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The Survival Rate and Its Related Factors in Hospitalized Covid-19 Patients in Fars Province in the South of Iran: A Hospital-Based Historical Cohort Study (2019 – 2022)

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Abstract

Background: The outbreak of the Covid-19 has been a serious threat to the health and lives of many people. This study aimed to determine the survival rate and its contributing factors in Covid-19 patients who were hospitalized in hospitals in Fars province.

Materials and Methods: This study is a hospital-based carried out on 119429 of Covid-19 hospitalized patients in the south of Iran within 2019 – 2022. Information of demographics and clinical characteristics, symptoms, and comorbidity of patients were extracted from medical records. The Kaplan–Meier curve and the Log rank test were used to compare survival rate in different groups. Cox regression was employed to determine the factors that affect survival.

Results: The mean age of the participants was 51.5 year. The density incidence of death was estimated to be 16.8, 4.6, and 43.9 per 1000 person-days for all of patient, intensive care unit patients, and intubated patients, respectively. The Multiple Cox Regression results suggested that risk of mortality is 5.61 times higher in patients over 75 years, 3 times higher in patients admitted to the intensive care unit, and 3.4 times higher in intubated patients. Also, the risk of mortality was higher in men and those with underlying disease.

Conclusion: We found out that being elder, being a male, hospitalization in the intensive care unit, and being intubated would increase the risk of mortality. Thus, it is treatment management of hospitalized patients is necessary, especially elderly patients and those with underlying diseases.

Keywords: Survival, Covid-19, Mortality, Risk Factors, Iran.

Introduction

The outbreak of the Covid-19 has been a serious threat to the health worldwide [1, 2], which was first discovered in the late December of 2019 in Wuhan, China [3]. As a highly communicable virus, Covid-19 spread all over the world in a short period of time [4], in a way that it infected 53,0961,822 people in the world until 5/28/2022 and led to the death of 6309729 people. In Iran, 7625463 people have been infected and 146757 died because of Covid-19 Until January 12, 2024 [5]. This is why the outbreak of Covid-19 has become a major health problem [2].

The disease caused by the Covid-19 virus usually leads to Influenza-like pneumonia, shortness of breath, and diminished saturation of oxygen levels in blood [3], and its clinical symptoms range from an asymptomatic, mild state to a broad, severe state [6]. The epidemiologic studies have reported that 80% of patients usually have mild symptoms of the disease and recover without the need of hospitalization as well as medical interventions [7], while 6-10% manifest severe symptoms of the disease, with the need to be hospitalized in ICU and use ventilator devices [8]. Further, the risk of mortality has

been reported higher in patients with severe form of the disease [7].

The overall mortality rate due to Covid-19 has been reported to be 0.25% [7] and various epidemiologic studies have introduced multiple factors affecting the overall mortality such as older age, gender, and the presence of underlying diseases such as cardiovascular diseases, the duration of hospitalization, being in the ICU, and intubation [2, 9-11]. Despite all of these, older age and the presence of comorbidities are two major risk factors for contracting the severe form of the disease and having higher mortality chances [12].

Although the survival rate of Covid-19 is high, identification of the factors that affect mortality is necessary in order to reduce it in subsequent waves. Heretofore, numerous studies have been conducted to recognize the determinants of the survival of Covid-19 patients [13]; Although so far some studies have identified factors affecting the survival of these patients, most of them have been conducted in small samples and have examined a limited number of variables affecting the disease. Meanwhile, while conducting studies in different regions of the world, on a large number of people can have an essential role in determining strategies for reducing mortality and in determining the priorities for the prevention as well as the control of Covid-19. Thus, this study was done to estimate the mortality rate and determine the factors affecting mortality in hospitalized patients in Fars province in the south of Iran.

Materials and Methods

This study is a hospital-based historical cohort study which performed on Covid-19 positive patients who were hospitalized in the hospitals operating under supervision of Shiraz University of Medical Sciences (SUMS) between 1/19/2020 and 3/6/2022. In general, the information related to the patients of about 40 hospitals from almost 30 cities of Fars province was collected, among which 10 hospitals were the referral centers for Covid-19. Fars province is located in the south of Iran. During the time of the study, 119429 patients diagnosed with the Covid-19 virus were under treatment in the hospitals considered as the Covid-19 treatment centers, who were followed up from the time of hospitalization to their discharge, and their survival status at discharge time or death during the hospitalization was recorded. Survival of patients is defined as improvements in the general condition and respiratory symptoms, not having a fever for at least 3 days, improved chest X-RAY scan, and having the minimum of at least one negative throat and nasal swab test result.

