Original Article

Risk factors and characteristics of hospitalized COVID-19 patients in Jordan

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ABSTRACT

الأهداف: للبحث في ظهور وتحديد العوامل التي تساهم في الإقامة بالمستشفى بين الأفراد الذين تم تشخيص إصابتهم بعدوى COVID-19.

المنهجية: في الفترة من 15 يونيو 2020 إلى 30 سبتمبر 2020، تم إجراء دراسة مقطعية باستخدام استبيان عبر الإنترنت في الأردن. وشملت الدراسة 657 مريضًا من مرضى COVID-19 الذين تعافوا بفترة لا تقل عن 3 أشهر بعد المرض. تم جمع البيانات الاجتماعية والديموغرافية والبيانات المتعلقة COVID-19. وتم توزيع الاستبيان على أعضاء جمعية "تجربتي مع COVID-19" في الأردن.

النتائج: بلغ معدل انتشار الإقامة بالمستشفى بين مرضى COVID-19 3%. كان المرضى الأكثر عرضة لخطر دخول المستشفى هم الذين يعانون من ارتفاع ضغط الدم (p=0.00)، ومرض السكري (p=0.00)، وأمراض القلب (p=0.009)؛ باستخدام مثبطات الإنزيم المحول للأنجيوتنسين (ACE) وحاصرات مستقبلات الأنجيوتنسين (ARBs) (p=0.00)؛ مع مؤشرات كتلة الجسم (BMI) أعلى من المعدل الطبيعي (p=0.005)؛ والذين تزيد أعمارهم عن 45 عامًا (p=0.00). باستخدام نسبة الأرجحية (OR)، كانت أهم عوامل خطر الدخول للمستشفى هي ارتفاع ضغط الدم (OR=7.1)، مرض السكري (OR=11.4)، أمراض القلب (OR=6.3)، استخدام مثبطات الإنزيم المحول للأنجيوتنسين وحاصرات مستقبلات الأنجيوتنسين (OR=10.8)، و BMI>25 (OR=5). لم يظهر لقاح الأنفلونزا الموسمية والتدخين والأعراض النفسية العصبية أي أهمية.

الخلاصة: يمكن أن يساعد تحديد الفئات المعرضة للخطر على مراقبة صحتهم واتخاذ التدابير الوقائية ضد الإصابة بعدوى COVID-19.

Objectives: To investigate the occurrence and identify the factors contributing to hospitalization among individuals diagnosed with COVID-19.

Methods: From June 15, 2020 to September 30, 2020, a cross-sectional study utilizing an online questionnaire was carried out in Jordan. The study included 657 COVID-19 patients who had recovered and had reached a minimum of 3 months post-illness. Sociodemographic and COVID-19-related data were collected. The questionnaire was distributed to members of the "My Experience with COVID-19 Association" in Jordan.

Results: The prevalence of hospitalization among COVID-19 patients was 3%. Patients with hypertension (p=0.00), diabetes mellitus (p=0.00), and heart disease (p=0.009); using angiotensin-converting enzyme inhibitors (ACE) and angiotensin-receptor blockers (ARBs) (p=0.00); with body mass indexes (BMI) above normal (p=0.005); and aged over 45 years (p=0.00) were at higher risk of hospitalization. Using an odds ratio (OR), hypertension (OR=7.1), diabetes mellitus (OR=11.4), heart disease (OR=6.3), angiotensin-converting enzyme inhibitors and angiotensin-receptor blockers use (OR=10.8), and having a BMI >25 (OR=5) were significant hospitalization risk factors. The seasonal influenza vaccine, smoking, and neuropsychological symptoms showed no significance.

Conclusion: Identifying high-risk groups can help them monitor their health and take preventive measures against COVID-19 infection.

