Are the Obese Patients and Patients with Severe Malnutrition at Increased Risk of Severe Coronavirus Disease 2019 during Hospital Admission?

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Abstract

BACKGROUND: Recently, authorities highlighted the need for nutritional management of individuals with severe acute respiratory syndrome coronavirus 2 infection.

AIM: The aim of the study was to evaluate the use of body mass index (BMI) and nutrition risk index (NRI) on hospital admission for detecting patients at risk for malnutrition and obesity and their association with patients' outcomes (disease type, length of hospital and home stay, and inflammatory markers).

METHODS: The study of 100 patients with confirmed diagnosis Coronavirus Disease-19 (COVID-19). Assessment of patients took place at City General Hospital 8th September, Skopje, transformed into main COVID-19 Center during pandemic. Primary outcomes were NRI and BMI scores, while secondary ones: length of home and hospital stay, number of symptoms, presence of co-morbidities, type of disease, serum albumin, and C-reactive protein (CRP).

RESULTS: Patients were classified according to BMI and NRI scores. Increased BMI and NRI were associated with a severe type of disease. Most of the patients with severe disease were: obese (83.3%) and patients with risk for malnutrition (53.3%). Obese patients had a longer length of home stay and higher CRP levels, but the level of albumin was lower in a group with a risk for malnutrition.

CONCLUSION: Future studies are needed to identify and quantify specific screening tool for nutrition deficiency in patients with COVID-19 infection.

Introduction

On the April 12, 2020, Macedonian health authorities reported 854 people with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. Few months later, coronavirus disease-2019 (COVID-19) is still a major health challenge for healthcare workers. Symptoms, laboratory, and radiology findings are the main targets of diagnosis [1]. Recently, European Society for Clinical Nutrition and Metabolism (ESPEN) published practical guidance for nutritional management of individuals with SARS-CoV-2 infections [2]. Hospitalized patients are at high risk of obesity or malnutrition upon hospital admission, even in the absence of chronic disease [3], [4], [5]. The underlying disease may directly decrease the dietary intake and to impair the appetite [6]. Furthermore, increased metabolism due to the stress of acute disease results in immune dysfunction, loss of fat-free mass and can lead to further inadequate dietary intake and deterioration of patients, as well as their nutritional status.

Nutrition deficiency represented by malnutrition and obesity, also, adversely affect clinical outcomes: Complications, length of stay (LOS), and mortality [7]. Nutritional deficiency is preventable and mostly reversible with adequate nutritional therapy. Therefore, it is important to perform nutrition risk screening systematically in all patients at the hospital admission in order to find those patients who are at risk. At present, there is no universally accepted gold standard for the assessment of nutrition status [8].

There are at least 33 different screening tools for nutrition risk [9]. In the present study, we applied two of them, namely nutrition risk index (NRI) and body mass index (BMI). We also measured serum albumin in each patient.

NRI is an easily applicable tool for detecting protein depletion. We can use this formula for its determination:

NRI=1.519 × serum albumin in g/L + (41.7 × present weight in kg/usual weight in kg)

For easier analysis, the calculator by Buzby can be used for its calculation.

BMI is calculated as the patient's weight in kg divided by the square of her/his height in meters.

We hypothesized that nutrition changes because of an acute illness or inadequate intake would affect the length of hospital stay LOS and the type of the disease.

Aim

The aim of this study was to evaluate the use of nutrition screening tools: BMI and NRI on hospital admission for detecting patients at risk for malnutrition and obesity and their association with patients' outcomes (type of disease, length of hospital and home stay, and inflammatory markers). Nutrition status of the patients was categorized into no risk and severe risk of malnutrition according to NRI. According to BMI, the patients were divided into either the normal group or in obese group. The actual study was a prospective observation study analyzing the need for evaluation of patients' nutrition status on hospital admission in City General Hospital 8th September in Skopje, Macedonia. We also wanted to assess whether the patients were obese or malnourished on hospital admission. Ethics approval was obtained by the Ethics Committee for the emerging infection of the hospital.