Diagnostic criteria: Patients with positive PCR test, or patients with clinical symptoms such as fever and respiratory problems who also had a history of contact with other Covid-19 patients were considered as cases of Covid-19. In addition, patients with clinical symptoms who also had signs of changes in chest CT scan imaging were considered as Covid-19 positive patients as well. The conditions of patients at the time of admission were checked and registered based on the guidelines and protocols of World Health Organization (WHO) plus the Ministry of Health, Treatment and Medical Education.

All required data in this study were extracted using the portal system of SUMS center of management, control and prevention of Covid-19. In this system, all the information of hospitalized patients plus outpatients who visited the Covid-19 medical centers under the control of SUMS are registered accurately according to the national guideline. The information used in this study include: the demographics such as age, gender, smoking and opium use, occupation (health/non-health sector), together with the clinical and hospital-related information (PCR test result, performance of chest CT scan, being intubated, and being hospitalized in the ICU). Further, the clinical symptoms of patients such as cough, fever, headache, dizziness, nausea, respiratory distress, myalgia, anosmia, ageusia, anorexia, and underlying diseases such as cardiovascular diseases, diabetes, hypertension, chronic kidney disease, chronic liver disease, asthma, and cancers were also investigated.

The outcome variable in this study was the survival status and death of patients during their hospitalization. Patients who did not meet the intended outcome (death) were considered as right censor. Quantitative variables were described with mean and standard deviation while qualitative variables with numbers and percentage. Chi-square test or Fisher's exact test was used to check the difference of qualitative variables in two groups of survivors and non-survivors. The density incidence of the death was calculated based on person-day, for the gender and some other variables, separately. In addition, the Kaplan-Meier curve was drawn to check the survival rate in both men and women, between ICU and non-ICU patients, intubated and non-intubated patients, as well as for different age groups. The differences in the survival rate in these groups were investigated with the Log rank test. The Cox Regression model was employed in order to identify mortality predictor variables. First, univaraite Cox Regression model was applied for all variables in the study. Finally, for controlling the confounding variables, multiple cox regression model was applied for all variables with a p-value of 0.2 or lower. The proportional hazard assumption (PH) for all variables was tested based on the scaled Schoenfeld residuals. All analyses were performed in Stata statistical software version 13. The level of significance was considered 0.5 for all variables.

Results

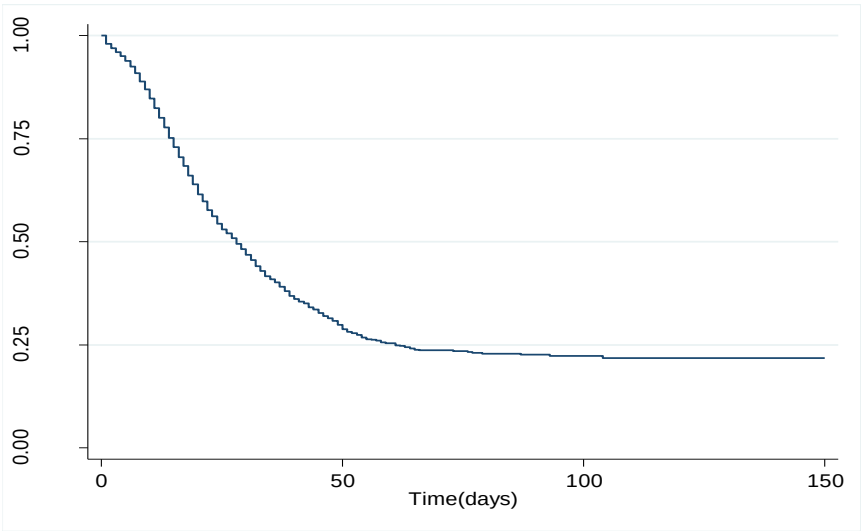
The density incidence of death in patients under study: The current study was carried out on 119429 hospitalized patients. The mean age of the patients in this study was 51.56±21.47 years, with women being 51.57±21.02 years, and men 51.56 ± 21.89. Men consisted 51.4% of the participants and with 10732 (9%) deaths occurring during the study. All patients in the study were followed-up for 636588 person-days and the density incidence was estimated 16.85 per 1000 person-days. The density incidence was calculated 15.22 per 1000 person-days for men and 18.33 per 1000 person-days for women, 4.6 per 1000 person-days for ICU patients, and 43.9 per 1000 person-days for intubated patients (Table1).

