Updates in
Emergency Medicine

Research Article

Risk factors of COVID-19 hospital stay prolongation: a retrospective analysis

Ayoub Tavakolian[1*], **Mina Movahedi Moqadam**[2*]

1 Department of Emergency Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.
2 Student Research Committee, Sabzevar University of Medical Sciences, Sabzevar, Iran.

* **Correspondence**: Ayoub Tavakolian. Department of Emergency Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran. Email: TavakkolianA@mums.ac.ir

Abstract:

Introduction: COVID-19 is a global concern and since the number of infected cases and affected countries had a sudden raise, hospitals got faced a huge number of patients. Long hospitalization lengths might contribute to high rates of bed occupancy. So, we focused on the risk factors of prolonged hospitalization length in this study.

Methods: This was a retrospective review of COVID-19 patients with a positive SARS-CoV-2 nasopharyngeal swab test, who were admitted to Vasei Sabzevar Hospital from February 20, 2020 to August 30, 2021. The primary outcome was hospitalization length and the secondary outcome was in-hospital death. A comprehensive list of demographic and clinical variables was collected. Hospitalization length was compared through the variables. Bed occupancy was calculated in an epidemic state of respiratory disease to predict hospital capacity in future epidemics.

Results: Out of 772 patients (mean age of 58.52 ± 17.62 years; 50.4% male) who were studied, the average length of hospitalization was 6.39 ± 4.22 days. The majority of patients (85.5%) were discharged and 112 of them (14.5%) were deceased. Statistics did not show a significant difference between deceased and recovered patients in the duration of hospitalization (P=0.860). The correlation test showed a positive and significant correlation between the length of hospital stay and lymphocyte count (r=-0.130, P=0.001); while not so powerful. This test also showed a negative and significant correlation between the patient's oxygen saturation percentage and the duration of hospitalization (r=-0.134, P<0.001). patients who had a history of high blood pressure had a significantly longer hospitalization period (6.76±4.524 days) than people without hypertension (5.79±3.596 days), P=0.039. there was a significant difference between the groups of subjects with different hypoxia severities and patients with severe hypoxia stayed longer at the hospital compared to others, p=0.003. During this epidemic peak, the hospital's occupancy rate was around 54% which was optimal compared to the standard maximum 80%; while is better to be calculated monthly.

Conclusion: Patients with underlying diseases, especially high blood pressure and patients with a low percentage of oxygen might need a longer duration of hospitalization. Our study data on hospitalization length should be interpreted with caution to not consider short hospitalization length as good an outcome as this stands for death time for deceased ones.

Keywords: Coronavirus, COVID-19, Length of hospitalization, Mortality

Citation: Tavakolian, A., & Movahedi Moqadam, M. Risk factors of COVID-19 hospital stay prolongation: a retrospective analysis. Updates in Emergency Medicine. Retrieved from https://uiemjournal.com/index.php/main/article/view/28

Received: April 12, 2022
Reviewed: October 25, 2022
Accepted: November 27, 2022
Published: December 5, 2022

Introduction

COVID-19 is a global concern and has become an important health problem as the number of infected cases and affected countries have increased rapidly (1-3). On March 11, 2020, the World Health Organization confirmed COVID-19 as a pandemic. As of March 31, 2020, more than 800,000 cases of

COVID-19 have been reported with more than 39,000 deaths, and only about 141,000 recoveries have been reported in 199 countries worldwide. Among high-ranking countries, Iran ranked seventh with more than 35,000 confirmed cases and more than 2,500 deaths (3). In most cases, mild symptoms of fever, cough, sore throat, and myalgia are seen (4-7). However, some cases can present with severe conditions such as multiple organ failure, acute respiratory distress syndrome, pulmonary edema, and pneumonia, that necessitate hospitalization (7-10). Studying the length of hospitalization among COVID-19 patients and its related factors can provide a better understanding of its impact on medical interventions as well as hospital capacities to deal with the increase in COVID-19 patients. Until today, the studies of COVID-19 have been mostly focused on epidemiological research, prevention and control, diagnosis and treatment (11-12). Fewer studies have investigated the length of stay of patients with COVID-19 during the pandemic. The median length of stay due to COVID-19 has been reported as 10-13 days in several studies in China (13-14). However, the length of stay depends on various factors, including the time elapsed from exposure to the onset of symptoms and from this onset to the time of hospitalization, as well as various country-specific factors. Various studies have stated that the average duration of hospitalization in patients can be different according to the admission and discharge criteria of patients. In addition, some studies have shown that other factors can have an effect on lengthening or shortening the hospitalization time, as well as patient-related conditions like comorbidities or hospital types of equipment (15-17).

