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# An Epidemiologic Analysis of COVID-19 and Severe Acute Respiratory Infection (SARI) Based on Hospital Data in Hormozgan Province in the South of Iran

Hossein Farshidi [1], Mehdi Hassaniazad [2], Abdollah Gharibzadeh [1], Mahmood Hosseinpoor [3], Abdoulhossain Madani [3,*], Shokrollah Mohseni [3], Ali Mouseli [3], Abdul-Jabbar Zakari [3], Farideh Fakhar [3], Asadollah Ahmadi [3], Taiyebeh Raznahan [3], Amin Ghanbarnejad [3], Hesamaldin Kamalzadeh Takhti [3], Teamur Aghamolaei [3], Gholamali Javdan [3], Farid Khorrami [3], Ali Heyrani [3], Maryam Rezaei [3], Hassan Morshedi [3], Fatemeh Noroziyan [3], Mahbobe Omrani [3], Mina Kamali [3], Nahid Shahabi [3], Roghaye Ezati Rad [3], Faeghe Zareei [3] and Sakineh Dadipoor [3]

[1]Department of Surgery, Cardiovascular Research Center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran
[2]Department of Infectious Disease, Infectious and Tropical Diseases Research Center, Research Institute for Health, Hormozgan University of Medical Sciences, Bandar Abbas, Iran
[3]Department of Public Health Social Determinants in Health Promotion Research Center, Research Institute for Health, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

[*]*Corresponding author*: Department of Public Health, Social Determinants in Health Promotion Research Center, Research Institute for Health, Hormozgan University of Medical Sciences, Bandar Abbas, Iran. Email: shmd_md@yahoo.com

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## Abstract

**Background:** From the general health perspective, the epidemiology of COVID-19 in Hormozgan Province, a region in the south of Iran marked by heavy traffic, can provide useful information to help control the epidemic of the disease in other provinces and the whole country.
**Objectives:** Thus, the present research aimed to epidemiologically analyze COVID-19 patients and patients with severe acute respiratory infection (SARI) based on hospital data in Hormozgan Province.
**Methods:** In the present observational, analytical, cross-sectional study, the epidemiologic data of all 2,055 patients with the symptoms of acute respiratory problems who visited hospitals in Hormozgan between February 20, 2020, and April 19, 2020, were analyzed and reported. Patients' demographic information included gender, age, and background diseases. Tabulated data, frequencies, and percentages were used for descriptive statistics, and the chi-squared test and odds ratios were used for inferential statistics.
**Results:** The ratios of male to female among people with COVID-19 and respiratory infection were 1.15 and 1.12, respectively. The mean age of the participants was 42.8 $\pm$ 21 years. The results revealed that contact with patients had the highest odds ratio (5.41 - 9.30, OR = 7.09) regarding COVID-19 as compared to SARI. Reduced sense of smell (1.86 - 12.87, OR = 4.89), muscular pain (1.24 - 2.14, OR = 1.63), coughs (1.14 - 1.86, OR = 1.46), and fever (1.14 - 1.83, OR = 1.45) showed to have the highest odds ratios concerning the symptoms. As for background diseases, cardiovascular disease (1.004 - 2.110, OR = 1.455), asthma (OR = 1.603, 1.040 - 2.473), and pulmonary chronic disease (1.456 - 3.854, OR = 2.369) had the highest odds ratios.
**Conclusions:** The present findings showed a statistically significant correlation between age and affliction with COVID-19. Moreover, the most prevalent symptoms of the disease were reduced sense of smell, muscular pain, coughs, and fever, as already mentioned in similar studies. The present research showed that patients with cardiovascular disease, asthma, or chronic pulmonary disease had the highest risk of COVID-19.

*Keywords:* COVID-19, Epidemiology, SARS-CoV-2, Hormozgan

## 1. Background

In December 2019, the World Health Organization (WHO) reported certain cases of pneumonia in Wuhan, China. This disease rapidly spread, and it was named coronavirus-2019 (nCoV-2019) by the WHO on January 12, 2020 (1-4). The outbreak of COVID-19 was as follows. The first case of infection was reported in December 2019 (5).

