Characteristics of re-admitted adult patients infected with severe acute respiratory syndrome Coronavirus 2 After initial hospitalization at King Salman Armed Forces Hospital, Tabuk, Saudi Arabia

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ABSTRACT

الأهداف: وصف الخصائص الإكلينيكية وعوامل الخطر المحتملة المرتبطة بإعادة الاستشفاء في غضون 30 يومًا من الخروج من المرضى البالغين في المستشفى المصابين بعدوى مؤكدة بفيروس كورونا 2 (SARS–CoV–2) والمتلازمة التنفسية الحادة الوخيمة.

المنهجية: أجريت هذه دراسة جماعية بأثر رجعي أجريت في مستشفى الملك سلمان للقوات المسلحة (KSAFH)، تبوك، المملكة العربية السعودية خلال الفترة ما بين مارس إلى نوفمبر 2020م. وقد أجريت الدراسة على 237 مريضًا مصابين بفيروس SARS–CoV–2 واستوفوا الشروط المطلوبة. اشتملت معايير الدراسة على (14 عامًا على الأقل ، مع خروجهم حيا من المستشفى لاحقًا).

النتائج: كانت الأعراض الأكثر شيوعًا هي السعال والحمىوضيق التنفس. أكثر الأمراض المصاحبة شيوعاً هي مرض السكري وارتفاع ضغط الدم . نصف الحالات اعتبرت حالات شديدة بينما 14.8% كانت حالات حرجة. كان معدل إعادة القبول 5.9% . كان المرضى الأكبر سنًا أكثر عرضة لإعادة الدخول مقارنة بالمرضى الأصغر سنًا. فيما يتعلق بالخصائص السريرية ، كان من المرجح أن يتم إعادة قبول المرضى ذوي الحالات الحرجة أكثر من الحالات الأقل خطورة. كان المرضى الذين يعانون من ظل الرئة من جانب واحد في الأشعة السينية للصدر ، وأولئك الذين لديهم تاريخ إيجابي لدخول وحدة العناية المركزة (ICU) أكثر عرضة لإعادة القبول مقارنة بأقرانهم. فيما يتعلق بالتاريخ الطبي، كان العامل الوحيد المرتبط بشكل كبير بإعادة القبول هو تاريخ الإصابة بحادث وعائي دماغي (CVA) ، حيث كان 22.2% من أولئك الذين لديهم تاريخ CVA مقارنة بـ 1.5% فقط من أولئك الذين ليس لديهم تاريخ CVA كانوا أكثر عرضة لإعادة القبول. من بين النتائج المختبرية، كان ارتفاع عدد الخلايا الليمفاوية (أكثر من 3 لكل ميكروليتر) مرتبطا بشكل كبير باحتمالية إعادة القبول.

الخلاصة: كان معدل إعادة القبول أو دخول المرضى إلى المستشفى في البداية بسبب Covid–19 مشابهًا للمعدلات التي أبلغت عنها معظم الدراسات الدولية المماثلة الأخرى. هناك ما يبرر مزيدًا من الدراسة الطولية متعددة المراكز للحصول على صورة أوضح للموقف.

Objectives: To describe the clinical characteristics and possible risk factors associated with re-hospitalization within 30 days of discharge among hospitalized adult patients with confirmed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection.

Methods: This is a retrospective cohort study conducted at King Salman Armed Forces Hospital (KSAFH), Tabuk, Saudi Arabia over the period between March to November 2020. The study was conducted over 237 patients who had confirmed SARS-CoV-2 and fulfilled the study inclusion criteria (at least 14 years old, with subsequently discharged alive from the hospital) were included.

Results: The commonest presenting symptoms were cough, fever, and dyspnea. The most frequent reported comorbid diseases were diabetes mellitus and hypertension. Half of cases were regarded as severe cases whereas 14.8% were critical cases. The rate of readmission was 5.9%. Older patients were more likely to be readmitted compared to younger patients. Regarding clinical characteristics, critically ill patients were more likely to be readmitted than less severe cases. Patients with unilateral lung shadow in chest x-ray, and those with positive history of Intensive care unit (ICU) admission were more likely to be readmitted compared to their peers. Regarding medical history, the only factor significantly associated with readmission were history of cerebrovascular accident (CVA), as 22.2% of those with CVA history compared to only 1.5% of those without CVA history were more likely to be readmitted. Among laboratory findings, high lymphocytic count (>3 per microliter) was significantly associate with likelihood for readmission.