Table 1. Density incidence of death among Covid19 patients hospitalized in Fars Province (2019-2022)

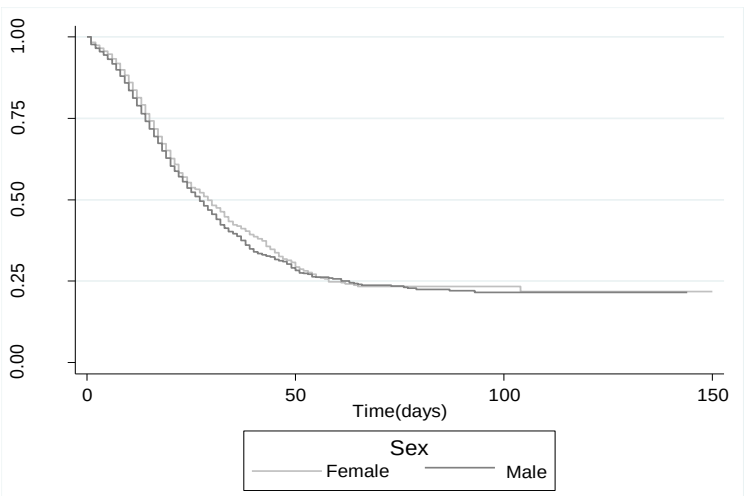
Variable		Faloow up by person-days	Cases of death	Density incidence (95% CI)	Log-rank test (Chi2,P-value)
Sex	**Women**	302595	4608	15.22(14.79-15.67)	**74.46(<0.0001)**
	Men	333993	6124	18.33(17.88-18.79)	
Age	**<25**	54368	233	4.2(3.7-4.8)	**3649(<0.0001)**
	25-49	192663	1411	7.3(6.9-7.71)	
	50-74	288076	5316	18.4(17.9-18.4)	
	>75	101481	3772	3.7(3.6-3.8)	
Intubated		81320	4031	4.9(4.8-5.1)	**9748(0.0001)**
Hospitalized in the ICU		110102	5162	4.6(4.5-4.8)	**2277(<0.0001)**
Total		636588	10732	16.85(16.54-17.17)	-

Fig. 1 illustrates the Kaplan-Meier curve for the survival of all patients based on gender, age groups, ICU hospitalization status, and intubation status. As manifested, the risk of mortality was higher in men than women, in those over 75-year age group than other age groups, in the ICU patients, and in the intubated patients. Furthermore, the Log rank statistical test was suggestive of a significant statistical difference in the risk of mortality of men ($p<0.0001$), older age groups ($p.v<0.0001$), ICU patients ($p<0.0001$), and intubated patients ($p<0.0001$, Chi2=9748) (Table 1). From all the 10732 deaths that occurred during the study, 8804 (82%) happened within the first 15 hospitalization days and 1524 (14.2%) took place between the 15th and 30th day of hospitalization. According to the results of the life table, the survival rate in the first 15 days was calculated as 87%.