From December 18, 2019, to December 29, 2019, five cases of acute respiratory syndrome were hospitalized, one of whom died (6). Until January 2, 2020, 41 patients were hospitalized, all known to be afflicted with COVID-19, as confirmed by laboratories. Less than half of this number had background diseases such as diabetes, hypertension, and cardiovascular diseases (7). Until April 18, 2020, as the WHO official website reported, a total number of 2,160,207 afflicted cases and 146,088 mortality cases due to COVID-19 were reported worldwide. These statistics in Iran were 79,494 and 4,958, respectively (8). Moreover, the numbers of positive cases and mortalities are ever-increasing. The current rate of mortality due to COVID-19 is about 3.4% compared to 9.6% for SARS and 34.4% for MERS (9, 10).

In the early stage of an epidemic, there is little or no information about new infections, although such information is strongly required. This is particularly true about COVID-19 (11). The occurrence of this epidemic might follow a non-linear trend and be disastrous. It is very similar to the SARS epidemic that occurred in Hong Kong in 2003 (12). The Ebola virus epidemic occurred in West Africa in 2013 - 2016, while the H1N1 epidemic occurred in 2009. Measles occurred recently in the U.S. (11).

Collecting the epidemiologic data about the disease and identifying the risk factors and groups at risk help provide key information to develop appropriate strategies, reduce adverse effects, develop preventive measures, and adopt the required methods of treatment management. As the demographic, social, economic, and cultural features vary across communities, it is essential to collect specific information in each community to plan health-related and therapeutic measures (12-14).

From the general health perspective, the epidemiology of COVID-19 in Hormozgan Province, which is marked by heavy traffic in the South of Iran, can provide key information to help control the prevalence of the disease in other provinces and countries.

## 2. Objectives

Thus, the present research aimed to analyze the epidemiology of COVID-19 and acute respiratory syndrome based on hospital data in Hormozgan Province.

## 3. Methods

The present observational, analytical, cross-sectional research was conducted in the Social Factors and Health Promotion Research Center of Hormozgan University of Medical Sciences. The study included all 2,055 patients diagnosed with acute respiratory symptoms in hospitals of Hormozgan Province (15 public hospitals affiliated to the university, three public hospitals not affiliated to the university, and two private hospitals) between February 20, 2020, and April 19, 2020. Of all patients participating in this research, 338 patients were diagnosed with COVID-19 in a lab.

The reverse transcription polymerase chain reaction (RT-PCR) was used to confirm the disease using throat or nasal swabs from the upper respiratory tract.

To collect data, we used the translated version of the COVID-19 questionnaire published by the WHO and the existing data in the national medical care monitoring center. The questionnaire consists of three sections, the first of which explores demographic information such as age, gender, education level, nationality, occupation, and place of residence. The second section explores risk factors such as a history of contact with a positive case of COVID-19, history of drug abuse, cigarette smoking, and background diseases (cancer, chronic liver disease, diabetes, chronic blood diseases, HIV/AIDS, immunodeficiency (acquired or congenital), pregnancy, cardiovascular diseases, chronic renal diseases, dialysis condition, asthma, chronic neurological disorders, and history of hypertension). The third section enquires about the symptoms and conditions of the disease, including fever, coughs, muscular pain, respiratory distress, low level of consciousness, loss (or reduced sense) of smell, loss (reduced sense of) of taste, seizure, CT scan result, intubation, PO2 level, and dialysis condition.

The present research is part of a research project approved by Hormozgan University of Medical Sciences (code: #980475) and the Ethics Committee (no.: HUMS.REC.1399.002). All information provided by the participants was kept confidential.

The collected data were entered into SPSS22 to be statistically analyzed. Tabulated data, frequency, and percentage were used for descriptive statistics, and the chi-squared test and odds ratio were used for inferential statistics.

