İstanbul Med J 2025; 26(3): 253-8
DOI: 10.4274/imj.galenos.2025.55070

The Relationship Between Malnutrition and Mortality in Patients Hospitalized with COVID-19

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ABSTRACT

Introduction: Coronavirus disease-2019 (COVID-19), caused by severe acute respiratory syndrome-coronavirus-2 infection, was first reported by the Chinese Center for Disease Control and Prevention in December 2019 in Wuhan. It is known that the risk of malnutrition adversely affects several clinical outcomes, such as the length of hospitalisation and mortality, in non-COVID-19 cases. Further, if this group of patients needs to be followed up in the intensive care unit (ICU), early diagnosis and rapid intervention are recommended. The aim of our study was to determine the effect of the presence of malnutrition risk on mortality and prognosis in patients hospitalised due to COVID-19.

Methods: One thousand one hundred seventy-seven patients who were diagnosed with COVID-19 and hospitalised after their polyclinics and emergency applications between March 2020 and July 2020 were evaluated. The malnutrition risk of the patients was evaluated using nutritional risk screening, and patients with a score of >3 were considered at risk of malnutrition. The relationship between malnutrition risk and mortality was then evaluated among patients with COVID-19, hospitalised in the service wards and the ICU.

Results: One thousand one hundred seventy-seven patients were eventually evaluated retrospectively. One hundred twenty-three (10.5%) were hospitalized in the ICU on arrival, and 862 (73.2%) were inpatients in the infection clinic. In addition, 120 (10.2%) patients were followed up in the ICU because they required intensive care. Mortality was evaluated in the entire inpatient group, with the number of observed deaths being n=232. The mortality rate was the highest in the intensive care unit (n=76, 32.8%), followed by the infectious diseases service (n=71, 30.6%). When the relationship between malnutrition risk and mortality was evaluated, mortality was found to be significantly higher in the patient group with malnutrition risk ($p<0.05$). The correlation between malnutrition risk and mortality in patients followed up in the ICU was found to be higher than that in all other groups. In addition, it was observed that the mortality rate of patients found to have a risk of malnutrition at the time of admission to the ICU during follow-up was higher than that of patients in the service wards.

Conclusion: Malnutrition risk is an important indicator for determining the prognosis of hospitalised patients. In our study, the risk of malnutrition increased the risk of mortality and length of hospitalisation among inpatients diagnosed with COVID-19. In our study, the mortality rate among the patient group with malnutrition risk was 42%. Moreover, malnutrition risk and mortality rate were higher in patients hospitalised in the ICU. Nutrition is an integral part of the treatment for COVID-19, as in all critically ill patients. Appropriate nutrition and a strong immune system are important components alongside any medication used to treat COVID-19. Prevention, diagnosis, and treatment of malnutrition should be routinely included in the treatment of patients with COVID-19.

Keywords: Malnutrition, mortality, COVID-19

Introduction

Coronavirus disease-2019 (COVID-19), caused by severe acute respiratory syndrome-coronavirus-2 infection, first reported by the Chinese Center for Disease Control and Prevention in December 2019 in Wuhan, Hubei province of China. It was later declared a global pandemic by the World Health Organization on 11 March 2020 (1).

Numerous studies have been published highlighting the potential risk and prognostic factors for the development and severity of COVID-19. The presence of comorbidities such as cardiovascular diseases and chronic obstructive pulmonary disease, along with age, has been identified as important determinants of mortality (2).

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Cite this article as: Çiftaslan Gökşenoğlu N, Ekinci O. The relationship between malnutrition and mortality in patients hospitalized with COVID-19. İstanbul Med J. 2025; 26(3): 253-8

Received: 08.01.2025
Accepted: 16.07.2025
Publication Date: 06.08.2025

However, little is known about the impact of nutrition on the prognosis and disease course of COVID-19.

Studies have reported that malnutrition risk is associated with worse disease course, and outcome, and greater susceptibility to infection.

It is known that malnutrition risk adversely affects several clinical outcomes, such as the length of hospitalisation and mortality, in non-COVID-19 cases (3,4). Furthermore, should this group of patients need to be followed up in the intensive care unit (ICU), early diagnosis and rapid intervention are recommended (5).

Nutritional risk screening-2002 (NRS-2002) is one of the recommended tests to assess malnutrition among inpatients (6).

