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# ORIGINAL: Correlation between Arterial Blood Oxygen Saturation, Underlying Diseases and Clinical Signs of COVID-19 Patients with Their Final Outcome

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**ABSTRACT**

**Introduction:** COVID-19 can rapidly cause lung damage and severe respiratory distress and subsequently reduce oxygen saturation (SPO2), especially in generally ill patients, which may be exacerbated if severe clinical symptoms or underlying diseases are added. This may lead to deterioration of blood oxygenation or even increase the risk of death when severe clinical symptoms or underlying diseases are present. Therefore, the aim of this study was to Evaluation of the relationship between arterial blood oxygen saturation level and outcome in COVID-19 patients.

**Material and Methods:** A cross-sectional study of 250 patients referred to Imam Sari Hospital with symptoms of respiratory infection, gastrointestinal, and general symptoms in January 2020 to September 2020. Data were analyzed using SPSS version 26.

**Results:** 27 out of 250 patients died. There is a positive correlation between systemic patient, SPO2 and less than 90% with death results (P<0/02). Patients with heart disease (44.4%), cancer (30.1%), diabetes (11.1%), cerebrovascular accident (18.5%) died (P<0/05). There was no positive correlation between weakness, fever, dyspnea, nausea, and diarrhea and appetite loss with death.

**Conclusion:** Based on the present study, it was found that patients whose clinical symptoms were associated with underlying disease and SPO2 to a severe and critical degree had a higher risk of adverse outcome such as death. People with underlying conditions such as DM, CVD, HTN, and a history of angiography and cancer are also more likely to die due to COVID-19. Most deaths in the present study had low SPO2 at before admission, indicating a strong association between patient mortality and severity of lung involvement and low SPO2.

## Introduction

COVID-19 broke out in Wuhan, China, in December 2019, affecting the global health, personnel, resources, and economies of most countries (1). Coronaviruses cause severe acute respiratory syndrome (SARS) (2, 3). The rate of spread of this virus is very high and it infects many people in a short time (4, 5). Since October

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29, 2020, more than 44 million people have been affected and more than 1.17 million deaths have been confirmed (6). This disease is caused by inhalation or touching nose, mouth and eyes. The duration of multiplication and pathogenesis has been reported to be 1 to 14 days (7, 8).

The clinical symptoms of the disease can range from asymptomatic to very severe (9). It may be accompanied by nonspecific and primary symptoms such as nausea, fatigue and body aches, headache, fever and chills, as well as cough, nausea and vomiting, diarrhea or abdominal pain, and in some cases may even be asymptomatic. Disease-related deaths with varying degrees of clinical symptoms have been reported (2). COVID-19 can rapidly cause lung damage and severe respiratory distress and subsequently reduce oxygen saturation (SPO2), especially in generally ill patients, which may be exacerbated if severe clinical symptoms or underlying diseases are added. This may lead to deterioration of blood oxygenation or even increase the risk of death when severe clinical symptoms or underlying diseases are present (10, 11).

Numerous studies have highlighted the importance of patients recovering from arterial hypoxia; Xie J et al (2020) found that an SPO2 above 90% combined with oxygen administration increased survival in patients with COVID-19 (12). Therefore, early identification of patients to increase SPO2 and administration of supplemental oxygen is of great importance. Information about the characteristics of COVID-19 patients who die is not clear (9). Therefore, the aim of this study was to Evaluation of the relationship between arterial blood oxygen saturation level and outcome in COVID-19 patients.

# Methods

## Study Design

A cross-sectional study of 250 patients referred to Imam Sari Hospital with symptoms of respiratory infection (fever and chills, runny nose, sore throat, shortness of breath, dry cough or sputum, sweating, etc.), gastrointestinal (nausea, vomiting, diarrhea, stomach pain, abdominal pain) and general symptoms (muscle pain, weakness and lethargy, headache, dizziness, and chest pain) in January 2020 to September 2020 after the approval of the Research Council of Mazandaran University of Medical Sciences and receiving the ethics code IR.MAZUMS.REC.1399.459 was done.

## Eligibility criteria

Inclusion criteria included COVID-19 based on clinical and the presence of lung involvement after approval by infectious disease specialists. A researcher-made questionnaire was used to collect data, which included demographic information and clinical signs of patients with underlying disease and SPO2 at intervals (Before admission, during hospitalization, and discharge time).