Conclusion: Readmission rate or patients hospitalization initially for Covid-19 was comparable to rates reported by most of other similar international studies. Further longitudinal larger multicentric study is warranted to have clearer image of the situation.

Keywords: Covid-19, readmission, predictors, Saudi Arabia

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Since the first cases were reported in December 2019, infection with sever acute respiratory syndrome (SARS)-CoV-2 has become a worldwide pandemic.[1,2] Covid-19, the illness caused by SARS-CoV-2 is becoming a concern for health care systems globally.[3,4] Symptoms of SARS-CoV-2 infection are diverse, range from asymptomatic disease to life-threatening complications, including acute respiratory distress syndrome, multisystem failure, and ultimately, death. Older patients and those with preexisting respiratory or cardiovascular conditions are more susceptible to suffer of severe complications.[5-7] Few studies have investigated discharge patterns and hospital readmissions among large groups of patients after an initial COVID-19 hospitalization.[8,11] In our setting, it was noticed that some patients required a second emergency room visit and re-hospitalization after the initial clinical improvement and hospital discharge. Yet, little is known about risk factors associated with re-hospitalization for those patients. Therefore, determining the overall rate of early representation at multiple time points and identification of possible risk factors associated with re-hospitalization within 30 days post the initial encounter is needed to inform clinical practice, discharge decisions, and public health priorities, such as health care resource planning. Therefore, the aim of this study was to describe the clinical characteristics of patients who were re-hospitalized during the 30 days of discharge among hospitalized adult patients with confirmed SARS-CoV-2 infection. Moreover, we aimed to assess the possible risk factors associated with re-hospitalization.

Methods. This is a retrospective cohort study among adult patients admitted to a tertiary care King Salman Armed Forces Hospital (KSAFH), Tabuk, Kingdom of Saudi Arabia between March and November, 2020 with confirmed SARS-CoV-2 as evidenced by positive polymerase chain reaction (PCR) test who fulfilled the study inclusion criteria (at least 14 years old, with subsequently discharged alive from the hospital). Patients with laboratory-confirmed SARS-CoV-2 who are not admitted to the hospital and those less than 14 years old were excluded. Data pertain to the study were collected from KSAFH medical records, medical files of 237 SARS-CoV-2 positive patients who fulfilled the inclusion criteria. Variables were chosen for this analysis based on a combination of their prevalence per patient across the dataset, relevance to SARS-CoV-2 based on previous literature and empirical evidence, and the goals of this study.

These features included demographic data, key vitals, date of positive SARS-CoV-2, severity of illness, co-morbidities, laboratory measurements, radiographic findings, medications, period of hospital stay during the initial hospitalization, type and timeline of complication during subsequent hospitalizations procedures during hospitalization (including intubation and non-invasive O_2 [oxygen] support), intensive care unit (ICU) course and the outcome (improved, died or readmitted). Microsoft Excel was used for data entry, cleaning, and coding while Statistical Package for the Social Science (SPSS) version 26 was used for data analysis. Frequency and percent were used for description of the categorical variables and presented in forms of tables and graphs. Chi square test, and Fisher exact test were used to assess the difference between patients of different characteristics considering the readmission rate. All statements were considered significant when *p*-value is less than 0.05. Permission was obtained from research ethics committee of KSAFH, Tabuk to grant approval to conduct the study.

Results. The study included 237 patients admitted with confirmed Covid-19 infection. Table 1 summarizes their demographic and personal characteristics. Males represented 58.6% of them. Almost two-thirds (64.1%) aged 64 years or less. Obese patients represented 42.3% of them. Prevalence of current smoking and pregnancy was reported among 2.6% of the total and 8.2% of females, respectively. Duration of symptoms till presentation to emergency room (ER) was 3 days or less among almost half of patients (49.7%). The commonest presenting symptoms were cough (74.6%), fever (72.9%), and dyspnea (64.8%). Regarding vital signs, maximum temperature ≥37.7c was reported by 46.4% of patients and oxygen saturation <93% was observed among 64.7% of patients. The most frequent reported comorbid diseases were diabetes mellitus (52.4%) and hypertension (48.9%). Half of cases were regarded as severe cases whereas 14.8% were critical cases (Table 1). Results of laboratory investigations are summarized in a categorized manner (Table 2). High D-dimer level (>0.5 g/L) was reported among 70.3% of patients while platelets count <150,000 per microliter was observed among 21.1% of them. Unilateral and bilateral lung shadows were present in chest x-rays of 19.2% and 58.1% of patients, respectively while normal chest x-rays were

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Table 1 - Demographic, personal, and clinical characteristics of patients admitted for Covid-19 at King Salman Armed Forces Hospital, Tabuk (March-November, 2020) (N=237).