By performing nutritional screening, further declines in nutritional status during hospitalisation can be prevented, and clinical outcomes improved.

The aim of our study was to determine the effect of the presence of malnutrition risk on mortality and prognosis in patients hospitalised due to COVID-19.

Methods

This study evaluated the risk of malnutrition using NRS-2002 scores in patients hospitalised in service wards and ICUs due to COVID-19. The study was approved by the University of Health Sciences Türkiye, Haydarpaşa Numune Training and Research Hospital Clinical Research Ethics Committee (approval number: HNEAH-KAEK 2021/121, date: 24.05.2021). In our hospital, 1,177 patients who were hospitalised with the diagnosis of COVID-19, after their polyclinic and emergency visits between March 2020 and July 2020 were evaluated. Patients who were hospitalised in the 21-bed ICU, infectious diseases clinic, internal medicine service, general surgery service, and nephrology clinic were included in the study.

For the diagnosis of COVID-19, the following were used as the diagnostic criteria: positive polymerase chain reaction (PCR) test for patients' samples obtained through nasal swabs; presence of COVID-19-specific findings on chest computed tomography (CT) or negative PCR and positive CT; presence of close contact with patients with a definitive diagnosis of COVID-19; symptoms such as fever, dry cough, anosmia, diarrhoea, myalgia, hypoxic respiratory failure, and lymphocytopenia; and elevated levels of D-dimer, ferritin, fibrinogen, and C-reactive protein (along with normal levels of procalcitonin).

Patients who needed inpatient treatment were hospitalised in accordance with the algorithm and criteria established by the Ministry of Health. The treatments recommended by the Ministry of Health were initiated at appropriate doses for the patients. Patients hospitalized in the ICU received ventilator support and were monitored according to their needs.

The patient records were reviewed retrospectively, and the data were evaluated. The patients' age, sex, comorbidities, and service under which they were treated were recorded.

The lengths of hospitalisations in the service wards and in the ICU were recorded. The intensive care needs of the patients in the service follow-up were evaluated, and the patients who were transferred from the service wards to the ICU were recorded. Inpatient mortality of patients hospitalised in the service wards and the ICU due to COVID-19 was evaluated.

The malnutrition risk of the patients was evaluated using NRS-2002, and patients with a score of >3 were considered to have the risk of malnutrition.

NRS-2002

A prescreening test was first performed, wherein the individual was asked whether their body mass index was <20.5 kg/m^2, whether they had lost weight in the last 3 months, whether there was a decrease in food intake in the last week, and whether the patient's condition was severe. If the answer to any of these questions was yes, the main screening was performed.

The NRS-2002 scoring system comprises two parameters: "nutritional status" and "severity of the underlying disease". It provides scores ranging from 1-3 for the individual's condition: "nourished", "mild malnutrition", "moderate malnutrition" or "severe malnutrition". In patients aged >70 years, 1 point was added to the total score. Those with a total score of ≥3 were assumed to be at risk of malnutrition, and a nutritional evaluation was recommended for these patients.

The risk of malnutrition was evaluated and recorded within the first 48 hours after the patient's hospitalisation.

NRS-2002 assessments were performed by an intensive care specialist, service physicians, three dietitians, and two nurses in the nutritional support team.

The relationship between malnutrition risk and mortality was then evaluated among patients with COVID-19 hospitalised in the service wards and the ICU.

Statistical Analysis

The IBM SPSS Statistics 25 program was used for evaluating the data on sex, age, polyclinic care, and length of hospitalisation of 1,177 patients with COVID-19. The crosstab analysis was employed for assessing malnutrition and mortality status. Chi-squared and Pearson's correlation analyses were performed to analyze the percentage and frequency distributions of the categorical variables. The age and length of hospitalisation variables were collected metrically and then converted into categorical variables based on standard deviation values.

Results

The flowchart of the study patients is summarised in Figure 1. During the study, 1,199 patients hospitalised in the inpatient service wards and ICUs at our hospital, between March 2020 and July 2020, were evaluated. Among these, 22 were referred to an external centre for different reasons, during their follow-up, and the data of 1,177 patients were eventually evaluated retrospectively.

The female/male ratio was 541/636 (46%/54%), and mean age of the included patients was 61.52±17.44 (range, 16-97) years (Table 1).

Chronic diseases included hypertension, chronic obstructive pulmonary disease, coronary artery disease and chronic kidney disease.