## Data collection

Demographic characteristics included age, sex, weight, marital status, history of smoking or opium use, level of education, clinical signs and underlying diseases. Saadat model pulse oximeter was used to measure SPO2. The severity of COVID-19 (according to the guidelines of the American Thoracic Society) is divided into three categories based on clinical symptoms and blood oxygen saturation; Critical: Patients with multiple clinical symptoms at the same time or severe weakness and lethargy with SPO2 less than 92% or decrease in level of consciousness; Severe: Patients with clinical signs of weakness and lethargy with SPO2 above 92%; Mild: Their SPO2 is also above 95% (11). Exclusion criteria included patients with good clinical condition (outpatient treatment).

## Statistical analysis

The mean ± standard deviation was used to describe the quantitative data, and the frequency and percentage were used for the qualitative data. The Kolmogorov-Smirnov test was used to assess the normality of the variables. The independent t-test, chi-square

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test, and Fisher's exact test were used to compare the results of groups. A P-value of less than 0.05 was considered statistically significant. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26 software.

## Results

Finally, 250 subjects were studied. The frequency of male patients was 137 (54.8%) and the rest were female. The mean length of hospital stay was 6.89 ± 5.4 days. 27 patients (10.8%) died, of which 15 were male and the rest were female (P = 0.93). The mean age of the patients was 57.3 ± 17 years. Examination of the correlation between SPO2 and final outcome at before admission, first day, middle and last day of hospitalization showed that mean SPO2 was significantly lower in deceased patients than in others (P< 0.05) (***Table 1***).

There was a positive association between death outcome and diseases such as cardiovascular disease (CVD), cancer, diabetes (DM), history of cerebrovascular accident (CVA) and also people with a history of appendectomy (P<0.05). Considering the fact that 37% of the deceased patients had hypertension (HTN) and 11.1% of them had immunodeficiency, there was no statistically significant difference (P<0.05). Fifty-five percent of the deceased had received a blood transfusion during hospitalization, and 48.1% had a central venous catheter (CVC). In addition, 14.8% of deceased patients had a chest tube, which was statistically significant (P<0.001). 81.5% of deceased patients were intubated (P<0.001). Of 250 patients, 25 required intubations, of whom 22 (88%) died and only 3 (12%) survived (P<0.001). Patients who were endotracheally intubated were significantly more likely to die than those who were not intubated, and those who required blood transfusions during hospitalization were also 10.7 times more likely to die (***Table 2***). Details of the relationship between the underlying disease and the final outcome of the patients were shown in ***Table 3***.

There was a significant relationship between those who died and some clinical symptoms. Clinical symptoms such as cough, fever, weakness and lethargy, myalgia showed a more prominent role and ***Table 4*** shows its details.

## Discussion

The main results of our study show that 27 (10.8%) of hospitalized patients died. The mortality rate was higher in males than females.

**Table 1. Relationship between mean SPO2 and final outcome frequency (percentage) at admission, first day of hospitalization, middle of hospitalization and last day of hospitalization**

| SPO2 | Complete recovery | Partial recovery | Discharge with personal consent | Death | P-Value |
|---|---|---|---|---|---|
| **Before admission** | 94.14 (4) | 91.9 (5.6) | 92.5 (2.4) | 88.6 (7.9) | 0.02 |
| **Without O2** | | | | | |
| 1st day of hospitalization | 94.1 (4.7) | 92.3 (4.8) | 92.3 (3.3) | 88.8 (7.3) | 0.01 |
| Middle of hospitalization | 97 (1.4) | 92.5 (3.2) | 93.3 (3) | 88.3 (5.4) | <0.001 |
| Last day of hospitalization | 97.8 (1.03) | 94.8 (2.3) | 93.2 (4.9) | 89.3 (7.5) | <0.001 |
| **With O2** | | | | | |
| 1st day of hospitalization | 98.1 (3) | 97 (7) | 96.1 (3.2) | 92.9 (0.4) | 0.03 |
| Middle of hospitalization | 99.9 (0.4) | 97.4 (3.1) | 97.36 (3.5) | 92.52 (5.05) | <0.001 |
| Last day of hospitalization | 100 | 98.91 (2.1) | 97.12 (4.3) | 85.6 (12.1) | <0.001 |

**Table 2. The result of logistic regression for the two variables of intubation and blood transfusion with patient death**

| | B | S.E. | Wald | P-Value | OR | 95%CI for OR | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| **Intubation** | 5.59 | 0.83 | 45.05 | 0.000 | 267.76 | 52.34 | 1369.82 |
| Blood transfusion | 2.37 | 0.83 | 8.07 | 0.005 | 10.71 | 2.09 | 54.99 |

