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COVID-19: An analysis on official reports in Iran and the world along with some comparisons to other hazards

Soheila Pouyan\textsuperscript{a}, Mojgan Bordbar\textsuperscript{b}, Mojdeh Mohammadi Khoshou\textsuperscript{c}, Soroor Rahmanian\textsuperscript{d}, Zakariya Farajzadeh\textsuperscript{e}, Bahram Heidari\textsuperscript{f}, Sedigheh Babaei\textsuperscript{a}, and Hamid Reza Pourghasem\textsuperscript{a}

\textsuperscript{a}Department of Natural Resources and Environmental Engineering, College of Agriculture, Shiraz University, Shiraz, Iran
\textsuperscript{b}Department of GIS/RS, Faculty of Natural Resources and Environment, Science and Research Branch, Islamic Azad University, Tehran, Iran
\textsuperscript{c}Watershed Management Engineering, Faculty of Natural Resources and Desert Studies, Yazd University, Yazd, Iran
\textsuperscript{d}Quantitative Plant Ecology and Biodiversity Research Lab, Department of Biology, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran
\textsuperscript{e}Department of Agricultural Economics, College of Agriculture, Shiraz University, Shiraz, Iran
\textsuperscript{f}Department of Plant Production and Genetics, School of Agriculture, Shiraz University, Shiraz, Iran

1 Introduction

The COVID-19 epidemic has faced the world with a health and economic crisis that has not been seen since the Spanish flu epidemic in 1918. The spread of the coronavirus has been unprecedented for the past 100 years, and even crises such as cholera and SARS outbreaks have not been as widespread and destructive as COVID-19. Previous infectious diseases have generally persisted in several countries or are controlled with the help of drugs, while COVID-19 is a different story. This virus was first identified on December 31, 2019, in Wuhan, China, and the World Health Organization called it COVID-19.\textsuperscript{1} The COVID-19 spread was rapidly started in China and moved to the rest of the world and affected more than 218 countries until January 31, 2021. From the beginning of infection until January 31, 2021, the number of registered cases infected by this virus has reached more than 83,055,202 cases, of which 1,811,358 have died (https://www.worldometers.info/coronavirus). The effects of the COVID-19, as a major socio-economic crisis referred to by the United Nations, have had a negative impact on the world and even developed countries, so that its continued spread has faced the World Health Organization with serious problems.\textsuperscript{2, 3} The transmission rate for COVID-19 is unknown; however, there is strong evidence of efficient human-to-human transmission. This virus is claiming more lives by affecting health systems, shaking the global economic foundations, and creating lasting geopolitical changes. Globally, strict efforts are being made to restrain what has become a profoundly destructive epidemic.\textsuperscript{4} Following the outbreak of this disease, countries, including Iran, have increased their planning and monitoring to quickly identify new possible cases of the disease and work to break the transmission chain. Iran is also one of the countries with the highest incidence statistics, with COVID-19.\textsuperscript{5} China has made significant progress in coronavirus control when other countries faced significant challenges with the spread of the pandemic. Centralized patient management has played an important role in the Chinese epidemic, thereby effectively reducing the transmission chain.\textsuperscript{6} It is noteworthy that in the United States and Europe, crisis management is based on the principles of immediate isolation of symptomatic or suspected individuals, prevention of gatherings, especially in indoor areas, observance of social distance, cancelation of unnecessary travel, closure of schools, and educational centers, as well as
providing care for the elderly and children done. Until January 31, 2021, the highest mortality rates were reported in the United States (441,324), Brazil (224,504), Mexico (158,536), India (154,392), the United Kingdom (106,367), Italy (88,516), France (76,201), Russia (72,029), Spain (58,319), and Iran (57,959), respectively. On January 31, 2021, Iran ranked 15th in terms of the total number of cases (1218,752) and 9th in terms of the number of deaths (57,959). At this time, China ranked 81st (87,027) and 45th (4634) in terms of the number of cases and deaths, respectively (https://www.worldometers.info/coronavirus).

Currently, the COVID-19 pandemic is one of the most important health issues in the world and Iran. Given the severity of the incidence of this disease, several researchers around the world have focused on the behavior of the virus and the effects of its far-reaching dimensions on human life. Therefore, reviewing the studies published in the Scopus profile has shown the allocation of 2.5% of all articles in the world to COVID-19 (https://www.scopus.com).