Patients and Methods

Nutrition screening tools were implemented in the COVID-19 Emergency Unit in City General Hospital 8th September in Skopje to enable screening of the nutritional status. A group of 100 adult patients affected by SARS-CoV-2 infection (aged 59 ± 60 years). A diagnosis of COVID-19 was confirmed according to the following criteria: History of epidemiological exposure, clinical symptoms of COVID-19-like pneumonia, positive result of a polymerase chain reaction (PCR) test, and pulmonary imaging changes with ground glass infiltration or consolidation. Our hospital become the main regional COVID-19 hospital in Macedonia and it was designed to accept all susceptive cases of COVID-19, but only patients with the confirmed diagnosis have been included in the study. Patients were analyzed at the hospital admission for demographics data, type (severity) of disease, symptoms, and co-morbidities.

Body fat and protein assessment were performed within 48 h of admission using measure of height and weight, as well as specific proteins in serum: albumin, globulin, and total proteins. Nutrition and dietary status of each patient were assessed by BMI, NRI, and serum levels of albumins and total proteins. NRI was calculated by an online calculator (https://www.mdcalc.com/nutritional-risk-index-nri) using serum albumin and recent body weight. BMI was also calculated using online calculator (https://www.calculator.net/bmi-calculator.html), entering patients' weight and height.

According to the NRI values, patients were classified into two groups: Nutritional risk group (NRI<83.5) and normal group without severe risk (NRI ≥83.5). According to the BMI, patients were classified into: Normal group (BMI ≤25), pre-obesity, and obese group, respectively. Pre-obesity and obese groups were merged into one group (BMI >25). Inflammatory status was also assessed within 48 h of admission using laboratory markers CPR and globulin. Lengths of hospital and home stay were filled latter, after hospitalization using medical records.

Results

A total number of 100 patients with COVID-19 were enrolled in the study. Patients' characteristics according to BMI groups are shown in Table 1.

There was no difference between the two BMI groups according to age (t = –0.073, p = 0.942), gender (χ^2 = 2.979, p = 0.084), presence of co-morbidities (χ^2 = 0.004, p = 0.948), level of albumin (t = 0.102, p = 0.919), and number of symptoms (t = –0.18, p = 0.857). Significantly more obese patients were detected in the group with severe COVID-19 (83.3%) than in the group with mild COVID-19 (53.2%) (χ^2 = 7.583, p = 0.023). The length of hospital stay was longer in the group with normal BMI (15.09 ± 10.19 vs. 11.33 ± 5.97), but the difference was not significant (t = 1.981, p = 0.054). The length of home stay before hospitalization was longer in the group with obese patients (4.73 ± 4.4 vs. 2.88 ± 2.68) (t = –2.217, p = 0.029). The level of C-reactive protein (CRP) was significantly higher in obese patients (130.14 ± 80.6) than in group with normal BMI (88.11 ± 63.79) (t = –2.643, p = 0.006).

Patients' characteristics according to NRI groups are shown in Table 2.

Table 2 demonstrates significant differences between groups of patients with different risk for malnutrition, where the group of patients with severe risk for malnutrition (NRI <83.5) had significantly lower levels of albumin (24.01 ± 3.48 vs. 31.91 ± 3.81) (t = 10.68, p < 0.001) and total proteins (64.42 ± 5 vs. 67.37 ± 5.78) (t = 2.69, p = 0.008), as well as significantly higher level of globulin (40.2 ± 5.75 vs. 35.87 ± 5.8) (t = –3.709, p < 0.001).

Table 3 shows the correlation coefficient between BMI and NRI.

