ORIGINAL ARTICLE

# The COVID-19 Mortality Rate and its Related Factors in Fars Province

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## Abstract

**Background:** The outbreak of COVID-19 has become the current crisis in most countries. Therefore, paying attention to the consequences and determinants of COVID-19. Mortality can lead to better control of the condition. This study aimed to investigate the COVID-19 mortality rate and its demographic and health determinants in Fars province.

**Methods:** This research was conducted using a quantitative method. For this purpose, available data for selected counties in Fars province were analyzed. The COVID-19 mortality rate was considered a dependent variable. In addition, the variables of literacy rate, urbanization rate, elderly population ratio, unemployment rate, the ratio of the active hospital, ratio of pre-hospital emergency stations, the ratio of centers for primary health care, and the ratio of active hospital beds were considered independent variables.

**Results:** Findings showed that the variables of the elderly population ratio, urbanization rate, and unemployment rate had a direct relationship with the COVID-19 mortality rate. The findings also indicated that the COVID-19 mortality rate in the 45-49 age range begins to accelerate and peaks between 95 and 99 years old. In addition, the literacy rate was inversely related to the COVID-19 mortality rate. The results also showed an inverse relationship between all the selected health variables and the dependent variable.

**Conclusion:** Improving the economic situation, specifically reducing the unemployment rate, emphasizing public education of the people, as well as improving the medical and health facilities, can facilitate the response to pandemics.

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**Keywords:** COVID-19 pandemic, Delivery of health care, Fars province, Mortality rate, Population aging

## Introduction

In the early 1900s and the first half of the twentieth century, the mortality rate in Iran was quite high. Between 1800 and 1900, the crude mortality rate was estimated to be between 36 and 40 per thousand people. The mortality rate dropped dramatically in the early twentieth century. From 1896-1901 to 1931-1926, the crude death rate decreased from 36 to 32 per thousand people; from 1956 to 1951, it was equivalent to 24 per thousand people. In the 1950s and 1990s, mortality rates dropped from 24 to 14 per thousand people. It is estimated to be 5.8 per thousand people in 2001. The drop in under-5 mortalities and the decline in infectious disease fatalities have both contributed to the fast reduction of mortality rate in recent decades.[1] Iran's crude mortality rate reached 5 per thousand people in 2020.[2] However, in the last two years, the emergence of a contagious viral illness has slowed reduction rate. COVID-19 has been declared a pandemic by the World Health Organization, which has declared a state of emergency.[3]

Since the end of February 2020, Iran's epidemic has expanded swiftly. Covid-19 has been the topic of many research in Iran since its breakout, each of which has looked at the issue from a different perspective.[4-9] Religious, cultural, political, cognitive, social, and emotional elements, for example, have been demonstrated to influence Iranians' perceptions of the disease.[10] The health crisis has also been shown to have the greatest impact on areas such as family and education, labor relations, and some social groups such as women, children, small business owners, and migrants.[11] Economically, it has also been shown that not implementing the right policies in the face of crises similar to COVID-19 can reduce productivity in the short term. In the long run, it can make the country's development difficult.[12] According to research on the psychological effects of the COVID-19 pandemic, older people and people with underlying disorders are more likely to experience significant psychological issues.[13] In this regard, it has been shown that reforming the country's health system is one of the most important factors in controlling the pandemic.[14] The results of studies also show that lifestyle training appropriate to critical situations can help to better deal with crises similar to COVID-19.[15] Training programs can be designed and implemented to increase self-esteem and positive emotions to make people resilient in the current situation because these factors are predictors of adaptive behaviors against COVID-19.[16] Overall, as mentioned, significant studies have been conducted on the COVID-19 crisis in the country. However, studies focusing on the explanatory factors and variables related to COVID-19 mortality rates are less visible. Conducting studies at the county level by provinces of the country and correlating the mortality rates caused by COVID-19 with those counties' health, demographic, and economic status can explain the differences in the mortality rate mentioned above to some extent. The current study aims to meet this goal for Fars province and provide a preliminary explanation of the mortality rates caused by COVID-19 in terms of demographic, economic, and health variables of those counties.