Among the included patients, 123 (10.5%) were hospitalised in the ICU on arrival, and 862 (73.2%) were in the infection clinic as inpatients. The remaining patients were followed up under the internal medicine, general surgery, and nephrology services. In addition, 120 (10.2%)

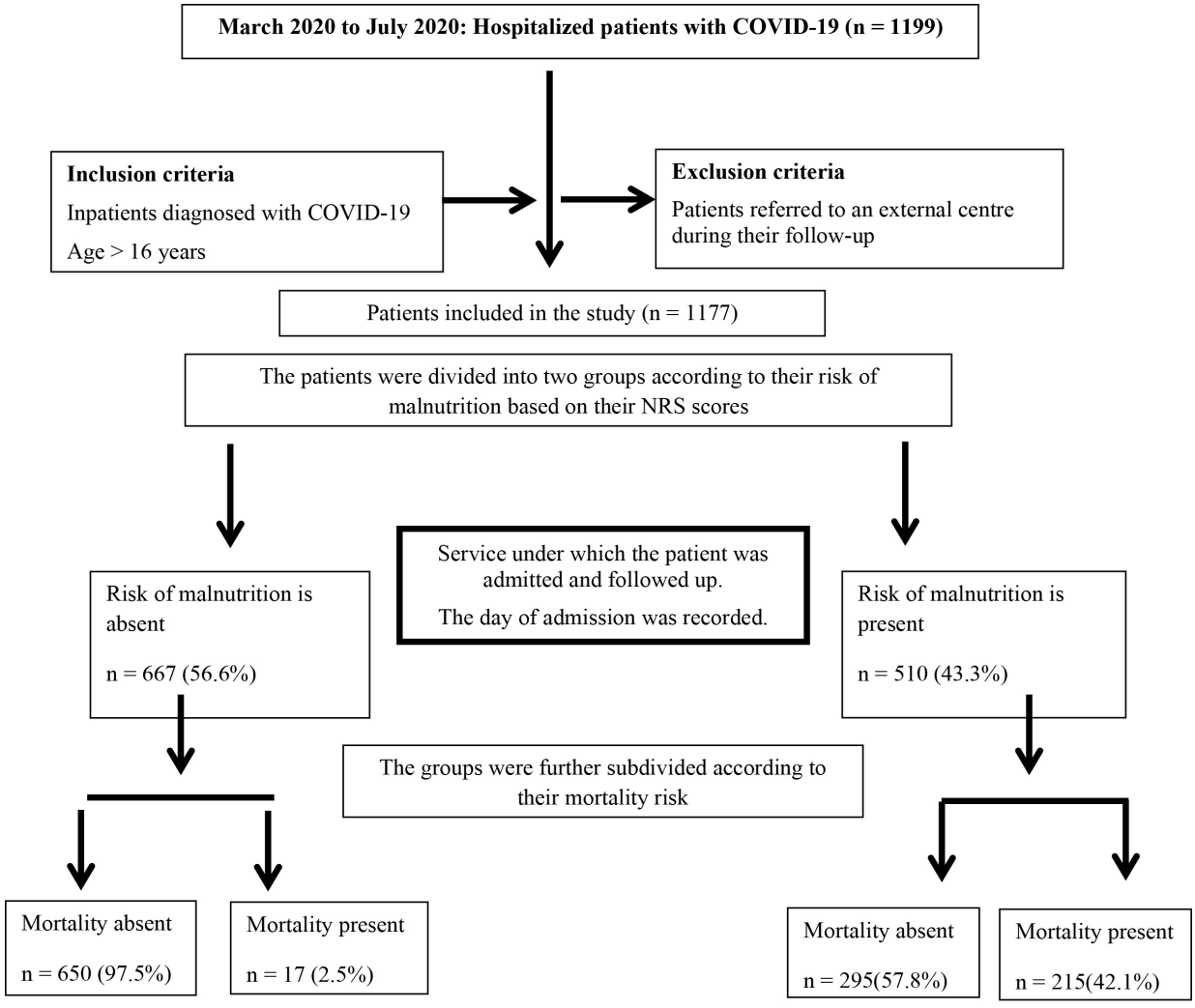

Figure 1. Flow chart of the study
COVID-19: Coronavirus disease-2019, NRS: Nutritional risk screening