Table 1: Patients' characteristics according to BMI groups

Variable	Normal group BMI ≤25 (n = 34)	Obese group BMI>25 (n = 66)	Statistic, p-value
Age (years) (mean ± SD)	59.68 ± 16.43	59.91 ± 11.83	t = -0.073,p = 0.942
Gender - n (%)			
Male (n = 65)	26 (40)	39 (60)	χ^2 = 2.979, p = 0.084
Female (n = 35)	8 (22.9)	27 (77.1)	
Type of disease - n (%)			
Mild (n = 47)	22 (46.8)	25 (53.2)	χ^2 = 7.583, p = 0.023
Moderate (n = 23)	7 (30.4)	16 (69.6)	
Severe (n = 30)	5 (16.7)	25 (83.3)	
With co-morbidities - n (%)	24 (70.6)	47 (71.2)	χ^2 = 0.004, p = 0.948
Length of hospital stay (days) (mean ± SD)	15.09 ± 10.19	11.33 ± 5.97	t = 1.981, p = 0.054
Length of home stay before hospitalization (days) (mean ± SD)	2.88 ± 2.68	4.73 ± 4.4	t = −2.217, p = 0.029
Albumin (mean ± SD) (g/L)	28.26 ± 6.02	28.15 ± 5.06	t = 0.102, p = 0.919
Globulin (mean ± SD) (g/L)	37.64 ± 5.67	38.17 ± 6.33	t = −0.404, p = 0.687
Total proteins (mean ± SD) (g/L)	65.96 ± 4.37	66.13 ± 6.21	t = −0.152, p = 0.880
Number of symptoms	2.44 ± 1.11	2.48 ± 1.17	t = −0.18, p = 0.857
CRP (mean ± SD) (mg/L)	88.11 ± 63.79	130.14 ± 80.6	t = −2.643, p = 0.006

BMI: Body mass index; SD: Standard deviation; CRP: C-reactive protein.

Table 2: Patients' characteristics according to NRI groups

Variable	Not severe risk for malnutrition (NRI≥ 83.5) (n = 51)	Severe risk for malnutrition (NRI< 83.5) (n = 47)	Statistic, p-value
Age (years) (mean ± SD)	60.2 ± 13.38	59.19 ± 13.96	t = 0.364, p = 0.717
Gender- n (%)			
Male (n = 63)	36 (57.1)	27 (42.9)	χ^2 = 1.840, p = 0.175
Female (n = 35)	15 (42.9)	20 (57.1)	
Type of disease - n (%)			
Mild (n = 45)	27 (60)	18 (40)	χ^2 = 2.165, p = 0.339
Moderate (n = 23)	10 (43.5)	13 (56.5)	
Severe (n = 30)	14 (46.7)	16 (53.3)	
With co-morbidities - n (%)	40 (78.4)	30 (63.8)	χ^2 = 2.555, p = 0.110
Length of hospital stay (days) (mean ± SD)	11.51 ± 6.26	13.85 ± 9.28	t = −1.474, p = 0.144
Length of home stay before hospitalization (days) (mean ± SD)	4.38 ± 3.17	3.66 ± 4.71	t = 0.866, p = 0.389
Albumin (mean ± SD) (g/L)	31.91 ± 3.81	24.01 ± 3.48	t = 10.68, p < 0.001
Globulin (mean ± SD) (g/L)	35.87 ± 5.8	40.2 ± 5.75	t = −3.709, p < 0.001
Total proteins (mean ± SD) (g/L)	67.37 ± 5.78	64.42 ± 5	t = 2.69, p = 0.008
Number of symptoms	2.37 ± 1.18	2.55 ± 1.12	t = −0.775, p = 0.440
CRP (mean ± SD) (mg/L)	118.57 ± 78.5	113.66 ± 78.7	t = 0.309, p = 0.758

BMI: Body mass index; SD: Standard deviation; CRP: C-reactive protein; NRI: Nutrition risk index.

Graphical representation of the correlation between BMI and NRI is shown in Figure 1.

Table 3: Analysis of correlation between BMI and NRI

Bivariate analysis	BMI	NRI	p-value
BMI	1	0.303*	0.002

*Pearson r; BMI: Body mass index; NRI: Nutrition risk index.

Previous table and graph demonstrate a significant positive correlation between BMI and NRI (r = 0.303, p = 0.002), or higher the BMI, higher the NRI.
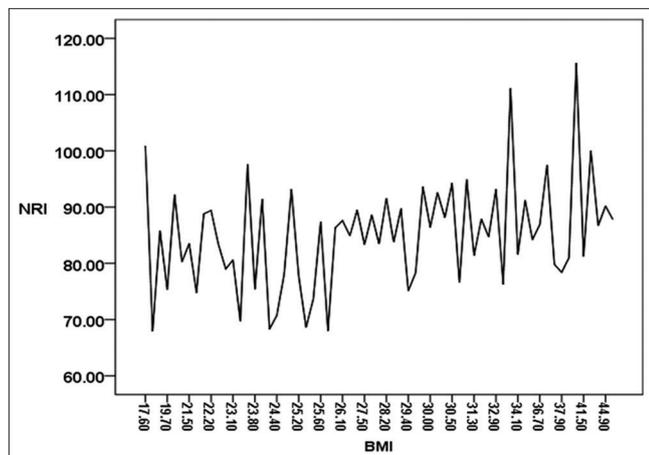

