



Nutrition improves COVID-19 clinical progress

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Abstract

Nutrition is a basic need and is crucial for the persistence of good health. This awareness has increased since December 2019 during the pandemic that the world is still facing. The importance of nutrition in infectious diseases was emphasized but the relationship between the severity of symptoms and nutrition status of individuals was not examined. This study compared the nutrition status of patients with COVID-19 admitted to the emergency service and the clinical severity of the disease. Based on the nutrition status of the 337 patients included in the study, 87.2% (294) of the patients were in the low-risk group while 12.8% (43) were in the high-risk group in terms of malnutrition. In the analysis conducted to examine the effect of nutrition on the severity of disease, the relationship between NRS 2002 and dyspnea, cough, weakness, fever, and other symptoms was statistically significant. It was concluded that healthy nutrition is crucial during the pandemic, and it is necessary to consider nutrition improvement as a way to cope with emerging viral infections.

Keywords Clinical symptoms · COVID-19 · NRS 2002 · Nutritional status

Introduction

Although the nutritional status is an indicator of health status and an element of resistance against diseases, it also affects susceptibility to infection via the immune system [1]. Previous studies have found a correlation between malnutrition and prognosis in respiratory infections [2]. Therefore, the nutritional status might influence the course of the new coronavirus, COVID-19, infection [3].

The role of optimal nutrition for managing the current COVID-19 pandemic cannot be underestimated. Nutrition has a demonstrable role in the prevention and treatment of moderate to severe respiratory and non-respiratory infections [4]. Nutrition affects the immune system, which has been known for centuries [5]. However, this information has come more into prominence during the COVID-19 pandemic [4].

Risk factors for COVID-19 include old age, the presence of chronic diseases such as diabetes or hypertension, immune system suppression, use of cigarettes, obesity, and malnutrition [6–8]. However, a weak immune system is one of the most important risk factors. A sufficient and balanced diet is a significant element to prevent infections and create natural immunity [9, 10]. Malnutrition is a risk factor for the severity and mortality of viral pneumonia [2, 11]. Similarly, in the recently defined COVID-19, malnutrition accelerates the inflammatory process and is associated with a long hospitalization period [2, 12, 13]. Therefore, it is very important to evaluate hospitalized patients in terms of malnutrition risk and take necessary precautions as well as monitor nutrition status during the clinical course of the disease [13, 14]. The nutrition status of patients with COVID-19 should be taken into consideration, and most of all, it should be remembered that malnutrition can be a prognostic factor for morbidity and mortality related to COVID-19. It is considered that the nutrition status of the individuals who visited the hospital due to COVID-19 might be related to the severity of the disease; however, there is an insufficient amount of study on this factor.

This study aimed to compare the nutrition status of the patients who visited an emergency service due to COVID-19 and the clinical severity of the disease and to examine the effect of nutrition status on the prognosis of the disease.

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Material and method

Sample

The study, which was retrospective and at a single-center, included a sample of the patients who visited the emergency service of the hospital between the dates of 1 March 2020 and 30 November 2020 and were admitted to the COVID-19 intensive care unit, COVID-19 palliative care clinic, or COVID-19 service. The sample size was calculated using the proportional stratified sampling method and using the sample calculation formula for a known universe with a 95% confidence interval as 337 patients in total: 29 patients from the COVID-19 intensive care unit, 31 patients from the COVID-19 palliative care clinic, and 277 patients from the COVID-19 inpatient service.

Patients were examined in two groups. The first group included the patients who received treatment in the intensive care unit and palliative care clinic with critical-extreme severity and the second group included the patients who received treatment in the inpatient clinic with medium-mild severity.

Patients were at least 18 years old and had positive PCR test results or clinical features compatible with COVID-19. In addition, to be able to exclude the effect of the patients' prognosis during the clinical process on their nutrition status, patients who were directly admitted from emergency service to the intensive care unit, palliative care clinic, or inpatient clinic were also included in the study.

Data collection

Research data were retrospectively collected using a data collection form that was prepared after a literature review and the Nutritional Risk Screening 2002 (NRS 2002) form through electronic healthcare records of the related healthcare institution. NRS 2002 scores performed at the first admission to the related clinic were used. Nutritional risk status was classified into two levels with patients who had NRS 2002 scores of at least 3 evaluated as high risk while patients who had NRS 2002 scores less than 3 were accepted as low risk.

