Chronic Diseases Journal

DOI: 10.22122/cdj.v12i2.895 Published by Vesnu Publications

Prevalence of long-term complications of COVID-19 infection in patients with underlying disease

Anvar Mohamadi[1], Hana Khosravi[2], Nasrin Moghimi[3], Ezatollah Rahimi[4]

1 Department of Internal Medicine, School of Medicine, Kurdistan University of Medical Sciences, Sanandaj, Iran
2 Department of Internal Medicine, School of Medicine, Kurdistan University of Medical Sciences, Sanandaj, Iran
3 Department of Internal Medicine, School of Medicine AND Clinical Research Development Unit, Kowsar Hospital, Kurdistan University of Medical Sciences, Sanandaj, Iran
4 Department of Internal Medicine, School of Medicine, Kurdistan University of Medical Sciences, Sanandaj, Iran

Original Article

Abstract

BACKGROUND: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is still a health problem worldwide. As our current knowledge about the interaction of various underlying diseases and their management in COVID-19 mortality is gradually evolving, the current study investigated the complications and outcomes of COVID-19 up to 1 year after infection in individuals with underlying diseases.

METHODS: In a retrospective cohort study, 725 patients with COVID-19 (414 women and 311 men) who had a history of specific diseases were selected and included in the study. The medical records of COVID-19 patients admitted to Kowsar Hospital, Iran, with cancer, kidney disease, history of organ transplant, history of cerebrovascular accident (CVA), and rheumatic diseases between 2020 and 2021 were investigated. In order to collect information about the condition of the patients and the complications, the patients were contacted until 1 year after contracting COVID-19. For analytical purposes and hypotheses, the chi-square t-test and analysis of variance (ANOVA) were used. Data analysis was performed in Stata software.

RESULTS: The most common underlying diseases among hospitalized patients were rheumatic diseases (28.3%), followed by cancer (25.5%), and a history of CVA (16.6%). Despite the treatment, 241 patients (33.2%) died, and 96 of them (13%) died after being discharged from the hospital.

CONCLUSION: The results of the present study showed that decrease in appetite and increase in the duration of hospitalization can be predictors of the probability of death after COVID-19 infection in patients with a history of the studied underlying diseases.

KEYWORDS: COVID-19; Long-term Complications; Rheumatic Diseases

Date of submission: 26 Oct. 2023, ***Date of acceptance:*** 04 Apr. 2024

Citation: Mohamadi A, Khosravi H, Moghimi N, Rahimi E. **Prevalence of long-term complications of COVID-19 infection in patients with underlying disease.** Chron Dis J 2024; 12(2): 130-9.

Introduction

Coronaviruses are the largest known ribonucleic acid (RNA) viruses[1] that are capable of infecting the respiratory system, digestive system, liver, and central nervous system. The new human coronavirus (COVID-19) disease, which is caused by the acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is now considered the most important health concern.[2,3]

The disease has a wide range of symptoms, varying from asymptomatic disease to pneumonia and life-threatening complications, including acute respiratory distress syndrome (ARDS), multi-organ failure, and finally, death.

Corresponding Author:
Ezatollah Rahimi; Department of Internal Medicine, School of Medicine, Kurdistan University of Medical Sciences, Sanandaj, Iran
Email: ezatrahimi258@gmail.com

The mortality rate of COVID-19 has varied from 0.27 to 10%.[4] COVID-19 is primarily a respiratory disease, mainly associated with pneumonia or minor upper respiratory tract symptoms. However, different organs can suffer significant damage due to the coronavirus. Acute kidney injury (AKI) is the most common complication associated with COVID-19 pneumonia, and more than 20% of patients requiring ventilation develop some degree of kidney failure. In addition, chronic kidney disease is a major risk factor for the severity and mortality of COVID-19.[5] Moreover, the complications and risk of this disease are higher for elderly people and patients with a previous history of underlying diseases and respiratory or cardiovascular diseases (CVDs). Due to the fact that patients with end-stage renal disease (ESRD) usually have other chronic systemic diseases such as hypertension, diabetes, and CVDs, they are at risk of severe COVID-19 infection and mortality.[6,8]

Among the patients who have always received attention in the health system in many countries are patients with underlying medical condition.[9] The health management of patients with primary illness one of the serious challenges of health policymakers. These diseases have always taken up a significant part of health resources due to their chronic nature, lack of definitive treatment, very high treatment costs, and the need for complex technologies and treatments.[9,10] Due to their nature, underlying diseases have complex challenges for treatment; thus, the readiness of the healthcare system to deal with such cases is vital and important. Therefore, it seems necessary to identify the complications of COVID-19.