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**Table 3. Relationship between the underlying disease in COVID-19 patients and the final outcome frequency (percentage)**

| Underlying disease | Complete recovery | Partial recovery | Discharge with personal consent | Death | P-value |
|---|---|---|---|---|---|
| **DM** | 1(14.3) | 60(29.9) | 4(26.7) | 3(11.1) | 0.04 |
| **HTN** | 0 | 66(32.8) | 8(53.3) | 10(37) | 0.09 |
| **immunodeficiency** | 1(14.3) | 12(6) | 2(13.3) | 3(11.1) | 0.48 |
| **Asthma** | 0 | 17(8.5) | 0 | 1(3.7) | 0.44 |
| **CVD** | 2(6/28) | 42(20.9) | 7(46.7) | 12(44.4) | 0.01 |
| **Angiography** | 0 | 18(9) | 5(33.3) | 3(11.1) | 0.02 |
| **CVA** | 0 | 7(3.5) | 2(13.3) | 5(18.5) | 0.007 |
| **COPD** | 0 | 3(1.5) | 1(6.7) | 0 | 0.39 |
| **Dyslipidemia** | 0 | 32(15.9) | 3(20) | 3(11.1) | 0.58 |
| **Renal disease** | 0 | 30(14.9) | 2(13.3) | 5(18.5) | 0.67 |
| **Cancers** | 0 | 12(6) | 1(6.7) | 8(30.8) | <0.001 |
| **Hypothyroidism** | 0 | 18(9) | 0 | 1(3.7) | 0.40 |
| **Cholecystectomy** | 0 | 5(2.5) | 2(13.3) | 1(3.7) | 0.13 |
| **Prostate surgery** | 0 | 13(6.5) | 0 | 1(3.7) | 0.62 |
| **Appendectomy** | 0 | 2(1) | 2(13.3) | 1(3.7) | 0.01 |
| **Blood transfusion** | 0 | 16(8) | 1(6.7) | 15(55.6) | <0.001 |
| **CVC** | 0 | 13(6.5) | 1(6.7) | 13(48.1) | <0.001 |
| **Chest tube** | 0 | 3(1.5) | 0 | 4(14.8) | 0.001 |
| **intubation** | 0 | 3(1.5) | 0 | 22(81.5) | <0.001 |
| **ICU admission** | 0 | 26(49.1) | 2(3.8) | 25(47.2) | <0.001 |

**Table 4. Relationship between the frequency (percentage) of clinical symptoms in COVID-19 patients and the final outcome**

| Symptoms | Complete recovery | Partial recovery | Discharge with personal consent | Death | P-Value |
|---|---|---|---|---|---|
| **Fever** | 5(71.4) | 132(66) | 9(60) | 13(50) | 0.41 |
| **Chills** | 3(42.9) | 88(44) | 7(46.7) | 5(19.2) | 0.11 |
| **Sweating** | 1(14.3) | 16(8) | 1(6.7) | 2(7.7) | 0.93 |
| **Headache** | 2(28.6) | 38(19) | 4(26.7) | 1(3.8) | 0.17 |
| **myalgia** | 4(57.1) | 75(37.7) | 6(40) | 2(7.7) | 0.01 |
| **Weakness and lethargy** | 3(42.9) | 86(43) | 9(60) | 12(42.6) | 0.64 |
| **Cough** | 3(42.9) | 117(58.5) | 9(60) | 7(26.9) | 0.02 |
| **Dyspnea** | 4(57.1) | 140(70) | 10(66.7) | 15(57.7) | 0.56 |
| **Loss of smell** | 0 | 7(3.5) | 1(6.7) | 0 | 0.63 |
| **Loss of taste** | 0 | 4(2) | 1(6.7) | 0 | 0.50 |
| **Nausea** | 2(28.6) | 67(33.5) | 4(26.7) | 6(23.1) | 0.70 |
| **Vomiting** | 2(28.6) | 61(30.7) | 3(20) | 6(23.1) | 0.73 |
| **Sore throat** | 1(14.3) | 10(5) | 2(13.3) | 0 | 0.21 |
| **diarrhea** | 1(14.3) | 29(14.5) | 4(26.7) | 6(23.1) | 0.46 |
| **Abdominal pain** | 0 | 20(10) | 1(6.7) | 5(19.2) | 0.35 |
| **Stomachache** | 1(14.3) | 1(0.5) | 0 | 0 | 0.01 |
| **Sputum** | 1(14.3) | 25912.5) | 4(26.7) | 1(3.8) | 0.20 |
| **Chest pain** | 0 | 35(17.5) | 4(26.7) | 4(15.4) | 0.48 |
| **anorexia** | 2(28.6) | 42(21) | 4(26.7) | 6(23.1) | 0.92 |
| **Vertigo** | 0 | 11(5.5) | 1(6.7) | 0 | 0.57 |