Studies conducted on COVID-19 have mainly focused on the clinical aspects and immunopathogenesis of the virus, cities, and urbanism in the future, economic effects, and social consequences of this virus. Consid-

2 Methodology

2.1 Statistical analysis of COVID-19

The present work is an applied and descriptive-analytical study. The statistical population of the study includes all the infected and deaths due to COVID-19 in Iran and the world. For statistical analysis of the prevalence of the COVID-19 virus, the official data reported for the world and Iran were used. This dataset was obtained from https://www.worldometers.info/coronavirus and https://github.com/owid/covid-19-data/tree/master/public/data, and the Ministry of Health and Medical Education. First, the high amount of monthly data for corona-caused infections and deaths in Iran were analyzed based on the months of Shamsi Hijri. Then, the data for the infected and dead cases of the world were examined for each continent. Finally, a comparison was made between the death rates due to COVID-19 and the 34 major causes of death in the world. The study data consisting of long-term data of the major deaths from 1990 to 2017 were obtained on an annual average from https://ourworldindata.org. Statistical analysis of available data is the most basic principle for planning and formulating control strategies, policy-making, and management.

2.2 Models for death cases trend

The behavior of the variable death cases was captured using a fourth-degree polynomial specification as follows:

\[
\text{Total death} (t) = a_0 + a_1 t + a_2 t^2 + a_3 t^3 + a_4 t^4
\]  

(1)

where Total death (t) represents the total number of deaths on day t and t denotes the days starting from 19th of February and 22 of January 22, 2020, for Iran and the world as a whole, respectively. Other specifications, including quadratic and third-degree polynomial specifications, were also examined and it was found that the fourth-degree form has more accurate predictions. The cubic form of the specification was used by Aik et al. to examine the Salmonellosis incidence in Singapore and for COVID-19 death cases in Iran by Pourghasemi et al.

We also used an ARMA model to compare the process generating the variables for Iran and the World. This model includes two processes: autoregressive (AR) and moving average (MA). An ARMA model of order \((p,q)\) can be written as:

\[
y(t) = \beta_0 + \sum_{i=1}^{p} \beta_i y_{t-i} + \sum_{j=1}^{q} \beta_j \varepsilon_{t-j}
\]  

(2)

where \(y\) is the dependent variable and \(\varepsilon\) is the white noise stochastic error term. In the applied model, \(y\) denotes the total number of deaths, and \(t\) is the number of days starting from the first day of death.
3 Results

3.1 Analysis of official reports of coronavirus spread in Iran

The number of coronavirus infections and deaths from the onset of the pandemic (February 19, 2020) of the pandemic to January 19, 2021 (11 months) according to the Shamsi Hiji (between Bahman 30, 1398 and Dey 30, 1399) in the country indicates that the number of infected and dead people in Iran was 1,342,134 and 56,973, respectively. The maximum number of daily infected cases (1365 individuals) from February 19, 2020, to March 19, 2020, was related to March 14. During the same period (30 days), the maximum number of deaths on March 19, 2020, was 149 individuals (Fig. 1). In other words, the average daily number of deaths was 43 in average in this period of 30 days.

Analysis of COVID-19 outbreaks from March 23 to March 30, the number of infected cases increased, with the highest number of daily infected cases of 3186 individuals found on March 30 (Fig. 2). However, a declining trend was observed from March 30 to April 19. The highest daily death rate (158 cases) in this month (March 20 to April 19) was reported on April 4 (Fig. 2). In other words, the average number of deaths was 124. Therefore, compared to 30 days in 2020 (February 19 to March 19), the country encountered three peaks for the number of deaths.

Analysis of the COVID-19 epidemic from April 20 to May 20 showed that the number of infected individuals was 44,738. The highest daily number of infected individuals was related to May 20, with 2346 individuals (Fig. 3). In other words, the number of people infected with the coronavirus in this month is approximately 0.7 of the previous month. The number of deaths reported between April 20 and May 20 was 2065. The highest daily death rate in this month was reported on April 27, which was 96 individuals (Fig. 3). The number of deaths from March 20 to April 19 was 0.54 1.62, which was higher than those reported from February 19 to March 19, 2020.

Analysis of coronavirus from May 21 to June 20 indicated that the number of infected cases increased, reaching 75,646. The highest number of daily infections was identified on June 4, with 3574 individuals. The number of infected cases in June was 1.69 times more than that reported in May and 1.19 times more than that in April (Fig. 4). The total number of deaths in June was 2325. The highest daily death rate in this month was related to June 19, which was reported in 120 individuals (Fig. 4). From May 21 to June 20, an increasing trend in the number of deaths was found compared to April 20 to May 20, with 260 individuals. In other words, the number of deaths from May 21 to June 20 was 1.13 times more than that between April 20 and May 20, 0.61 times more than those from March 20 to April 19, and 1.82 times more than those from February 19 to March 19, 2020.

The number of coronavirus-infected cases from June 21, 2020, to July 21, 2020, in Iran was 76,243. The highest daily number of infected cases was found on July 8, with 2691 individuals (Fig. 5). It should be emphasized that the daily number of COVID-19 cases was over 2000 individuals every day in July. According to the analysis, the number of infected cases from June 21 to July 21 was 1.19 times more than that from March 20 to April 19, 1.70 times more than those from April 20 to May 20, and 1.01 times more than those from May 21 to June 20. In addition, the total number of
FIG. 1  The number of daily infected cases and daily deaths in Iran from February 19 to March 19, 2020 (from Bahman 30 to Esfand 29, 1398).