The pandemic caused by COVID-19 has caused human casualties and serious health concerns in Iran and the world. This disease is a new and emerging disease, and there are limited studies on the complications caused by this disease, especially in certain patients. The current study investigated the prevalence of long-term complications of COVID-19 infection in patients with underlying disease.

Methods

This retrospective cohort study was performed on patients with underlying diseases, including cancer, kidney disease, organ transplant, history of cerebrovascular accident (CVA), and rheumatic diseases, who were hospitalized in Kowsar and Tohid Hospitals in Sanandaj, Kurdistan Iran, between May 2020 and May 2021 due to COVID-19.

Inclusion criteria: all patients with specific diseases, including cancer, kidney, and organ transplant patients, as well as patients with a history of CVA, and patients with rheumatological diseases who were infected with COVID-19 (with a definite diagnosis by PCR) and were hospitalized.

Exclusion criteria: negative PCR, emigration and leaving the province, and lack of consent to participation.

In previous studies, the prevalence of certain diseases in patients due to COVID-19 patients estimated to be about 20%. Based on this, the sample size for this study was at a 95% confidence interval (CI), and error of one-tenth of the sample was about 614 people, of which and 725 people were examined in this study.

$$n = \frac{Z_{1-\alpha/2}{}^2 \times P \times (1-P)}{(d)^2} = \frac{1.96^2 \times 0.20 \times (1-0.20)}{(0.1)^2} = 614$$

First, demographic and clinical information were collected, follow-up was conducted by internal residents, and medical records of all people with a history of specific diseases affected by COVID-19 were examined. If the patient had died, their medical file information was extracted and recorded. Then, they were contacted in order to follow up and find out about the condition of the patients and the complications until 1 year after the disease. If necessary, they were invited to the hospital

clinic for further examination and investigations. Each patient was examined during hospitalization and up to 1 year after infection in terms of possible complications and various outcomes such as transplant rejection, recurrence of malignancy, exacerbation and recurrence of rheumatic diseases, exacerbation of CVA, and exacerbation of blood diseases such as anemia or thrombocytopenia, and death.

In this study, quantitative variables were presented as mean and standard deviation, and qualitative variables as numbers and percentages. Moreover, for analytical purposes and hypotheses, chi-square and t-test, and analysis of variance (ANOVA) were used if normality assumptions were established, and non-parametric equivalent tests were used otherwise. Statistical analyses were performed in Stata software (version 14; StataCorp, College Station, TX, USA). P-values of less than 0.05 were considered statistically significant.

The information of all patients will be kept confidential by the project manager. The trial was approved by the Research Council of the Faculty of Medicine (IR.MUK.REC.1401.040).

Results

In this study, 725 patients with COVID-19 (414 women and 311 men) who had a history of underlying diseases were selected and included in the study. The mean ± standard deviation (SD) of age of the patients in the study was 57.22 ± 17.6 years (16 to 110 years). In addition, 45% of them were over 60 years of age, 48% were between 20 and 60 years of age, and only 7% of patients were under 20 years of age. About half of the patients (50%) were unemployed (unemployed-housewives-retired) and 2.5% of the employed were medical personnel. According to the findings of this study, the most common underlying diseases among hospitalized patients were rheumatic diseases (28.3%), cancer (25.5%), and CVA history (16.6%). Hospitalization in the intensive care unit (ICU) was reported in 7.2% and the need for ventilation in 10.5% of patients. Furthermore, 10.6% of patients were vaccinated against coronavirus.

Among the patients, 134 (18.5%) were infected with COVID-19 again within a year, and 33 patients (4.6%) needed to be hospitalized again due to worsening symptoms or lack of recovery.

Finally, 241 patients (33.2%) died despite treatment; 145 (20%) patients died in the hospital and another 96 (13%) died after discharge from the hospital. Of the deceased people, 28.2% had rheumatic diseases, 26.6% had cancer, 17% a history of CVA, 13.3% a history of chronic kidney disorders (CKDs), 10% a history CVDs, 1.4% a history of thyroid disorders, and < 1% had a history of organ transplantation.