## 4. Results

Since February 23, 2020, when the first definite case of COVID-19 was diagnosed in Qeshm Island in Iran, until the end of April 19, 2020, a total number of 2,055 cases of the disease or cases with symptoms of acute respiratory syndrome visited provincial medical centers. The average age

of the visitors was about 43 ± 21 years (min = 1, max = 100). From among these patients, based on the PCR lab test results, a total number of 338 (16.4%) cases were diagnosed with COVID-19 and 1,717 (83.6%) cases with acute respiratory syndrome, who began to receive the required medical care.

Table 1 shows the gender distribution of all patients diagnosed with COVID-19 and SARI. Overall, 53% of them were male, and 47% were female. No statistically significant difference was found between the COVID-19 and SARI groups in terms of gender. Besides, 181 (53.6%) positive cases were male, and 157 (46.4%) were female. Among the patients with SARI, these percentages were 52.9 and 47.1%, respectively. Yet, no statistically significant difference was found between these groups in terms of gender. The proportion of male to female COVID-19 and SARI patients was 1.15 and 1.12, respectively.

Table 2 shows the age distribution of all patients. The average age was 42.8 ± 21 years (R = 1 - 100). The majority of the participants belonged to the 21 - 40 age group. Among COVID-19 cases, 29.7% of the patients belonged to the 31 - 40 age group and 20.8% to the 41 - 50 group, both including the majority of COVID-19 cases. Moreover, 20.1% of SARI cases belonged to the 31 - 40 age group and 18.6% to the 21 - 30 age group, both comprising the majority of SARI patients.

Figure 1 indicates the spatial distribution of SARI patients in the whole province. The occurrence rate of the disease (SARI afflicted cases) per 100,000 population was 232.03 in Kish, 158.2 in Parsian, and 232.03 in Bandar Abbas. Moreover, the highest occurrence rate of COVID-19 was 101.65 (per 100,000), 25.83 (per 100,000), and 21.85 (per 100,000) in Hajiabad.

Table 3 summarizes the odds ratios of some correlates of COVID-19 versus SARI. The odds ratios showed no statistically significant differences between males and females (OR = 1.02, 0.813 - 1.29) and people with Iranian and foreign nationality (OR = 1.29, 0.748 - 1.94). The results showed that contact with patients (OR = 7.09, 5.41 - 9.30) was the main related risk factor.

The present research showed that the reduced sense of smell (OR = 4.89, 1.86 - 12.87), respiratory distress (OR = 2.86, 2.23 - 3.66), positive CT scan (OR = 1.82, 1.05 - 3.16), muscular pain (OR = 1.63, 1.24 - 2.14), coughs (OR = 1.46, 1.14 - 1.86), and fever (OR = 1.45, 1.14 - 1.83) were the significant related symptom.

The odds ratio of background diseases in COVID-19 versus SARI patients is presented in Table 4. The present results showed that chronic pulmonary disease (OR = 2.369, 1.456 - 3.845), asthma (OR = 1.603, 1.040 - 2.473), and cardiovascular disease (OR = 1.455, 1.004 - 2.110) had the highest odds ratios of background diseases among COVID-19 cases compared to SARI.

## 5. Discussion

Hormozgan Province is located in the south of Iran and the north of the Persian Gulf and Oman Sea. It is marked by a population of 1,578,183 people and a geographical length of about 1,100 kilometers and an area of 70,000 square kilometers. Bandar Abbas is located near the center and is about 400 kilometers away from the farthest city in the east and 400 kilometers from the farthest city in the west.

In the present epidemiologic study, 2,055 patients participated who were diagnosed with SARI or COVID-19 and were hospitalized between January 21 and May 2020. The present research revealed that 181 (53.6%) COVID-19 patients were male, and 157 (46.4%) were female. Among SARI patients, these percentages were 52.9 and 47.1%, respectively. No statistically significant correlation was found between gender and the disease. The proportion of male to female participants afflicted with COVID-19 and SARI was 1.15 and 1.12, respectively, which is consistent with the related literature. In a study in China, men showed to be infected more than women (7, 15, 16). This is in line with the SARS and MERS research findings (17). Because the genome sequence of SARS-CoV-2 includes 79% of the SARS-CoV sequence, similar findings can be quite well expected (18). The above-mentioned results might indicate that men experience a more severe condition of the disease (19).