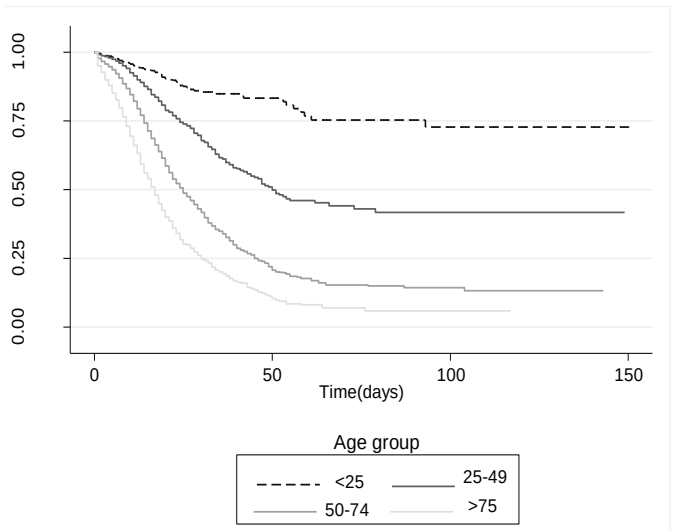
The demographic, clinical and hospital-related characteristics of Covid-19 patients: The characteristics of men and women have been examined separately in terms of mortality and survival in Table 3. As can be interpreted, the number of deaths in the 50-74 age group has been significantly higher in women (50.5%) and men (39.5%) than in other age groups. The prevalence of hospitalization in ICU (39.3%) and intubation (48.5%) was significantly higher in women who died during the study period than in survivors. Moreover, In Non-Survival men, 36.2% were hospitalized in ICU and 47.6% were intubated in men who survived. Further, 94.5% of the non-survival women and 94.1% of the non-survival men had radiological evidence of lung involvement, which was significantly higher than that in the surviving group. The most common symptoms in the non-survival women were respiratory distress (71.3%), cough (32.4%), and fever (24.8%), and in men were respiratory distress (70.9%), cough (32.55%), and fever (26.5%). The prevalence of cardiovascular diseases (23.85), hypertension (39.9%) and diabetes (27.8%) was higher in the non-survival women than in the surviving women. These diseases were also more prevalent in men (Table 2).



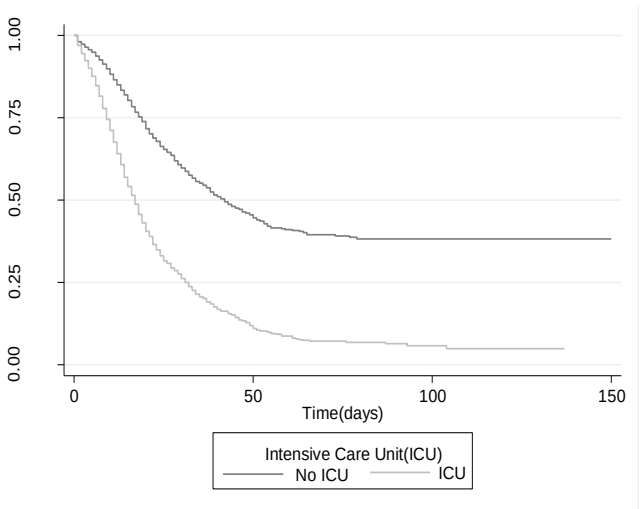
(A): Total Patients



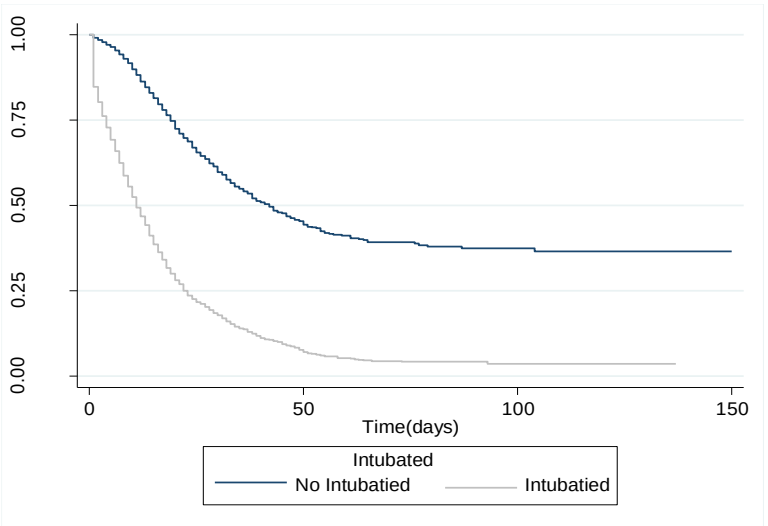
(B): Gender



(C): Age group



D) Hospitalization in the ICU



(E): Intubated

Fig. 1. Kaplan Meier survival curve in Covid-19 paietant by (A): Total paietant (B): gender, (C): age group, (D): Hospitalization in the ICU, and (E): intubated in Shiraz Province (2019-2022)

