Website: http: jebhpme.ssu.ac.ir
EBHPME 2024; 8(1): 68-82
EISSN: 2538-4716

Evidence Based Health Policy, Management & Economics

ORIGINAL ARTICLE

Predictors of Post-COVID-19 Recovery: A Single-Center Study

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A B S T R A C T

Background: The average duration of recovery time in COVID-19 patients after contracting can be affected by various factors. Understanding the average duration of recovery time is important in formulating preventive measures/interventions. This study aims to assess predictors of post-COVID-19 recovery.

Methods: This observational longitudinal study was conducted among COVID-19 patients admitted to Vasei Hospital in Sabzevar, Iran in 2021. Data were extracted from the Hospital Information System. COVID-19 Experiences (COVEX) questionnaire was used to assess the type and severity of symptoms. Patients who were admitted to the hospital were assessed at baseline and were followed up one month and two months after discharge through telephone calls. Chi-square test was used to examine the association between demographic variables, clinical variables, disease symptoms, and time to recovery.

Results: A total of 250 COVID-19 cases were followed up for 30 and 60 days after discharge. The mean duration of recovery from COVID-19 was significantly higher in women, old patients, those with higher BMI, cases without physical activity, those with severe chest CT scan results, patients with severe diseases, and those who were discharged after 30 days (*P-Value*< 0.05). Patients with dry cough and chest pain were less likely to make a full recovery after 30 days. The cases with dry cough, headache, dyspnea, and chest pain were less likely to make a full recovery after 60 days than those without (*P-Value*< 0.05).

Conclusion: Health providers in healthcare centers should give priority to high-risk groups (e.g. those with severe chest radiography results, and those with severe disease severity). The presence of dry cough and chest pain was found to be a risk factor for delayed recovery. Initial assessment of COVID-19 patients, such as chest CT scans, can predict the severity of the disease and unfavorable outcomes. Moreover, it seems the management of comorbidities can play a vital role in recovery from COVID-19.

Keywords: COVID-19, Post-COVID-19 recovery, Recovery time, Disease outcomes, Iran

Introduction

COVID-19 is an infectious disease caused by the spread of the severe acute respiratory coronavirus 2 (SARS-CoV-2) from human to human (1). Severe acute respiratory infection symptoms frequently occur (2) in the early stages of the disease. Some patients rapidly develop acute respiratory distress syndrome (3) and other serious complications (4). Half of the patients who have recovered from a mild symptomatic infection can still have SARS-COV-2, which can make the spread of the disease even more difficult (5). The most common initial symptoms are fever, cough, fatigue, dyspnea, dry cough, diarrhoea, and pneumonia (6, 7), with more specific

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[DOI: 10.18502/jebhpme.v8i1.16619]

symptoms including taste and smell loss (2, 8, 9). Symptoms of COVID-19 usually appear between 2 and 14 days after exposure (6, 7), Many COVID-19 patients were asymptomatic or experienced mild symptoms and recovered without medical treatment (10, 11). Yet, the disease severity in some patients varies from asymptomatic to severe, with organ failure and death (12).

According to the report by World Health Organization (WHO)-China joint mission on COVID-19, the estimated recovery time is two weeks for patients with mild infection and 3-6 weeks for patients with serious illnesses (13). Studies from different countries, including Iran demonstrated various figures for average recovery time, ranging from 8 to 36 days (14-23).

The duration of recovery time of COVID-19 can be affected by factors such as age, sex, comorbidities, presence of symptoms at the time of admission, having underlying diseases, clinical manifestation during admission, low oxygen saturation, neutrophil-lymphocyte ratio, corticosteroid therapy, time from onset to hospitalization, breathing rate, and severity of the disease (14-17, 19, 24-30). A study in Iran found that factors such as age, sex, coronary heart disease (CHD), cancer, and using antiviral drugs were associated with the chance of recovery (31). A study in Japan reported that fever and the period from illness onset to hospitalization were associated with increased odds of prolonged duration of viral shedding (17). A study in Italy also reported that high Body Mass Index (BMI) was associated with a longer duration of viral shedding in COVID-19 patients (32). Similarly, a study showed that the main factors influencing MERS Co-V recovery rate were age, pre-existing diseases, and the severity of the disease (33).