## Methods

In the present study, the method of secondary data analysis was used. The scope of the present study is Fars province. For this purpose, the information for the counties covered by Shiraz University of Medical Sciences was analyzed. In the first step, the number of deaths caused by COVID-19 from the beginning of the pandemic to the end of October 2021, according to the counties covered by Shiraz University of Medical Sciences, was taken from that center. In the next step, the population of the counties in the province was adapted from the last census conducted in 2016, and finally, the COVID-19 mortality rate was calculated per 100,000 people and considered a dependent variable in the research. In addition, the ratio of the population aged 60 and over to the total population or the proportion of the elderly population, the literacy rate of the total population aged six and over, the rate of urbanization, the total unemployment rate, the ratio of the number of hospital beds per 10000 people, the ratio of centers for primary health care per 100,000 people, the ratio of active hospitals per 100,000 people, and the ratio of pre-hospital emergency stations per 100,000 people were considered independent variables. Since the exact number of residents of the counties can be adapted from the general population and housing censuses, the most accurate population statistics go back to 2016. Therefore, in the present research, the population of the counties has been taken from the last census in 2016. It should be noted that due to the relatively constant trend of population changes in the province in previous decades, Using population in 2016 will not create a significant error. It is worth mentioning that statistics related to health variables are also taken from the latest statistical yearbook of Fars province, available on the National Statistics Portal of Iran.

## Results

Table 1 shows that the highest COVID-19 mortality rate belongs to Shiraz county, with a figure of about 260 per 100,000 people, and the lowest rate, with a figure of about 96 per 100,000 people, belongs to Arsanjan county. The findings of the table also show that the lowest and highest proportions of the elderly population, with figures of about 7 and 12 percent, belong to the counties of Kavar and Abadeh, respectively. The rate of urbanization varies from about 28 percent for Rostam county to about 92 percent for Shiraz county. The lowest and highest literacy rates, with 79.4 and 93.1 percent, are allocated to Rostam and Shiraz counties. Also, the highest and lowest unemployment rates, with figures of about 18 and 7 percent have been calculated for the counties of Kavar and Mamasani. The highest and lowest ratios of hospitals to population were obtained for Khorrambid and Rostam counties, respectively. Shiraz county has the highest ratio of active hospital beds to the population. Shiraz and Rostam counties have the highest and lowest proportions of centers for primary health care, respectively. The findings also show that the counties of Shiraz and Bavanat have recorded the lowest and highest proportions of pre-hospital emergency stations, respectively.

In the following, descriptive statistics on the COVID-19 mortality rate will be presented in the form of bar graphs, and then the relationship between the independent variables of the research and the dependent variable will be examined through scatter plots.