Table 2. General characteristics, symptoms and underlying disease in Covid-19 paiteaint in the survival and non-survival groups by gender in Fars Province (2019-2022)

Variable		Women(N=58008)				Men(N=61422)			
		Survival (N=53399)	Non-Survival (N=4608)	Total	P-value	Survival (N=55298)	Non-Survival (n=6124)	Total	P-value
Age group	<25	5575(10.4)	105(2.3)	5680(9.8)	0.0001	6505(11.8)	128(2.1)	6633(10.8)	0.0001
	25-49	19124(35.8)	610(13.2)	19734(34)		19878(35.9)	801(13.1)	20679(33.7)	
	50-74	22226(41.6)	2325(50.5)	24551(42.3)		21507(38.9)	2991(48.8)	24498(39.9)	
	>75	6474(12.1)	1568(34)	8042(13.9)		7408(13.4)	2204(36)	9612(15.6)	
Smoking		323(0.61)	30(0.65)	353(0.61)	0.7	2103(3.5)	271(4.43)	237(3.8)	.0018
Opium user		399(0.75)	76(1.6)	475(0.82)	0.0001	23117(4.2)	335(5.4)	2652(4.3)	0.0001
ICU		3950(7.4)	1813(39.3)	5763(9.9)	0.0001	4258(7.7)	2218(36.2)	6476(10.5)	0.0001
Intubated		1738(3.2)	2243(48.6)	3981(6.8)	0.0001	2362(4.2)	2919(47.6)	5281(8.6)	0.0001
PCR positive		24268(43.4)	2781(32.5)	27049(42.5)	0.0001	24114(45.3)	3600(33)	27714(44.05)	0.0001
Health worker		469(1.08)	11(0.29)	480(1.8)	0.0001	402(0.91)	23(0.47)	425(0.86)	0.0001
Close contact		2118(39.5)	1650(35.8)	22768(39.2)	0.0001	19991(36.1)	2147(35.06)	22138(36.04)	0.0001
CT positive		28451(9)	3227(94.5)	31678(92.2)	0.0001	30578(91.3)	4163(94.1)	3474(91.3)	0.0001
Symptom									
Fever		18747(35.1)	1143(24.8)	19890(34.2)	0.0001	20700(37.4)	1628(26.5)	22328(36.3)	0.0001
Cough		23909(44.7)	1494(32.4)	25403(43.7)	0.0001	23546(42.5)	1992(32.5)	25538(41.5)	0.0001
Myalgia		17234(32.2)	1004(21.7)	18238(31.4)	0.0001	16426(29.7)	1164(19)	17590(28.6)	0.0001
Respiratory distress		2355(44.1)	3273(71.3)	26829(46.2)	0.0001	25003(45.2)	4344(70.9)	29347(47.7)	0.0001
Anosmia		662(1.24)	18(0.39)	680(1.17)	0.0001	520(0.94)	26(0.42)	546(0.89)	0.0001
Ageusia		426(0.8)	18(0.39)	444(0.77)	0.002	301(0.55)	24(0.39)	325(0.53)	0.11
Nausea		4937(9.4)	260(5.6)	5197(9.14)	0.0001	3759(6.9)	255(4.2)	4014(6.6)	0.0001
Vomiting		3333(6.3)	194(4.24)	3527(6.2)	0.0001	3017(5.58)	197(32)	3214(5.3)	0.0001
Diarrhea		2180(4.17)	118(2.5)	2298((4.04)	0.0001	2396(4.4)	104(1.7)	2500(4.16)	0.0001
Anorexia		5169(9.8)	430(9.4)	5599(9.8)	0.28	5212(6.9)	505(8.3)	5717(9.5)	0.0001
Headache		6657(12.8)	263(5.8)	6920(12.28)	0.0001	5864(10.9)	265(4.4)	6129(10.2)	0.0001
Dizziness		2098(4.05)	110(2.45)	2208(3.9)	0.0001	2035(3.8)	142(2.3)	2177(3.6)	0.0001
Underlying disease									
Cancer		1969(3.6)	278(6.03)	2247(3.8)	0.0001	2481(4.4)	393(4.4)	643(1.05)	0.0001
Cardiovascular disease		6077(11.3)	1097(23.8)	7174(12.3)	0.0001	6332(11.4)	1381(22.5)	7713(12.56)	0.0001
Diabetes		8204(15.3)	1283(27.8)	9487(16.1)	0.0001	6137(11.1)	1219(19.9)	7356(11.9)	0.0001
Hypertension		11822(22.1)	1838(39.9)	13660(23.6)	0.0001	8374(15.1)	1722(28.13)	10096(16.48)	0.0001
Chronic kidney disease		1148(2.1)	259(5.6)	1407(2.4)	0.0001	1519(2.75)	362(5.9)	1881(3.06)	0.0001
Chronic liver disease		340(06)	74(1.61)	414(0.71)	0.0001	502(0.91)	141(2.3)	643(1.05)	0.0001
Asthma		1446(2.7)	152(3.3)	10598(2.75)	0.01	1057(1.9)	118(1.9)	1175(1.9)	0.93

