		.605		.389	
Medical graduates								
Upper 25%	14.24	8.78, 19.71	31.51	19.40, 43.61	10.23	7.43, 13.03	4.74	2.87, 6.61
Lower 25%	27.49	17.86, 42.50	23.04	20.19, 25.89	12.76	696, 18.57	3.89	1.86, 5.91
Between groups *P*	.201		.182		.441		.810	
Nursing graduates								
Upper 25%	28.51	21.18, 35.85	23.62	17.32, 29.92	9.65	7.34, 11.96	4.82	3.58, 6.06
Lower 25%	31.74	17.29, 46.20	24.81	20.18, 29.44	10.41	6.98, 13.85	3.59	2.27, 4.91
Between groups *P*	.696		.765		.718		.182	

Meta-analysis of variance (ANOVA) subgroup analysis by viewpoint 1–4. Viewpoint 1–4: 8 weeks from the time of mortality in each country. Between groups *P*: Difference between groups *P* value.
CI = confidence interval.

By viewpoint 4, the upper 25% had an increase in the mortality rate of 3.27%, and the lower 25% of countries had an increase in the mortality rate of 4.64%. It is significant ($P = .25$).

3.4.4. Number of nurses in health resources. The number of Nurses among Health Resources does not have a significant difference in the mortality rates of countries by quartile.

3.4.5. Number of medical graduates in health resources. The number of medical graduates among Health Resources does not have a significant difference in the mortality rates of countries by quartile.

3.4.6. Number of nursing graduates in health resources The number of nursing graduates among Health Resources does not

have a significant difference in the mortality rates of countries by quartile.

3.5. Increase in mortality rate according to health risk (upper 25% and lower 25%) by 30 OECD countries (viewpoints 1 to 4) (Table 6)

3.5.1. Daily smokers in health risk. Daily smokers in health risk were not significant difference among these countries($P > .05$).

3.5.2. Alcohol consumption in health risk. Alcohol consumption in Health risk was not significant difference among these countries($P > .05$).

3.5.3. Overweight or obese population in health risk Overweight or obese populations in Health risk were not significant difference among these countries($P > .05$).

3.6. Increase in mortality rate according to health status (upper 25% and lower 25%) by 30 OECD countries (viewpoints 1 to 4) (Table 7)

3.6.1. Life expectancy at birth in health status. In Life Expectancy at birth, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

3.6.2. Life expectancy of men in health status. In Life Expectancy of Men, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

3.6.3. Life expectancy of women in health status. Countries that fall in the upper 25% with regard to the life expectancy of women ≥65 include Australia, Canada, France, Italy, Japan, South Korea, Spain, and Switzerland. The lower 25% of countries include China, Hungary, India, Lithuania, Mexico, Poland, Russia, and Turkey. By viewpoint 2, the upper 25% of countries had an increase in the mortality rate of 27.17% and the lower 25% had an increase in the mortality rate of 21.07%. It is significant ($P = .048$) (Table 7).

By viewpoint 4, the upper 25% of countries had an increase in the mortality rate of 6.95%, and the lower 25% of countries had an increase in the mortality rate of 4.50%. It is significant ($P = .039$).

3.6.4 Infant mortality rates in health status. Countries that fall in the upper 25% with regard to infant mortality rates include Canada, China, India Mexico, Poland, Russia, and Turkey. The lower 25% of countries include Estonia, Iceland, Italy, Japan, Norway, Slovenia, Spain, and Sweden. By viewpoint 4, the upper 25% of countries had an increase in the mortality rate of 5.32%, and the lower 25% of countries had an increase in the mortality rate of 3.18%. It is significant ($P = .003$) (Table 7).

3.6.5. Potential years of life lost in health status. In potential years of life lost, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

3.6.6. Mortality from cancers in health status. In mortality from cancers, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

3.6.7. Suicide rates in health status. In suicide rates, there was no significant difference in mortality between the upper 25% and lower 25% of countries according to the viewpoint.

4. Discussion

This research was based on the fact that OECD countries have different COVID-19 mortality rates. This could be because the OECD countries have different health and medical characteristics (health care use, health equipment, health, resource, health risk, and health status).

Table 3 shows the health care use variable doctors' consultations; the lower 25% of countries had an increase in the mortality rate of 27.21% which was higher than the upper 25% countries' increase in the mortality rate of 20.51% by viewpoint 2. There were significant differences between the countries ($P = .023$). On ordinary days, doctor's consultations were highly frequent in OECD countries and the upper 25% of countries include Australia, Germany, Hungary, Japan, Lithuania, Russia, South Korea, and Turkey. The upper 25% of the OECD countries had spent sufficient time and experienced good or fair (partially poor) quality medical service with regard to doctors' consultations than the lower 25% countries.[18] As the patients in the upper 25% of countries received good quality medical service, their increase in mortality rate was lower than the lower 25% of countries. This finding is very significant for national COVID-19 death control. The health care use variable, influenza vaccination rate (≥65 years) was significant ($P = .005$)

Table 6

Increase in mortality rate according to health risk during viewpoint.