The present findings showed that 3.8% of COVID-19 patients were intubated. In China, almost 3.2% of patients with COVID-19 required intubation and invasive ventilation at certain stages of the disease, which agrees with the present findings (20). Moreover, in some research in China, 20% of patients were intubated. This inconsistency might be because the research was conducted on deceased cases (21).

The present research showed that the 31 - 40 age group and the 91 - 100 group comprised respectively 21.7% and .6% of the patients (i.e., the maximum and minimum rates). This is consistent with research carried out in the U.S. (22). However, in a study by Chen in Wuhan in China, the highest rate belonged to the 50 - 59 age group, which is not consistent with the present findings (23). It appears that the findings are well predictable according to the age distribution of these groups. A vast majority of school and university

**Table 1.** Gender Distribution of all Patients (COVID-19 and SARI) Visiting Hospitals in Hormozgan, Iran (February 20 to April 19, 2020)[a]

| Gender | COVID-19 | SARI | Total | P Value |
|---|---|---|---|---|
| **Male** | 181 (53.6) | 908 (52.9) | 1089 (53.0) | 0.822 |
| **Female** | 157 (46.4) | 809 (47.1) | 966 (47.0) | |

[a]Values are expressed as No. (%).

**Table 2.** Age Distribution of all Patients (COVID-19 and SARI) Visiting Hospitals in Hormozgan, Iran (February 20 to April 19, 2020) (P Value = 0.0001)[a, b]

| Age, y | COVID-19 | SARI | Total |
|---|---|---|---|
| **< 1** | 1 (0.3) | 28 (1.6) | 29 (1.4) |
| **1 - 5** | 1 (0.3) | 69 (4.0) | 70 (3.4) |
| **6 - 10** | 3 (0.9) | 33 (1.9) | 36 (1.8) |
| **11 - 20** | 12 (3.6) | 116 (6.8) | 128 (6.2) |
| **21 - 30** | 49 (14.5) | 319 (18.6) | 368 (17.9) |
| **31 - 40** | 100 (29.7) | 345 (20.1) | 445 (21.7) |
| **41 - 50** | 70 (20.8) | 187 (10.9) | 257 (12.5) |
| **51 - 60** | 49 (14.5) | 208 (12.2) | 257 (12.5) |
| **61 - 70** | 32 (9.5) | 199 (11.6) | 231 (11.2) |
| **71 - 80** | 14 (4.2) | 113 (6.6) | 127 (6.2) |
| **81 - 90** | 5 (1.5) | 89 (5.2) | 94 (4.6) |
| **91 - 10** | 1 (0.3) | 12 (0.7) | 13 (0.6) |
| **Total** | 337 (100) | 1718 (100) | 2055 (100.0) |

[a]Values are expressed as No. (%).
[b]Age range: 1 - 100 (42.8 ± 21.3.) years.