Characteristics	n	%
Gender		
Female	98	41.4
Male	139	58.6
Age (years)		
≤64	152	64.1
≥65	85	35.9
Body mass index (n=163)		
Underweight	1	0.6
Normal	30	18.4
Overweight	63	38.7
Obese	69	42.3
Current smoking	6	2.6
Current pregnancy (n=98)	8	8.2
Duration of symptoms till presentation to ER (days) (n=231)		
≤3	115	49.7
4-7	87	37.7
>7	29	12.6
Presenting symptoms (n=236)		
Fever	172	72.9
Chills	88	37.3
Sweating	86	36.4
Cough	176	74.6
Sputum	32	13.7
Headache	66	28.0
Loss of smell	2	0.8
Sore throat	34	14.4
Dyspnea	153	64.8
Chest pain	7	3.0
Abdominal pain	24	10.2
Nausea	48	20.3
Vomiting	39	16.5
Diarrhea	40	16.9
Loss of appetite	30	12.8
Body ache	58	24.6
Vital signs		
Maximum temperature		
<37.7	127	53.6
≥37.7		
Oxygen saturation "%" (n=235)	110	46.4
≥93	83	35.3
<93	152	64.7
Comorbid diseases		
Diabetes mellitus (n=231)	121	52.4
Hypertension (n=229)	112	48.9
Sickle cell disease (n=228)	1	0.4
Chronic lung diseases (n=228)	24	10.5
Heart diseases (n=228)	29	12.7
Immune compromised (n=229)	5	2.1
Cancer (n=229)	2	0.9
Kidney diseases (n=229)	24	10.1
Rheumatic diseases (n=185)	2	1.1
Cerebrovascular accident (n=77)	9	11.7
Renal transplant (n=229)	4	1.7
Mild	58	25.2
Moderate	23	10.0
Severe	115	50.0
Critical	23	14.8

Table 2 - Results of laboratory investigations of patients admitted for Covid-19 at King Salman Armed Forces Hospital, Tabuk (March-November 2020) (N=237).

Laboratory investigations	n	%
White blood cell count (per microliter) (n=232)		
<4000	10	4.3
4000-11000	145	62.5
>11000	77	33.2
Platelets (per microliter) (n=232)		
<150,000	49	21.1
15000-400000	174	75.0
>400000	9	3.9
Lymphocytes (per microliter) (n=231)		
<1	29	12.6
1-3	198	85.7
>3	4	1.7
Erythrocyte sedimentation rate (mm/hr) (n=89)		
1-31	11	12.4
>31	78	87.6
C-reative protein (mg/dL) (n=168)		
0.0-0.3	10	6.0
>0.3	158	94.0
Ferritin (micrograms per liter) (n=121)		
3-244	45	37.2
>244	76	62.8
D-Dimer (g/L) (n=202)		
0-0.5	60	29.7
>0.5	142	70.3
Creatine kinase (U/L) (n=119)		
<26	5	4.2
26-192	83	69.7
>192	31	26.1
Low density lipoprotein (mg/dL) (n=212)		
81-234	39	18.4
>234	173	81.6
Albumin (g/dL) (n=224)		
34-50	74	33.0
>50	150	67.0
Total bilirubin (mg/dL) (n=225)		
0-14	201	89.3
>14	24	10.7
AST (units per liter) (n=221)		
<15	9	4.1
15-37	107	48.4
>37	105	47.5
ALT (units per liter) (n=227)		
<30	95	41.9
30-65	89	39.2
>65	43	18.9
Alkaline phsphatase (U/L) (n=163)		
<50	15	9.2
50-136	133	81.6
>136	15	9.2
Creatinine (mg/dL) (n=225)		
<53	19	8.4
53-115	163	72.5
>115	43	19.1