Currently, there is not enough information about the epidemiology and clinical characteristics and mortality rate of patients with COVID-19 in the Middle East, especially Iran, which is considered one of the most important focal points of this disease worldwide. Therefore, this study was conducted with the aim of evaluating the mortality rate and duration of hospitalization of patients with COVID-19 hospitalized in Vasei Sabzevar Hospital and related factors.s

Methods

Study design, setting, and ethical considerations:

This study was a retrospective study based on a hospital record review from records of all patients admitted to Vasi Sabzevar Hospital, a 214-bed hospital, during the 6 months of February 20, 2020 to August 30, 2021.

All information about the patients was extracted from the patients' files by referring to the Medical Records Unit of Vasei Sabzevar Hospital after presenting the introduction letter of the project initiation by the Vice President of Hospital. To ensure that the patients' identities are protected and that their privacy is respected, all hospital records were de-identified. This study protocol was approved by university ethics committee in research with code of IR.MEDSAB.REC.1400.059.

Participants

The criteria for entering the study include: patients with COVID-19 based on a positive PCR test and the exclusion criteria included the incompleteness of the patient file information and the impossibility of a telephone interview, discharge with personal consent, sending the patient to other medical centers for continued treatment. Sampling was conducted by the census sampling method.

Variables

The primary outcome was hospitalization length that was extracted from electronic records, as well as the secondary outcome of the in-hospital any-cause mortality.

Exposures are demographic information (age, sex, marital status, place of residence) and comorbidities (smoking history, addiction, underlying diseases, obesity), and clinical data.

Clinical data included Blood oxygen saturation on the first visit, laboratory results, and presenting symptoms. Self-reported economic status was recorded. Standard BMI classification was used to check patients' BMI. According to this classification, BMI of less than 18.5 was considered thin (Underweight), between 18.5-24.9 was normal, between 25-29.9 was Pre-obese Overweight, between 30-34.9 was grade 1 obesity, between 35-39.9 was grade 2 obesity and BMI greater than 40 was considered as Grade 3 obesity.

Bed occupancy assessment:

To calculate the hospital's occupancy rate during the epidemic peak, we used the following estimate:

Occupancy rate = (Total number of occupied beds / Total number of beds) x 100%

Total number of occupied beds = Total number of admissions x Mean hospitalization length

Sources of bias:

The information bias is possible as data were collected retrospectively from previously recorded data by the hospital staff. Predesigned checklists were provided to minimize any inconsistency in data collection.

Data analysis:

Data analysis using SPSS software version 241 and using descriptive statistical tests (mean, standard deviation and percentage) and inferential (Chi-square, Mann-Whitney, Kruskal-Wallis) were significant at the $P<0.05$ level.

Results

Total number of 1805 records of patients with suspected COVID-19 were available at Vasi Sabzevar hospital during the first 6 months of the onset of the disease, based on the exclusion criteria of the study, 1027 patients were excluded due to a negative PCR test and 6 patients were excluded for various reasons, including incomplete file information and unwillingness to participate in the study, discharge due to personal consent, sending to other medical centers for continued treatment, etc. and finally 772 patients were examined.