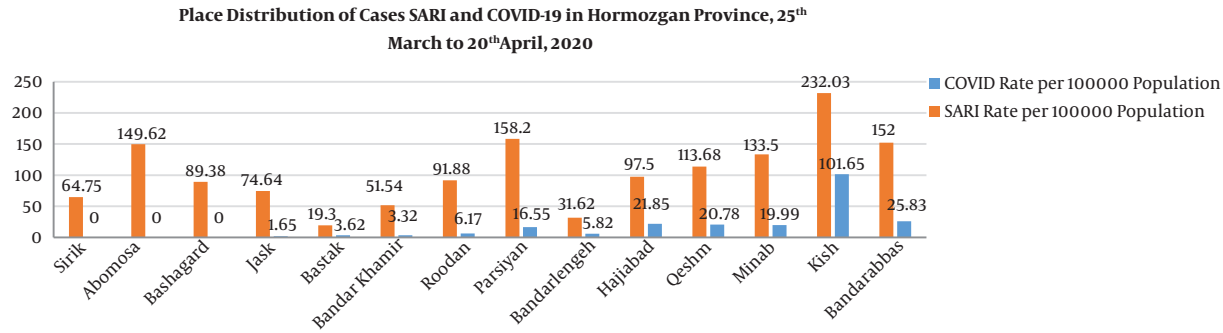


**Figure 1.** Spatial distribution of all cases (COVID-19 and SARI) in Hormozgan Province from February 20 to April 19, 2020

students are below 30 years of age, and social distancing is adhered to much more strictly in schools and universities (if not already closed). That is why the prevalence of the disease is lower in this age group. People between 31 and 40 years of age work outside the home and are thus more at risk. Furthermore, in the age group above 91 years, who are more at risk, there are more and more public warnings, and thus, the rate of the disease is lower among them.

The present research indicated that those with cardiovascular disorder, asthma, and chronic pulmonary background disease had the highest risk factor of COVID-19. Yet, in a study conducted in Iran, diabetes, cardiovascular disease, and hypertension, in sequence, showed to be the foremost risk factors (24). In another study of COVID-19 in 14 states in the U.S., hypertension, obesity, and metabolic disease showed to play a major role (22). In a relevant work

**Table 3.** Crude Odds Ratios (OR) of Some Correlates of COVID-19 Versus SARI[a]

| Factors | COVID-19 | SARI | P Value | OR | 95% CI | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| **Gender** | | | 0.822 | 1.02 | 0.813 | 1.29 |
| Male | 181 (53.6) | 908 (52.9) | | | | |
| Female | 157 (46.4) | 809 (47.1) | | | | |
| **Nationality** | | | 0.422 | 1.29 | 0.748 | 1.94 |
| Iranian | 317 (93.8) | 1590 (92.6) | | | | |
| Foreigner | 21 (6.2) | 127 (7.4) | | | | |
| **Contact with patients** | | | 0.000 | 7.09 | 5.41 | 9.30 |
| Yes | 142 (42) | 159 (9.3) | | | | |
| No | 196 (58) | 1558 (90.7) | | | | |
| **Fever** | | | 0.002 | 1.45 | 1.14 | 1.83 |
| Yes | 166 (49.1) | 686 (40) | | | | |
| No | 172 (50.9) | 1031 (60) | | | | |
| **Cough** | | | 0.002 | 1.46 | 1.14 | 1.86 |
| Yes | 220 (65.1) | 963 (56.1) | | | | |
| No | 118 (34.9) | 754 (43.9) | | | | |
| **Muscle pain** | | | 0.000 | 1.63 | 1.24 | 2.14 |
| Yes | 88 (26) | 305 (17.8) | | | | |
| No | 250 (74) | 1412 (82.2) | | | | |
| **Respiratory distress** | | | 0.001 | 2.681 | 2.234 | 3.664 |
| Yes | 229 (67.8) | 727 (42.3) | | | | |
| No | 109 (32.2) | 990 (57.7) | | | | |
| **Decreased consciousness** | | | 0.353 | 1.239 | 0.787 | 1.949 |
| Yes | (25) | 7.4 (104) | | | | |
| No | (313) | 92.6 (1613) | | | | |
| **Decrease Sense of smell** | | | 0.000 | 4.89 | 1.86 | 12.87 |
| Yes | 8 (4.5) | 9 (1) | | | | |
| No | 169 (95.5) | 931 (99) | | | | |
| **Decrease T sense of taste** | | | 0.644 | 1.69 | 0.176 | 16.34 |
| Yes | 1 (0.3) | 3 (0.2) | | | | |
| No | 337 (99.7) | 1714 (99.8) | | | | |
| **Convulsions** | | | 0.374 | 1.19 | 1.17 | 1.22 |
| Yes | 0 (0) | 4 (0.2) | | | | |
| No | 338 (100) | 1713 (99.8) | | | | |
| **Cigarette** | | | 0.231 | 0.489 | 0.148 | 1.16 |
| Yes | 3 (1.7) | 32 (3.4) | | | | |
| No | 174 (98.3) | 908 (96.6) | | | | |
| **Opium** | | | 0.925 | 1.038 | 0.478 | 2.253 |
| Yes | 8 (4.5) | 41 (4.4) | | | | |
| No | 169 (95.5) | 899 (95.6) | | | | |
| **Intubation** | | | 0.070 | 0.584 | 0.325 | 1.051 |
| Yes | 13 (3.8) | 110 (6.4) | | | | |
| No | 325 (96.2) | 11607 (93.6) | | | | |
| **PO2** | | | 0.446 | 0.822 | 0.638 | 1.219 |
| < 93 | 51 (15.1) | 288 (16.8) | | | | |
| > 93 | 287 (84.9) | 1429 (83.2) | | | | |
| **CT** | | | 0.030 | 1.827 | 1.055 | 3.165 |
| Positive | 83 (82.2) | 323 (71.6) | | | | |
| Negative | 18 (17.8) | 1128 (28.4) | | | | |