	Viewpoint 1		Viewpoint 2		Viewpoint 3		Viewpoint 4	
Variable	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]
Daily smokers								
Upper 25%	35.41	25.36, 45.46	23.60	18.48, 28.71	13.52	11.35, 15.68	6.07	5.19, 6.94
Lower 25%	17.15	7.99, 26.32	24.26	22.01, 26.51	14.57	8.63, 20.51	6.26	5.55, 6.97
Between groups *P*	.061		.815		.744		.425	
Alcohol consumption								
Upper 25%	22.53	17.35, 27.71	24.90	20.22, 29.58	13.78	11.69, 15.87	6.24	3.12, 9.37
Lower 25%	32.05	18.68, 45.42	23.54	18.95, 28.13	11.04	7.43, 14.65	3.92	2.56, 5.28
Between groups *P*	.193		.684		.199		.182	
Overweight or obese population								
Upper 25%	31.47	20.93, 42.01	21.50	17.58, 25.42	12.71	3.08, 22.34	5.77	3.16, 8.38
Lower 25%	31.24	18.12, 44.36	25.55	23.08, 28.03	10.73	7.36, 14.11	3.70	2.00, 5.40
Between groups *P*	.765		.087		704		.224	

Meta-analysis of variance (ANOVA) subgroup analysis by viewpoint 1–4. Viewpoint 1–4: 8 weeks from the time of mortality in each country. Between groups *P*: Difference between groups *P* value.
CI = confidence interval.

Table 7

Increase in mortality rate according to health status during viewpoint

Variable	Viewpoint 1		Viewpoint 2		Viewpoint 3		Viewpoint 4	
	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]	Increase mortality rate	95% CI [lower, upper]
Life expectancy at birth								
Upper 25%	35.00	17.05, 52.94	23.56	20.45, 26.66	8.18	5.57, 10.80	3.32	2.26, 4.39
Lower 25%	29.74	17.60, 41.88	21.07	16.87, 25.26	11.67	8.30, 15.03	4.50	3.09, 5.92
Between groups *P*	.634		.350		.109		.243	
Life expectancy at 65 men								
Upper 25%	19.85	14.01, 25.68	16.56	9.30, 23.82	13.87	8.19, 19.55	9.47	2.59, 16.36
Lower 25%	28.89	16.05, 41.72	20.97	16.36, 25.59	10.67	7.24, 14.09	3.83	2.44, 5.22
Between groups *P*	.209		.315		.344		.115	
Life expectancy at 65 women								
Upper 25%	32.43	19.60, 45.26	27.17	22.81, 31.53	13.57	10.76, 16.38	6.95	5.10, 8.80
Lower 25%	29.74	17.60, 41.88	21.07	16.87, 25.26	11.67	8.30, 15.03	4.50	3.09, 5.92
Between groups *P*	.765		.048		.394		.039	
Infant mortality rates								
Upper 25%	27.60	14.91, 40.29	26.69	22.67, 30.70	15.13	9.70, 20.56	5.32	3.80, 6.84
Lower 25%	27.18	7.82, 46.54	24.53	21.67, 27.39	9.24	6.09, 12.40	3.18	2.17, 4.19
Between groups *P*	.792		.390		.066		.003	
Potential years of life lost								
Upper 25%	27.29	14.57, 40.01	20.37	16.86, 23.89	12.42	1.68, 23.17	3.65	1.36, 5.94
Lower 25%	21.04	8.99, 33.09	21.96	18.93, 25.00	10.32	6.85, 13.79	3.79	1.70, 5.89
Between groups *P*	.298		.502		.715		.660	
Mortality from cancer								
Upper 25%	20.77	6.54, 35.01	28.19	20.18, 36.20	11.12	8.59, 13.64	3.91	2.49, 5.33
Lower 25%	34.77	22.88, 46.65	21.26	17.11, 25.41	9.93	6.68, 13.17	4.26	2.88, 5.65
Between groups *P*	.139		.132		.952		.726	
Suicide rates								
Upper 25%	25.46	16.79, 34.14	24.74	22.21, 27.26	13.49	5.26, 21.73	4.03	3.00, 5.06
Lower 25%	38.64	24.79, 52.9	21.34	17.04, 25.64	9.11	5.84, 12.38	3.27	2.02, 4.51
Between groups *P*	.234		.182		.200		.256	

Meta-analysis of variance (ANOVA) subgroup analysis by viewpoint 1–4. Viewpoint 1–4: 8 weeks from the time of mortality in each country. Between groups *P*: Difference between groups *P* value.
CI = confidence interval.

by viewpoint 2 in the upper 25% of countries that include Australia, Belgium, Canada, Israel, Mexico, South Korea, and the United Kingdom. These countries had a high influenza vaccination among the elderly. However, the COVID-19 mortality rate was higher in the upper 25% of countries (28.78%) than in the lower 25% of countries (20.13%). The upper 25% of countries had a high population rate of elderly people. The COVID-19 infections and complications are more severe in the elderly. In the United States, the mortality rate of the elderly (≥65 years) is as high as 78.9%.[19] The upper 25% of countries had an elderly population of a minimum ≥14%[20] and therefore, had many elderly deaths.