Of the patients under investigation, 205 had a history of rheumatic diseases. Their average age was 56.77 ± 17.34 years (22 to 110 years). Furthermore, 43% of them were over 60 years of age and 60% of them were women. About 11% of them were vaccinated against the coronavirus. The most common clinical symptoms of these patients were shortness of breath (54%), loss of appetite (49%) and cough (48%). The need for special care and the use of ventilation in these patients was found to be 8.8% and 11.2%, respectively. Based on the follow-up carried out for 1 year after COVID-19 infection, the disease relapsed in 61 of them (38%), 46 people (29%) needed to change their medicine, and 56 patients (35%) had to increase the dose of the drug. Finally, 68 patients (33.2%) died; 44 (21.5%) patients died in the hospital and another 24 (11.7%) died after discharge from the hospital.

Demographic and clinical characteristics of COVID-19 patients with a history of cancer showed that 185 of the patients under investigation had a history of cancer. Their average age was 57.72 ± 17.82 years (19 to 106 years); moreover, 47% of them were over 60

years of age and 56% of them were women. About 9% of them were vaccinated against COVID-19. The most common clinical symptoms of these patients were shortness of breath (62%), cough (45%) and loss of appetite (42%). The need for special care and the use of ventilation in these patients were 5.4% and 9.2%, respectively. In the follow-up carried out for 1 year after COVID-19 infection, no recurrence of malignancy was observed in the patients. However, 49 people (32.2%) needed to change their medicine and the dosage of the medicine used by 75 patients (49.7%) was changed. Finally, 64 patients (34.6%) died; 33 (17.8%) patients died in the hospital and another 31 (16.8%) died after discharge from the hospital.

Demographic and clinical characteristics of COVID-19 patients with a history of CKDs showed that 90 patients had CKDs. Their average age was 55.77 ± 18.21 years (18 to 85 years), 41% of them were over 60 years of age, and 56% of them were women. About 12% of them were vaccinated against the coronavirus. The most common clinical symptoms of these patients were shortness of breath (69%), cough (41%), and loss of appetite (39%). The need for special care and the use of ventilation in these patients was 5.6% and 12.2%, respectively. Among these patients, 28 (31.1%) had a history of hemodialysis; during the follow-up conducted for 1 year, another 15 patients (17%) needed hemodialysis. Finally, 32 patients (35.6%) died; 18 (20%) patients died in the hospital and another 14 (15.6%) died after discharge from the hospital.

Demographic and clinical characteristics of COVID-19 patients with a history of CVA showed that 120 patients had a history of CVA. Their average age was 57.21 ± 16.96 years (21 to 99 years), 42% of them were over 60 years of age, and 51% of them were women. About 11% of them were vaccinated against the coronavirus. The most common clinical symptoms of these patients were shortness of breath (63%), loss of appetite (52%), and cough (42%). The need for special care and the use of ventilation in these patients were 8.3% and 6.7%, respectively. Follow-ups for 1 year after COVID-19 infection demonstrated that the clinical conditions of 52 patients (54.7%) had worsened, 30 patients (31.6%) needed to change their medicine, and the dosage of the medicine used by 49 people (51.6%) was changed. Finally, 41 patients (34.2%) died; 25 (20.8%) patients died in the hospital and another 16 (13.3%) died after discharge from the hospital (Table 1).

Demographic and clinical characteristics of COVID-19 patients with a history of CVD showed that 71 of the patients had a history of CVD. Their average age was 58.23 ±17.40 years (23 to 99 years), 48% of them were over 60 years of age, and 55% of them were women. About 13% of them were vaccinated against the coronavirus. The most common clinical symptoms of these patients were found to be loss of appetite (70%), followed by shortness of breath (63%) and cough (52%). The need for special care and the use of ventilation in these patients were 0.7% and 12.7%, respectively. A 1-year follow-up after COVID-19 infection revealed that the clinical conditions of 11 patients (20.4%) had worsened, 26 people (48.1%) needed to change their medicine, and the dosage of the drug was changed in 37 patients (68.5%). Finally, 24 patients (33.8%) died; 17 (23.9%) patients died in the hospital and another 7 (9.9%) died after discharge from the hospital (Table 1).