[a] Values are expressed as No. (%).

**Table 4.** Crude Odds Ratios (OR) of Several Chronic Diseases Correlating with COVID-19 Versus SARI[a]

| Chronic Disorders | COVID-19 | SARI | P Value | OR | 95% CI | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| **Cancer** | | | 0.167 | 0.443 | 0.135 | 1.452 |
| Yes | 3 (0.9) | 34 (2) | | | | |
| No | 335 (99.1) | 1683 (98) | | | | |
| **Diabetes** | | | 0.606 | 0.882 | 0.546 | 1.423 |
| Yes | 21 (6.2) | 120 (7) | | | | |
| No | 317 (93.8) | 1597 (93) | | | | |
| **Chronic liver disease** | | | 0.096 | NA | NA | NA |
| Yes | 0 (0) | 14 (0.8) | | | | |
| No | 338 (100) | 1703 (99.2) | | | | |
| **Chronic blood diseases** | | | 0.09 | 0.375 | 0.115 | 1.221 |
| Yes | 3 (0.9) | 40 (2.3) | | | | |
| No | 335 (99.1) | 1677 (97.7) | | | | |
| **HIV** | | | NA | NA | NA | NA |
| Yes | 0 (0) | 0 (0) | | | | |
| No | 338 (100) | 1717 (100) | | | | |
| **Immune deficiency** | | | 0.513 | 1.697 | 0.341 | 8.446 |
| Yes | 2 (0.6) | 6 (0.3) | | | | |
| No | 336 (99.4) | 1711 (99.7) | | | | |
| **Pregnancy** | | | 0.544 | 0.722 | 0.252 | 2.073 |
| Yes | 4 (1.2) | 28 (1.6) | | | | |
| No | 334 (98.8) | 1689 (98.4) | | | | |
| **Cardiovascular disease** | | | 0.047 | 1.455 | 1.004 | 2.110 |
| Yes | 40 (11.8) | 145 (8.4) | | | | |
| No | 298 (88.2) | 1572 (91.6) | | | | |
| **Chronic renal disease** | | | 0.422 | 0.704 | 0.297 | 1.666 |
| Yes | 6 (1.8) | 43 (2.5) | | | | |
| No | 332 (98.2) | 1674 (97.5) | | | | |
| **Dialysis** | | | 0.547 | 0.593 | 0.107 | 3.295 |
| Yes | 3 (50) | 27 (62.8) | | | | |
| No | 3 (50) | 16 (37.2) | | | | |
| **Asthma** | | | 0.031 | 1.603 | 1.040 | 2.473 |
| Yes | 29 (8.6) | 95 (5.5) | | | | |
| No | 309 (91.4) | 1623 (94.5) | | | | |
| **Chronic pulmonary disease** | | | 0.000 | 2.369 | 1.456 | 3.854 |
| Yes | 25 (7.4) | 56 (3.3) | | | | |
| No | 313 (92.6) | 1661 (96.7) | | | | |
| **Chronic neurological disorders** | | | 0.497 | 0.660 | 0.197 | 2.209 |
| Yes | 3 (0.9) | 23 (1.3) | | | | |
| No | 335 (99.1) | 1694 (98.7) | | | | |
| **Other chronic disorders** | | | 0.136 | 0.674 | 0.401 | 1.135 |
| Yes | 17 (5) | 125 (7.3) | | | | |
| No | 321 (95) | 1592 (92.7) | | | | |