Table 4 shows that the health equipment variable hospital beds were significant (P = .007) by viewpoint 2. The upper 25% of countries with regard to hospital beds include Austria, Germany, Hungary, Japan, Lithuania, Poland, Russia, and South Korea. These countries had a COVID-19 mortality rate of 25.30%. But lower 25% of countries had a COVID-19 mortality rate of 33.52%. Thus, the number of hospital beds affected COVID-19 mortality rates significantly. Therefore, hospital beds can make a comparative difference in the medical work environment for patient treatment in a pandemic situation.

Table 5 shows that the health resources variable, health spending, is significant (P = .002) by viewpoint 2. Health spending refers to the cost incurred in the consumption of personal health care goods and services. The upper 25% of countries with regard to this indicator include Austria, Denmark, Germany, Luxembourg, Norway, Sweden, and Switzerland. However, these countries had a higher increase in mortality rate (31.39%) than the lower 25% countries (22.19%). This could be because of the higher number of COVID-19 deaths by viewpoint 2. On ordinary days, the health spending of the upper 25% of countries was at a personal level. Similar interpretations can be made for the indicator of pharmaceutical spending as well. The upper 25% of countries with regard to this indicator include Australia, Belgium, Canada, Germany, Japan, South Korea, and Switzerland. These countries, which have high Gross Domestic Product (GDP) and Gross National Income (GNI), had an increase in the mortality rate of 30.36%. The countries with high GDP[21] & GNI per capital[22] have many floating populations which move based on the economy and market conditions. Regarding health spending, the lower 25% of countries include China, Estonia, Hungary, India, Mexico, Poland, Russia, and Turkey. With regard to pharmaceutical spending, the lower 25% of countries include China, Denmark, Estonia, India, Israel, Mexico, Poland, and Turkey. These countries have minimal low GNI per capita (<20,000 dollars) excluding Denmark, Israel, and Estonia (≥20,000 dollars).[23] The health resources variable, the number of doctors, was significant (P = .025) by viewpoint 4. With regard to the number of doctors, the upper 25% of countries include Austria, Denmark, Germany, Lithuania, Norway, Russia, Sweden, and Switzerland. These countries showed a low COVID-19 mortality rate. The lower 25% of countries include China, India, Japan, Mexico, Poland, South Korea, Turkey, and the United States. These countries showed a higher COVID-19 mortality rate than the upper 25% of countries. Based on this result, it can be deduced that an adequate number of doctors will be able to deliver good quality medical service in countries and high-quality medical service improves the overall medical efficiency.[24]

Table 7 shows that the health status variable, life expectancy ≥65 years for women was significant (P = .039) by viewpoint 4. The COVID-19 mortality of elderly women aged 65 and older was high in the top 25%. It is estimated that countries with a

higher life expectancy of women aged 65 or older will have a high proportion of the elderly population. Based on this, it can be inferred that the main age group affected by COVID-19 has a higher proportion of elderly aged over 65 years with chronic diseases.[25] Furthermore, the top 25% of countries with the highest infant mortality rate had a significantly higher COVID-19 mortality rate (P = .003) by viewpoint 4. Countries with high infant mortality rates reflect low levels of health care and are thought to lack the coping skills to fight the COVID-19 infection.[26]

This study has the following limitations. First, although COVID-19 deaths are calculated by country, we were able to identify the relevant factors only in those countries whose official data were provided by the OECD. Second, the related factors required to secure clear data were limited, therefore, more variables could not be included in the analysis. To effectively manage infectious diseases in the future, international organizations should expand and regularly update their database so that the data can be used for significant research in the health care field.

5. Conclusion

We recommend that the countries improve their medical consultations and service to ameliorate people's health. The countries that have experienced the COVID-19 pandemic need to strengthen their medical infrastructure to prepare for large-scale disease outbreaks in the future. To prevent the spread of such outbreaks, it is necessary to reduce the health inequality between population groups and achieve health equity regardless of the income gap, rather than vaccination of specific countries. To develop and implement health equity the following measures are suggested: management of noncommunicable diseases, a solid health insurance system, a stable supply of medical supplies, and strengthening the competency of health care workers. Additionally, to secure collective herd immunity, a fair and transparent discussion should continue among health policymakers to discourse on vaccination priorities.

Author contributions

Conceptualization: J-MH; methodology: A-RK; software: M-GK; validation: A-RK, C-YP; formal analysis: M-GK; investigation: S-JL; resources: J-MH; data curation: S-JL; writing – original draft preparation: S-JL; writing – review and editing: S-JL and M-GK; supervision: C-YP, A-RK; project administration: J-MH. All authors have read and agreed to the published version of the manuscript.

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