Given that occurrences of outbreaks increase the demand for hospital beds and supportive care medical equipment in public health facilities, especially in developing countries (28), identifying the factors that delayed/postponed the recovery rate of admitted patients is of high importance in planning medical resources allocation, improving the quality of healthcare, and developing useful interventions/measures (27).

Owing to differences in risk factors, the recovery rate of COVID-19 may vary among patients and countries. To the best of the authors' knowledge, most studies addressed factors affecting recovery period from COVID-19 and /or its predictors and were conducted as cross-sectional and/or retrospective follow-up or followed-up patients after discharge. Therefore, given that few studies assessed the factors affecting recovery at an interval of two months, this study aims to examine factors affecting recovery at two different times after discharge among COVID-19 patients in Sabzevar, Iran, in 2021.

Materials and Methods

Study design

This was an observational longitudinal study.

Study population and setting

The study participants included all the COVID-19 patients who were admitted to Vasei Hospital's COVID-19 ward in Sabzevar, Khorasan Razavi Province, Iran, from 24 October 2021 to 24 December 2021.

Sampling method and sample size

Eligibility criteria

In this study, diagnostic criteria for SARS-CoV-2 virus were based on radiologist report or positive results of nasopharyngeal COVID-19 RT-PCR. Pharyngeal swabs tests were collected from each patient for the detection of SARS-CoV-2 Viral Nucleic Acid using Reverse Transcriptase Polymerase Chain Reaction (rRT-PCT).

All the COVID-19 patients who were admitted to the hospital at a one-week interval were included in the study. A convenience consecutive sampling approach was used. Inclusion criteria were being > 18 years old, having positive COVID-19 RT-PCR tests which were confirmed by the specialists, the cases with their chest CT scan results verified by a

[DOI: 10.18502/jebhpme.v8i1.16619]

radiologist, and the patients who were hospitalized in the COVID-19 ward from 24 October 2021. Those who were hospitalized in a non-COVID-19 ward due to cardiovascular disease or surgery and COVID-19-unrelated complications within two months after discharge, were excluded from the study.

Follow-up

Patients with clinical manifestations admitted to the hospital were assessed using COVID-19 Experiences (COVEX) questionnaire (34) at baseline (on day 7 after the onset of symptoms) and were followed up for one month and two months after discharge through telephone calls. Eligible participants were interviewed from 24 October 2021 to 24 December 2021.

Data collection tools/ clinical data collection

The required information was extracted from Hospital Information System (HIS) or through telephone calls to patients on days 7, 30, and 60 after the onset of symptoms. Data were accessed from 24 October 2021 to 24 December 2021 for research purposes. The information was as follows: dyspnea, fever, weight loss, chest pain, flu symptoms (headache, sore throat, myalgia), gastrointestinal disturbances (e.g., diarrhea, vomiting), smell and taste loss, the persistence of COVID-19 symptoms, or continuity or a renewed need for sick leave, general condition (worse, similar or better than before COVID-19), dyspnea using the modified Medical Research Council scale, chest pain, palpitations, smell, and taste loss on an analogue scale (from 0, total/absolute anosmia, up to 10, normal) at the worst moment of illness and after 1-month follow-up, headache, weakness,
body temperature >38°C, myalgia, arthralgia, gastrointestinal disturbances (i.e., diarrhoea, vomiting, pain), and skin symptoms. Each symptom was considered only if it was not present before the disease.

Data related to demographic characteristics (e.g. sex, gender, education, smoking status, physical activity, BMI) and clinical characteristics were extracted from medical records and the HIS. The researchers used COVEX questionnaire to measure COVID-19's specific diagnosis, symptoms, and behaviors (NIH Repository of COVID-19 Research Tools). According to the COVEX questionnaire, illness severity is defined as mild (dry cough, headache, nausea/diarrhoea, aches, and pains, low-grade fever, no need to see a doctor or hospitalization), moderate (coughing, high fever (> 100.0^{o} Fahrenheit or 37.8^{o} Celsius), chills, feeling that you cannot get out of bed, shortness of breath), severe (breathlessness, complications leading to pneumonia), and critical (respiratory failure, septic shock, and/or organ dysfunction or failure).