The predictors of death in patients with Covid-19: Based on the univariate Cox regression results, age, gender, positive PCR test, hospitalization in ICU, being a health worker, symptoms such as fever, cough, respiratory distress, abdominal pain, nausea, diarrhea, headache, dizziness, intubation status, opium use, anosmia, nausea, myalgia, as well as underlying diseases such as diabetes, chronic kidney diseases, chronic liver diseases, and cardiovascular diseases were identified as predictors of mortality in Covid-19

patients. After performing the multiple Cox regression to control the confounders, the results revealed that after old age, intubation is the strongest risk factor for death in these individuals, so that the risk of mortality in those who were intubated was 3.4 times higher than those who were not (HR: 3.4 95% CI: 3.22-3.64). Further, the risk of mortality in patients with radiological evidence of lung involvement was 1.5 times higher than the patients without lung involvement (HR: 1.5 95% CI: 1.35-1.74), and in those who were admitted to the ICU, it was 1.3 times higher than the patients who were hospitalized in other wards (HR: 1.24 95% CI: 1.17-1.35). The results also indicated that as age increased, so did the risk of mortality in patients, in a way that risk of mortality of patients over 75 was 5.61 times higher; in patients between 50-74 years, it was 2.89 times higher; and in patients between 25-50 years, the rate was 1.6 times higher compared to the patients under 25 years ($p<0.0001$). In terms of the clinical symptoms, risk of mortality in patients with respiratory distress was 1.36 times higher, than among patients without respiratory distress. However, having a fever, cough, and headache were identified as protective factors against mortality caused by Covid-19. The results of this study indicated that having underlying diseases such as cardiovascular disease, cancer, diabetics, chronic kidney diseases, and chronic liver diseases increased the risk of mortality in patients (Table 3).

Table 3. Predictors of death in Covid-19 paietant in Fars Province (2019-2022)

Variable		Univariate cox regression			Multvariate cox regression		
		HR	**95%CI**	**P-value**	**HR_{adj}**	**95%CI**	**P-value**
Age group	**<25**		1			1	
	25-49	1.8	1.57-2.07	0.0001	1.61	1.21-2.15	0.0001
	50-74	4.4	3.86-5.02	0.0001	2.89	2.18-3.83	0.0001
	>75	8.7	7.68-10.02	0.0001	5.61	4.24-7.44	0.0001
Sex	**Female**		1			1	
	Male	1.18	1.13-1.22	0.0001	1.07	1.01-1.13	0.007
ICU	**No**		1			1	
	Yes	2.58	2.48-2.66	0.0001	1.43	1.35-1.52	0.0001
Intubated	**No**		1			1	
	Yes	5.94	5.71-6.18	0.0001	3.42	3.22-3.64	0.0001
PCR	**Negative**		1			1	
	Positive	1.39	1.33-1.45	0.0001	1.24	1.17-1.32	0.0001
CT positive	**Negative**		1			1	
	positive	1.57	1.42-1.73	0.0001	1.53	1.35-1.74	0.0001
Symptom							
Fever	**No**		1			1	
	Yes	0.63	0.6-0.66	0.0001	0.86	0.81-0.92	0.0001
Cough	**No**		1			1	
	Yes	0.72	0.69-0.75	0.0001	0.87	0.82-0.92	0.0001
Respiratory distress	**No**		1			1	
	Yes	2.19	2.1-2.2	0.0001	1.36	1.27-1.44	0.0001
Headache	**No**		1			1	
	Yes	0.52	0.48-0.57	0.0001	0.77	0.68-0.86	0.0001
Underlying disease							
Cancer	**No**		1			1	
	Yes	1.12	1.03-1.21	0.005	1.28	1.13-1.44	0.0001
Cardiovascular disease	**No**		1			1	
	Yes	1.87	1.79-1.95	0.0001	1.15	1.08-1.23	0.0001
Diabetes	**No**		1			1	
	Yes	1.5	1.43-1.57	0.0001	1.12	1.06-1.2	0.0001
Chronic kidney disease	**No**		1			1	
	Yes	1.49	1.37-1.62	0.0001	1.38	1.23-1.55	0.0001
Chronic liver disease	**No**		1			1	
	Yes	1.35	1.18-1.55	0.0001	1.4	1.35-1.75	0.002