FIG. 2  The number of daily infected cases and daily deaths in Iran from March 20 to April 19, 2020 (from Farvardin 1 to Farvardin 31, 1399).

FIG. 3  The number of daily infected cases and daily deaths in Iran from April 20 to May 20, 2020 (from Ordibehesht 1, 1399 to Ordibehesht 31, 1399).
dead people in July in Iran was 5127, and the highest daily death rate in this month (June 21 to July 21) was related to July 21, which was reported to be 229 individuals (Fig. 5). The number of deaths from June 21 to July 21 was 2.21 times higher than those from May 21 to June 20, 2.48 times higher than those detected from April 20 to May 20, 1.34 times higher than those in the period from March 20 to April 19 and 4.02 times more than those in the period from February 19 to March 19, 2020.

Analysis of coronavirus spread between July 22 and August 21 illustrated that the total number of infected cases was 75,937 individuals and the highest daily number of infected cases was related to August 4, with 2751 individuals (Fig. 6). In August, the total number of dead people was 5742 and the highest daily death (235 individuals) in this month (July 22 to August 21) was found on July 28 (Fig. 6). In Asia, of the 49 countries affected by the coronavirus
this month (July 22 to August 21), Iran has the second-highest place in terms of the number of infections and deaths, while it is ranked 10th in Asia in terms of population.

Analysis of coronavirus-infected cases from August 22 to September 21 illustrated that the total number of infected individuals was 70,717, and the highest daily number of infected individuals was related to September 21, with 3341 individuals (Fig. 7). Additionally, the total number of dead people was reported to be 4102 and the highest daily death rate in this month (from August 22 to September 21) was related to September 20, which was 183 individuals (Fig. 7).

Analysis of the COVID-19 outbreak between September 22 and October 21 illustrated that the total number of infected cases was 124,056 and 5616 on October 21, respectively (Fig. 8). In addition, the total number of dead people in this month was 6870 and the highest daily death rate in this month (from September 22 to October 21) was related to October 19, which was 337 individuals (Fig. 8).

The total number of infected people from October 22, 2020, to November 20, 2020, was 282,179. The highest daily number of infected individuals was related to November 16, with 13,421 individuals (Fig. 9). In addition, the total number of dead people in November in Iran was 12,550, and the highest daily death rate in this month (from October 22 to November 20) was related to November 16, which was reported to be 489 individuals (Fig. 9).

Analysis of the COVID-19 outbreak from November 21 to December 20 illustrated that the total number of infected individuals was 330,007, with the highest daily number of infected cases (14,051 individuals), which was related to November 27 (Fig. 10). In addition, the total number of dead people in this month was 9719 and the highest daily death rate in this month (November 21 to December 20) was related to November 24, which was 483 individuals (Fig. 10).

The number of COVID-19 cases from December 21, 2020, to January 19, 2020, in the country indicated that the total number of infected people was 183,750. The highest daily number of infected individuals was observed on January 15, with 6485 individuals (Fig. 11). In addition, the total number of dead people in January in Iran was 3348, and the highest daily death rate in this month (from December 21 to January 19) was related to December 21, which was reported to be 191 individuals (Fig. 11).

In this study, the number of infected patients and deaths from onset (February 19, 2020) to January 19, 2021 (11 months) in Iran was reported. The results of infected patients showed that the highest number of infected patients was related to the period of November 21 to December 20, followed by the period of October 22 to November 20, the period of December 21 to January 19, the period of September 22 to October 21, the period of June 21 to July 21, the
period of July 22 to August 21, the period of May 21 to June 20, the period of August 22 to September 21, the period of March 20 to April 19, the period of April 20 to May 20, and the period of February 19 to March 19, respectively (Fig. 12). Moreover, the result of deaths showed that the highest rate of deaths was related to the period of October 22 to November 20, followed by the period of November 21 to December 20, the period of September 22 to October 21, the period from July 22 to August 21, the period from June 21 to July 21, the period from August 22 to September 21, the period of March 20 to April 19, the period of December 21 to January 19, the period of May 21 to June 20, the period of April 20 to May 20, and the period of February 19 to March 19, respectively (Fig. 13).
The total number of coronavirus infections and deaths from January 2020 to January 2021 in the world indicates that the maximum number of infected and dead people were related to December 2020 and January 2021, which were 20,124,074 and 406,831, respectively. In addition, the minimum number of infections and deaths was related to January 2020 (Figs. 14 and 15). The majority of coronavirus cases were related to December 2020 (19.57%), followed by January 2021 (18.77%), and November 2020 (16.79%). In addition, the majority of coronavirus deaths were related to January 2021 (18.27%), followed by December 2020 (15.72%), and November 2020 (12.26%) (Fig. 16 and Table 1).