Patients with or without clinical symptoms of pneumonia who did not use oxygen therapy were defined as having mild or moderate COVID-19. According to WHO definition, patients with pneumonia symptoms who require oxygen therapy but do not require ICU admission are defined as having severe COVID-19 (35). The severity of COVID-19 was determined based on the latest diagnostic and treatment guidelines of Ministry of Health (36).

Data analysis

Data were analyzed using $SPSS_{22}$ software. Descriptive statistics (frequency and percent) were used to describe demographic and clinical variables. Chi-square test was used to examine the association between demographic variables, clinical variables, disease symptoms, and time to recovery. Univariate Binary Logistic Regression Model and Multiple Logistic Regression Model were used to examine the association between recovery time and sociodemographic and clinical characteristics as well as disease symptoms.

Ethical considerations

This study was a part of a comprehensive professional doctorate thesis in specialized medicine, approved by the Ethics Committee of Sabzevar University of Medical Sciences, Iran (Reference No: IR.MEDSAB.REC.1400.105). The purpose of the study was explained to each participant and written informed consent was

[DOI: 10.18502/jebhpme.v8i1.16619]

obtained from all of them prior to the study. Participation was voluntary and anonymous, and subjects were informed of their right to withdraw from the study at any time. The authors had no access to any identifying information as part of the study. Permission was obtained from the authorities of the hospital prior to the study.

Results

A total of 250 COVID-19 cases were followed up for 30 and 60 days after discharge. More than half of the patients (50.4%) were women. The majority of participants were aged < 45. Most of the participants (85.2%) had an educational level of high school diploma or less. Most of them were non-smokers/ not current smokers (87.2%). 89.6% of participants had no physical activity, and 60% had a BMI of between 25–29. Approximately 70% of patients had no diabetes or diabetes complications. Chest CT scan result, the severity of the disease during hospitalization, and the disease severity of most patients were moderate. The length of hospital stay of most patients was > 3 days. Most of the participants had no lung involvement.

As shown in Table 1, a significant association was found between gender, age, education, and the duration of recovery time (*P-value*< 0.001). Women were more likely to make a full recovery after 60 days. Older patients (> 54 years old) were less likely to make a full recovery after 30 days compared with the younger ones. Patients with higher education level recovered more quickly (full recovery after 30 days) than those with lower education levels.

The results of this study showed that the rate of full recovery after 30 days was significantly lower in patients with higher BMI (30-39) (*P-value*< 0. 001). Physical inactivity, diabetes, and diabetes complications led to delayed recovery. Patients who were not physically active regularly (*P-Value*< 0. 001) and those with diabetes and diabetes complications (*P-value*< 0. 05) were less likely to make a full recovery after 30 days than those without. There was a significant and negative association between smoking status and full recovery after 30 and 60 days. Those who smoked were less likely to make a full recovery after 30 (*P-value*< 0. 05) and 60 days (*P-value*< 0. 001).

Moreover, patients with severe lung involvement were less likely to make a full recovery after 30 and 60 days (*P-Value*< 0. 001). The results of the chest CT scan, lung involvement, and disease severity were the same. Patients with severe chest problem after radiography result and those with severe disease were less likely to make a full recovery after 30 and 60 days.

In this study, a longer length of hospital stay was significantly associated with a delay in recovery time. It was found that more lung involvement and longer length of hospital stay were negative prognosis for a full recovery of both 30 and 60 days.