Demographic and clinical characteristics of COVID-19 patients with a history of organ transplantation showed that 12 people had a history of organ transplantation. Their average age was 59.58 ± 13.24 years (40 to 88 years), 50% of them were over 60 years of age, and 58% of them were women. About 8% of them were vaccinated against coronavirus. The most common clinical symptoms of these patients were shortness of breath (58%), weight loss (45%), and loss of appetite (33%) (Table 1).

Table 1. Comparison of clinical and demographic characteristics of COVID-19 patients with different underlying diseases

	Rheumatic diseases	Cancer	CVD	CVA	CKD	Organ transplant	P
Age (years)	56.77 ± 17.34	57.72 ± 17.82	58.23±17.4	57.21 ± 16.96	55.77 ± 18.21	59.58 ± 13.24	
Gender							0.380
Female	123 (60.0)	104 (56.2)	39 (54.9)	61 (50.8)	50 (55.6)	7 (58.3)	
Male	82 (40.0)	81 (43.8)	32 (45.1)	59 (49.2)	40 (44.4)	5 (41.7)	
Hospital stay (days)	4.35 ± 2.64	4.50 ± 2.65	4.51 ± 2.76	4.48 ± 2.58	4.57 ± 2.24	3.83 ± 1.40	
Need ICU							0.790
Yes	18 (8.8)	10 (5.4)	5 (7.0)	10 (8.3)	5 (5.6)	1 (8.3)	
No	187 (91.2)	175 (94.6)	66 (93.0)	110 (91.7)	85 (94.4)	11 (91.7)	
Need for ventilation							0.310
Yes	23 (11.2)	17 (9.2)	9 (12.7)	8 (6.7)	11 (12.2)	4 (33.3)	
No	182 (88.8)	168 (90.8)	62 (87.3)	112 (93.3)	79 (87.8)	8 (66.7)	
Vaccination							0.960
Yes	22 (10.7)	16 (8.6)	9 (12.7)	13 (10.8)	11 (12.2)	1 (8.3)	
No	183 (89.3)	169 (91.4)	62 (87.3)	107 (89.2)	79 (87.8)	11 (91.7)	
Mortality							0.730
Yes	68 (33.2)	64 (34.6)	24 (33.8)	41 (34.2)	32 (35.6)	2 (16.7)	
No	137 (66.8)	121 (65.4)	47 (66.2)	79 (65.8)	58 (64.4)	10 (83.3)	
Shortness of breath	111 (54.1)	114 (61.6)	45 (63.4)	76 (63.3)	62 (68.9)	7 (58.3)	0.330
Cough	99 (48.3)	83 (44.9)	37 (52.1)	51 (42.5)	31 (41.1)	4 (33.3)	0.650
Sore throat	36 (17.6)	24 (13.0)	10 (14.1)	16 (13.3)	14 (15.6)	2 (16.7)	0.910
Myalgia	64 (31.2)	76 (41.1)	23 (32.4)	43 (35.8)	35 (38.9)	3 (25.0)	0.120
Headache	33 (16.1)	27 (14.6)	10 (14.1)	15 (12.5)	13 (14.4)	3 (25.0)	0.790
Diarrhea	13 (6.3)	10 (5.4)	1 (1.4)	4 (3.3)	2 (2.2)	0 (0)	0.400
Loss of appetite	101 (49.3)	77 (41.6)	50 (70.4)	63 (52.5)	34 (37.8)	4 (33.3)	< 0.001
Weight Loss	37 (23.0)	35 (23.0)	5 (9.3)	36 (37.9)	19 (26.4)	5 (45.5)	0.003

CVA: Cerebrovascular accident; CVD: Cardiovascular disease; CKD: Chronic kidney disorders

The need for special care and the use of ventilation in these patients were 8.3% and 33.3%, respectively. In the follow-ups carried out for 1 year after COVID-19 infection, the clinical conditions of 3 patients (25.0%) had worsened, in 1 case (8.3%), it was necessary to change the medicine, and the dosage of the medicine was changed in 3 cases (25.0%). Rejection of the transplanted organ was not observed in any of the patients. Finally, 2 patients (16.7%) died; 1 patient (8.3%) died in the hospital and 1 person (8.3%) died after discharge from the hospital.