The incidence and mortality rate of this disease probably affects older men with various diseases and may lead to severe and even fatal respiratory diseases such as SARS as Ciceri et al, stated in their study that age is one of the major risk factors for death (13). Rezza and Zhou and colleagues from Italy, South Korea, China and the United States also reported a higher mortality rate in men in their study, which may be due to biological, cultural and behavioral reasons, weakened immune system and lower resistance. The body of the elderly may partially justify this (14, 15). This study shows that low social

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status increases the risk of viral disease. There was a positive correlation between low education level and deaths, which may be due to the fact that people with lower education are less aware of how to prevent and follow health protocols. This result is in line with the study of Jafarabadi et al (2). The present study showed that clinical symptoms such as dyspnea (67.7%), fever (63.6%) and cough (54.4%), weakness and lethargy (44%), chills (41.2%), nausea (31.6%) and vomiting (28.8%) have high prevalence and are considered effective clinical symptoms in COVID-19. In the study by Goyal et al, cough, fever, dyspnea, myalgia, diarrhea, nausea and vomiting accounted for the highest percentage of clinical symptoms, respectively (16).

Most patients with COVID-19 experience these clinical symptoms, and since the outcome of death is significantly associated with low SPO2 and lung involvement, it can be said that the outcome of death follows the clinical signs of lung involvement and SPO2. They also experienced lower blood pressure. The above findings were consistent with the study by Zhou et al., with the difference that there was no significant association between myalgia and cough in the study by Zhou et al. (17). Other important findings were shortness of breath and hypoxemia and a strong significant correlation. SPO2 > 90% was associated with in-hospital death, which was consistent with a study by Xie et al. (18). It seems that people with lower clinical symptoms and underlying diseases are more likely to die with SPO2, and since arterial blood oxygen saturation increases significantly with oxygen uptake in all outcomes. Therefore, it is recommended that patients are able to prevent disease progression and severity of lung involvement by visiting medical centers in a timely manner and receiving oxygen and medications early (18). Our findings also show that patients with heart disease, high blood pressure, and diabetes are at higher risk for developing COVID-19 (19). The death outcome in heart disease was 44.4% and this rate was 20.9% for patients with relative improvement. It should be noted that 11.1% of patients with death outcome had a history of angiography, which was consistent with the study of Ruan et al. (20). Also, 37% of the deceased had HTN and 32.8% of the patients had a partial recovery, and this value was zero for patients with complete recovery. In the study by Cunningham et al., 31.2% of deaths were due to HTN (21). Considering that in this study, no significant correlation was seen between the final outcome and HTN, but the present study shows a high percentage of people who died of HTN (19). 11.1% of the deceased had DM and this amount was 29.9% for patients who left the center with partial recovery and 14.3% for complete recovery, which indicates a positive correlation between DM and death. This study was consistent with the study of Yu et al. (22).

Therefore, it is recommended that more attention be paid to prevention and personal hygiene, isolation, social distance, and regular use of medications for CVD, HTN, and DM, as well as to the severity of clinical symptoms and underlying disease. It is noteworthy that 30.8% of patients with cancer were fatal, 6% of patients with partial recovery and this value was zero in patients with complete recovery, suggesting that cancer patients are weaker against COVID-19 infections and the body's ability to fight infections is lower. These individuals may have a worse post-disease condition and outcome, which is consistent with the study by Zhang et al. (23). It is recommended that cancer patients undergoing antitumor therapy be screened for COVID-19 infection as much as possible and avoid treatments that suppress the immune system, severe weakness and lethargy, and nausea and vomiting as much as possible. In case of infection, the drug dose should be reduced simultaneously with the disease.

## Conclusion

Based on the present study, it was found that patients whose clinical symptoms were associated with underlying disease and SPO2 to a severe and critical degree had a higher

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risk of adverse outcome such as death. People with underlying conditions such as DM, CVD, HTN, and a history of angiography and cancer are also more likely to die due to COVID-19. Most deaths in the present study had low SPO2 at before admission, indicating a strong association between patient mortality and severity of lung involvement and low SPO2. Early referral of patients with symptoms of respiratory distress may promote patient survival. Also, the high percentage of cancer deaths in the present study showed that cancer patients have worse condition and outcome in relation to COVID-19 infections and are much more susceptible.

### Ethical standards statement

This study was the result of a research project with ethics code IR.MAZUMS.REC.1399. 459 in 2020 in Mazandaran University of Medical Sciences.

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### Conflicts of interest

The authors declare no conflict of interest regarding publication of this article.

### Authors' contributions

All authors have intellectually committed to the study design and process. The final manuscript was revised and accepted by all authors.

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