Of the 772 patients who were studied, 112 patients died and 660 patients were discharged from the hospital. The average hospitalization length of the patients was equal to 6.39 ± 4.22 days. The maximum hospitalization period was 31 days and the minimum was one day. The average age of the patients was 58.52 ± 17.62 years. The youngest patient was 11 years old and the oldest patient was 98 years old. Among the 772 examined patients, 383 (49.6%) were female and 389 (50.4%) were male, and the majority of them were married (79.1%). Among the examined patients, 517 patients with COVID-19 were from Sabzevar city and 219 (28.4%) were from rural residents of this city. 16 patients (2.1%) were residents of welfare care centers, nursing homes, prisons, etc.). The average BMI in patients was 26.25 ± 4.65. The majority of patients had normal BMI (45.6%) and BMI above 30 was observed in 124 patients. In examining the economic status of the patients, it was found that most of the patients with COVID-19 had a low economic status and only 50 patients (6.5%) had a high economic status. In the review of underlying disease records, 481 patients (62.3%) had a history of underlying disease. The most diseases reported in patients are high blood pressure or 280 people (36.2%), type 2 diabetes in 189 (24.5%), hyperlipidemia in 134 (17.4%), cardiac ischemia in 125 (16.2%), COPD in 84 (10.9%), heart failure in 52 people (6.7%) and recent hospitalization due to COVID-19 in 44 people (6.1%). It was found that 97 patients had a history of opium consumption and 48 patients had a history of smoking. In the examination of the clinical symptoms of patients upon arrival, it was found that the highest frequency was related to respiratory symptoms at 61.8%, followed by feeling weak and lethargic at 13.7% and gastrointestinal symptoms at 10.2%. Fever was also seen as one of the most common symptoms among patients.

Table 1. frequency and percentage of demographic variables of patients with COVID-19

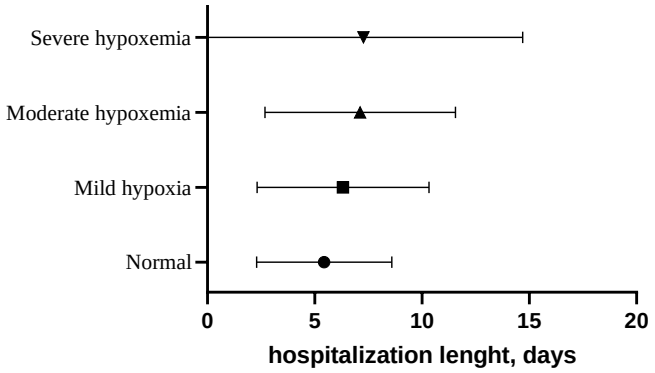
	Variable status	n	%
Gender	Female	383	49.6
	Male	389	50.4
Marital status	Single	161	20.9
	Married	611	79.1
Area of living	City	517	67.0
	Village	219	28.4
	other	20	2.6
Classification of body mass index	Thin	14	1.8
	Normal weight range	352	45.6
	Overweight	282	36.5
	Class 1 obesity	98	12.7
	Class 2 obesity	15	1.9
	Class 3 obesity	11	1.4
Economic status	Top	50	6.5
	Medium	326	42.3
	Down	395	51.2

The results of the Mann-Whitney test showed that there was no significant difference between the duration of hospitalization based on gender (P=0.287), place of residence (P=0.641) and BMI classification (P=0.662). In the examination of the type of underlying disease and the duration of hospitalization, no relationship was found (P>0.05); except observed in patients with high blood pressure. In other words, patients who had a history of high blood pressure had a significantly longer hospitalization period (6.76±4.524 days) than people without hypertension ((5.79±3.596 days)), P=0.039.

In examining the relationship between the duration of hospitalization based on the patient's clinical symptoms, the Kruskal-Wallis test showed that there is no significant difference between the type of clinical symptom of the patient and the duration of the patient's hospitalization (P=0.359). In examining the status of the patient's oxygen saturation percentage and hypoxia severity, the Kruskal-Wallis test showed that there was a significant difference between the groups of subjects with different hypoxia severities and patients with severe hypoxia stayed longer at the hospital, p=0.003, (figure 1). Statistics did not show a significant difference between deceased and recovered patients in the duration of hospitalization (P=0.860).