Statistical analysis

In this study, to examine the effect of nutrition status (NRS 2002 score ≥ 3 and NRS 2002 score < 3) on the clinical course of COVID-19 disease (critical/extreme and medium/mild), the logistic regression analysis and chi-square test were used to examine the relationship between demographic variables and the NRS 2002 risk score. In addition, mean standard deviation was used for descriptive statistics. The significance level was defined as $p < 0.05$.

Ethics committee approval

To conduct this study, ethical approval numbered 2021/16 was received from Clinical Research Ethics Committee and research permission was obtained from the institution where the study was conducted. To be able to perform the study, permission from the scientific research platform of the Turkish Ministry of Health was obtained. In addition, necessary permissions were obtained from the hospital where the study was carried out and whose records were accessed.

Findings

The mean age of the 337 patients involved in the research was 60.60 ± 15.5 , and 56.7% (191) were female. While 82.2% (277) of the patients had a medium-mild severity of COVID, 17.8% (60) had critical-extreme severity. According to NRS 2002 scores, 87.2% (294) of the patients had a low risk of malnutrition while 12.8% (43) of the patients had a high risk of malnutrition. Demographic characteristics, symptoms, and NRS 2002 scores of the patients are presented in Table 1.

As a result of the chi-square analysis performed between age groups and COVID-19 severity, a statistically significant difference was determined between the groups ($p = 0.0001$). As seen in the table, individuals aged 60 and over were hospitalized with the diagnosis of COVID-19 more than other age groups ($n = 178$) and their processes were more critically severe than other groups ($n = 47$).

χ^2 analyses conducted to examine the severity of the COVID-19 in diagnosed patients according to their nutrition risk level and their symptoms are presented in Table 2. Accordingly, there was a significant relationship between the severity of COVID-19 disease ($p = 0.0001$) and the symptoms of the patients (age $p = 0.0001$, dyspnea $p = 0.0001$, cough $p = 0.008$, weakness $p = 0.005$, fever $p = 0.004$, and other $p = 0.032$).

The risk relationship between COVID-19 symptoms and NRS 2002 was examined through a logistic regression analysis (Table 3). Through logistic regression analysis (model 1), the relationship between COVID-19 and NRS 2002 was found to be statistically significant ($p < 0.05$). Patients who had an NRS 2002 score higher than 3 were at 5.6 times higher risk than the patients who had an NRS 2002 score lower than 3 ($p = 0.0001$, 95% CI = 66.636–1321.163).

Individuals who experienced dyspnea and had malnutrition had a 2.7 times higher risk compared with the individuals who did not have malnutrition (model 2) ($p = 0.0001$, 95% CI = 0.021–0.225). On the other hand, although statistically significant relationships were found between cough,

Table 1 Demographic characteristics, symptoms, and NRS 2002 scores of the participants

Characteristics	Mild/moderate		Critical/severe		Total	
	Number	Percent	Number	Percent	Number	Percent
Age						
18–30	14	4.2	0	0	14	4.2
31–60	131	43.0	14	23.3	145	43.3
> 60	132	52.8	46	76.7	178	52.8
Gender						
Female	165	59.6	26	43.3	191	56.7
Male	112	40.4	34	56.7	146	43.3
BMI						
Weak	0	0	6	10.0	6	1.8
Normal	40	14.4	17	28.3	57	16.9
Fatty	157	56.7	27	45.0	184	54.6
Obese	80	28.9	10	16.7	90	26.7
Smoking						
	36	13.0	12	20.0	48	14.2
Chronic disease						
Hypertension	95	34.3	27	45.0	122	36.2
Diabetes	68	24.5	17	28.3	85	25.2
COPD/asthma	32	11.6	9	15.0	41	12.2
Other	30	10.8	21	35.0	51	15.1
Symptom						
Dyspnea	122	44.0	58	96.7	180	53.4
Cough	172	62.1	31	51.7	203	60.2
Fatigue	77	27.8	4	6.7	81	24.0
Fever	61	22.0	1	1.7	62	18.4
Other	28	10.1	10	16.7	38	11.3
Clinical						
Intensive care	0	0	29	48.3	29	8.6
Palliative	0	0	31	51.7	31	9.2
Service	277	100	0	0	277	82.2
NRS 2002						
≥ 3	2	0.7	41	68.3	43	12.8
< 3	275	99.3	19	31.7	294	87.2