[DOI: 10.18502/jebhpme.v8i1.16619]

Table 1. The socio-demographic and clinical characteristics of participants and the rate of full recovery after 30 and 60 days

Variable	Category	Frequency (%)	Full recovery after 30 days			Full recovery after 60 days		
			%	X^2	*P*	%	X^2	*P*
Gender	Male	124 (49.6)	12.90	2.30	0.12	58.9	13.38	< 0.0001
	Female	126 (50.4)	7.10			80.2		
Age group	<45 years old	119 (47.6)	16	9.69	<0.001	68.1	0.70	0.70
	45-54 years old	56 (22.4)	7.10			67.9		
	>54 years old	75 (30)	2.70			73.3		
Education status	High school diploma or lower	213 (85.2)	7.50	9.90	<0.001	70.4	0.46	0.49
	University education	37 (14.8)	24.30			64.9		
BMI	<25	66 (26.4)	15.20	7.12	0.08	72.7	11.89	<0.001
	25-29	150 (60)	6			68.7		
	30-39	20 (8)	20			90		
	>40	14 (5.6)	14.30			35.7		
Smoking status	Yes	32 (12.8)	0	4.07	0.04	40.6	14.56	<0.001
	No	218 (87.2)	11.50			73.9		
Physical activity	Yes	26 (10.4)	30.80	13.90	<0.001	65.4	0.24	0.62
	No	224 (89.6)	7.60			70.1		
Diabetes	Yes	67 (26.8)	3	5	0.02	74.6	1.09	0.29
	No	183 (73.2)	12.60			67.8		
Diabetes complications	Yes	63 (25.2)	3.20	4.36	0.03	73	0.46	0.49
	No	187 (74.8)	12.30			68.4		
Lung disease	Yes	13 (5.2)	0	1.52	0.21	38.5	6.28	0.01
	No	237 (94.8)	10.50			71.3		
Chest CT scan results	Mild	27 (10.8)	33.30	19.33	<0.001	92.6	16.29	<0.001
	Moderate	24 (53.2)	7.50			72.2		
	Severe	133 (9.6)	0			41.7		
The severity of the disease during hospitalization	Mild	31 (12.4)	32.30	19.35	<0.001	93.5	9.23	0.01
	Moderate	114 (45.6)	7.90			65.8		
	Severe	30 (12)	0			70		
Lung involvement	No involvement	16	50	86.63	<0.001	100	55.61	<0.001
	1	36	41.70			100		
	2	85	2.4.			81.2		
	3	113	0			46.9		
Length of hospital stay	< 3 days	90	15.60	4.54	0.03	82.2	9.43	<0.001
	> 3 days	145	6.90			63.4		
Disease severity	Mild	23	43.50	37.83	<0.001	100	13.90	<0.001
	Moderate	117	5.10			61.5		
	Sever	33	0			57.6		

[DOI: 10.18502/jebhpme.v8i1.16619]

As shown in Table 2, the most common symptom/signs were fatigue (n = 191), followed by dry cough (n = 125), and fever (n=123). The least common symptoms were sore throat (n=10) and taste and smell loss (n=17).

In the present study, dry cough (*P-value* <0.001) and chest pain (*P-value*= 0.01) were significantly associated with full recovery after 30 days, and the patients with these signs/symptoms were less likely to make a full recovery after 30 days. Moreover, patients with cough and sore throat (*P-value* < 0.05) were more likely to make a full recovery after 60 days, while those with dry cough, headache, dyspnea (*P-Value*<0.001), and chest pain (*P-value*= 0.01) were less likely to make a full recovery after 60 days compared with those without.

Table 2. Frequency of disease symptoms and their relationship with full recovery after 30 and 60 days

Symptoms and signs	Category	Frequency (%)	Full recovery after 30 days			Full recovery after 60 days		
			%	X^2	*P*	%	X^2	*P*
Dry cough	Yes	125 (50)	0	27.77	<0.001	60	10.88	<0.001
	No	125 (50)	20			79.20		
Fatigue	Yes	191 (76.4)	9.40	0.29	0.58	70.70	0.44	0.50
	No	59 (23.6)	11.90			66.10		
Headache	Yes	57 (22.8)	14	1.33	0.24	50.90	12.23	<0.001
	No	193 (77.2)	8.80			75.10		
Fever	Yes	123 (49.2)	8.10	0.94	0.33	69.90	0.01	0.91
	No	127 (50.8)	11.80			69.30		
Sore throat	Yes	10 (4)	20	1.15	0.28	100	4.55	0.03
	No	240 (96)	9.60			68.30		
Smell and taste loss	Yes	17 (6.8)	11.80	0.06	0.80	82.40	1.40	0.23
	No	233 (93.2)	9.90			68.70		
Joint pain	Yes	19 (7.6)	10.50	0.00	0.93	84.20	2.07	0.15
	No	231 (92.4)	10			68.40		
Dyspnea	Yes	24 (9.6)	0	2.95	0.08	41.70	9.79	<0.001
	No	226 (90.4)	11.10			72.60		
Cough	Yes	42 (16.8)	7.10	0.45	0.49	83.30	4.50	0.03
	No	208 (83.2)	10.60			66.80		
Chest pain	Yes	72 (28.8)	2.80	5.86	0.01	58.30	6.07	0.01
	No	178 (71.2)	12.90			74.20		