Keywords: COVID-19, hospitalization, risk factors, drugs, comorbidity

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In March 2020, the World Health Organization (WHO) officially declared the COVID-19 outbreak, caused by the SARS-CoV-2 virus, as a pandemic.[1] Symptom severity in COVID-19 patients varies widely and remains poorly understood.[2-4] While a large proportion of COVID-19 patients are asymptomatic, reported illnesses among symptomatic patients range from mild cold-like symptoms to severe illness and death.[2] Fever, cough, and dyspnea are frequently cited as the most commonly reported symptoms among individuals infected with COVID-19.[5,6]

As a measure against the COVID-19 pandemic, the government of Jordan took decisive action by implementing a comprehensive statewide lockdown. This involved the temporary closure of educational institutions, prohibiting public gatherings, and imposing travel restrictions by shutting down borders and airports. These measures were put in place to effectively curb the rapid transmission of the virus.[7] Consequently, at the time of this study, only a small number of COVID-19 cases were detected, and few patients were hospitalized. Notably, this study was conducted prior to the emergence of various COVID-19 variants.[8]

As the pandemic has advanced, numerous underlying medical conditions have been recognized as potential risk factors for COVID-19 hospitalization, encompassing various health conditions, including heart disease, diabetes, hypertension, and smoking.[9,10] The worldwide smoking increase, including in Jordan, may be a risk factor for COVID-19 complications and hospitalization. Additionally, some medications—particularly angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin-receptor blockers (ARBs)—have been suspected in augmenting the pathogenicity of COVID-19.[11] Conversely, a study carried out in the United Kingdom (UK) found that influenza vaccination was associated with significantly decrease risk of hospitalization in people diagnosed with COVID-19.[12]

However, most COVID-19 patients have mild symptoms and do not require hospitalization; many studies have focused solely on hospitalized patients, disregarding nonhospitalized patients. The objective of this study is to assess the prevalence of COVID-19 hospitalization and identify the risk factors associated with patients who require hospitalization due to COVID-19.

Methods. A systematic search method was employed to find relevant prior research on the topic. Extensive literature searches were conducted on reputable websites such as PubMed and the WHO to gather pertinent information. A cross-sectional, self-reported online survey was conducted to collect data from 657 individuals who had recovered from COVID-19 during the specified period from June 15, 2020 to September 30, 2020. The survey was administered in Arabic and made available through a web-based platform created using Google Forms. Participants were recruited from all 12 provinces of Jordan and were required to meet specific inclusion criteria, including being aged 18 or older, having tested positive for COVID-19 by PCR for the first time, and having no preexisting neurological or psychiatric conditions. Participants were recruited through the My Experience with COVID-19 Association, which has 28,000 recovered COVID-19 patients as members. They were reached through social media platforms. Ethical approval was obtained from the Ethics Committee, Mutah University, Al Karak, Jordan (approval no.: 1082023).

To ensure data completeness, participants were prompted to complete all questionnaire items before proceeding. Participants had the option to voluntarily withdraw from the study at any given point. The survey comprised 2 sections. The first section focused on sociodemographic information and COVID-19-related medical histories, and the second section focused on symptoms, severity, hospitalization, and the psychological effects of the disease. After 6 weeks, 657 completed surveys were collected and analyzed using descriptive statistics and inferential tests, such as the Chi-square, odds ratio (OR), and confidence interval (CI), with a *p*-value threshold of 0.05 for statistical significance. Data analysis was performed using the Statistical Package for the Social Sciences, Windows version 25.0 (IBM Corp., Armonk, NY).

Results. This study investigated the clinical and sociodemographic characteristics of 657 recovered COVID-19 patients in Jordan from 2020 to 2021. The patients had an average age of 30.55±11.9 years, ranging from 18 to 78 years. A small percentage (3%) of patients had a prior history of hospital admissions during their COVID-19 illness. Females accounted for 67.6% of the patient population, including 23 individuals who were pregnant. The majority of patients (77.6%) experienced at least one psychological symptom throughout the course of their illness (Table 1). Of the comorbidity diseases, 4.4% of the patients had diabetes mellitus, 6.4% had hypertension, 2% had heart disease, and 18% were smokers (Table 2). The study also found that hospitalization among COVID-19 patients was significantly related to several symptoms, including exhaustion, fever, shortness of

Table 1 - Sociodemographic and clinical presentation of 657 recovered COVID-19 patients in Jordan 2020–2021.