Table 2 Relationship between the NRS 2002 score with the severity of COVID-19 disease and symptoms

Characteristics		NRS 2002		Total	X ²	df	p
		≥ 3	< 3				
Severity of COVID-19	Mild/moderate	2	275	277	202,527	1	0.0001
	Severe/critical	41	19	60			
Clinical	Intensive care	29	0	29	337,000	2	0.0001
	Palliative	12	19	31			
	Service	2	275	277			
Dyspnea	Yes	40	140	180	31,079	1	0.0001
	No	3	154	157			
Cough	Yes	18	185	203	6,950	1	0,008
	No	25	109	134			
Fatigue	Yes	3	78	81	7,856	1	0,005
	No	40	216	256			
Fever	Yes	1	61	62	8,481	1	0,004
	No	42	233	275			
Other symptoms	Yes	9	29	38	5,592	1	0,032
	No	34	265	299			

Table 3 Regression analysis results between the NRS 2002 score and COVID-19 severity and symptoms

Variable	β	S.E	Wald	df	<i>p</i>	Odds	95% C.I. for Exp(<i>B</i>)	
							Lower	Upper
Model 1 (severity of COVID-19)								
NRS 2002								
< 3 (Ref)								
> 3	5.593	0.762	55.812	1	0.0001	296.711	66.636	1321.163
Constant	-3.020	0.724	17.397	1	0.0001	0.049		
χ^2 : 158.699, df: 1, <i>p</i> =0.0001 *Nagelkerke <i>R</i> squared: 0.618								
Model 2 (dyspnea)								
NRS 2002								
< 3 (Ref)								
> 3	-2.686	0.610	19.390	1	0.0001	0.068	0.021	0.225
Constant	2.590	0.599	18.724	1	0.0001	13.333		
χ^2 : 36.945, df: 1, <i>p</i> =0.0001 *Nagelkerke <i>R</i> squared: 0.14								
Model 3 (cough)								
NRS 2002								
< 3 (Ref)								
> 3	0.858	0.332	6.677	1	0.010	2.357	1.230	4.517
Constant	-0.329	0.309	1.129	1	0.288	0.720		
χ^2 : 6.778, df: 1, <i>p</i> =0.0001 *Nagelkerke <i>R</i> squared: 0.03								
Model 4 (weakness)								
NRS 2002								
< 3 (Ref)								
> 3	1.572	0.613	6.574	1	0.010	4.815	1.448	16.009
Constant	-2.590	0.599	18.724	1	0.0001	0.075		
χ^2 : 9.765, df: 1, <i>p</i> =0.0001 *Nagelkerke <i>R</i> squared: 0.04								
Model 5 (fever)								
NRS 2002								
< 3 (Ref)								
> 3	2.398	1.022	5.503	1	0.019	10.996	1.484	81.500
Constant	-3.738	1.012	13.645	1	0.0001	0.024		
χ^2 : 12.014, df: 1, <i>p</i> =0.0001 *Nagelkerke <i>R</i> squared: 0.05								
Model 6 (other symptoms)								
NRS 2002								
< 3 (Ref)								
> 3	-0.883	0.423	4.364	1	0.037	0.413	0.181	0.947
Constant	-1.329	0.375	12.572	1	0.0001	0.265		
χ^2 : 9.909, df: 1, <i>p</i> =0.0001 *Nagelkerke <i>R</i> squared: 0.023								

Binary logistic regression analysis. *Ref.* Reference, β beta coefficient, *S.E* standard error

weakness, fever, and other symptoms with NRS 2002, explanatory ratios were very low (models 3, 4, 5, 6).