Table 2 shows the frequency of clinical symptoms of COVID-19 in patients with a history of various underlying diseases. There was a significant difference in the frequency of symptoms of loss of appetite and weight loss in people with a history of various diseases. Decreased appetite in CVD patients was significantly more than in other patients ($P < 0.001$). Furthermore, weight loss in people with a history of organ transplantation was significantly higher than other patients ($P = 0.003$). The information related to the factors affecting the mortality of patients is presented in table 3.

The results of multivariate regression analysis showed that the symptom of loss of appetite increased the occurrence of death in COVID-19 patients with underlying diseases up to 5.41 times (OR: 5.41; 95% CI: 3.55-8.23; $P < 0.001$). However, the symptom of headache had no significant impact on death in COVID-19 patients with underlying diseases (OR: 0.65; 95% CI: 0.36-1.18; $P = 0.160$).

Table 2. Frequency distribution of hospitalized COVID-19 patients

	Shortness of breath	Cough	Loss of appetite	Myalgia	Weight loss	Headache	Sore throat	Diarrhea
Rheumatic Diseases	54.1	48.3	49.3	31.2	23.0	16.1	17.6	6.3
Cancer	61.6	41.6	44.9	41.1	23.0	14.6	13.0	5.4
CKD	68.9	41.1	37.8	38.9	26.4	14.4	15.6	2.2
CVA	63.3	42.5	52.5	35.8	37.9	12.3	13.3	3.3
CVD	63.4	52.1	70.4	32.4	9.3	14.1	14.1	4.1
Organ Transplantation	58.3	33.3	33.3	25.0	45.5	25.0	16.7	-

CKD: Chronic kidney disorders; CVA: Cerebrovascular accident; CVD: Cardiovascular disease

Additionally, increased length of hospitalization was one of the factors predicting the possibility of death after COVID-19 in the study patients (OR: 1.73; 95% CI: 1.56-1.90; P < 0.001).

Discussion

SARSCoV-2 remains a worldwide health problem. Although our present knowledge about the interaction of various underlying diseases and their management with mortality caused by COVID-19 is gradually evolving, there are still many unanswered questions about the impact of COVID-19 on various underlying diseases and their prognosis.[12] Therefore, in this study, the complications and outcomes of COVID-19 were investigated in a period of 1 year after infection in patients with a history of underlying and rheumatic diseases.

The conditions of 725 patients with COVID-19 (414 women and 311 men; average age: 57.22 ± 17.6 years) who had a history of underlying diseases, including cancer, kidney disorders, organ transplant, history of CVA, and rheumatic diseases, were investigated. Furthermore, 45% of them were over 60 years of age and only 7% of patients were under 20 years of age. According to the findings of this study, the most common underlying diseases among hospitalized patients were rheumatic diseases (28.3%), cancer (25.5%), and CVA history (16.6%).

Table 3. Factors related to mortality in COVID-19 patients with different underlying diseases

Variables		Mortality		P
		Yes (n = 241)	No (n = 484)	
Age		56 (41.5-69.5)	58 (43-71)	0.240†
Gender	Female	128 (53.1)	286 (59.1)	0.130¥
	Male	113 (46.9)	198 (40.9)	
Duration of hospitalization (days)		6 (4-8)	3 (3-4)	<0.001†
Change medication	Yes	26 (27.1)	137 (28.3)	0.910¥
	No	70 (72.9)	347 (71.7)	
Changing the dose of medicine	Yes	35 (36.5)	209 (43.3)	0.260¥
	No	61 (63.5)	274 (56.7)	
Shortness of breath	Yes	146 (60.6)	294 (60.7)	0.990
	No	95 (39.4)	190 (39.3)	
Myalgia	Yes	77 (32)	189 (39)	0.070
	No	164 (68)	295 (61)	
Cough	Yes	110 (45.6)	218 (45)	0.940
	No	131 (54.4)	266 (55)	
Loss of appetite	Yes	173 (71.8)	172 (35.5)	< 0.001
	No	68 (28.2)	312 (64.5)	
Headache	Yes	27 (11.2)	83 (17.1)	0.030
	No	214 (88.8)	401 (82.9)	

Hospitalization in the ICU was reported in 7.2% and the need for ventilation in 10.5% of patients. Moreover, 10.6% of patients were vaccinated against corona virus. Furthermore, 241 patients (33.2%) died despite the treatment, 96 of whom (13%) died after being discharged from the hospital. Of the deceased people, 28.2%, 26.6%, 17%, 13.3%, 10%, 1.4%, and < 1% had rheumatic diseases, cancer, and a history of CVA, a history of CKD, a history of CVDs, a history of thyroid disorders, and a history of organ transplantation, respectively.