AST: aspartate transaminase ALT: alanine transaminase

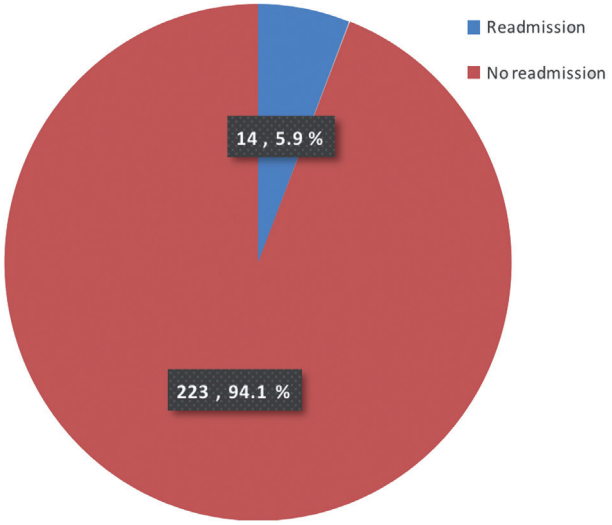

Figure 1 - Rate of readmission among patients admitted for COVID-19 at King Salman Armed Forces Hospital, Tabuk (March-November 2020).

Table 3 - Demographic and personal factors associated with readmission of COVID-19 cases after hospital discharge (N=237).

Characteristics	Hospital readmission		*P*-value
	No n=223	Yes n=14	
Gender			
Female	94 (95.9)	4 (4.1)	0.238*
Male	129 (92.8)	10 (7.2)	
Age (years)			
≤64	148 (97.4)	4 (2.6)	0.006*
≥65	75 (88.2)	10 (11.8)	
Body mass index (n=163)			
Underweight	1 (100)	0 (0.0)	0.997**
Normal	29 (96.7)	1 (3.3)	
Overweight	61 (96.8)	2 (3.2)	
Obese	67 (97.1)	2 (2.9)	
Current smoking			
No	214 (96.8)	7 (3.2)	0.827*
Yes	6 (100)	0 (0.0)	
Current pregnancy (n=98)			
No	215 (93.9)	14 (6.1)	0.610*
Yes	8 (100)	0 (0.0)	

*Fischer exact test, **Chi-square test

presented in 22.6 % of the patients. Admission to ICU was reported among 18% of the involved patients and positive blood or sputum cultures were reported among 4.3% and 5% of patients admitted for Covid-19. Out of 237 patients admitted throughout the period March-November 2020, 14 patients were readmitted (5.9%) (Figure 1). Older patients (≥65 years) were more likely to be readmitted compared to younger patients (11.8% vs. 2.6%), p=0.006. Regarding clinical characteristics, critically ill patients were more likely to be readmitted than less severe cases, p=0.031. Patients with unilateral lung shadow in chest x-ray (p=0.004), and those with positive history of ICU admission (p=0.006) were more likely to be readmitted compared to their peers (Table 4). Regarding medical history, the only factor significantly associated with readmission were history of cerebrovascular accident (CVA), as 22.2% of those with CVA history compared to only 1.5%% of those without CVA history were more likely to be readmitted, p=0.035 (Table 5). Among laboratory findings, high lymphocytic count (>3 per microliter) was significantly associated with likelihood for readmission, p=0.001 (Table 6).

Discussion. Some patients who were hospitalized and discharged for COVID-19 are readmitted to the hospital for further hospitalization because of some risk factors. In the current study we aimed estimate the rate of re-hospitalization of patients with COVID-19 as well as to identify potential risk factors for that. Initial hospitalization of Covid-19 cases is greatly influenced by many factors including the quality of care, the capacity of the medical system, and availability of hospital beds in the pandemic period.[12,13] Readmission, is influenced beside patients` demographic, and clinical factors by the quality of post- discharge care discharge care.[8,14] Rate of readmission in the present study was 5.9%. Higher rate was reported by others in Turkey[12] (7.1%) and Unites States (13.3% and 20%).[15,16] Different rate was also reported from the United States (6.7%) 30 days after discharge and Spain (4.4%).[10,11,17] However, lower rate was observed in South Korea (4.3%) It seems that the rate of readmission was affected by the duration between discharge and re-discharge. In the present study, we did not specify this duration Among studied demographic factors, in the present study, older patients (≥65 years) were more likely to be readmitted compared to younger patients. The same has been confirmed in studies carried out in South Korea,[10] China,[18,19] and United States.[20] This observed higher rate of readmission among the United States (New York City) older population in different studies, including the present one could be explained by the fact that with aging, there is reduction in the response of immune system to viral infection, so it lasts longer in the body of elderly, causing returning of symptoms or positive PCR which might cause readmission.[21,23]

In the present study, no gender difference was reported between patients readmitted and those not re-admitted after initial hospitalization. Some others reported that males were more likely than females to be

Table 4 - Clinical factors associated with readmission of COVID-19 cases after hospital discharge (N=237).