As Figure 1 (The figure on the right) shows, the

**Table 1:** Distribution of the studied counties in terms of independent and dependent variables

| County | The COVID-19 mortality rate (per 100,000 people) | Elderly population ratio | Urbanization rate | Literacy rate | Unemployment rate | Hospital ratio | Hospital beds ratio | Centers for primary health care ratio | Emergency stations ratio |
|---|---|---|---|---|---|---|---|---|---|
| Abadeh | 216.2 | 11.9 | 87.5 | 89.8 | 10.0 | 1.0 | 17.6 | 24.8 | 6.0 |
| Arsanjan | 96.0 | 8.4 | 41.4 | 88.9 | 10.8 | 2.3 | 10.3 | 70.2 | 4.7 |
| Estahban | 159.8 | 10.1 | 70.3 | 88.2 | 8.9 | 1.5 | 14.7 | 43.6 | 5.8 |
| Eghlid | 172.8 | 10.2 | 60.9 | 85.6 | 12.7 | 1.1 | 11.8 | 56.5 | 5.3 |
| Bavanat | 148.8 | 10.9 | 40.5 | 83.9 | 8.8 | 2.0 | 6.5 | 41.7 | 9.9 |
| Pasargad | 109.6 | 8.8 | 62.0 | 84.8 | 10.1 | 3.3 | 18.9 | 49.8 | 6.6 |
| Kharameh | 189.6 | 9.3 | 37.2 | 84.7 | 10.7 | 1.8 | 5.7 | 54.7 | 3.6 |
| Khorrambid | 104.9 | 8.8 | 82.9 | 88.1 | 8.2 | 4.0 | 7.7 | 39.6 | 9.9 |
| Darab | 113.7 | 8.2 | 45.1 | 86.4 | 8.5 | 0.5 | 9.6 | 53.1 | 4.5 |
| Rostam | 132.9 | 10.4 | 27.6 | 79.4 | 16.4 | 0.0 | 0.0 | 99.1 | 4.5 |
| Zarin Dasht | 99.7 | 7.2 | 60.7 | 84.1 | 11.6 | 1.4 | 5.7 | 34.2 | 4.1 |
| Sepidan | 119.7 | 10.0 | 28.3 | 82.9 | 11.4 | 2.2 | 11.6 | 51.6 | 4.4 |
| Sarvestan | 173.2 | 9.7 | 56.3 | 87.7 | 11.2 | 2.6 | 8.4 | 47.2 | 5.2 |
| Shiraz | 259.2 | 9.8 | 91.6 | 93.1 | 12.4 | 2.1 | 32.8 | 11.8 | 1.8 |
| Farashband | 138.6 | 9.1 | 60.6 | 81.2 | 13.9 | 2.2 | 7.0 | 59.4 | 6.6 |
| Firozabad | 114.5 | 10.5 | 62.2 | 84.5 | 11.3 | 0.8 | 11.6 | 49.4 | 5.8 |
| Ghirokazin | 122.2 | 8.1 | 59.0 | 83.9 | 15.6 | 1.4 | 4.6 | 46.3 | 8.4 |
| Kazeron | 217.1 | 10.2 | 55.6 | 84.8 | 13.8 | 1.1 | 7.7 | 39.1 | 3.4 |
| Kavar | 141.9 | 7.0 | 37.8 | 82.5 | 7.5 | 1.2 | 2.3 | 37.0 | 4.8 |
| Lamerd | 128.6 | 8.0 | 49.8 | 87.6 | 10.8 | 2.2 | 14.8 | 56.7 | 4.4 |
| Marvdasht | 120.6 | 8.0 | 51.5 | 86.5 | 15.6 | 0.3 | 7.1 | 54.4 | 2.5 |
| Mamsani | 128.5 | 10.8 | 55.0 | 82.4 | 18.4 | 0.9 | 12.8 | 72.3 | 3.4 |
| Mehr | 108.0 | 7.4 | 49.6 | 86.5 | 8.0 | 1.5 | 4.0 | 64.8 | 6.2 |
| Neyriz | 105.9 | 9.2 | 57.1 | 87.2 | 10.7 | 0.9 | 10.9 | 30.0 | 4.4 |
| Total | 165.1 | 9.4 | 70.1 | 89.0 | 12.2 | 1.5 | 19.5 | 34.8 | 4.0 |