Discussion

The current study was performed on 119429 Covid-19 patients who were admitted to the hospitals under the operation of SUMS. In this study, the survival rate and survival-related factors in patients were evaluated. The mean age of patients was 51 years where higher age,

being a male, hospitalization in ICU, intubation, positive PCR test, cardiovascular diseases, diabetes, chronic kidney diseases, chronic liver diseases, and respiratory distress were identified as risk factors of increased risk of mortality in Covid-19 patients.

The density incidence was estimated to be 16.8 cases per 1000 person-days. In Italy, the density incidence rate was estimated as 11 cases per 1000 person-days, which in line with our study, was higher in men than women (12.05 in men vs. 9.3 in women per 1000 person-days) [14]. In another study performed in Ethiopia on 422 hospitalized patients with an average age of 41 years, the density incidence was estimated as 6.5 cases per 1000 person-days, which was very different from our study [7]. This difference can be due to the larger sample size in addition to the higher mean age of the participants in the current study. Furthermore, the mortality rate of Covid-19 in the patients under study was estimated to be 9%, which was in line with the rate estimated in Mexico as 9.4% [2] (20 from 38) and India as 8.1% [15], and close to the estimated mortality rate in Ethiopia which was 11.1% (3.8) and New York in USA which was 13.1% [16]. However, it was lower compared to the estimated mortality rate in some countries like Italy with an estimated mortality rate of 25.2% [17] and Belgium with an estimated mortality rate of 29.9% [18]. The differences in the mortality rates in different parts of the world depend on various factors including differences in the age composition of populations, the prevalence of comorbidities in different parts of the world, differences in the number of diagnostic tests performed, the capacity of hospital admissions, the method for identifying and diagnosing patients, and the capability of health care systems [3, 14].

In the current study, the survival rate of patients was 87% within the first 15 days of the hospitalization while the mortality rate was 23%. In line with this study, a study in Italy reported the mortality rate as 22% in the first 14 days of the hospitalization [14] and in Ethiopia, it was estimated to be 22% in the first 14 days [8]. Murillo-Zamora et al. estimated that the mortality rate of patients admitted in the first 14 days is 47.6% [6]. Sousa et al. reported a mortality rate of 23% in the first 24 days and a survival rate of 87% [10].

It was shown that the risk of mortality was higher in the older patients in the current study. Approximately half of the women who lost their lives due to Covid-19 were between 50 and 74 years old and 34% were over 75 years old. Also, 48.8% of non-survival men were between 50 and 74 years old and 36% were over 75 years old. In line with our study, many other studies have shown that the probability of survival in the older age groups was lower [3, 4, 19-22]. In Mexico, women aged between 50 and 74 had a 2.3-fold higher risk of mortality and men aged between 50 and 74 had an 8.77-fold higher risk of mortality [2]. The risk of mortality was 15.4 times higher in men over 75 years old [2]. Murillo-Zamora et al also reported a higher risk of mortality in patients over 60. In the Ethiopian study, the risk of mortality in patients over 64 was estimated as 2.5 times higher [7]. The reason for the higher mortality at older ages could be due to the dysfunction of T cells and B cells as well as the overproduction of cytokine type 2 which leads to a reduction in the immune system's response to the viral replication, as well as increased long-term inflammatory responses which lead to increased mortality [11, 23]. These results may indicate that older patients infected with Covid-19 need to receive more specific and better treatment resources [24].