Characteristics	n (%)	Hospitalized n (%)	χ^2	*P*-value	OR	CI 95%
Male	213 (33.4)	9 (4.2)	1.49	0.222	1.7	0.7–4
Female	444 (67.6)	11 (2.5)				
Body mass index						
<25	295 (44.9)	3 (1.2)	7.7577	0.005	5	0.05–0.6
≥25	330 (50)	16 (4.8)				
Smoking						
Yes	118 (18)	2 (1.7)	0.887	0.346	0.49	0.1–2.1
No	539 (82)	18 (3.3)				
Neuropsychological						
Yes	510 (78)	17 (3.3)	0.64	0.422	0.6	0.17-2
No	147 (22)	3 (2)				
Age						
<45	553 (84.1)	8 (1.4)	30.2	0.00	8.8	3.5-22.3
≥45	104 (15.9)	12 (11.5)				
Pregnant females						
Yes	23 (5.2)	1 (4.3)	0.58	0.55	1.8	0.2-15.25
No	421 (94.8)	19 (4.5)				
Influenza vaccine						
Yes	53 (7.8)	3 (5.6)	1.2	0.26	2.0	0.5-7
No	604 (92.2)	17 (2.8)				

OR: odds ratio, CI: confidence interval

Table 2 - Relationship of the presence of comorbidities to hospital admission among COVID-19 patients.

Comobidies	n (%)	Hospital admission n (%)	X^2	*P*-value	OR	CI 95%
Diabetes Mellitus						
Yes	29 (4.4)	6 (20.6)	31.94	0.00	11.422	4.0-32
No	628 (95.6)	14 (2.2)				
Hypertension						
Yes	42 (6.3)	6 (14.2)	19.6	0.00	7.143	2.5-19.6
No	615 (93.7)	14 (2.2)				
Heart disease						
Yes	13 (2)	2 (15.4)	6.82	0.009	6.313	1.3-30.5
No	644 (98)	18 (2.7)				
ACEI or ARB						
Yes	24 (3.6)	5 (20.8)	26.7	0.00	10.8	3.5-32
No	633 (96.4)	15 (2.3)				

OR: odds ratio, CI: confidence interval, ACEI: angiotensin-converting enzyme inhibitors, ARB: angiotensin-receptor blockers

breath, blurred vision, memory disturbance, cough, and speaking difficulty (Table 3). Patients ≥45 years showed a significantly higher hospitalization rate (11.5%) than patients who are younger than 45 (1.4%) year old. Overweight patients (normal BMI 18.5-24.9) also showed a significantly higher hospitalization rate (4.8%) during COVID-19 illness than patients with BMIs lower than 25 (1.2%) (Table 1). Significantly higher rates of admission were also detected among patients with a medical history of diabetes, hypertension, and cardiovascular disease. Patients taking ACEIs and ARBs were 10 times more likely to be admitted to the hospital during COVID-19 illness than the counter group (Table 2). However, other factors, such as the seasonal influenza vaccine, smoking, gender, and neuropsychological symptoms, showed no significant relationship to hospitalization risk (Table 1).

Discussion. As of June 28, 2022, the global health has been greatly affected by the COVID-19 pandemic, resulting in a substantial number of cases, estimated at 767.51 million, and a significant death toll

Table 3 - Symptoms of hospitalized and nonhospitalized COVID-19 patients.