Discussion

This study examined the relationship between the nutritional status of the individuals who were diagnosed with COVID-19 and the severity of their disease. For this purpose, the relationship between the NRS 2002 score and the severity of disease was examined using χ^2 analysis and the result

was statistically significant ($\chi^2 = 202.52$, *p* = 0.0001). The logistic regression analysis indicated that the individuals with a higher nutrition score had a 5.6 times higher risk for an extreme-critical COVID-19 severity (*p* = 0.0001, 95% CI = 66.636–1321.163). Accordingly, individuals who are at risk for malnutrition had a more serious COVID-19 clinical course. In viral infections such as COVID-19, the effect of nutrition on catching the disease and/or the prognosis of the disease should not be ignored. In line with our findings, in a study conducted with 355 adults, the prevalence of malnutrition was high (71.83%) in a general cohort of COVID-19

patients [14]. In addition, Allard et al. reported that about 40% of patients admitted for COVID-19 pneumonia had malnutrition and about 35% of them had severe nutritional risk [2]. In our study, individuals who were malnourished had higher COVID-19 severity. Accordingly, adequate nutrition might have a significant role in COVID-19 progression and it might relieve symptoms and reduce the individuals' complaints. It was concluded that for the individuals with a severe course of COVID-19, determining nutritional status would be useful.

Examining the clinics where the individuals included in the study were admitted, patients with a higher malnutrition risk were admitted to the intensive care unit and palliative care clinics where more advanced care is required ($\chi^2=337.00$, $p=0.0001$). In a study that examines the prevalence and severity of malnutrition in hospitalized COVID-19 patients, the overall prevalence of malnutrition was 42.1% (moderate: 23.7%, severe: 18.4%), and the prevalence of malnutrition reached 66.7% in patients admitted to the intensive care unit [11]. In a study conducted regarding the evaluation of nutrition and the provided nutritional therapy in COVID-19 patients, almost all of the patients were at nutritional risk and one-half were malnourished. In the same study, the frequency of nutritional risk, malnutrition, disease/inflammation burden, and decreased intake of hospital diet differed among the intensity of care settings, where the patients were managed according to the severity and stage of the disease. However, malnutrition affected one-half of patients in both intensive care units and emergency services [15]. Malnutrition differs according to the severity of disease in COVID-19 patients and the care settings where the disease is managed.

Examining the relationships between the COVID-19 symptoms and nutritional risk status, the relationship between dyspnea ($\chi^2=31.07$, $p=0.0001$), cough ($\chi^2=6.95$, $p=0.008$), weakness ($\chi^2=7.85$, $p=0.005$), fever ($\chi^2=8.48$, $p=0.004$), and other symptoms ($\chi^2=5.59$, $p=0.032$) was statistically significant. The results of the logistic regression analysis indicated that the risk of dyspnea was 2.6 times higher in individuals with a higher nutrition score ($p=0.0001$, 95% CI=0.20–0.275). Dyspnea was the symptom that was most affected by nutrition status. Taking into consideration that dyspnea is the most apparent symptom of the disease, the effect of nutrition status on the severity of infection is clearly seen.

In a cross-sectional study that evaluates the risk of malnutrition in COVID-19 patients, no significant difference was found in the symptoms such as cough, fatigue, dyspnea, muscle soreness, headache, and diarrhea between the groups separated according to nutrition risk, although fever was more frequently observed in the patients with a higher risk of malnutrition [16]. In this study, the symptom of fever was low among the patients (18.4%) but was associated with

malnutrition risk. Although the ratio is low, it is important to evaluate the nutritional status of the individuals who visit the hospital with the symptom of fever. Examining the individuals who had cough, weakness, and other symptoms, it was seen that their malnutrition risk was high. Although the prevalence of symptoms differs overall, the individuals with symptoms had insufficient nutritional status.

Conclusion and Recommendations

Malnutrition interacts with infections in a vicious cycle and not only increases the risk and severity of infection, but also can be a result of the infection itself [13]. The aim of nutrition screening is to determine the patients who are at nutritional risk to prevent further decline in their nutrition status during their hospitalization and to improve their clinical outcome accordingly.

Similarly, supporting diets with micronutrients might improve or optimize immunity function against viral infections; therefore, public health officials should consider nutrition interventions as a way to cope with the emerging viral infections. Prevention, diagnosis, and treatment of malnutrition should be routinely involved in the management of patients with COVID-19. The use of screening tools like NRS-2002 will be useful to determine the “at risk” situations.

To conclude, as there is no known effective treatment or treatment method for the life-threatening pandemic of COVID-19, all potential therapeutics, interventions, and prevention strategies that can reduce the incidence or severity of infection are crucial. Examining the results of this study and other studies, healthy nutrition is vitally important during the pandemic process. Taking into consideration the budgets reserved for treatments in hospitals during the pandemic, improving the nutritional status of patients with COVID-19 is an economically viable option that might improve the outcomes for patients.

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