FIG. 12  The highest number of infected cases for 11 months from February 19, 2020, to January 19, 2021, in Iran (between Bahman 30, 1398 and Dey 30, 1399).

FIG. 13  The highest number of deaths in Iran for 11 months from February 19, 2020, to January 19, 2021 (between Bahman 30, 1398 and Dey 30, 1399).

The total number of coronavirus infections and deaths from January 2020 to January 2021 in the world indicates that the maximum number of infected and dead people were related to December 2020 and January 2021, which were 20,124,074 and 406,831, respectively. In addition, the minimum number of infections and deaths was related to January 2020 (Figs. 14 and 15). The majority of coronavirus cases were related to December 2020 (19.57%), followed by January 2021 (18.77%), and November 2020 (16.79%). In addition, the majority of coronavirus deaths were related to January 2021 (18.27%), followed by December 2020 (15.72%), and November 2020 (12.26%) (Fig. 16 and Table 1).

FIG. 14  Total monthly coronavirus infections in the world (from January 2020 to January 2021).
FIG. 15  Total monthly deaths in the world (from January 2020 to January 2021).

FIG. 16  Percentage of total cases and total deaths in continents and Iran (2021.01.31).

| Month, 2020 | % Total cases | % Total deaths |
|-------------|---------------|----------------|
| January, 2020 | 0.01 | 0.01 |
| February, 2020 | 0.07 | 0.12 |
| March, 2020 | 0.77 | 1.86 |
| April, 2020 | 2.34 | 8.67 |
| May, 2020 | 2.83 | 6.18 |
| June, 2020 | 4.15 | 5.99 |
| July, 2020 | 6.95 | 7.51 |
| August, 2020 | 7.69 | 7.88 |
| September, 2020 | 8.27 | 7.36 |
| October, 2020 | 11.80 | 8.15 |
| November, 2020 | 16.79 | 12.26 |
| December, 2020 | 19.57 | 15.72 |
| January, 2021 | 18.77 | 18.27 |

TABLE 1  The percentage of coronavirus infections and deaths in the world (from January 2020 to January 2021).
3.2 Comparison of COVID-19 mortality rate and other hazards in Iran and the world

According to long-term data from 1990 to 2017, the most important causes of mortality in Iran and the world were studied separately in different continents of the 34 major deaths worldwide, cardiovascular diseases and tumors are ranked first and second, respectively.

The death rate from coronavirus is the eighth leading cause of death worldwide (Fig. 17). In Europe, which showed 30% of coronavirus-caused deaths in the world, it ranked third after cardiovascular disease and tumors (Fig. 18). Coronavirus mortality in Asia accounted for 18.6% of coronavirus-caused deaths worldwide, which ranked 15 among 34 fatalities in Asia (Fig. 19). In Oceania, corona-caused deaths account for approximately 0% of the world’s corona-related deaths and it is ranked 32nd among the 34 leading causes of death in Oceania (Fig. 20). Coronavirus-caused deaths in Africa account for only 3.5% of coronavirus deaths and it is ranked 19th among the 34 leading causes of death in Africa (Fig. 21). South America accounts for 20%, North America accounts for 28% of the world’s coronavirus-caused deaths, and COVID-19 related mortality is the third leading cause of death in South and North America after cardiovascular and tumors (Figs. 22 and 23). In Iran, coronavirus-related mortality accounts for 3% of the global mortality rate due to this virus, and this fatal factor is the second leading cause of death after cardiovascular and tumor diseases, road accidents, and neonatal disorders (Fig. 24).

3.3 Comparison of world and Iranian death cases trend

Fig. 25 and the ARIMA model results presented in Table 2 indicate that the Iranian death cases experience a relatively flatter trend compared to the world. As shown in Fig. 25, both cases are presented with a fourth-degree polynomial specification; however, those for the world case sound steeper. For both, the number of deaths is increasing exponentially, but for the World at a steeper rate. This fact has been examined more deeply and quantitatively in Table 2, where the ARIMA estimation results have been presented. In addition, the ARCH specification was applied to model volatility as well. Based on the polynomial model, the number of deaths increased over the selected horizon. The first derivative of the estimated model, which turns it into a third-degree polynomial equation, represents daily death cases. However, the current trend of death cases failed to show an acceptable turning point, while there is some
FIG. 18  The death rate from Coronavirus and other lethal factors in Europe.