Table 1. The risk of malnutrition based on the characteristics of the patients

	Total	Risk of malnutrition is absent	Risk of malnutrition is present
Sex, n (%) (female%/male%)	541/636 (46%/4%)	295/372 (44.2%/55.8%)	246/264 (48.2%/51.8%)
Age, years	61.52±17.44 (16-97)	61±5.3	60±2.6
Comorbidities, n (%)	752	462 (61%)	290 (39%)
Length of hospitalisation, days (mean ± SD)	8.28±7.51	7.65 (±4.9)	9.11 (±9.8)
Follow-ups in the service wards, n (%)	934	641 (68.6%)	293 (31.3%)
Follow-ups in the intensive care unit, n (%)	243	26 (10.6%)	217 (89.3%)

SD: Standard deviation

patients were followed up in the ICU due to the need for intensive care during service follow-ups.

The demographic characteristics of the patients are summarised in Table 1.

Table 2 shows the total number of patients with malnutrition risk among the hospitalised patients, and the number of patients with malnutrition risk divided by the service wards to which they were admitted.

Mortality was evaluated in the entire inpatient group and was observed to be n=232. The mortality rate was the highest in the ICU (n=76, 32.8%), followed by the infectious diseases service (n=71, 30.6%).

When the relationship between malnutrition risk and mortality was evaluated, mortality was found to be significantly higher in the patient group with malnutrition risk (Table 3) ($p<0.05$).

The correlation between malnutrition risk and mortality in patients followed up in the ICU was found to be higher than that in all other groups. In addition, it was observed that the mortality rate was higher for patients who were at risk of malnutrition during follow-up. This observation was particularly noted when they were admitted to the ICU, compared to the patients in the service wards (Table 4).

Analysis was performed on the effect sizes derived from the crosstab results showing the distribution of malnutrition and mortality status. Since the relevant analysis was based on crosstab results, Cramer's V value was taken into account for the effect size. Accordingly, it has a high effect size. size (Cramer's V value: 0.493).

Discussion

Malnutrition risk is an important indicator for determining the prognosis of hospitalised patients. In our study, it was observed that malnutrition increased mortality risk, and length of hospitalisation among inpatients diagnosed with COVID-19.

COVID-19 is most commonly followed by pneumonia in hospitalised patients. One of the factors that negatively affects the prognosis for community-based pneumonia is nutritional deficiency. An appropriate nutritional status is important for maintaining an adequate immune response against infections (7-10).

A study has reported that malnutrition was found to be one of the factors affecting mortality in cases of viral infections caused by influenza A and B, which are respiratory tract-associated viruses (11).

Table 2. Total number of patients with malnutrition risk and number of patients with malnutrition risk according to the service wards they were admitted to

	Those with malnutrition risk, n (%)	Those without malnutrition risk, n (%)	Total
Infectious diseases service	257 (21.8%)	605 (51.4%)	862
Intensive care unit	123 (10.5%)	0	123
Patients transferred from the service ward to the intensive care unit	94 (18%)	26 (3%)	120
Internal medicine service	18 (1.5%)	26 (2.2%)	44
Other	18 (3%)	10 (1%)	148
Total	510 (43.3%)	667 (56.7%)	1,177

Other: General surgery service and nephrology service

Table 3. Relationship between malnutrition and mortality

	Risk of malnutrition is absent n (%)	Risk of malnutrition is present n (%)	Total	p value
No mortality	n=650 (68.8%)	n=295 (31.2%)	945	
Mortality	n=17 (7.3%)	n=215 (92.7%)	232	
Total	667	510	1,177	<0.005

Table 4. Mortality of patients at risk of malnutrition depending on the service wards they were admitted to

Those at risk of malnutrition	Mortality is absent n (%)	Mortality is present n (%)	Total
Infectious diseases service	193 (65.4%)	64 (29.8%)	257
Intensive care unit	47 (15.9%)	76 (35.3)	123
Patients transferred from the service ward to the intensive care unit	25 (8.5%)	69 (32.1%)	94
Other	30 (10.2%)	6 (2.8%)	36
Total	295 (58%)	215 (42%)	510

Other: Internal medicine service, nephrology service and general surgery service

In another study evaluating viral pandemics in the past years, regions with high malnutrition levels were found to have the highest mortality rates (12).