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Table 3 indicates the results of the Univariate Binary Logistic Model for recovery after 30 and 60 days. Compared to those aged <45 years old, the patients >54 years old were 0.086 less likely to recover after 30 days (OR 0.14, *P-Value*=0.01). Those who had physical activity were 5.41-fold more likely to recover after 30 days. Those with diabetes (OR = 0.21, *P-value*= 0.04) and diabetes complications (OR 0.23, *P-Value*=0.05) were 0.079 and 0.077 less likely to recover after 30 days, respectively. Patients with longer lengths of hospital stay (>3 days) were less likely to recover after 30 (OR = 0.40, *P-Value* = 0.03) and 60 days (OR = 0.37, *P-value*= 0.00). Patients whose chest CT scan result was moderate were less likely to recover after 30 (OR = 0.16, *P-value*= 0.001) and 60 (OR = 0.20, *P-Value*= 0.05) days. Moreover, patients with severe chest CT scan result (OR = 0.16, *P-value*= 0.001) were 0.095 less likely to recover after 60 days. By increasing the lung involvement score, the odds of recovery after 30 (OR = 0.14, *P-Value*< .0001) and 60 (OR = 0.16, *P-value*< .0001) days were lower.

Moreover, the results of this study showed that males (OR = 0.35, *P-value*<.0001), who smoked (OR = 0.24, *P-value*<.0001), and those with BMI >40 kg/m (OR = 0.20, *P-Value*<.0001) were more likely to recover after 60 days. Patients with lung disease were 0.075 less likely to recover after 30 days (OR 0.25, *P-value* =0.01).

Table 3. Univariate Binary Logistic Model for recovery after 30 and 60 days

Variables	Recovery after 30 days				Recovery after 60 days			
	Sig.	Exp(B)/ crude OR	95% C.I.for EXP(B) Lower	Upper	Sig.	Exp(B)/ crude OR	95% C.I.for EXP(B) Lower	Upper
Gender (reference group = female)								
Male	.13	1.92	.81	4.54	<.0001	.35	.20	.62
Age (reference group = <45 years old)								
45-54 years old	.11	.40	.13	1.25	.97	.99	.50	1.95
>54 years old	.01	.14	.03	.63	.43	1.29	.68	2.44
Smoking status (reference group = No)								
Yes	-	-	-	-	<.0001	.24	.11	.52
BMI (reference group = <25)								
25-29	.03	.35	.13	.92	.54	.82	.43	1.56
30-39	.60	1.40	.38	5.06	.12	3.37	.71	16.03
>40	.93	.93	.18	4.81	.012	.20	.06	.70
Physical activity (reference group = No)								
Yes	.00	5.41	2.05	14.25	.62	.80	.34	1.89
Diabetes (reference group = No)								
Yes	.040	.21	.04	.93	.29	1.39	.74	2.63
Diabetes complications (reference group = No)								
Yes	.053	.23	.05	1.02	.49	1.24	.66	2.35
Lung disease (reference group = No)								
Yes	-	-	-	-	.019	.25	.07	.79
Length of hospital stay (reference group = <3 days)								
>3 days	.038	.40	.17	.94	.003	.37	.19	.71
Chest CT scan result (reference group = mild)								
Moderate	.001	.16	.05	.45	.03	.20	.04	.92
Severe	-	-	-	-	.00	.05	.01	.29
Lung involvement score	<.0001	.14	.07	.26	<.0001	.16	.09	.28