Men had a higher mortality risk than women in our study, which was consistent with the results of many other survival studies [2, 6, 25]. A meta-analysis study also indicated that the risk of mortality is higher in men than women [8]. It seems that some immunological and biological aspects in men can play an important role [26]. Men usually have a weaker immune system and visit medical centers to receive medical care less than women do [3]. However, the role of cultural and behavioral factors should not be overlooked. Due to working outdoors, men are more exposed to infected people than women, which increases the risk of infection. Hormones can also be another reason for this.

In this study, patients who were admitted in the ICU and intubated patients had lower survival rates. Specifically, 39.3% of non-survival women and 36.2% of non-survival men were admitted to the ICU while 48% of non-survival women and 47% of non-survival men were intubated. Similar to our results, lower survival rates were reported in other studies in these groups [27, 28]. In the Mexican study, the risk of mortality was 2.8 times higher in intubated women and 1.4 times higher in intubated men [2]. In Florida, the duration of the hospitalization and the risk of mortality were higher in these group of patients [8]. This may be due to the fact that these people have a severe form of the disease and their immune system regulation plus immune response are disrupted, which increases their mortality. Failure to regulate the autoimmune response in these individuals may be the result of a cytokine storm. This is because an increase in cytokines can lead to increased lung damage and consequently increased mortality [7].

In the current study, patients with fever, cough, and headache had a lower risk of mortality, while those with respiratory distress had a higher risk of mortality. However, this can be due to the impact of different pandemic waves and changes in Covid-19 strains as well as its role in the onset of mild and severe symptoms.

Cardiovascular diseases, chronic kidney diseases, chronic liver diseases, diabetes, and cancer also increase mortality and lower survival. The prevalence of these diseases in non-survival men and non-survival women

was 64.8% and 55%, respectively, the most common of which were cardiovascular diseases, followed by diabetes. The highest risk of mortality was seen in patients with underlying cardiovascular diseases (1.8 times). Studies in China and Fortaleza have also reported a higher mortality due to Covid-19 risk in patients with underlying cardiovascular disease [1, 10]. Murillo-Zamora as well as Eshrati and colleagues also reported a higher risk of mortality in patients with underlying diabetes [3, 6]. In addition, studies in Mexico, Ethiopia, and Iran have identified renal and hepatic disease as an independent and strong risk factor for lower survival in patients with Covid-19 [3, 6]. Notwithstanding, comorbidities affect the autoimmune responses and metabolic stresses that characterize these diseases, reducing the ability to respond to pathogens [7]. In patients with renal diseases, SARS-Covid- 2 adheres to their epithelial cells and disturbs the balance of acid-base and electrolyte homeostasis, resulting in the mortality of these individuals. The role of the angiotensin-converting enzyme 2 in myocardial cells and cardiac endothelial cells should also be considered [2]. Elevated levels of troponin I and D are other factors that exacerbate the disease and increase mortality in these individuals [3].

Our study was a historical cohort study which examined a large proportion of people and had a higher sample size than many other studies. In addition, patients' information was collected accurately under the supervision of the Corona Committee of Fars Province. However, we did not have access to the exact date when the symptoms began and we did not know the patients' condition after their discharge.

Conclusion

The risk of mortality was higher in older patients, men, patients hospitalized in the ICU, and intubated patients, as well as patients with underlying diseases such as cardiovascular diseases, diabetes, chronic kidney diseases, and chronic liver diseases. Thus, careful control and proper care for these patients is essential. Due to the persistence of the disease, the need to provide the necessary equipment for the treatment of patients, especially the elderly and patients with underlying diseases is necessary to avoid poor prognosis of the disease and its adverse consequences. The results of this study will help health policy makers develop effective strategies to reduce mortality caused by Covid-19.

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Ethical Considerations

This study has been in agreement with the Helsinki declaration and Iranian national guidelines for ethics in research, with informed written consent also obtained from all participants.

Code of Ethics

This study was approved by the Ethics Committee of Shiraz University of Medical Sciences with code IR.SUMS.REC.1399.068.

Authors' Contributions

AM and LM did the research, wrote the manuscript, and contributed to data collection. LM and MRK critically reviewed the manuscript and approved the final version. SSD and LM did the research, analyzed the data, and critically reviewed and edited the manuscript. All authors have read and approved the man.

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