Spearman's correlation test was used to investigate the relationship between the hospitalization duration variable and quantitative variables. The results of this test showed that there are no correlations between age (r=0.044, P=0.217), BMI(r=-0.012, P=0.741), and count of white blood cells (r=-0.010, P=0.787) with the length of hospitalization. Also, Spearman's correlation test showed a positive and significant correlation between the length of hospital stay and lymphocyte count (r=-0.130, P=0.001); while not so powerful. This test also showed a negative and significant correlation between the patient's oxygen saturation percentage and the duration of hospitalization (r=-0.134, P<0.001). The results of the present study showed that the variable age, WBC count, Lymphocyte count, SPO2 and duration of hospitalization were related to the mortality rate (P<0.05). So the deceased patients were older and their WBC and Lymphocyte values were higher. While there was no significant difference between BMI and the length of hospitalization of patients who died and were discharged (P>0.05).

Figure 1. Comparison of the average duration of hospitalization of patients with COVID-19 based on hypoxia severity



The results of the present study indicated that there was no relationship between gender and the final outcome of in hospital mortality. While in the study of the marital status and the place of residence of patients with COVID-19, a significant relationship was observed with the final outcome of the patient. Among the deceased, 69.9% were married and 30.4% were single. In the study of the place of residence, 55.4% of the patients who were infected with COVID-19 and lived in the city and 37.5% of the people living in the village died. An important point is regarding people who were residents of nursing homes and welfare homes or prisons, according to the results below, half of the infected people died from this source of pollution and the other half recovered. Chi-square test also showed a significant difference between a person's place of residence and the mortality rate of patients with COVID-19 (P=0.001). The highest percentage of death was in people with low economic status (58.9%), but this difference was not significant compared to groups with high and medium economic status (P=0.06). In order to investigate the relationship between the patient's final outcome and BMI classification and history of smoking and drug use in patients with COVID-19, the chi-square test did not show a significant relationship (P>0.05). So that patients with a background of type 2 diabetes, high blood pressure, ischemic heart diseases, heart failure, chronic obstructive pulmonary disease (COPD), chronic kidney failure (CKD), the mortality rate was higher (P=0.001). Regarding the history of malignancy in the patients and the high mortality rate in them, there was also a significant relationship (P=0.01). While the history of hyperlipidemia had no effect on the final outcome of the patients (P=0.61). In examining the relationship between the initial complaint of the patient at the time of hospitalization and the final outcome of the patient, it was found that the patients who presented with respiratory symptoms and decreased level of consciousness significantly had the highest number of deaths among them, and a high percentage of patients died with respiratory symptoms and decreased level of consciousness (52.7% and 25.9% respectively).

Occupancy Rate

Assuming the hospital wants to maintain a target occupancy rate of 80% (which is considered safe for patient care),

Table 2. Comparison of demographic and laboratory variables and duration of hospitalization between deceased and discharged patients

	Deceased	**Discharged**	
	SD ± Mean	SD ± Mean	P.Value
Age	69.42±15.180	56.67±17.349	0.001
BMI	26.05±5.18	26.29±4.55	0.56
SPO2	80.1±15.021	90.84±5.795	0.001
WBC Count	8475.27±4509.68	6374.77±3669.65	0.001
Lymphocyte Count	1538.03±2656.56	1342.75±1487.8	0.2
Length of stay in hospital	6.92±5.317	6.3±4.005	0. 860

we can calculate the maximum number of admissions as follows:

Maximum number of admissions = 214 x 80% / 6.39 = 2679.06

Therefore, the hospital can handle a maximum of around 2679 admissions during a respiratory disease epidemic if it wants to maintain a target occupancy rate of 80%. However, it's important to note that this is just an estimate and other factors such as staffing levels, availability of equipment, and severity of the epidemic can also affect the hospital's capacity to handle admissions.

Discussion

At present, there is not enough information about the epidemiology and clinical features and the mortality rate of COVID-19 patients in the Middle East, especially Iran, a country that is considered one of the most important focal points of this disease worldwide. On the other hand, studying the duration of hospitalization among COVID-19 patients and its related factors can provide a better understanding of its impact on medical interventions as well as hospital capacities to deal with the increase of COVID-19 patients. To date, the studies of COVID-19 have been mostly focused on epidemiological research, prevention and control, diagnosis and treatment (19, 20). Therefore, this study was conducted with the aim of evaluating the duration of hospitalization of patients infected with the new corona virus admitted to Vasei Sabzevar Hospital and related factors.