Clinical factors	Hospital readmission No n=223‡	Yes n=14‡	*P*-value
Severity (n=230)			
Mild	57 (98.3)	1 (1.7)	0.031*
Moderate	23 (100)	0 (0.0)	
Severe	109 (94.8)	6 (5.2)	
Critical	29 (85.3)	5 (14.7)	
Duration of symptoms before presentation (n=231)			
≤3	105 (91.3)	10 (8.7)	0.067*
4-7	86 (98.9)	1 (1.1)	
>7	27 (93.1)	2 (6.9)	
Maximum temperature			
<37.7	118 (92.9)	9 (7.1)	0.408*
≥37.7	105 (95.5)	5 (4.5)	
Oxygen saturation (n=235)			
≥93	81 (97.5)	2 (2.4)	0.102**
<93	141 (92.8)	11 (7.2)	
Fever (n=236)			
No	58 (90.6)	6 (9.4)	0.172*
Yes	164 (95.3)	8 (4.7)	
Chills (n=236)			
No	139 (93.9)	9 (6.1)	0.900*
Yes	83 (94.3)	5 (5.7)	
Sweating (n=236)			
No	140 (93.3)	10 (6.7)	0.528**
Yes	82 (95.3)	4 (4.7)	
Cough (n=236)			
No	54 (90.0)	6 (10.0)	0.122*
Yes	168 (95.5)	8 (4.5)	
Sputum (n=234)			
No	189 (93.6)	13 (6.4)	0.403**
Yes	31 (96.9)	1 (3.1)	
Headache (n=236)			
No	158 (92.9)	12 (7.1)	0.196**
Yes	64 (97.0)	2 (3.0)	
Loss of smell (n=236)			
No	220 (94.0)	14 (6.8)	0.885**
Yes	2 (100)	0 (0.0)	
Sore throat (n=236)			
No	188 (93.1)	14 (6.9)	0.106**
Yes	34 (100)	0 (0.0)	
Dyspnea (n=236)			
No	79 (95.2)	4 (4.8)	0.414**
Yes	143 (93.5)	10 (6.5)	
Chest pain (n=236)			
No	216 (94.3)	13 (5.7)	0.352**
Yes	6 (85.7)	1 (14.3)	
Abdominal pain (n=236)			
No	198 (93.4)	14 (6.6)	0.213**
Yes	24 (100)	0 (0.0)	
Nausea (n=236)			
No	176 (93.6)	12 (6.4)	0.430**
Yes	46 (95.8)	2 (4.2)	

*Chi-square test, **Fisher exact test, ‡Difference due to missing values

Table 4 - Clinical factors associated with readmission of COVID-19 cases after hospital discharge (N=237) (continuation).

Clinical factors	Hospital readmission No n=223‡	Yes n=14‡	*P*-value
Vomiting			
No	184 (93.4)	13 (6.6)	0.292**
Yes	38 (97.4)	1 (2.6)	
Diarrhea (n = 236)			
No	183 (93.4)	13 (6.6)	0.278**
Yes	39 (97.5)	1 (2.5)	
Loss of appetite (n=235)			
No	195 (95.1)	10 (4.9)	0.087**
Yes	26 (86.7)	4 (13.3)	
Body ache (n=236)			
No	167 (93.8)	11 (6.2)	0.535**
Yes	55 (94.8)	3 (5.2)	
Chest x-ray (n=234)			
Normal	53 (100)	0 (0.0)	0.004*
Unilateral shadow	38 (84.4)	7 (15.6)	
Bilateral shadow	129 (94.9)	7 (5.1)	
ICU admission (n=234)			
No	185 (96.4)	7 (3.6)	0.006*
Yes	36 (85.7)	6 (14.3)	
Blood culture (n=211)			
Negative	192 (95.0)	10 (5.0)	0.640**
Positive	9 (100)	0 (0.0)	
Sputum culture (n=220)			
Negative	199 (95.2)	10 (4.8)	0.114**
Positive	9 (81.8)	2 (18.2)	