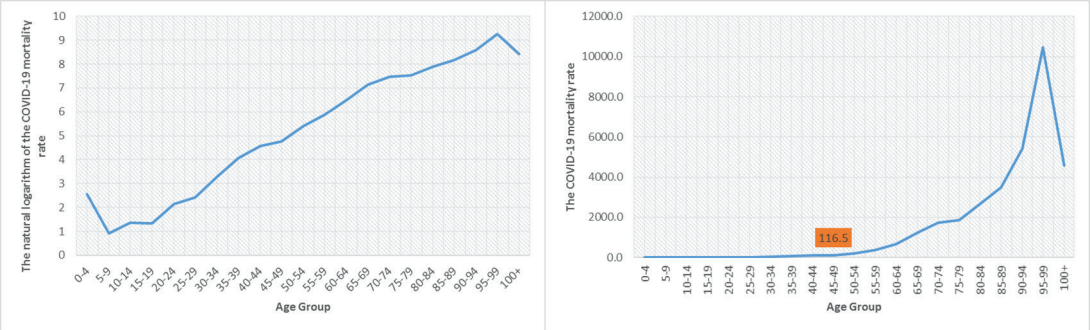


**Figure 1:** The age pattern of Covid-19 mortality rate in the studied counties of Fars province.

COVID-19 mortality rate, in the studied counties, has started to rise from the 45-49 age group and has an increasing trend until the 95-99 age range. In other words, the mortality rate in the 45–49 age group has reached over 100 (per 100,000 people) and is peaking in the 95–99 age group. To show the differences in the COVID-19 mortality rate by age more accurately, the natural logarithm of the mortality rates was calculated. The graph on the left depicts the above-mentioned mortality age pattern.

As Figure 2 shows, the COVID-19 mortality rate in most counties in Fars province is higher among men than women. The COVID-19 mortality rate for men and women, in all the studied counties, was equal to 185.7 and 143.9 per 100,000 people, respectively. The counties of Kharameh, Sarvestan, Bavanat, Neyriz, and Pasargad are exceptions to the above rule, as women living in these counties have experienced higher mortality rates than men. The highest difference in mortality rates between men and women was recorded in Sarvestan and Bavanat counties, where the mortality rate for women was much higher than their male counterparts.

The information in Figure 3 indicates that the COVID-19 mortality rate in urban areas is generally higher than in rural areas of the counties of Fars province. In all studied counties, the mentioned mortality rate in urban and rural areas was 203.6 and