Symptoms	n (%)	Hospital admissions n (%)	X^2	*P*-value	OR	CI 95%
Shortness of breath						
Yes	220 (33.0)	14 (6.3)	12.34	0.0	4.882	1.8-12.8
No	437 (67.0)	6 (1.3)				
Blurred vision						
Yes	61 (9.2)	5 (8.1)	6	0.014	3.45	1.21-9.8
No	596 (90.8)	15 (2.5)				
Fever						
Yes	284 (43.2)	16 (5.6)	11.3	0.001	5.5	1.8-16.6
No	373 (56.8)	4 (1.0)				
Cough						
Yes	263 (40.0)	13 (4.9)	5.3	0.021	2.87	1.1-7.3
No	394 (60.0)	7 (1.7)				
Difficulty in speaking or moving						
Yes	82 (12.4)	8 (9.7)	13.4	0.00	5.07	2-12
No	575 (87.6)	12 (2.0)				
Diarrhea						
Yes	189 (28.7)	10 (5.2)	4.5	0.033	2.559	1.04-6.2
No	468 (71.3)	10 (2.1)				
Nausea						
Yes	170 (25.9)	7 (4.1)	0.89	0.34	1.5	0.6-3.9
No	487 (74.1)	13 (2.7)				
Disturbance in taste and smell						
Yes	412 (62.7)	12 (2.9)	0.06	0.79	0.8	0.3–2.2
No	245 (37.3)	8 (3.2)				
Disturbance in memory						
Yes	68 (10.4)	5 (7.3)	4.7	0.02	3.0	1.06–8.6
No	589 (89.7)	15 (2.5)				
Throat pain						
Yes	263 (40.0)	9 (3.4)	0.02	0.6	1.2	0.5–3.0
No	394 (60.0)	11 (2.7)				
General exhaustion						
Yes	366 (55.7)	17 (4.6)	7.1	0.007	4.6	1.3–16
No	291 (44.3)	3 (1.0)				
Sneeze						
Yes	152 (23.1)	3 (1.97)	0.7	0.3	0.5	0.16–1.9
No	505 (76.9)	17 (3.3)				
Joint pain						
Yes	317 (48.2)	13 (4.1)	2.3	0.12	2.0	0.8-5.1
No	340 (51.8)	7 (2.0)				
Headache						
Yes	366 (55.7)	14 (3.8)	1.7	0.19	1.8	0.7-4.9
No	291 (44.3)	6 (2.0)				
Sweating						
Yes	133 (20.2)	4 (3.0)	0.001	0.97	0.9	0.3-2.9
No	524 (79.8)	16 (3.0)				
Redness in eye						
Yes	77 (11.7)	4 (5.9)	1.3	0.24	1.9	0.6-5.9
No	580 (88.3)	16 (2.7)				
Chills						
Yes	213 (32.4)	9 (4.2)	1.4	0.22	1.7	0.7-4.2
No	444 (67.6)	11 (2.4)				
Runny nose						
Yes	142 (21.6)	2 (1.4)	1.6	0.2	0.39	0.09-1.7
No	515 (78.4)	18 (3.4)				
Back pain						
Yes	176 (26.7)	6 (3.4)	0.1	0.7	1.1	0.44-3.11
No	481 (73.3)	14 (2.9)				

OR: odd ratio, CI: confidence interval

of approximately 6.94 million worldwide.[13] The first case reported in Jordan was in March 2020; by August of the same year, only 1,208 cases had been reported in the country. This small number is attributed to the strict measures taken by the Jordanian government to effectively curb the transmission of the virus.[7]

This study found that the hospital admission rate for COVID-19 patients in Jordan was 3%, much lower than the UK's 13% rate. The variation can be linked to the lockdown measures enforced by the Jordanian government and the country's younger population compared to the UK's population.[14,15]

We identified several common symptoms that were significant factors in COVID-19 patient hospital admission, including pulmonary symptoms, such as shortness of breath (OR=8.8); extrapulmonary symptoms, such as blurred vision (OR=3.4); and disturbances in speech or movement (OR=5.5). These findings are consistent with previous studies.[16,17]