*Chi-square test, **Fisher exact test, ‡Difference due to missing values, ICU: intensive care unit

readmitted.[8,10,17,18] It should be taken into consideration the small sample size in the present study as the total number of readmitted patients was 14, so despite the rate of males who re-admitted was higher than that of females, this did not reach a statistically significant level. The higher rate of readmission among men compared to women could be attributed to the more active immune response to the coronavirus in women compared to men, moreover the virus remain in the women's bodies for a shorter.[24,25] Additionally, the prevalence of chronic illnesses and risk behaviors time. such as smoking, in general, are higher in men than women, which may have contributed to the adverse impacts of the coronavirus.[26] Among studied comorbid chronic diseases, only cerebrovascular accidents were associated with likelihood of readmission in this study. Studies from South Korea[27,28] reported that Covid-19 patients with underlying chronic diseases were more likely to be readmitted. Also, in Switzerland, patients with coronary artery disease, atrial fibrillation, and aortic stenosis were more likely to be readmitted while in USA, the likelihood of readmission was higher in

Table 5 - Medical history associated with readmission of COVID-19 cases after hospital discharge (N=237).

Medical history	Hospital readmission No n=223‡	Yes n=14‡	*P*-value*
Diabetes mellitus (n=231)			
No	107 (97.3)	3 (2.7)	0.299
Yes	115 (95.0)	6 (5.0)	
Hypertension (n=229)			
No	113 (96.6)	4 (3.4)	0.615
Yes	108 (96.4)	4 (3.6)	
Sickle cell disease (n=228)			
No	220 (96.9)	7 (3.1)	0.969
Yes	1 (100)	0 (0.0)	
Chronic lung diseases (n=228)			
No	197 (96.6)	7 (3.4)	0.454
Yes	24 (100)	0 (0.0)	
Heart diseases (n=228)			
No	194 (97.5)	5 (2.5)	0.219
Yes	27 (93.1)	2 (6.9)	
Immune compromised (n=229)			
No	217 (96.9)	7 (3.1)	0.855
Yes	5 (100)	0 (0.0)	
Cancer (n = 229)			
No	220 (96.9)	7 (3.1)	0.940
Yes	2 (100)	0 (0.0)	
Kidney diseases (n=229)			
No	199 (97.1)	6 (2.9)	0.544
Yes	23 (95.8)	1 (4.2)	
Rheumatic diseases (n=185)			
No	178 (97.3)	5 (2.7)	0.064
Yes	1 (50.0)	1 (50.0)	
Cerebrovascular accident (n=77)			
No	67 (98.5)	1 (1.5)	0.035
Yes	7 (77.8)	2 (22.2)	
Renal transplant (n=229)			
No	218 (96.9)	7 (3.1)	0.882
Yes	4 (100)	0 (0.0)	

*Fischer exact test, ‡Difference due to missing values

Table 6 - Laboratory findings associated with readmission of COVID-19 cases after hospital discharge (N=237).