FIG. 19  The death rate from Coronavirus and other lethal factors in Asia.
### Oceania

| Cause                              | Deaths |
|------------------------------------|--------|
| Cardiovascular diseases            | 293867 |
| Chronic respiratory diseases       |        |
| Neoplasms                          | 168495 |
| Lower respiratory infections       | 166601 |
| Neonatal disorders                 | 125776 |
| Diabetes mellitus                  | 104718 |
| Diarrheal diseases                 | 96699  |
| Road injuries                      | 73939  |
| Digestive diseases                 | 57346  |
| Chronic kidney disease             | 54109  |
| Self-harm                          | 53207  |
| Tuberculosis                       | 43339  |
| Maternal disorders                 | 41207  |
| Drowning                           | 10317  |
| Cirrhosis and other chronic liver diseases | 155725 |
| HIV/AIDS                           | 34909  |
| Nutritional deficiencies           | 27375  |
| Protein-energy malnutrition        | 26764  |
| Meningitis                         | 25305  |
| Interpersonal violence             | 25288  |
| Alzheimer disease and other dementias | 18697 |
| Malaria                            | 17017  |
| Intestinal infections              | 9678   |
| Fire, heat, and hot substances     | 7813   |
| Hepatitis                          | 6200   |
| Parkinson disease                  | 13992  |
| Poisonings                         | 13982  |
| Environmental heat and cold exposure | 13977 |
| Exposure to forces of nature       | 13891  |
| Alcohol use disorders              | 1249   |
| Drug use disorders                 | 1012   |
| Covid_19                           | 1554   |
| Conflict and terrorism             | 1577   |
| Terrorism                          | 0      |

**FIG. 20** The death rate from Coronavirus and other lethal factors in Oceania.

### Africa

| Cause                              | Deaths |
|------------------------------------|--------|
| HIV/AIDS                           | 1065103|
| Lower respiratory infections       | 786236 |
| Cardiovascular diseases            | 726971 |
| Chronic respiratory diseases       | 710003 |
| Diarrheal diseases                 | 700381 |
| Malaria                            | 684401 |
| Tuberculosis                       |        |
| Neoplasms                          |        |
| Digestive diseases                 | 241894 |
| Nutritional deficiencies           | 203094 |
| Protein-energy malnutrition        | 196830 |
| Meningitis                         | 189679 |
| Road injuries                      | 149270 |
| Cirrhosis and other chronic liver diseases | 139251 |
| Diabetes mellitus                  | 137598 |
| Maternal disorders                 | 99268  |
| Chronic kidney disease             | 93157  |
| Covid_19                           | 83061  |
| Alzheimer disease and other dementias | 65153 |
| Interpersonal violence             |        |
| Self-harm                          | 51939  |
| Conflict and terrorism             | 49752  |
| Drowning                           | 44284  |
| Fire, heat, and hot substances     | 25836  |
| Intestinal infections              | 21066  |
| Hepatitis                          | 17442  |
| Poisonings                         | 10315  |
| Parkinson disease                  | 9455   |
| Alcohol use disorders              |        |
| Drug use disorders                 |        |
| Environmental heat and cold exposure |        |
| Terrorism                          |        |
| Exposure to forces of nature       |        |

**FIG. 21** The death rate from Coronavirus and other lethal factors in Africa.
FIG. 22  The death rate from Coronavirus and other lethal factors in North America.

FIG. 23  The death rate from Coronavirus and other lethal factors in South America.
FIG. 24  The death rate from Coronavirus and other lethal factors in Iran.

\[
y = -1E-05x^4 + 0.0105x^3 - 1.9332x^2 + 206.34x - 2495.3
\]
\[
R^2 = 0.9943
\]

\[
y = 0.0009x^4 - 0.6492x^3 + 161.69x^2 - 6973.4x + 52169
\]
\[
R^2 = 0.9992
\]

FIG. 25  Actual cases versus estimated cases in Iran and the World.

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evidence showing that a turning point in infection is expected. For instance, it has been reported for SARS incidence,\textsuperscript{37} HAV,\textsuperscript{38} ARI,\textsuperscript{39} and A(H1N1)v.\textsuperscript{40} It is worth noting that a turning point means that after passing the peak, it is expected to show a decreasing trend. This fact may also reveal the different nature of the COVID-19 virus compared to other viruses. Another possibility is that the measures taken up to now have not been enough and effective and other measures are needed. Regarding the leading coefficient of the polynomial model, we may expect a decreasing trend in Iran’s daily cases in the future. It is worth noting that the comparison of the specified models is more appropriate for investigating the effectiveness of the measures taken by the corresponding health body rather than using it to predict future values.