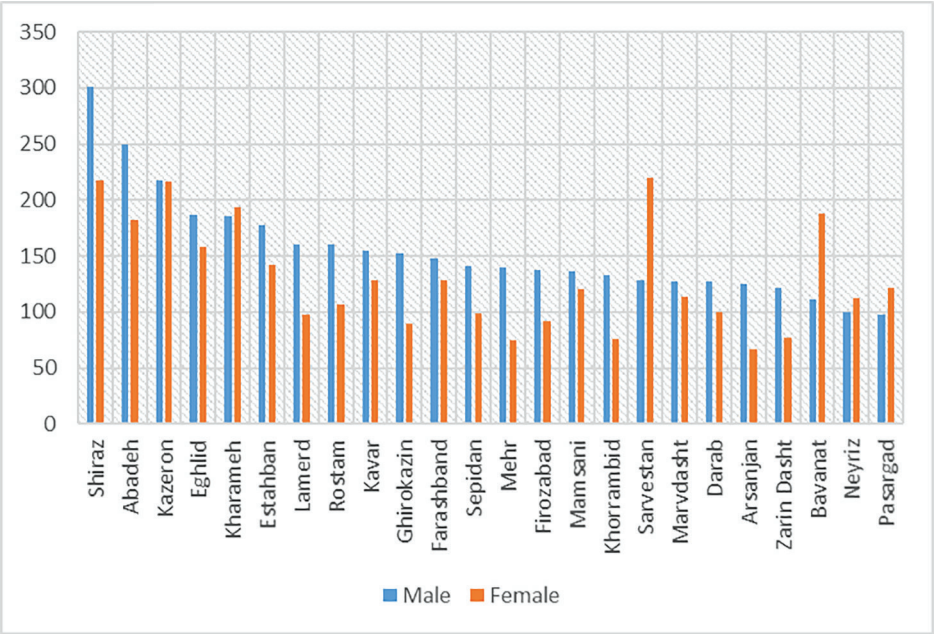


**Figure 2:** The COVID-19 mortality rate by sex in the studied counties of Fars province

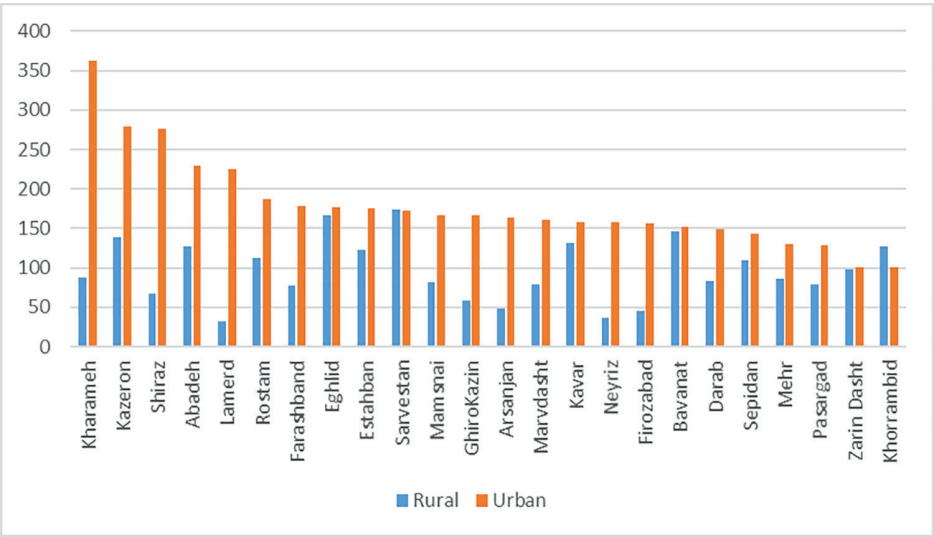


**Figure 3:** The COVID-19 mortality rate by residence place in the studied counties of Fars province

74.6 per 100,000 people, respectively. In Khorrambid and Sarvestan counties, the mortality rate in rural areas is higher than in urban areas, and in other cases, the general rule is the same. The highest mortality rate in urban areas belongs to the county of Kharameh, while the lowest belongs to the county of Khorrambid. In contrast, the highest and lowest mortality rates in rural areas are allocated to Sarvestan and Lamerd counties.

Figure 4 shows that the relationship between the literacy rate and the COVID-19 mortality rate is negative, i.e., as the population literacy rate decreases, the COVID-19 mortality rate increases. Increased urbanization is associated with an increased COVID-19 mortality rate. A positive relationship has been found between the proportion of the elderly population and the COVID-19 mortality rate among the counties of Fars province. In other words, counties with older age structures have recorded higher COVID-19 mortality rates. In addition, a negative correlation has been obtained between the unemployment rate and the COVID-19 mortality rate, i.e. the increase in the unemployment rate has been associated with higher COVID-19 mortality rates. Of course, it should be noted that the above relationship is very weak. Considering the values of $R^2$, it can be said that among the demographic and economic variables selected in the present study, the elderly population ratio has the strongest correlation with the COVID-19 mortality rate. Urbanization rate, literacy rate, and unemployment rate are in the next ranks in terms of correlation rate, respectively.