[DOI: 10.18502/jebhpme.v8i1.16619]

Table 4 shows the results of multiple logistic regressions model for recovery after 30 and 60 days. Being a male patient, not having physical activity and having a higher score of lung involvement was significantly associated with the time for recovery. The chance of recovery after 30 days among males (OR = 4.58, *P-value* = 0.001) and those with physical activity (OR = 6.35, *P-Value* = 0.00) were respectively 4.5 and 6.35-fold higher. In addition, the higher the lung involvement score, the lower odds of recovery after 30 (OR = 0.13, *P-value*< .0001) and 60 (OR = 0.17, *P-value*<.0001) days. Also, the odds of recovery after 60 days among men (OR = 0.37, *P-value* = 0.00) were lower (0.063) than women.

Table 4. Multiple logistic regressions model for recovery after 30 and 60 days

Variables	Recovery after 30 days				Recovery after 60 days			
	Sig.	Exp (B)/ adjustment OR	95% C.I.for EXP (B) Lower	Upper	Sig.	Exp (B)/ adjustment OR	95% C.I.for EXP (B) Lower	Lower
Gender (reference group = female)								
Male	.014	4.58	1.35	15.51	.003	.37	.20	.71
Physical activity (reference group = No)								
Yes	.007	6.35	1.64	24.61	-	-	-	-
Lung involvement score	<.0001	.13	.06	.27	<.0001	.17	.09	.30

Table 5 demonstrates the results of the Univariate Binary Logistic Model for recovery after 30 and 60 days regarding disease symptoms. Patients with chest pain were respectively 0.081 and 0.052 less likely to recover after 30 (OR = 0.19, *P-Value* = 0.02) and 60 days (OR = 0.15, *P-value* = 0.01). Patients with dry cough (OR = 2.53, *P-value*= 0.001) and cough (OR = 2.48, *P-value* = 0.03) were approximately 2.5-fold more likely to recover after 60 days. The researchers also found that those with headache (OR = 0.34, *P-value* = 0.00) and dyspnea (OR = 0.27, *P-value* = 0.00) were less likely to recover after 60 days.

Table 5. Univariate Binary Logistic Model for recovery after 30 and 60 days

Variables	Recovery after 30 days				Recovery after 60 days			
	Sig.	Exp(B))/ crude OR	95% C.I.for EXP(B) Lower	Upper	Sig.	Exp(B))/ crude OR	95% C.I.for EXP (B) Lower	Upper
Dry cough (reference group = No)								
Yes	-	-	-	-	.001	2.53	1.44	4.44
Fatigue (reference group = No)								
Yes	.586	.77	.30	1.95	.50	1.23	.66	2.30
Headache (reference group = No)								
Yes	.252	1.69	.68	4.14	.001	.34	.18	.63
Fever (reference group = No)								
Yes	.335	.66	.28	1.53	.91	1.03	.60	1.76
Sore throat (reference group = No)								
Yes	.296	2.35	.47	11.77	-	-	-	-
Smell and taste loss (reference group = No)								
Yes	.802	1.21	.26	5.66	.24	2.12	.59	7.63
Joint pain (reference group = No)								
Yes	.937	1.06	.23	4.89	.162	2.46	.69	8.72
Dyspnea (reference group = No)								

[DOI: 10.18502/jebhpme.v8i1.16619]

Variables	Recovery after 30 days				Recovery after 60 days			
	Sig.	Exp(B))/ crude OR	95% C.I.for EXP(B)		Sig.	Exp(B))/ crude OR	95% C.I.for EXP (B)	
			Lower	Upper			Lower	Upper
Yes	-	-	-	-	.003	.27	.11	.64
Cough (reference group = No)								
Yes	.502	.65	.18	2.28	.03	2.48	1.04	5.87
Chest pain (reference group = No)								
Yes	.028	.19	.04	.83	.015	.48	.27	.86

Table 6 indicates the results of the multiple logistic regressions model for recovery after 30 and 60 days regarding disease symptoms. Dry cough, headache, dyspnea, and chest pain were found to be significantly associated with recovery time. The odds of recovery among patients with chest pain after 30 (OR = 0.19, *P-value* = 0.02) and 60 (OR = 0.49, *P-value* = 0.02) days were lower. The odds of recovery after 60 days among those with headache was higher (OR = 0.37, *P-value* = 0.00). Further, the odds of recovery after 60 days among those with dry cough (OR = 2.50, *P-Value* = 0.00) was 2.5-fold higher.