In the study by Özışık et al. (13), the risk factors of mortality for respiratory tract infections caused by influenza-like viruses were investigated. It was found that the risk of malnutrition was associated with poor clinical outcomes in the patient group that required hospitalisation.

An increase in body temperature leads to a 10%-15% increase in energy consumption per degree (°C). The increase in energy consumption during the disease course is also a result of the increase in sympathetic activity (14). However, in patients with COVID-19, symptoms such as fever (88.7%), cough (>80%), respiratory distress (18.6%), along with gastrointestinal (GIS) symptoms like diarrhoea (3.8%) and nausea (5.0%) may be observed. While fever, chills, tachypnoea, increased work of breathing, hypoxia, inflammation and cytokine storm increase energy consumption in patients with COVID-19, GIS problems impair intake and facilitate malnutrition (15,16).

As a result, resistance to infections decreases and disease burden increases (17).

Our study observed that the risk of malnutrition prolonged the length of hospitalisation and increased mortality due to COVID-19.

In a meta-analysis published by Abate et al. (18) in 2021, the prevalence of malnutrition among hospitalised patients was found to be 49.11% (11.57%-88.39%).

This meta-analysis included 14 studies and 4187 inpatients with COVID-19 (19).

The risk of malnutrition among inpatients was found to be 43.3%.

The meta-analysis also showed that the mortality rate among hospitalised patients with COVID-19 was 10 times higher than that among those who were well-nourished (18). The mortality rate among malnourished patients with COVID-19 in the included studies ranged from 10% to 59.09%.

In the study conducted by Zhao et al. (20) on 413 severe and critical patients, in which the risk of malnutrition was evaluated based on the NRS-2002 score, the mortality rate and length of hospitalisation were found to be high in patients with malnutrition.

In our study, the mortality rate among the patient group with malnutrition risk was 42%. Further, malnutrition risk and mortality rate were higher in patients hospitalised in the ICU.

In our study, malnutrition risk was determined using NRS-2002. Studies have shown that NRS-2002, mini nutritional assessment-long/short, and nutritional risk index are better than other tests in detecting malnutrition in hospitalised patients (21).

ESPEN recommends the use of NRS-2002 in hospitalised patients. The values reported in the literature of its sensitivity, specificity and positive predictive value are around 62, 93 and 85%, respectively (22).

Studies have shown that biomarkers are poor indicators of nutritional status, malnutrition risk calculated based on albumin levels is low because prealbumin levels can be affected by critical illness, infection, liver disease, and kidney disease (18,23).

Considerable uncertainty remains about nutritional management in COVID-19, with recommendations based on the guidelines of the European Society for Clinical Nutrition and Metabolism and the American Society for Parenteral and Enteral Nutrition, expert opinions, and clinical experience.

Compared with other studies in the literature, our study was conducted with a higher number of patients, and significant results were obtained when evaluating the relationship between malnutrition risk and mortality.

Although nutritional status has not been adequately studied in patients with COVID-19, nutritional disorders appear to be associated with worse disease course and outcome, possibly due to greater susceptibility to infection.

Nutrition is an integral part of the treatment for COVID-19, as in all critically ill patients. Appropriate nutrition and a strong immune system are as important as any other intervention used to treat COVID-19. The prevention, diagnosis, and treatment of malnutrition should be routinely considered in the care of patients with COVID-19.

Study Limitations

Malnutrition was evaluated with the NRS score in hospitalized patients diagnosed with COVID-19, and different measurement techniques could also be added to diagnose malnutrition. Since this constitutes a critical patient group requiring isolation, methods such as anthropometric measurements were not used.

Conclusion

The risk of malnutrition in patients with COVID-19 who receive inpatient treatment may have a negative effect on their prognosis. malnutrition increased the length of hospitalisation. Hence, determining the risk of malnutrition and supporting a patient's nutrition during inpatient treatment should be integral to the treatment.

Ethics

Ethics Committee Approval: The study was approved by the University of Health Sciences Türkiye, Haydarpaşa Numune Training and Research Hospital Clinical Research Ethics Committee (approval number: HNEAH-KAEK 2021/121, date: 24.05.2021).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions: Concept - N.Ç.G., O.E.; Design - N.Ç.G., O.E.; Data Collection or Processing - O.E.; Analysis or Interpretation - N.Ç.G., O.E.; Literature Search - N.Ç.G.; Writing - N.Ç.G., O.E.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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