We found that comorbidities, such as diabetes, heart disease, hypertension, and obesity, as well as certain medications used to treat hypertension (ACEIs and ARBs), were significant risk factors for hospital admission in COVID-19 patients. Our findings are consistent with previous studies.[18-20] These comorbidities may interact with COVID-19 pathogenesis, potentially leading to severe illness. For example, individuals diagnosed with diabetes have a heightened susceptibility to developing severe cases of COVID-19 infection for reasons that include impaired immune responses, and coexisting complication, such as cardiovascular disease and obesity.[21,22] These factors can result in prolonged symptomatology even after illness.[23] Diabetes can also affect various organs and systems in the body, including the respiratory system, which can exacerbate COVID-19's impact on the lungs. Moreover, hyperglycemia in patients with diabetes can cause the overproduction of proinflammatory cytokines, which can cause a cytokine storm, leading to increased COVID-19 severity.[21] Hypertension may also contribute to severe COVID-19 illness due to the interaction between hypertension and arterial stiffness, which can lead to vascular damage, inflammation and finally calcification.[24] Hypertension may additionally play a role in the emergence of diverse health conditions and complications, which are common in severe COVID-19 cases.[25,26] Although some studies have suggested potential protective effects of ACEIs and ARBs on COVID-19 severity, others have reported conflicting results, indicating that the impact of these drugs remains controversial.[27,28] Our study found that these medications were significant risk factors for hospital admission (OR=10.8, CI: 3.5–32.9), potentially due to up regulating the expression of ACE2 receptors in the respiratory tract, which are binding sites for the virus.[29]

Research indicates that advanced age is linked to a higher likelihood of experiencing severe illness caused by COVID-19. This association may be attributed to age-related alterations in the immune system, also known as immunosenescence.[30] In addition, obesity is associated with impaired metabolic health and chronic inflammation, both of which have been implicated in increasing COVID-19's severity. Obese individuals may also have reduced lung function and increased respiratory effort, potentially contributing to more severe disease outcomes.[31]

Surprisingly, we found no significant relationship between smoking and hospitalization despite the high smoking and e-cigarette use rates in Jordan.[32] This finding is consistent with a study that failed to find a significant relationship between smoking and COVID-19 hospitalization.[33] However, another study found a significant relationship between smoking and COVID-19 severity.[34] It is possible that the dilatational effect of individuals with preexisting diseases and smoking cessation during the pandemic may decrease hospitalization odds.

Finally, we could not prove a significant relationship between receipt of the seasonal influenza vaccine and decreased hospitalization odds in our study. This finding is contrary to a study carried out in England.[12] However, the low mean age of our study sample may have affected this result, as older individuals are more likely to receive the seasonal influenza vaccine.[35] The findings of our epidemiological study shed light on factors that contribute to the risk of with COVID-19 hospitalizations. This research contributes to the existing body of knowledge by identifying several novel risk factors, including diabetes mellitus, hypertension, age, heart disease, and the use of ACEI and ARB medications, which are associated with a higher likelihood of hospitalization. These results have important implications for future research. Firstly, further investigations are needed to elucidate the underlying mechanisms through which these risk factors have a notable impact on the severity and ultimate outcome of COVID-19 cases. Additionally, future studies should explore interventions and preventive strategies that target these specific risk factors, with the aim of reducing the burden of COVID-19 hospitalizations.

Study limitations. The study's limitations encompass the utilization of self-reported data, which introduces the potential for recall bias and social desirability bias. The survey was carried out online in Arabic, which

could have excluded individuals without internet access or technology proficiency, resulting in a potentially biased sample. Additionally, the convenience sampling method used through a single association and social media recruitment may introduce selection bias.

In summary, our study offers valuable insights into the correlation between the characteristics of COVID-19 patients and the need for hospitalization. The analysis revealed significant associations between various risk factors and the likelihood of hospitalization among patients. These research findings have substantial relevance in the current pandemic landscape, providing crucial insights for clinical decision-making and guiding public health interventions. Notably, our findings uncovered several new and important aspects in the landscape of COVID-19 hospitalizations. For instance, we observed a significant association between the use of ACEI medications and an increased likelihood of hospitalization, which has not been extensively explored in prior studies.

Furthermore, our study emphasizes the significance of diabetes mellitus as a risk factor in predicting severe COVID-19 outcomes, making a noteworthy contribution to the existing knowledge base. By emphasizing these new and important aspects, our study broadens the understanding of COVID-19 risk factors and helps guide future research and clinical decision-making.

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