In the present study, the average duration of hospitalization of the patients was 6.39 ± 4.22 days. During the investigation of factors affecting the duration of hospitalization, the patient's gender, place of residence, history of smoking and drug use, BMI, clinical symptoms and the final outcome of the patients did not make a significant difference in the length of hospitalization. While low oxygen level, history of underlying disease, especially high blood pressure significantly prolonged the hospitalization time in patients with COVID-19. Also, Pearson's correlation test showed a linear and negative relationship between lymphocyte count and length of hospitalization, as well as between low oxygen level and length of hospitalization. Wu et al. studied 125 patients with COVID-19 in Wuhan, China, the results showed that the average length of hospitalization was 13 days with a range of 10-17 days (21). Although in this study, the factors affecting the length of hospitalization have many similarities with our study, but what seems to have caused a difference is the high length of hospitalization of patients in Wuhan, China.

In another study examining 33 patients in Vietnam, where no deaths were reported, the average length of stay in the hospital was 21 days (IQR=16-34) and the multivariate regression model showed that the place of residence is significantly related to long hospitalization time (22). In Rosenthal's study, examining 64,781 patients with COVID-19 with a mortality rate of 11.4%, it was stated that the average duration of hospitalization in floor was 7.7 days and in patients admitted to the ICU was 7.3 day (23). One reason for the difference in the average duration of hospitalization in the studies could be due to the different criteria for admission and discharge of patients from the hospital. These criteria include ensuring that the symptoms are resolved and observing 2 negative PCR samples at least 24 hours before discharge (24). It is very important to understand the duration of hospitalization of patients with COVID-19 in the hospital in order to plan and predict bed occupancy, as well as to check the needs of personnel and equipment. Different studies also stated the duration of hospitalization in the hospital for COVID-19 patients from one week to 2 months, and the average duration of hospitalization in the intensive care unit was also reported between 3 and 4 weeks (25).

Conclusion

Prolonged hospitalization means more medical burden and overuse of health facilities. This study showed some populations of COVID-19 that are at risk of experiencing higher risk of prolonged hospitalization.

Declarations:

Funding:

Sabzevar University of Medical Sciences.

Conflicts of interest:

None.

Authors' contributions:

AT and MMM wrote the study protocol, collected datasets, performed statistical analyses, and wrote the manuscript.

Acknowledgments

None.

Ethical considerations

The study was approved by the Institutional Review Board of Sabzevar University of Medical Sciences.

REFERENCES

1. Cortegiani A, Ippolito M, Ingoglia G, Iozzo P, Giarratano A, Einav S. Update I. A systematic review on the efficacy and safety of chloroquine/hydroxychloroquine for COVID-19. Journal of critical care. 2020.
2. Shahriarirad R, Khodamoradi Z, Erfani A, Hosseinpour H, Ranjbar K, Emami Y, et al. Epidemiological and clinical features of 2019 novel coronavirus diseases (COVID-19) in the South of Iran. BMC infectious diseases. 2020;20(1):1-12.
3. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia. New England Journal of Medicine. 2020.
4. Alavi-Moghaddam M. A novel coronavirus outbreak from Wuhan City in China, rapid need for emergency departments preparedness and response; a letter to editor. Archives of academic emergency medicine. 2020;8(1).
5. Derespina KR, Kaushik S, Plichta A, Conway Jr EE, Bercow A, Choi J, et al. Clinical Manifestations and Outcomes of Critically Ill Children and Adolescents with Coronavirus Disease 2019 in New York City. The Journal of pediatrics. 2020.
6. Rabi DM, McBrien KA, Sapir-Pichhadze R, Nakhla M, Ahmed SB, Dumanski SM, et al. Hypertension Canada's 2020 comprehensive guidelines for the prevention, diagnosis, risk assessment, and treatment of hypertension in adults and children. Canadian Journal of Cardiology. 2020;36(5):596-624.
7. Bai Y, Yao L, WeiT, Tian F, Jin D-Y, Chen L, et al. Presumed asymptomatic carrier transmission of COVID-19. Jama. 2020;323(14):1406-7.
8. Tavakoli A, Vahdat K, Keshavarz M. Novel coronavirus disease 2019 (COVID-19): an emerging infectious disease in the 21st century. ISMJ. 2020;22(6):432-50.
9. Yang Y, Lu Q, Liu M, Wang Y, Zhang A, Jalali N, et al. Epidemiological and clinical features of the 2019 novel coronavirus outbreak in China. MedRxiv. 2020.
10. Rodriguez-Morales AJ, Cardona-Ospina JA, Gutiérrez-Ocampo E, Villamizar-Peña R, Holguin-Rivera Y, Escalera-Antezana JP, et al. Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis. Travel medicine and infectious disease. 2020:101623.
11. Yang J, Zheng Y, Gou X, Pu K, Chen Z, Guo Q, et al. Prevalence of comorbidities in the novel Wuhan coronavirus (COVID-19) infection: a systematic review and meta-analysis. International journal of infectious diseases. 2020.
12. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. Jama. 2020;323(13):1239-42
13. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, etal. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected

pneumonia in Wuhan, China. Jama. 2020;323(11):1061-9.
14. Guan W-j, Ni Z-y, Hu Y, Liang W-h, Ou C-q, He J-x, et al. Clinical characteristics of coronavirus disease 2019 in China. New England journal of medicine. 2020;382(18):1708-20.
15. Liu X, Zhou H, Zhou Y, Wu X, Zhao Y, Lu Y, et al. Risk factors associated with disease severity and length of hospital stay in COVID-19 patients. Journal of Infection. 2020;81(1):e95-e7.
16. Chen S, Zhang Z, Yang J, Wang J, Zhai X, Bärnighausen T, et al. Fangcang shelter hospitals: a novel concept for responding to public health emergencies. The Lancet. 2020.
17. Clark A, Jit M, Warren-Gash C, Guthrie B, Wang HH, Mercer SW, et al. How many are at increased risk of severe COVID-19 disease? Rapid global, regional and national estimates for 2020. medRxiv. 2020.
18. Shi Z, Mehrotra A, Gidengil CA, Poon SJ, Uscher-Pines L, Ray KN. Quality of care for acute respiratory infections during direct-to-consumer telemedicine visits for adults. Health Affairs. 2018;37(12):2014-23.
19. Papizadeh S, Moradi P, Mehr MH, Amerkani S, Nezhad RF, Saadati H, et al. Epidemiologic and clinical characteristics of 186 hospitalized patients with COVID-19 in Tehran, Iran: A retrospective, single-center case series. 2020.
20. Jalili M, Payandemehr P, Saghaei A, Sari HN, Safikhani H, Kolivand P. Characteristics and mortality of hospitalized patients with COVID-19 in Iran: a National Retrospective Cohort Study. Annals of internal medicine. 2020.
21. Wu Y, Hou B, Liu J, Chen Y, Zhong P. Risk factors associated with long-term hospitalization in patients with COVID-19: a single-centered, retrospective study. Frontiers in Medicine. 2020;7.
22. Thai PQ, Dinh TS, Van Hoang TH, Luu NM, Hung LX, Luu NH, et al. Factors associated with the duration of hospitalization among COVID-19 patients in Vietnam: A survival analysis. Epidemiology & Infection. 2020:1-20.
23. Rosenthal N, Cao Z, Gundrum J, Sianis J, Safo S. Risk Factors Associated With In-Hospital Mortality in a US National Sample of Patients With COVID-19. JAMA network open. 2020;3(12):e2029058-e.
24. Brücher BL, Nigri G, Tinelli A, Lapeña JFF, Espin-Basany E, Macri P, et al. COVID-19: Pandemic surgery guidance. 4open. 2020;3:1.
25. Rees EM, Nightingale ES, Jafari Y, Waterlow NR, Clifford S, Pearson CA, et al. COVID-19 length of hospital stay: a systematic review and data synthesis. COVID-19 length of hospital stay: a systematic review and data synthesis. BMC Medicine 2020;18(270): 1-22