In the follow-up for 1 year after COVID-19 infection, the disease had flared up in 38% of patients with rheumatic diseases. Malignant recurrence was not observed in cancer patients. In 17% of patients with CKD, renal failure worsened and required hemodialysis. Rejection of the transplanted organ was not observed in any of the patients. A significant relationship was observed between re-infection with COVID-19 within 1 year after the initial infection and the type of underlying disease of the patients, so that re-infection was significantly higher in patients with a history of organ transplantation and CKD compared to other patients (P = 0.010). There was also a significant difference between the frequency of symptoms of loss of appetite and weight loss in cases with a history of various diseases. Decreased appetite in cardiovascular patients was significantly more than other patients (P < 0.001). Weight loss was also significantly higher in people with a history of organ transplantation than other patients (P = 0.003).

However, decreased appetite increased the probability of death in COVID-19 patients with a history of underlying disease. The increase in the duration of hospitalization was also one of the predictors of the probability of death after infection with COVID-19.

Several studies have evaluated the outcomes of COVID-19 infection among patients with rheumatic diseases. Results of a large population-based study found that people with rheumatoid arthritis had a higher chance of being hospitalized or dying than other patients. However, after adjusting for age, sex, and comorbidities, there was no higher chance of these poor outcomes.[13] In the study by Cordtz et al. (2021), the risk of hospitalization with COVID-19 was 46% higher in patients with rheumatic disease than the general population, but only people with rheumatoid arthritis remained at risk of a severe outcome using a fully adjusted model.[14]

In a study of 17 million adults in a UK primary care database, the risk of death from COVID-19 was slightly higher for rheumatology patients than for the general population.[15] In a similar study, the risk of death from COVID-19 was higher in patients with rheumatoid arthritis compared to healthy people.[16] In an analysis of more than 31000 adults in a US electronic medical record database, the higher risk of death from COVID-19 was not significant for people with rheumatic disease.[17] Since the start of the COVID-19 pandemic, several studies have reported mortality in cancer patients, owing to the impact of infrastructural constraints such as staff shortages, closures and prioritization of selected clinical or non-emergency services, as well as the potential effects of the virus on tumorigenesis and cancer recurrence.[18] Viral infections have been a big challenge for cancer patients and oncologists in the last few decades. What connects the pathogenesis of cancer and viral infections is that the immune system loses its ability to distinguish between self and non-self. Since the beginning of the COVID-19 pandemic, several studies have shown that cancer patients are more susceptible to severe infection and have a higher mortality rate due to COVID-19.[19] COVID-19 is associated with side effects caused by the immune system, including tissue inflammation, impaired activity of T cells and NK cells, neutrophil hyperactivation, and thrombocytosis. It also interferes with cell proliferation, metabolism,

and other regulatory mechanisms involved in tumorigenesis.[20]

It seems that one of the driving factors involved in the severe outcomes of COVID-19 is the reduction of angiotensin-converting enzyme 2 (ACE2) caused by viral infection.

Previous reports have shown that ACE2 can exert several antitumor effects, including suppression of angiogenesis and cancer metastasis. As a result, ACE2 reduction may be a factor in tumor progression and metastasis. Cytokine release syndrome is a life-threatening consequence of severe COVID-19 disease. Reports have shown that many cytokines may be elevated in the plasma of patients with severe COVID-19, including those that can influence cancer progression.[21] The results of this study showed that although the rate of hospitalization and mortality of cancer patients due to COVID-19 was high, it was not significantly different to that of individuals with other underlying diseases. In other words, the risk of mortality was similar to other diseases such as renal, cardiac, and rheumatic diseases. During 1 year after infection, no recurrence of malignancy was reported in any of the patients. Longer follow-up and more extensive research seems to be needed to better understand the potential long-term effects of COVID-19 on cancer outcome.