The ARIMA time series models for the death variables of the whole world and Iran are presented in Table 2. These models may show the process of generating the variables in the time horizon. The data series stationarity was tested to evaluate whether the variable was stationary or not. The results of the unit root test for Iran showed that the death case

| Regressor | Coefficient | Standard error | t-statistics | Probability |
|-----------|-------------|----------------|--------------|-------------|
| World Mean Eq. | Constant | -5.436 | 443,247.3 | -0.000 | 1.000 |
| | AR(6) | 0.256 | 0.025 | 10.318 | 0.000 |
| | AR(7) | 0.743 | 0.072 | 10.317 | 0.000 |
| | MA(1) | -0.586 | 0.026 | -22.466 | 0.000 |
| | MA(8) | 0.289 | 0.015 | 19.137 | 0.000 |
| | Dummy | -592.949 | 353.304 | -1.678 | 0.093 |
| Variance Eq. | Constant | 843.739 | 301.922 | 2.794 | 0.005 |
| | Resid\textsuperscript{2}(-1) | 0.558 | 0.098 | 5.646 | 0.000 |
| | GARCH(-1) | 0.672 | 0.042 | 15.757 | 0.000 |
| | Dummy | 116,803.7 | 64,816.40 | 1.802 | 0.071 |
| | Adjusted R\textsuperscript{2} | 0.540 | | | |
| | Q(5)\textsuperscript{a} | 5.012 | | 0.025 | |
| | Q(6)\textsuperscript{a} | 5.282 | | 0.071 | |
| | Heteroskedasticity (ARCH) | 0.002 | | 0.960 | |
| Iran Mean Eq. | Constant | 275.401 | 79,934.73 | 0.003 | 0.997 |
| | AR(1) | 0.999 | 0.000 | 325,463.5 | 0.000 |
| | MA(1) | -0.395 | 0.060 | -6.581 | 0.000 |
| | MA(7) | 0.153 | 0.058 | 2.619 | 0.008 |
| | MA(8) | 0.163 | 0.060 | 2.716 | 0.006 |
| | Dummy | -105.274 | 52.225 | -2.015 | 0.043 |
| Variance Eq. | Constant | 5254.662 | 1229.806 | 4.272 | 0.000 |
| | Resid\textsuperscript{2}(-1) | 0.206 | 0.083 | 2.471 | 0.013 |
| | Dummy | -5051.708 | 1229.239 | -4.109 | 0.000 |
| | Adjusted R\textsuperscript{2} | 0.976 | | | |
| | Q(5)\textsuperscript{a} | 3.661 | | 0.057 | |
| | Q(6)\textsuperscript{a} | 4.563 | | 0.102 | |
| | Heteroskedasticity (ARCH) | 0.646 | | 0.421 | |

\textsuperscript{a} Q(p) is the significance level of the Ljung-Box statistics, in which the first p of the residual autocorrelations are jointly equal to zero.
series are not stationary at the level and the first difference showed stationarity; however, it was found that there was a break at the 9th month as well. Thus, a breakpoint unit root test was conducted. In addition, this breakpoint was included in the ARIMA model using dummy variables. The world’s series was also difference-stationary, but the second-order differenced series was found to be stationary. This may also reveal the curvature of the steeper trend, as illustrated in Fig. 25.

As shown in Table 2, the world model is generated by an ARIMA (2(6, 7),2,2(1, 8)) process, while for the Iranian death trend, a simpler process was obtained, resulting in an ARIMA (1,1,2(1, 7, 8)). Although the absolute values of the AR terms for both are similar, it is worth noting that the data for the world was applied after two different times, indicating a slower process of an increasing trend for Iran compared to those of the world.

In addition to the equation that is an ARIMA model, the variance of the series was examined using Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models. For Iran’s specification, GARCH (1,0) was estimated, while for the World’s data, GARCH (1) was found to be appropriate. Given the significant coefficients for these variables, the death cases for the World tend to fluctuate more than those in Iran. This is a fact that is not easily captured in the trends shown in Fig. 25.

Another interesting result was a breakpoint that was found in the unit root test of data applied in Iran. It was observed that in the 9th month after the first death cases were reported, a steeper increasing trend was observed. The negative coefficient for the dummy variable shows lower death cases for the first 9 months in Iran. In addition, in the variance equation, lower volatility is observed for the first 9 months. In other words, after 9 months, an increasing wave of death cases is observed, while it has experienced higher volatility. This higher volatility may stem from the periodical efforts of the government to quarantine and impose more social restrictions. For the world’s cases, a dampening trend was found in the last 37 days; however, the estimated coefficients were significant only at the 10% level.

Generally speaking, the diagnostic statistics indicate that the estimated models are acceptable because the Q-statistics indicate that the residuals are not significantly correlated. In addition, the ARCH effect was not significant, indicating insignificant volatility in the residuals of the estimated equations. In addition, except for dummy variables in the World’s specification and the dummy variable in the mean Eq. of specifications presented for Iran, the coefficients are significant at 99%.

4 Discussion

The COVID-19 epidemic is a global challenge and threat in recent history and the need for timely, appropriate and cost-effective policies and measures to restrain and mitigate its deadly consequences is essential. Reviewing monthly statistics showed that from February 19, 2020, to January 19, 2021, Iran had been faced with three major peaks of COVID-19 infections. The first peak was 1 month after the onset of the disease between March 20 and April 19, 2020, the second peak was from May 21 to June 20, 2020, and the third peak was from September 21 to October 2020. The main problem in Iran is the large number of domestic trips that have contributed to the rapid spread of the virus and has faced the country with three peaks over a period of 11 months (February 19, 2020–January 19, 2021).

