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RISK FACTORS RELATED TO COVID-19 SURVIVAL AND MORTALITY: A CROSS-SECTIONAL-DESCRIPTIVE STUDY IN REGIONAL COVID-19 REGISTRY IN FASA, IRAN

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ABSTRACT

INTRODUCTION: The COVID-19 pandemic, as the most important health challenge in the world today, has made numerous irretrievable damages to the social, economic, and health dimensions of societies, especially in developing countries. An essential measure that can be taken to prevent and control the disease is to identify risk factors related to its prognosis and mortality rate. Therefore, this study aimed at investigating COVID-19 survival and mortality risk factors and their relationship with the demographic characteristics of the subjects diagnosed with the disease.

MATERIAL AND METHODS: The present study is cross-sectional and descriptive. The samples consist of 1395 patients diagnosed with COVID-19 admitted to medical centers affiliated with Fasa University of Medical Sciences. The subjects were selected by census sampling. Data were collected using demographic information forms, paraclinical and radiological tests, and clinical examinations. Data were analyzed using SPSS version 18 via descriptive tests, paired t-tests, one-way ANOVA, and post hoc tests.

RESULTS: According to the data, the participants' average age was 57.72 ± 4.63 years, and most of them (56.41%) were male. The mortality rate among the participants was estimated to be 13.19%. The results of the study showed a significant relationship between the survival status of patients with COVID-19 and underlying chronic diseases such as diabetes and cardiovascular and renal diseases ($p < 0.05$).

CONCLUSIONS: Identifying high-risk groups is an important measure that health professionals should consider in controlling epidemics. The findings of this study showed that the presence of underlying chronic diseases such as diabetes and cardiac and renal conditions, which are associated with immune system defects, are among the most important factors related to the COVID-19 mortality.

KEYWORDS: COVID-19; risk factors; survival status; underlying diseases

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INTRODUCTION

In December 2019, several cases of acute respiratory disease were reported, the first being in Wuhan City, Hubei Province, China [1, 2]. The disease, which was originally known as coronavirus pneumonia and was later called COVID-19, quickly spread from Wuhan to other parts of the world, to the extent that the World Health Organization declared the COVID-19 outbreak a global pandemic [3].

The virus, called SARS-CoV-2, is transmitted by respiratory droplets that symptomatic patients release when coughing and sneezing, but may also be transmitted by asymptomatic carriers before symptoms begin. Although the virus has been observed in clinical specimens like the tears and feces of positive patients with COVID-19, the transmission of the disease through the mouth, feces, or conjunctiva is still contested. Studies have shown higher viral loads in the nasal cavity than in the throat, with no difference in viral loads between symptomatic and asymptomatic individuals [4, 5]. The incubation period of the SARS-CoV-2 can reach up to 14 days with a median of 2.5 days. Almost all patients experience one or more symptoms within 5–12 days of contracting the virus [6].

The COVID-19 clinical symptoms are heterogeneous and range from mild symptoms such as fever, dry cough, and shortness of breath to acute respiratory distress syndrome (ARDS) which may ultimately lead to death. Moreover, an asymptomatic period has also been reported, which poses a challenge to controlling the infection [7, 8].

Given the complexity of its transmission and lack of established treatments, COVID-19 is highly challenging at the global level [9, 10]. This is particularly catastrophic for middle- and low-income countries with low levels of health literacy, weak health care system, and insufficient critical care facilities [11].

Although many countries have started vaccination, considering the complicated nature of the virus, new variants have been emerging in different parts of the world [12] indicating the importance of addressing all dimensions of the COVID-19 pandemic and the related health challenges.

Based on global reports, clinical characteristics and health status of COVID-19 patients are important factors affecting their recovery and mortality rate [13]. Despite unsparing efforts by researchers and experts to better understand the diagnostic and clinical features of the disease, our current understanding of mortality risk factors in patients with COVID-19 is still limited [14, 15]. Such risk factors are not widely identified, and many have remained in a state of uncertainty. Therefore, considering the importance of identifying risk factors and their role in adopting prevention, treatment, and rehabilitation programs and strategies, this study also aimed at determining COVID-19 mortality risk factors and the patient's demographic characteristics.

MATERIAL AND METHODS

The current study is cross-sectional, descriptive, and analytical. The research population included all the COVID-19 patients in the city of Fasa in 2020–2021.

Sample size and sampling method

The sampling was carried out based on census. All patients with COVID-19 admitted to the medical centers of Fasa University of Medical Sciences who were registered in the COVID-19 System were invited to participate in the study. A total of 1395 people entered the study.