Table 6. Multiple logistic regressions model for recovery after 30 and 60 days

Variables	Recovery after 30 days				Recovery after 60 days			
	Sig.	Exp(B)/ adjustment OR	95% C.I.for EXP(B)		Sig.	Exp(B)/ adjustment OR	95% C.I.for EXP(B)	
			Lower	Upper			Lower	Upper
Dry cough (reference group = No)								
Yes	-	-	-	-	.002	2.50	1.39	4.50
Headache (reference group = No)								
Yes	-	-	-	-	.004	.37	.19	.73
Dyspnea (reference group = No)								
Yes	-	-	-		.065	.41	.16	1.05
Chest pain (reference group = No)								
Yes	.028	.19	.04	.83	.026	.49	.26	.91

Discussion

This study examined the period of time for recovery post-COVID-19 and its associated factors among COVID-19 patients hospitalized at Vasei Hospital in Sabzevar, Iran. In this study, sex, age, education status, smoking status, higher BMI, lung involvement, length of hospital stay, disease severity, dry cough, and chest pain were significantly associated with delayed viral clearance/time to recovery.

In this study, old-aged patients and those with a low level of education had a higher risk for delayed recovery as compared with their counterparts. The reports from studies in China (11, 28), Korea (37), Vietnam (38, 39), and Ethiopia (19, 40) also revealed that old aged patients had lower recovery rates from the infection compared with younger ones. This may be due to the suppression of immunity against infection and the presence of different underlying conditions among older individuals. Additionally, older age is associated with degeneration of pulmonary function that contributes to severe COVID-19 cases and poor clinical outcomes (19).

[DOI: 10.18502/jebhpme.v8i1.16619]

Also, patients with low education levels may not take the disease seriously due to their little knowledge. As a result, patients may delay or refuse their treatment. Hence, their recovery time may take longer than those with higher education levels. Unlike other studies that reported males had a longer duration of recovery time and a higher risk of delayed viral clearance as compared with females (14, 23), in this study females had higher odds of making a full recovery after 60 days than their counterparts. The discrepancy between studies might be attributed to differences in disease severity, study setting, sample size, and socioeconomic conditions.

Moreover, it was found that those who were physically active regularly were more likely to make a full recovery after 30 days. A study in Japan found that many older individuals who did physical activity were resilient against the pandemic. Physical activity is important for maintaining health and activity and preventing adverse health outcomes, such as incident disability (23). In the current study, those with higher BMI (between 30-39) were more likely to make a recovery after 60 days. A study in Italy reported that obesity (BMI > 30) was related to a longer hospital stay and longer duration of viral shedding in COVID-19 patients (32). This result was in line with previous studies, in which similar results were found (19, 32, 41). In contrast, a study in Ethiopia showed that the risk of delayed recovery was not influenced by BMI and the presence of signs or symptoms (14). This discrepancy can be due to differences in the population studied, study setting, and period. A larger patient group may be needed to test for a body weight effect in Iranian patients.

The results of current study showed that those with diabetes and diabetes complications were less likely to make a full recovery after 30 days, which were in line with the studies which showed diabetes contributed to prolonging the recovery period (14, 23, 42). The presence of chronic health conditions, such as diabetes, hypertension, and chronic renal disease could increase the risk of COVID-19-related hospitalization, length of hospital stay, and the duration of recovery (43). Furthermore, diabetes was associated with an increase in severity and ICU admissions of COVID-19 patients (44, 45). The results of this study were also consistent with the studies that suggested lung disease and smoking are possible risk factors for delayed recovery from COVID-19 (46, 47). This is not difficult to understand because smoking can worsen the severity of COVID-19 (48), and COVID-19 is severe in patients with lung cancer (49). Therefore, the presence of these can contribute to prolonging the recovery period.