From April 20 to May 20, 2020, and December 21, 2020, to January 19, 2021, a declining trend was observed for the number of infected and deaths cases due to COVID-19. The reduction rate of the number of infected and deaths cases from April 20 to May 20, 2020, was 1.4 and 1.86, respectively, compared to the period of March 20 to April 19, 2020, and the same reduction rate in the period of December 21, 2020–January 19, 2021, were 1.80 and 2.90, respectively, compared to December. It is noteworthy that Iran has implemented two full quarantine periods, including the closure of shopping centers, educational centers, restaurants, hotels, and entertainment centers on February 21, 2020–April 13, 2020, and November 1, 2020–December 12, 2020. This has been the main reason for the decrease in the number of infected and deaths in the months after the quarantine period; especially in the second period of quarantine, the intercity and interprovincial restrictions of personal cars were also added to the previous restrictions and it has reduced domestic travel and concentrations of crowds in recreational centers. Therefore, there has been a further decline in the period from December 21, 2020, to January 19, 2021. Some demographers have reported that the rapid spread of COVID-19 in Italy was also due to high intergenerational contact, especially among young travelers who travel from Milan to their villages.

In the Pourghasemi et al. study, the comparison between the statistics of six continents from February 19 to June 14 showed that the highest mortality rate was related to Europe (42.21%), and the highest number of cases was observed in North America (31.12), which was consistent with the results of this study despite adding another period of 7 months. Studies on the COVID-19 virus in different countries have also shown that factors such as (1) age and family structure, (2) patterns of cohabitation, (3) individual characteristics such as socioeconomic status, and (4) ethnicity and mobility have great impacts on the incidence and spread of coronavirus.
Since the world has made significant progress in dealing with many of the deadly causes, high-income countries have viable strategies to cope with infectious diseases, whereas in low-income countries in South Africa, the majority of people die due to infection with the AIDS virus. The use of contaminated water or the loss of children and mothers are among the factors commonly seen in African countries. Coronavirus disease is one of the most dangerous and acute problems that the world has been unable to do much to treat. It should be noted that when faced with a new viral epidemic such as COVID-19 with complicated and unknown biology and transmission potential, it is highly important to estimate the impact of disease on public health in terms of disease severity and mortality. Under these circumstances, estimating the underlying cause of death using a standard approach throughout the country provides a powerful tool for rapidly achieving unbiased estimates of COVID-19 mortality and its impact on different age groups as well as different countries and regions. As statistics show, high-income and populous countries show higher mortality rates for this virus. As the data showed, the Corona-caused mortality rate in Europe, North America, and South America, as well as Iran, followed a similar trend. Contrary to popular belief, the death rate in African countries is significantly lower, but catastrophic death rates are seen in European and American countries. One of the causes of high mortality in European countries is the aging population because most corona victims are elderly. Other factors include the lack of a clear border and travel bans between EU countries, especially at the beginning of the pandemic, because there are no strict rules for travel between different countries in the EU and the disease is transmitted very quickly.

Africa accounts for 17% of the world’s population, but it includes only 3.5% of the reported cases of COVID-19 worldwide. All deaths are important; therefore, we should not discount the seemingly small number, and certainly, the data collected in a wide range of countries is of variable quality. Most African countries, even with less advanced health systems, still experience lower rates of COVID-19 mortality. Although the highest mortality rate in Africa has been related to the HIV, Africa has been less vulnerable to the coronavirus compared to other countries in the world.

In Lawal, the average age and life expectancy were lower in most African countries than in other countries, and this has created a population pyramid consisting of a predominantly young population in Africa, while Western countries and other developed countries have a predominantly older population. This discrepancy may be explained by the higher birth rates in less developed African countries and more advanced health systems in developed countries, which allow their citizens to live longer. Additionally, Africa, with its less advanced health systems, continues to suffer from communicable and noncommunicable diseases that lead to reduced life expectancy. In this regard, mortality data showed that 65-year-old mortality is clearly higher in the West and other developed countries than in Africa. This is obviously because a much larger proportion of the population in the West and other industrialized countries tends to be over 65 years old in comparison with the population of Africa, and this rate is reflected in the COVID-19 mortality rate, as older people are most likely to be at risk of dying from COVID-19.