[a]Values are expressed as no. (%).

of research in China, hypertension, diabetes, and cardiovascular diseases comprised the top factors involved in the mortality rate (21). This inconsistency is due to the different patterns of background diseases in different regions. Zhang et al. (15) in Wuhan, China, showed that hypertension, diabetes, and fatty liver were the main risk factors of

COVID-19. Chen et al. (23) in China indicated that cardiovascular diseases and diabetes were the primary risk factors of COVID-19. Wang showed that hypertension, diabetes, and cardiovascular diseases were the main risk factors (23). In a similar work of research, Huang reported diabetes, hypertension, and cardiovascular diseases as the main risk factors (7).

The present research revealed that the most common symptoms of COVID-19 were the loss of smell, muscular pain, coughs, and fever, which is consistent with a body of related research. Several studies were conducted in Wuhan, China, showing that fever, coughs, and shortness of breath were among the most common symptoms (7, 23). Wang et al. in China showed that fever, fatigue, and dry coughs were among the main symptoms (23). Another study in China indicated that fever, coughs, and expectoration were the most common symptoms of the disease, in sequence (25).

One strength of the present research is the large sample and accurate recording of the data in national systems by experienced researchers. This could increase the accuracy and precision of data analysis. Furthermore, an attempt was made to ensure the confidentiality of patient participants' information, which further added to the precision of data recording and more willing participation. One weakness of the resent research is the lack of a precise recording of some symptoms since the outbreak of the epidemic. Moreover, because of labeling COVID-19 patients and public fear, some people refrained from visiting hospitals and thus were not included in this research.

### *5.1. Suggestions for Further Research*

Research on mortalities and outpatients can help provide a more precise and complete picture of clinical manifestations, the trend of the disease, and risk factors. It is also suggested that further research be conducted in different demographic clusters to recognize social and cultural factors affecting the epidemic of this disease.

### *5.2. Conclusions*

The present findings showed a statistically significant correlation between age and affliction with COVID-10. Moreover, the most common symptoms of the disease were found to be the loss of smell, muscular pain, coughs, and fever, all already mentioned in the related body of literature. The present research showed that patients with cardiovascular disease, asthma, or chronic pulmonary disease had the most risk factors of COVID-19.

Therefore, it is recommended that the public be appropriately and adequately informed of background diseases and risk factors, as well as the most common symptoms of the disease, to visit hospitals or healthcare centers on time. As contact with patients showed to be the foremost risk factor of COVID-19, educational campaigns are required to encourage the public to stay home and avoid going out when not necessary. They need to be encouraged to avoid crowded places, wear masks, and adhere to social distancing. Macro-level planning and education are required, as the present research showed. As COVID-19 is considered a global threat to health, it still needs to be thoroughly investigated.

## Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

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## Footnotes

**Authors' Contribution:** The authors read and approved the final manuscript. Each author has contributed individually and significantly to the development of the manuscript.

**Conflict of Interests:** The authors declare no competing interests.

**Ethical Approval:** This study has a code of ethics that numbered HUMS.REC.1399.002 from the Vice-Chancellor for Research and Technology of Hormozgan University of Medical Sciences.

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**Informed Consent:** This study was performed using the information recorded in the hospital admission systems of patients with an acute respiratory infection, and there was no need for intervention on patients.

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