In the current study, lung involvement, chest CT scan result, and length of hospital stay were negative prognosis for making a full recovery after 30 and 60 days. Undoubtedly, these factors correlate with each other. Due to varying guidelines of COVID-19 care, the length of hospital stay is likely to depend on the level of care required and also the geographic setting. Besides, staff, beds, the equipment required, pathways of treatment, and patients' characteristics can influence the duration and level of care needed (50). A chest CT scan is a valuable modality to measure the extent of lung involvement (51). A cross-sectional study of 478 COVID-19 patients also reported that lung involvement and consolidation lesions on chest CT scans were associated with more extended hospitalization and the recovery period (51). Ahlstrand et al (52) demonstrated that the score of chest CT at hospital admission correlated closely with hospital length of stay and ICU admission (52). Moreover, a high CT score and diffuse distribution of lung lesions in COVID-19 indicated disease severity and short-term mortality (53). The researchers found that the risk of delayed recovery was influenced by disease severity. Studies reported that factors such as age and comorbidities could impact the disease severity (54-57).

In this study, fatigue, dry cough, and fever were the leading symptoms of COVID-19. Studies derived from Wuhan population reported that the most common clinical characteristics at the beginning

[DOI: 10.18502/jebhpme.v8i1.16619]

were fever, fatigue, and cough (58, 59). Similar to the findings of this study, Yazdi et al (51) reported that fever and dyspnea were the most common symptoms. The symptoms of dry cough and chest pain were found to be a risk factor/negative prognosis for delayed recovery. Patients with dry cough, headache, sore throat, cough, chest pain, and dyspnea had a significantly longer duration of recovery time and were more likely to make a full recovery after 60 days. The finding were in line with the studies conducted in Ethiopia (14) and Iran (23, 51) which suggested that cough and dyspnea significantly affected the recovery duration. The presence of dyspnea at baseline could prolong the recovery period and increase the possibility of death and severe disease in patients with COVID-19 (23). The results did not present a significant association between smell and taste loss, joint pain, and recovery duration.

Univariate Binary Logistic Regression confirmed the results this study. Older patients were less likely to recover after 30 days. This result was consistent with previous studies conducted in different settings (60-62). It is well known that COVID-19 severity increases with age. Also, those with diabetes and diabetes complications were less likely to recover after 30 days. This was supported by a recent study conducted in Ethiopia (61). This was because diabetes as a chronic illness could deteriorate the immunity of the patient due to COVID-19 infections. Furthermore, those with a higher length of stay and lung disease were less likely to recover after 60 days.

According to the multiple logistic regressions, women and those with physical activity had a greater chance of recovery from COVID-19 when compared with their counterparts. Moreover, those with symptoms such as headache, dyspnea, and chest pain took longer to recover compared to those without, and had a lower chance of recovery from COVID-19. Similarly, dry cough was significantly associated with delayed recovery time. This result was in line with a previous study. A higher prevalence of dyspnea in patients with severe or critical COVID-19 was reported in other studies as well (23, 63).

One limitation of this study was that the sample size was small. Future studies should involve a large patient population.

Conclusions

The study revealed that the elderly, women, those with a lower level of education, patients with diabetes and diabetes complications, those with severe chest radiography results, patients with a severe disease, and those with more lung involvement and higher disease duration were more likely to experience a longer recovery period. Health providers in healthcare centers should give priority to these high-risk groups at the time of triage. The presence of dry cough and chest pain was found to be a risk factor for delayed recovery. Initial assessment of COVID-19 patients, such as chest CT scans, can predict the severity of the disease and unfavorable outcomes.

Acknowledgment

The authors would like to thank the hospital staff for their cooperation during the study. We also thank the participants and patients who kindly volunteered to take part in this study.

Conflict of interests

The authors declared no conflict of interests.

Authors' contributions

N.R and A.Y designed research; N.R, A.Y, R.Sh, A.k and S.k conducted research; H.J performed statistical analysis; H.J wrote the paper. A.Y had primary responsibility for final content. All authors read and approved the final manuscript.

Funding

This study was financed by Sabzevar University of Medical Sciences, Iran (Grant No: 99276).

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