Studies by Nadim et al. conducted in Europe and the United States have shown that COVID-19 causes AKI in 20 to 40% of hospitalized patients.[22]

In addition, recent research by Torjesen in 2021 has shown that people who have recovered from COVID-19, even in mild cases of the disease, are at a higher risk of developing kidney diseases.[23] Therefore, it seems that care after the acute stage of the disease in patients with COVID-19 should include attention and care for AKI and CKD because, in addition to the destructive effects that the virus can have on the kidneys, drug therapy can also intensify the nephrotoxic effects.[24] Another problem that exists is that the long-term effects of COVID-19 cause AKI to lead to CKD. In this regard, in a study conducted by Jewell et al. on AKI related to COVID-19 and its incidence, risk factors, and outcomes in a large UK cohort, it was shown that AKI increased relatively among hospitalized patients with COVID-19.[25]

In the current study, 17% of patients with CKD developed renal failure and required hemodialysis within 1 year after COVID-19 infection. Moreover, re-infection with COVID-19 within a year after the initial infection was significant in CKD patients compared to other people with other underlying problems. Other findings of this study indicated no rejection of the transplanted organ within 1 year after COVID-19 infection. In patients with a history of transplantation, re-infection with COVID-19 in the first year was significant, as well as weight loss in them compared to other patients; therefore, it seems necessary to pay more attention to vaccination and nutrition management in optimizing the care of these patients. In addition, the effectiveness of the vaccine used and the usefulness of additional doses of the vaccine should be considered.

In this study, although the mortality rate was not related to the type of underlying disease of the people, the increase in the duration of hospitalization and the decrease in appetite increased the probability of death in patients after contracting COVID-19. Considering that many factors can influence the risk of death due to COVID-19 infection in people with underlying diseases, the obtained results should be interpreted with caution and more attention should be paid to removing confounding factors in future studies.

The main limitation of this study was related to the fact that all the side effects of suffering from the studied diseases and corona disease were unknown to the researcher; it was difficult to evaluate and record those side effects that could not be predicted from the

beginning of the study. This issue was resolved by inserting an option of other complications in the checklist.

It is recommended that future studies investigate the long-term complications of COVID-19 disease in people with underlying diseases and the healthy population.

Conclusion

Based on the findings presented in our study, the risk of re-infection with COVID-19 in people with a history of organ transplant and CKD was higher than other underlying diseases. Furthermore, increased duration of hospitalization and decreased appetite were among the factors predicting the probability of death after COVID-19 infection in patients with a history of underlying diseases. Larger population studies with long-term follow-up of patients as well as more accurate assessment of confounding factors and their elimination are needed to confirm the obtained findings.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

We would like to thank the Office of Vice Chancellor for Research and Technology Affairs of Kurdistan University of Medical Sciences and the Faculty of Medicine for their financial support. We also thank the staff of Kowsar Hospital in Sanandaj City who helped us perform this research.

Financials support and sponsorship

This work was supported by a grant from Kurdistan University of Medical Sciences to Ezatollah Rahimi.