Procedure

After the proposal was approved by the Research Deputy of the university and received the code of ethics permission from the university's Research Committee, the researcher referred to the university's Treatment Deputy to carry out the study. The participants' demographic and clinical data extracted from the COVID-19 system were analyzed. Moreover, in order to obtain precise clinical information, the researcher referred to the medical centers affiliated with the university and examined the participants from admission to discharge or death.

Data collection instruments

A demographic information questionnaire, paraclinical data, and clinical examinations were used to collect data in this study.

Demographic information questionnaire

The questionnaire included personal information (age, sex, marital status, place of residence, education, occupation, illness duration, and history of physical illness).

Paraclinical data

Paraclinical data included the results of all tests performed by the relevant specialists for the participants

Table 1. The relationship between survival status and demographic characteristics of the participants

Variable n (%)		Survival status				p value
		Death		Survival		
		Percentage	Number	Percentage	Number	
Age		15.1	71.98	18.73	55.55	< 0.001
Gender	Female	42.9	79	43.7	529	0.45
	Male	57.1	105	56.3	682	
Marital status	Single	0	0	1.3	16	0.10
	Married	100	184	98.7	1195	
Education	Illiterate	45.7	84	26.2	317	< 0.001
	Below High School Diploma	21.7	40	19	230	
	High school Diploma	26.6	49	38.2	463	
	High School Diploma and above	6	11	16.6	201	
Smoking	No	40.8	75	36.7	445	0.16
	Yes	59.2	109	63.3	766	
Alcohol consumption	No	40.2	74	36.3	440	0.17
	Yes	59.8	110	63.7	771	

during the treatment period. The participants' radiology test results were also analyzed. All laboratory results were collected using hospital electronic records. Reverse transcriptase polymerase chain reaction (RT-PCR) was performed on nasopharyngeal samples, which precisely describe the characteristics of the diagnostic kit. In summary, total RNA was extracted using High Pure RNA Isolation (Roche Diagnostics, Penzberg, Germany). RT-PCR for coronavirus genes was performed with Taqman® Premix TAKARA (TaKaRa, Dalian, China) according to the manufacturer's recommended protocol.

Clinical examinations

The results of vital sign assessment and the state of body systems monitored by medical professionals during hospitalization or visits to medical centers were analyzed.

Data analysis

SPSS version 18 was used for data analysis. Descriptive statistics indicators including frequency, percentage, mean, and standard deviation as well as inferential statistics such as; independent t-test, Chi-square, and ANOVA, were used to analyze the data. Logistic regression was used to determine the risk factors associated with COVID-19 contracting and mortality and the confounding factors. A p value less than 0.05 ($p \leq 0.05$) was considered as statistically significant.

Ethical approval

Informed written consent was obtained from all the participants before participating in the study. The present study was conducted in accordance with the principles of the revised Declaration of Helsinki, a statement of ethical principles, which directs physicians and other participants in medical research involving human subjects. The participants were assured about the anonymity and confidentiality of their information Moreover, the study was approved by the local Ethics Committee of Fasa University of Medical Sciences, Fasa, Fars province, Iran (Ethics code: IR.FUMS.REC.1400.151)

RESULTS

The participants in the current study included a total number of 1395 patients with COVID-19 who were registered in the COVID System. According to the data, the participants' average age was 57.72 ± 4.63 years, and most of them (56.41%) were male. The mortality rate among the participants was estimated to be 13.19%. Data analysis did not show any significant difference between gender, marital status, smoking, and alcohol consumption in regard to their relationship with the participants' survival status (Tab. 1).

Results also indicated a significant difference ($p < 0.05$) between the survival status of people

Table 2. The relationship between survival status and underlying diseases of the participants

Variable n (%)		Survival status				p value
		Death		Survival		
		Percentage	Number	Percentage	Number	
Diabetes	Yes	29.3	54	8.5	103	< 0.001
	No	70.7	130	91.5	1108	
Cardiovascular diseases	Yes	54.3	100	11.3	137	< 0.001
	No	45.7	84	88.7	1047	
Chronic renal disease	Yes	37	68	3.1	37	< 0.001
	No	63	116	96.9	1174	
Chronic hepatic disease	Yes	2.2	4	0.3	4	0.01
	No	97.8	180	99.7	1207	
Autoimmune diseases	Yes	2.2	4	0.2	3	0.007
	No	97.8	180	99.8	1208	
Cancer	Yes	0	0	0.2	3	0.65
	No	100	184	99.8	1208	
Chronic pulmonary disease	Yes	1.1	2	0.7	9	0.43
	No	98.9	182	99.3	1202	
ICU admission	Yes	67.4	124	19.7	238	< 0.001
	No	32.6	60	80.3	973	

ICU — intensive care unit

with COVID-19 and underlying diseases such as diabetes, cardiovascular diseases, chronic renal diseases, and autoimmunity as well as hospitalization in the ICU department ($p < 0.05$). There was no significant difference between cancer, organ transplant, and chronic pulmonary diseases in terms of their relationship with the survival status of COVID-19 patients (Tab. 2).