Moreover, the low mortality rate due to corona in the Pacific continent can be attributed to the isolation of this continent and the lack of relations with other parts of the world. Social distance, public health measures, and reduced international travel might have been effective in reducing the spread of the disease in Australian society. The results of the Yamamotoa and Bauer study showed that (1) differences in social behaviors and culture of the people in the two regions; (2) the possible prevalence of dangerous viruses in Central Europe due to multiple viral infections, and the involvement of related viral immune factors; and (3) possible involvement of health factors, including cultural and behavioral differences between people in Central Europe and Eastern Asia, viral factors, and even anthropological issues such as human evolution were the main factors affecting the differences between the two continents. In the Sorci et al. study, economic parameters played an equal role in the formation of COVID-19 mortality. With the increase in the number of severe cases during the epidemic, the healthcare system may encounter difficulties and may not be able to receive and treat all those in need of special care. Therefore, mortality may be due to health care systems that are not sufficient to deal with the large number of cases requiring simultaneous hospitalization in special care units. In this study, several proxies were used to describe each country’s investment in the healthcare system and a negative relationship was found between the number of hospital beds and corona mortality rates. Contrary to this view, however, they found that the death rate from the coronavirus was highest in countries with high GDP per capita and high overall health expenditures as a share of GDP. This is a strange result, but it confirms the notion that the rich countries of Europe and North America have paid a lot of damage to this infection. In general, the relationship between investment in the healthcare system and coronavirus mortality appears to be more complex than expected. In Iran, COVID-19-related mortality is the second most common cause of death. One of the most important reasons for the difference in mortality rates in some countries, such as Iran, with other countries, is the lack of attention to the observance of health protocols.
Factors such as age, sex, underlying diseases, and broader social factors influence the understanding of the impact of coronavirus disease on mortality worldwide. Recall that the use of younger age structures in low-income countries may be partially compensated by health system weakness and a higher prevalence of HIV, tuberculosis, and other chronic diseases. In fact, in countries with poorer health, we will see a change in the age distribution of COVID-19 related deaths in a younger population compared to rich and healthier countries with a higher rate of underlying diseases such as diabetes and hypertension. Data from the United States and the United Kingdom also show that some ethnic minorities and communities with socio-economic disadvantages are at a high risk of mortality due to COVID-19 infection. Undoubtedly, accelerating biological aging along with social and economic harm plays an important role in the incidence of COVID-19 world. Naturally, the real world represents a more complex dynamic, but there is still a strong relationship between age and mortality due to COVID-19.

5 Conclusions

Analysis of the statistical reports of coronavirus infections and deaths in Iran showed that the spread of the virus in different months, from the start of the outbreak (February 19, 2020) to January 19, 2021, has an increasing trend, so that the highest number of coronavirus infections and deaths were reported in November 21 to December 20, 2020, and October 21 to November 20 and 2020, respectively. The highest number of coronavirus infections and deaths were detected in North America and Europe in December 2020 and January 2021, respectively. Among the 34 leading causes of death worldwide, coronavirus was ranked 8th, 19th, 15th, 3rd, 32nd, and 2nd in Africa, Asia, Europe, North America, South America, and Oceania, respectively.

A fourth-degree polynomial and an ARIMA model were applied to examine and compare the general trend of death cases in the world and Iran. While these models apply only one variable, that is, death cases, which are available daily, they are well-powered in depicting the general trend. These tools may be recommended for two reasons. First, they apply only one variable, that is, death cases, which are the most important and easily available. Second, they indicate the effectiveness of the measures taken by governments. The behavior of the estimated equations simply shows how the variable behavior would be if the current attempts to continue. In addition, the estimated models can be used to predict the number of cases in the following days; however, this contribution is less significant than the above-mentioned contributions.

Comparing the general trends of Iran and the world reveals that the trend of death is similar, while the Word’s cases show significant volatility and a higher tendency to increase. The more significant volatility for the World may mean that some countries experience volatility in death cases in a direction different from the others, leading to more fluctuation in the death cases. Generally speaking, the significant volatility may mean that even though it is more than 1 year that several attempts have been made to cope with the virus outbreak, the attempts have not been properly and globally adopted, leading to trial-and-error measures and many different treatments. Another source of fluctuation is periodic widespread quarantine, which has been taken after an increasing outbreak. It is not expected to encounter a decreasing trend, indicating the urgent need to keep measures such as quarantine and even leaving room for other attempts with stronger restrictions. Although restricting attempts have been the main measure to cope with the outbreak, governments are always choosing a combination of social and economic restrictions and infection outbreaks because there is a tradeoff between them. The lower the social restrictions, the more the infection outbreak will be, and vice versa.

The Literature shows that the most important factors for coronavirus spread in Iran are the lack of social distance, travel, and high population density due to various events and holidays, which accelerated the spread of the disease. Although the months of complete quarantine have had a great impact on reducing the corona-caused infections and deaths, according to the results of this study, evaluating how the virus has spread and the impact of quarantine and public closure measures requires a comprehensive analysis beyond health indicators. Since the coronavirus is new and unknown, and studies and research have been unable to find a distinct treatment for the virus, analyses presented in the current study might be effective in strategic decision-making and provide solutions on how to deal with the virus epidemic and understand how it spreads.

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