References

1. Yin Y, Wunderink RG. MERS, SARS and other coronaviruses as causes of pneumonia. Respirology. 2018; 23(2): 130-7.
2. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. Acta Biomed. 2020; 91(1): 157-60.
3. Spinelli A, Pellino G. COVID-19 pandemic: perspectives on an unfolding crisis. Br J Surg. 2020; 107(7): 785-7.
4. Oke J, Heneghan C. Global Covid-19 case fatality rates [Online]. [cited 2020 Oct 7]; Available from URL: https://www.cebm.net/covid-19/global-covid-19-case-fatality-rates/
5. Cantaluppi V, Guglielmetti G, Dellepiane S, Marengo M, Mehta RL, Ronco C. A call to action to evaluate renal functional reserve in patients with COVID-19. Am J Physiol Renal Physiol. 2020; 319(5): F792-F795.
6. Weiss P, Murdoch DR. Clinical course and mortality risk of severe COVID-19. Lancet. 2020; 395(10229): 1014-5.
7. Wu C, Chen X, Cai Y, Xia J, Zhou X, Xu S, et al. Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. JAMA Intern Med. 2020; 180(7): 934-43.
8. Li SY, Tang YS, Chan YJ, Tarng DC. Impact of the COVID-19 pandemic on the management of patients with end-stage renal disease. J Chin Med Assoc. 2020; 83(7): 628-33.
9. Huang L, Wang Y, Wang L, Lv Y, Liu Q. Coronavirus disease 2019 (COVID-19) pneumonia in a hemodialysis patient: A case report. Medicine (Baltimore). 2020; 99(27): e20956.
10. Yazdian G, Karimi I, Tofighi S. Comparative study on health management of special patients and designing a model in Iran. Research in Medicine. 2008; 32(4): 271-8.
11. Moiseev S, Avdeev S, Brovko M, Yavorovskiy A, Novikov PI, Umbetova K, et al. Rheumatic diseases in intensive care unit patients with COVID-19. Ann Rheum Dis. 2021; 80(2): e16.
12. Li J, Fan JG. Characteristics and mechanism of liver injury in 2019 coronavirus disease. J Clin Transl Hepatol. 2020; 8(1): 13-7.
13. Reilev M, Kristensen KB, Pottegard A, Lund LC, Hallas J, Ernst MT, et al. Characteristics and predictors of hospitalization and death in the first 11 122 cases with a positive RT-PCR test for SARS-CoV-2 in Denmark: A nationwide cohort. Int J Epidemiol. 2020; 49(5): 1468-81.
14. Cordtz R, Lindhardsen J, Soussi BG, Vela J, Uhrenholt L, Westermann R, et al. Incidence and severeness of COVID-19 hospitalization in patients with inflammatory rheumatic disease: a nationwide cohort study from Denmark. Rheumatology (Oxford). 2021; 60(SI): SI59-SI67.

15. Williamson EJ, Walker AJ, Bhaskaran K, Bacon S, Bates C, Morton CE, et al. Factors associated with COVID-19-related death using OpenSAFELY. Nature. 2020; 584(7821): 430-6.
16. Topless RK, Phipps-Green A, Leask M, Dalbeth N, Stamp LK, Robinson PC, et al. Gout, Rheumatoid arthritis, and the risk of death related to coronavirus disease 2019: An analysis of the UK Biobank. ACR Open Rheumatol. 2021; 3(5): 333-40.
17. Harrison SL, Fazio-Eynullayeva E, Lane DA, Underhill P, Lip GYH. Comorbidities associated with mortality in 31,461 adults with COVID-19 in the United States: A federated electronic medical record analysis. PLoS Med. 2020; 17(9): e1003321.
18. Fara MG, Stein LK, Skliut M, Morgello S, Fifi JT, Dhamoon MS. Macrothrombosis and stroke in patients with mild Covid-19 infection. J Thromb Haemost. 2020; 18(8): 2031-3.
19. Klok FA, Kruip MJHA, van der Meer NJM, Arbous MS, Gommers DAMP, Kant KM, et al. Incidence of thrombotic complications in critically ill ICU patients with COVID-19. Thromb Res. 2020; 191: 145-7.
20. Tang N, Li D, Wang X, Sun Z. Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. J Thromb Haemost. 2020; 18(4): 844-7.
21. Francescangeli F, De Angelis ML, Baiocchi M, Rossi R, Biffoni M, Zeuner A. COVID-19-induced modifications in the tumor microenvironment: Do they affect cancer reawakening and metastatic relapse? Front Oncol. 2020; 10: 592891.
22. Nadim MK, Forni LG, Mehta RL, Connor MJ, Liu KD, Ostermann M, et al. COVID-19-associated acute kidney injury: consensus report of the 25th Acute Disease Quality Initiative (ADQI) Workgroup. Nat Rev Nephrol. 2020; 16(12): 747-64.
23. Torjesen I. Covid-19: Infection increases the risk of kidney disease even in mild cases, finds study. BMJ. 2021; 374: n2189.
24. Yende S, Parikh CR. Long COVID and kidney disease. Nat Rev Nephrol. 2021; 17(12): 792-3.
25. Jewell PD, Bramham K, Galloway J, Post F, Norton S, Teo J, et al. COVID-19-related acute kidney injury; incidence, risk factors and outcomes in a large UK cohort. BMC Nephrol. 2021; 22(1): 359.