There was a significant relationship between the survival status of patients and symptoms of fever, chills, muscle pain, sore throat, shortness of breath, nausea, diarrhea, and cough (new or exacerbation of chronic cough) ($p < 0.05$). However, the relationship was not significant for runny nose, abdominal pain, and anosmia (Tab. 3).

According to results, survival status was significantly related to levels of hemoglobin O_2 saturation, hemoglobin, platelet count, urea nitrogen, creatinine, white blood cells, lymphocytes, and neutrophils in the blood ($p < 0.0001$), but its relationship with sodium and potassium levels was not significant. The relationship between mortality and hemoglobin O_2 saturation, cardiovascular diseases, chronic renal disease, hypoxemia symptoms, and hospitalization in the ICU was significant in the presence of other variables ($p < 0.05$) (Tab. 4).

DISCUSSION

The purpose of the present study was to investigate risk factors of COVID-19 infection and related mortality and demographic characteristics in 1395 patients at Fasa University of Medical Sciences. Initial results indicated that the mortality of COVID-19 patients was significantly related to diabetes, cardiovascular diseases, chronic renal diseases, and chronic hepatic diseases. Most patients who died after contracting SARS-CoV-2 had reported diabetes, cardiovascular diseases, and chronic renal disease. In the same vein, the results of a retrospective study conducted by Wostyn et al. [13] found that the most frequent common comorbidities observed in COVID-19 patients were diabetes mellitus (48.26%) and hypertension (45.27%). Therefore, it can be concluded that inflammatory conditions, diagnosis with concomitant diseases, especially uncontrolled diabetes mellitus, and the use of steroids were associated with long-term hospitalization.

Diabetic patients are at a higher overall risk of infection because they are more likely to suffer from multiple innate immune defects. Since overall mortality from cardiovascular diseases is decreasing among diabetic patients, pneumonia with various pathogens has become an important mortality risk

Table 3. The relationship between survival status and clinical symptoms of the participants

Variable n (%)		Survival status				p value
		Death		Survival		
		Percentage	Number	Percentage	Number	
Fever	Yes	78.3	144	54.3	658	< 0.001
	No	21.7	40	45.7	553	
Shivering	Yes	91.8	169	78.3	948	< 0.001
	No	8.2	15	21.7	263	
Muscular pain	Yes	77.2	142	43.1	522	< 0.001
	No	22.8	42	56.9	689	
Runny nose	Yes	7.1	13	8	97	0.39
	No	92.9	171	92	1114	
Sore throat	Yes	75.5	139	68.4	828	0.02
	No	24.5	45	31.6	383	
Shortness of breath	Yes	92.9	171	71.8	870	< 0.001
	No	7.1	13	28.2	341	
Nausea	Yes	19	35	6.8	82	< 0.001
	No	81	149	93.2	1129	
Stomachache	Yes	84.2	155	78.2	947	0.03
	No	15.8	29	21.8	264	
Diarrhea	Yes	12.5	23	2.8	34	< 0.001
	No	87.5	161	97.2	1177	
Cough (new or exacerbation of chronic cough)	Yes	20.1	37	4.5	55	< 0.001
	No	79.9	147	95.5	1156	
Dry cough	Yes	21.2	39	57	690	< 0.001
	No	78.8	145	43	521	
Productive cough	Yes	58.7	108	14.7	178	< 0.001
	No	41.3	76	85.3	1033	
Anosmia	Yes	48.4	89	1.6	19	< 0.001
	No	51.6	95	98.4	1192	

factor in these patients. There is currently no consensus on whether people with diabetes are more vulnerable to COVID-19, but it is assumed that they are at a greater risk of infection, severe illness, and death. For example, the first three COVID-19 deaths in Hong Kong all occurred in diabetic patients [16]. On the other hand, COVID-19 patients, especially those with severe respiratory complications, are faced with an increased risk of mortality. In addition, COVID-19 not only can progress to a severe acute respiratory syndrome, but also can disrupt the proper functioning of other organs (such as the heart, kidneys, and liver), indicating the need for special care in these patients [17]. Therefore, it can be concluded that the results of the present study are consistent with the results of the mentioned studies.

The results of a review study conducted by Gao et al. [18] showed cases of acute kidney damage in COVID-19 patients. Evidence has shown that the virus can directly cause kidney damage. This damage can be attributed to changes in the amount of oxygen in the body, which can be harmful to the kidneys. These results are in line with the results of the present study.