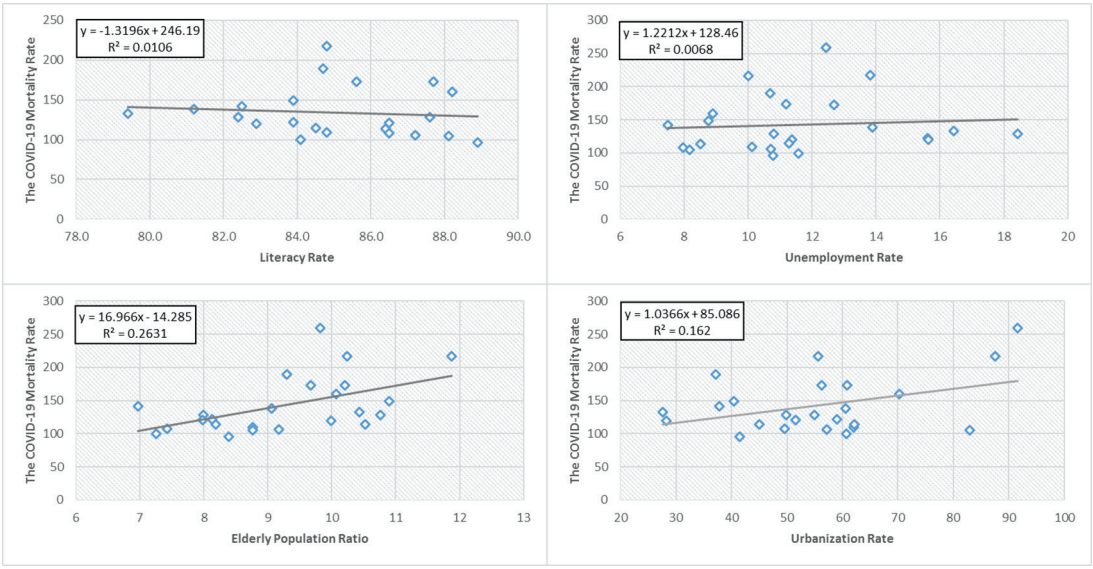


**Figure 4:** Relationship between the demographic-economic variables and the COVID-19 mortality rate in the studied counties of Fars province

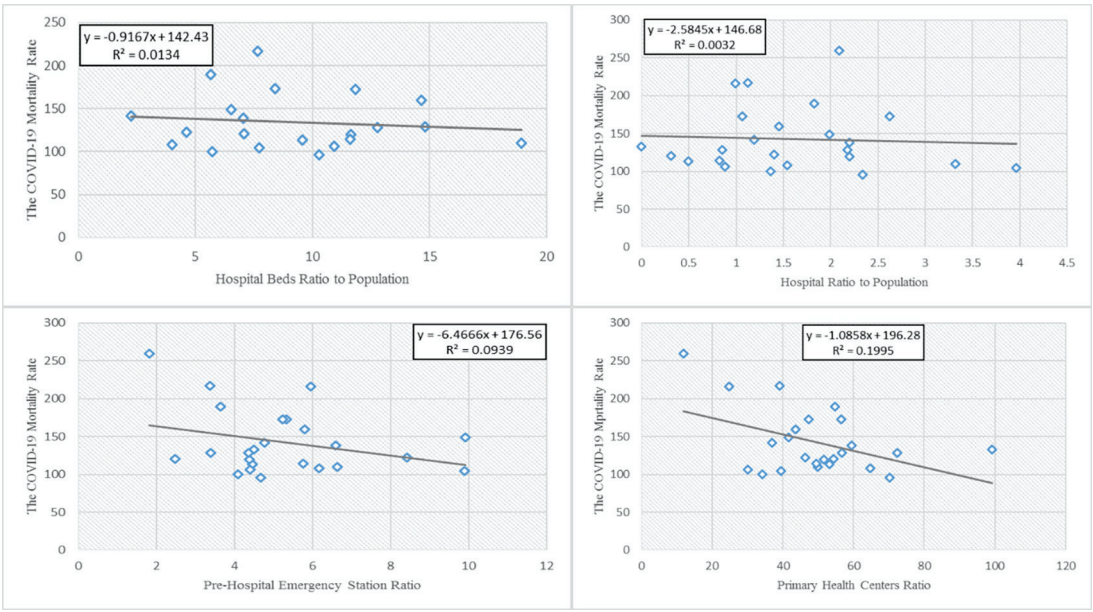


**Figure 5:** Relationship between the health variables and the COVID-19 mortality rate in the studied counties of Fars province

Figure 5 indicates the negative correlation between the ratio of pre-hospital emergency stations and the ratio of centers for primary health care with the COVID-19 mortality rate. The above relations are of considerable intensity. The relationship between the active hospital ratio, and active hospital beds ratio variables with the COVID-19 mortality rate has a negative direction, i.e., by increasing the mentioned ratios, the desired mortality rate will decrease. Of course, it should be noted that the intensity of the mentioned relationships is weak. Among the health variables used, the strongest intensity of the relationship belongs to centers for primary health care ratio and pre-hospital emergency stations ratio, respectively. The intensity of the relationship between the ratio of active hospitals to the population has been recorded as the weakest.