Laboratory findings	Hospital readmission No n=223‡	Yes n=14‡	*P*-value
White blood cell count (per microliter) (n=232)			
<4000	10 (100)	0 (0.0)	
4000–11000	138 (95.2)	7 (4.8)	0.652*
>11000	72 (93.5)	5 (6.5)	
Platelets (per microliter) (n=232)			
<150,000	45 (91.8)	4 (8.2)	
15000–400000	167 (96.0)	7 (4.0)	0.366
>400000	8 (88.9)	1 (11.1)	
Lymphocytes (per microliter) (n=231)			
<1	24 (82.8)	5 (17.2)	
1–3	192 (97.0)	6 (3.0)	0.001*
>3	3 (75.0)	1 (25.0)	
Erythrocyte sedimentation rate (mm/hr) (n=89)			
1–31	10 (90.9)	1 (9.1)	0.558**
> 31	73 (93.6)	5 (6.4)	
C-reactive protein (mg/dL) (n=168)			
0.0–0.3	10 (100)	0 (0.0)	0.498**
>0.3	147 (93.0)	11 (7.0)	
Ferritin (micrograms per liter) (n=121)			
3–244	43 (95.6)	2 (4.4)	0.604
>244	72 (94.7)	4 (5.3)	
D-Dimer (g/L) (n = 202)			
0–0.5	58 (96.7)	2 (3.3)	0.386**
>0.5	134 (94.4)	8 (5.6)	
Creatine kinase (U/L) (n=119)			
<26	4 (80.0)	1 (20.0)	
26–192	79 (95.2)	4 (4.8)	0.370*
>192	29 (93.5)	2 (6.5)	
Low density lipoprotein (mg/dL) (n=212)			
81–234	38 (97.4)	1 (2.6)	0.315**
> 234	162 (93.6)	11 (6.4)	
Albumin (g/dL) (n=224)			
34–50	67 (90.5)	7 (9.5)	0.055*
>50	145 (96.7)	5 (3.3)	
Total bilirubin (mg/dL) (n=225)			
0–14	190 (94.5)	11 (5.5)	0.627**
>14	23 (95.8)	1 (4.2)	
AST (units per liter) (n=221)			
<15	8 (88.9)	1 (11.1)	
15–37	103 (96.3)	4 (3.7)	0.478*
>37	98 (93.3)	7 (6.7)	
ALT (units per liter) (n=227)			
<30	89 (93.7)	6 (6.3)	
30–65	86 (96.6)	3 (3.4)	0.577*
>65	40 (93.0)	3 (7.0)	

*Chi-square test, *Fischer exact test, ‡Difference due to missing values

patients with chronic diseases.[8,29] In Spain and China hypertensive patients, chronic obstructive pulmonary disease and pulmonary fibrosis were more likely to be readmitted.[30,31]

In the current study, patients with history of ICU admission during initial hospitalization were more likely to be readmitted. This was confirmed by the results of Cosdon (2021) who observed admission to the ICU or mechanical ventilation were significantly associated with being re-admitted.[15]

Patients with high lymphocytic count in the present study had greater risk for readmission compared to those with normal lymphocytic count while other laboratory findings were not associated with readmission. In another study, elevated AST or low albumin levels were linked to readmission.[15] Nematshahi et al[32] indicated

Table 6 - Laboratory findings associated with readmission of COVID-19 cases after hospital discharge (N=237) (continuatuon).

Laboratory findings	Hospital readmission		*P*-value
	No n=223‡	Yes n=14‡	
Alkaline phosphatase (U/L) (n=163)			
<5	14 (93.3)	1 (6.7)	
50–136	125 (94.0)	8 (6.0)	0.563*
>136	13 (86.7)	2 (13.3)	
Creatinine (mg/dL) (n=225)			
<53 (n = 19)	18 (94.7)	1 (5.3)	
53–115 (n = 163)	155 (95.1)	8 (4.9)	0.866
>115 (n = 43)	40 (93.0)	3 (7.0)	

*Chi-square test, *Fischer exact test, ‡Difference due to missing values

that high creatinine level during initial hospitalization increased the probability of readmission. In accordance with others studies,[10,32,33] having shadows in chest x-ray was a determinant for re-admission of cases in the current study, which indicates the development of pneumonia. Therefore, it has been documented that chest imaging is a propriate tool for managing patients with COVID-19 after initial discharge.[34,35]

Study limitations. The study aim is to investigate the rate and predictors of readmission after initial hospitalization among Covid-19 patients in Saudi Arabia. However, some limitations should be mentioned. First of all, the study was carried out in only one healthcare facility which affects the ability to generalize the results over population in other healthcare facilities in Saudi Arabia or even in Tabuk. Second, its design as a retrospective cohort study depending for getting information on the accuracy of medical records is considered another limitation of the study. Finally, our results might be underpowered to detect a significant associations, because the relatively small sample size as only 14 patients were readmitted, so we could not apply multivariate logistic regression analysis to control for the confounders among significant risk factors in univariate analysis. Therefore, caution is warranted in interpreting our results.

In conclusion, readmission rate of patients hospitalized initially for Covid-19 was comparable to rates reported by most of other similar international studies. Older patients, those with history of CVA, high level of lymphocytic county, admitted to ICU, and with lung shadow in chest x-ray were more likely to be readmitted. Therefore, the results of the current study will help in identifying the most vulnerable patients that will help in providing those population with information of the possible being readmitted because of some preventable habits. Further longitudinal larger multicentric study is warranted to have clearer image of the situation.

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