Other results of the study showed a significant relationship between the COVID-19 patients' survival status and symptoms of fever, chills, muscle pain, sore throat, shortness of breath, nausea, diarrhea, and dry or productive cough (new or exacerbation

Table 4. The relationship between survival status and paraclinical data of the participants

Variable	Survival status						p value
	Death			Survival			
	Standard Deviation	Mean	Number	Standard Deviation	Mean	Number	
O_2 Sat	7.38	78.04	160	4.06	90.13	1073	< 0.001
HB	2.3	12.23	184	1.89	12.72	1211	0.007
PLT	84.42	182.74	177	91.30	208.76	1194	< 0.001
BUN	33.27	37.14	182	12.82	17.51	1171	< 0.001
Cr	1.36	1.73	178	2.39	1.21	1154	< 0.001
Na	21.90	129.90	179	15.99	131.86	1111	0.25
WBC	5.18	9.45	174	4.49	7.10	1177	< 0.001
Lym	7.47	12.15	166	15.14	21.88	1164	< 0.001
Neut	9.08	82.54	159	30.90	72. 29	1093	< 0.001

O2 Sat — Oxygen saturation; HB — Hemoglobin; PLT — Platelets; BUN — Blood urea nitrogen; Cr — Creatinine; Na — Sodium; WBC — White blood cells; Lym — lymphocytes; Neut — Neutrophils

of chronic cough). Thus, patients who reported more respiratory symptoms were in a more unfavorable condition. The mentioned results are consistent with that of Wang et al. [17] who reported high mortality for COVID-19 patients, especially those with severe respiratory complications and low levels of oxygen saturation. Long-term hyperpyrexia indicates intracellular inflammatory reactions, which is considered an unfavorable prognosis in affected patients. On the other hand, hepatic involvement in COVID-19 can be related to the direct cytopathic effect of the virus, uncontrolled immune responses, sepsis, or drug-induced liver injury. The proposed mechanism of SARS-CoV-2 entry into cells is through angiotensin-converting enzyme 2 (ACE2) receptors, which are abundant in alveolar type II cells. ACE2 receptors are mostly expressed in the digestive system, vascular endothelium, and Cholangiocytes of the liver, causing fever, muscle pain, and digestive problems [19].

The results of the study showed no significant relationship between survival status and gender, marriage, smoking, and alcohol consumption. Likewise, Chadeau et al. [20] found that male sex, lower education level, and non-white ethnicity were associated with the risk of contracting COVID-19. In this regard, the results of a case-cohort study by Mirjalili et al. [21] conducted in Iran showed that mortality was higher in the case group and elderly people compared to other patients. They recommended that special attention be given to at-risk and elderly patients in terms of providing proper diet, strengthening self-care, and providing long-term medical and healthcare facilities. Older patients with lymphopenia, hypomagnesemia, high CRP, and/or high creatinine upon admission are at a higher risk of mortality from COVID-19 infection, showing the need for timely and strong treatment measures for this age group by healthcare professionals [22]. Another study found an association between the male gender and lower education level with the risk of contracting COVID-19 [20]. These results are inconsistent with the results of the present study. This discrepancy can be attributed to the fact that the current study is a cross-sectional study and can only show a correlation among variables, while the mentioned studies are cohort-based and longitudinally designed with a higher ability to determine cause and effect relationships. In this regard, an all-embracing systematic review study is recommended to pinpoint points of consensus in the results of such studies.

Study limitation

The literature on coronavirus continues to accumulate, with new information and new papers published each day; therefore, our study cannot be considered exhaustive and might not recognize the possible other factors that affect COVID-19 mortality.

Strength of study

Although many studies have been conducted in the field of COVID-19 in other countries, the study based on the COVID -19 registry with large sample size is limited. One of the strengths of the present study is the large sample size and the use of data from the COVID-19 registry.

CONCLUSIONS

According to the results of the present study, a history of underlying chronic diseases including diabetes and cardiovascular, renal, and hepatic diseases was the most important risk factor related to the survival status of COVID-19 patients. Given the nature of these diseases and their negative effects on the immune system, they expose COVID-19 patients to more severe complications leading to a higher mortality rate. Therefore, it is essential that healthcare professionals and managers consider preventive measures and programs with a higher level of efficiency for these patients. This is particularly important given that lack of a multidimensional approach to the problem in question can put the lives of the affected people at risk. Moreover, it can incur huge economic costs for the healthcare system society. Therefore, it seems that identifying target groups and providing necessary training to them to prevent infectious diseases such as Covid-19 will be the most important and first necessary action. This requires an all-round and collaborative action by all people in the healthcare team, including nurses, physicians, and healthcare professionals.

Article information and declarations

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Conflict of interests

There are no conflicts of interest.

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