## Discussion

In most parts of the world, the transition from high to low mortality rates is a health and medical achievement. In addition to changes in the level and rate of mortality, other changes have occurred in the causes of mortality. The transition from deaths caused by viral, infectious, and parasitic diseases to deaths caused by non-infectious and non-parasitic diseases and the eradication of many infectious diseases, is known as the epidemiological transition. Nonetheless, the global outbreak of COVID-19 in the last two years has demonstrated the fragility of the aforementioned transitions. The spread of COVID-19 in Iran, like in many other countries, led to a medical and health crisis and many economic consequences. The relatively high number of cases and definite deaths caused by COVID-19 in the country occurred at a level

that attracted the attention of many policymakers and academics. Since the outbreak of COVID-19 in the country, many studies have been written about it.

Studies have shown that there are many causes and consequences for COVID-19 mortality rates. The age and sex structure of the population, as well as the economic situation of the countries, had been the determinants of COVID-19 mortality, which has been confirmed in previous studies.[17-20] This study aimed to investigate the factors related to the COVID-19 mortality rates among the counties of Fars province. The results showed that the COVID-19 mortality rate starts to rise from 45 to 49 (116.5 per 100,000 people) and has an increasing trend until the age of 95-99 (10451.0 per 100,000 people). The COVID-19 mortality rate was higher among men (185.7 per 100,000 people) than women (143.9 per 100,000 people). Generally, the COVID-19 mortality rate was higher in urban areas (203.6 per 100,000 people) than in rural areas (74.6 per 100,000 people).

The study of the relationship between variables showed that by increasing the population's literacy rate, the COVID-19 mortality rate decreases. Hence, the population's high literacy rates can lead to more and better adherence to health guidelines and self-care behaviors in the face of illness. Increased urbanization rate was associated with increased mortality from COVID-19. This finding could be due to the high population density in urban areas. There was a positive relationship between the proportion of the elderly population and the COVID-19 mortality rate, which indicates the effect of the population's age structure on the mortality rates. The relationship between the population's age structure and the mortality rate of COVID-19 has been confirmed in other studies.[18, 19] The relationship between the unemployment rate and the mortality rate was positive, i.e., the increase in unemployment rates was associated with higher mortality rates. Among the selected demographic and economic variables, the elderly population ratio strongly correlated with the COVID-19 mortality rate. In terms of relationship intensity, the urbanization, literacy, and unemployment rates were ranked next, respectively. The findings also showed a negative relationship between the ratio of pre-hospital emergency stations and the ratio of centers for primary health care with the COVID-19 mortality rate. Therefore, the role of primary health care and emergency centers, which can also reduce the pressure on hospitals in times of crisis, such as the COVID-19 pandemic, is very important. In other words, equipping these centers can prevent acute and tough situation. The relationship between the variables of active hospital beds ratio and active hospital ratio with the COVID-19 mortality rate had a negative direction, i.e., by increasing the mentioned ratios, the mortality rate decreases. Among the studied health variables, the strongest relationships belonged to the variables of the ratio of centers for primary health care and the ratio of emergency stations, respectively. In general, the ratio of the elderly population and the ratio of centers for primary health care had the strongest relationship with the COVID-19 mortality rates.

## Conclusion

In general, given the trend of changes in the population's age structure, aging, and the possibility of crises similar to COVID-19 in the future, it is necessary to pay attention to the requirements to deal with such conditions and there should be an agenda of planners and relevant officials to be involved in cirisis when happened. Implementing a self-care training program among the elderly can also be effective. In addition, the development of medical and health services, such as the building and equipping health and hospital centers, can help better deal with similar crises. Reducing the unemployment rate can also lead to a reduction in deaths caused by contagious diseases.

**Conflict of Interest:** None declared.

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