Figure 1: Graphical representation of the correlation between body mass index and nutrition risk index

Results of our study are showing that obese patients impose a higher risk for worse outcome according to the findings that significantly more obese patients were detected in the group with severe COVID-19, the length of home stay was longer in obese patients, and the level of CRP was significantly higher in this group of patients. Despite the detected correlation between BMI and NRI, we have found that there were no significant associations between NRI and other variables analyzed.

Discussion

ESPEN emphasizes the need to manage the diet of patients with COVID-19 infection. Inadequate dietary intake is one of the main reasons for the increased risk of infection [10]. Furthermore, inadequate dietary intake can lead to rapid obesity or malnutrition [11], [12]. Malnutrition and obesity are common findings of hospital dependencies for surgical patients [13], but the situation with patients infected with COVID-19 is unclear, especially if the patient has severe symptoms. Some studies demonstrated that obesity measured as BMI, and malnutrition defined as hypoalbuminemia or decline of serum albumin, were associated with an increased risk of developing severe pneumonia in COVID-19 [14], [15], [16].

The reported incidence of a severe type of disease of the patients in our study was 30%. Our data also showed that obese and NRI risk group patients had a severe type of disease in respect to non-obese and normal NRI group.

In the course of severe progress of COVID-19, the major component is hyper-inflammation [17]. Many nutrients have a role in supporting the immune system to defend against pathogens. Hence, regarding to COVID-19 infection, it is important to evaluate the nutrition status of each patient. Furthermore, nutrition deficiency needs to be considered in severe cases of COVID-19.

Body fat is biologically active and a source of pro-inflammatory factors, so bone marrow infection leads to a further increase in the production of pro-inflammatory cytokines [18]. In our study, even the normal BMI group showed an incidence of increased CRP. In patients classified according to NRI, the CRP was almost identical. It was, therefore, difficult to conclude whether malnutrition was a result of inflammation alone and not of inadequate dietary intake. However, given the significant reduction in albumin and high BMI, malnutrition is thought to be related to the severity of COVID-19. Further studies are needed to determine the screening tool to detect the cause of malnutrition.

Many studies have aimed to predict the number of hospital beds required for COVID-19 [19].

Several studies have shown a close relationship between LOS and dietary status [20], [21], [22]. In our study, the risk group had a longer LOS compared to those who were not at risk. Among obese patients, LOS at home before hospitalization was longer than that of patients with a normal BMI. This suggests that obesity affects breathing difficulties even before inflammation sets in [23]. Due to obesity, the patient always had difficulty breathing. His/her dyspnea he/she thought that was related to obesity and not to COVID-19 infection. We suppose that this is the reason why he/she is consulting the physician later on. Further research is needed, including other factors, such as demographics, laboratory analyses, and particularly the LOS at home.

In our study, increased BMI was associated with a higher disease rate, longer stay at home, and higher CRP levels. In contrast, no difference was observed between the two BMI groups for albumin level and number of symptoms. Increased NRI was associated with a serious form of the disease, longer hospital stay, and lower albumin levels. There appears to be a slight difference in CRP seen in a group of patients at different risk of malnutrition.

Our study has some limitations, but the fact that our hospital was the Main Regional COVID-19 Center brought us pleasure because we have the opportunity to collect data and to be the first to do that in the country.

Patients very often came late in the course of their illness, so they were not included because their weight and height could not be measured. When we collected the data retrospectively, we could not get all the information. For example, a patient due to respiratory discomfort, he/she refused to talk about eating properly, or LOS was affected by the PCR test results, even if he/she felt well.

Conclusion

BMI and NRI are well-established screening tools for the assessment of nutritional status on hospital admission. Nutritional care plans should be developed and implemented to maintain and improve patients' nutritional status. This study opened the question: Can we manage the acute illness easily with a better outcome if patients' examination starts with nutrition assessment, initially? Further investigations are also needed for the factors affecting the length of home stay, especially during a pandemic when the number of hospital beds is limited and the number of patients rapidly increases.

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