Pure Appl. Biol., 12(1):1-10, March, 2023
http://dx.doi.org/10.19045/bspab.2023.120001

Research Article

Nutritional assessment of Covid-19 patients admitted in intensive care units in Pakistan

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Citation

Zainab Bibi, Muhammad Tariq Saeed, Mahpara Safdar, Rezzan Khan, Anam Zehra, Syeda Nimra Naqvi, Madiha Ghazanfar, Omair Ali Shan, Zubair Hussain and Mir Muhammad Nasir Qayyum. Nutritional assessment of Covid-19 patients admitted in intensive care units in Pakistan. Pure and Applied Biology. Vol. 12, Issue 1, pp1-10. http://dx.doi.org/10.19045/bspab.2023.120001

Received: 28/12/2021 Revised: 27/02/2022 Accepted: 03/03/2022 Online First: 18/04/2022

Abstract

Coronavirus disease 2019 (COVID-19) can be life threating if untreated. Early diagnosis and effective nutritional management can save life. To assess the nutritional status and predict possible outcomes of critical patients Sequential Organ Failure Assessment (SOFA), nutrition risk in critically ill patients (NUTRIC), and acute physiology and chronic health evaluation (APACHE) score has been used. This retrospective observational study was conducted on confirmed COVID-19 cases in Intensive Care Unit (ICU) of Shifa hospital between November 24, 2020 to May 31, 2021. The demographic, clinical and laboratory information was obtained from hospital records. Risk factors for COVID-19 were identified and compared using multivariate logistic regression analysis. The nutritional risk for each patient was assessed. In this study 162 COVID-19 patients with median age of 64 years (IQR: 56-74) were included. Hypertension (59.2%) was found to be the most common comorbidity and the most prevalent symptoms upon admission were fever (54.9%). The patients in critical condition were supplied nutrients through nasogastric route (61.7%) while 37.7% and 0.6 % were assisted through oral and total parenteral nutrition (TPN) route. The Glasgow comma score was found to be mild (72.2%) (GCS>12) with increased creatinine, white blood cell count, C-reactive protein (CRP C), and glycosylated haemoglobin HbA1c level were present. Interestingly based on SOFA, APACHE and NUTRIC score low insignificant malnutrition risk was observed. Our study found different demographic factors and comorbidities have a substantial impact on COVID-19 patients, as evidenced by demographic, laboratory, clinical, and nutritional risk factors.

Keywords: Apache Score; Covid-19; Nutritional Assessment; Nutric Score; Sofa Score

Introduction

Initially in December 2019 an outbreak of pneumonia with unknown case occurred in Wuhan, Hubei Province, China; which in a single month affected more than 60 people [1]. Later on enveloped positive-sense ribonucleic acid (RNA) virus was discovered which was given name COVID-19. This virus was found to severely affect respiratory system and infected subject was

the main route of transmission. In mild cases the disease appeared asymptomatic with infection of upper respiratory tract while in severe cases patients were found to have breathing issues heart failure, and septic shock [2].

Depending upon severity of disease patients with COVID-19 might stay in the intense care unit (ICU) anywhere from a few days to weeks. Critically ill COVID- 19 patients who are on the mechanical ventilation support need the prescription of a registered dietician nutritionist (RDN) enteral nutrition (EN) and parenteral nutrition (PN) to fulfil nutrition demand [3-5]. More than 70 % of hospitalized adult patients and are often associated with increased risk and prevalence of malnutrition with presentation of multiple chronic diseases or co-morbidities, including diabetes and cardiovascular diseases, effect. An interaction of the diseases, disease state, and nutritional status in hospitalized patients with co-morbidities adds complexity to meeting nutritional needs [6-8].

As a prognostic marker Glasgow coma scale let us know about assessment level of consciousness following a trauma and similar approach in his study as first manifestation of COVID-19 [9].

Patients with COVID-19 have been reported that in addition to critical illness, there may be significant effects on appetite, conscious state and direct gastrointestinal effects resulting in nausea, vomiting, diarrhoea, and feeding intolerance. These factors adversely impact nutritional intake and status resulting in impaired glucose utilisation and increased protein breakdown and energy utilisation [10]. Among comprehensive treatment of critically ill patients in ICU, recognizing nutritional risk is crucial because there is limited available data to guide the optimal nutritional management of patients with COVID-19 [11-13]. Therefore, a timely assessment off nutritional risk should be done to provide appropriate nutritional intervention that may reduce the length of ventilator dependency, ICU/hospital stay and mortality [14].

The nutrition risk in critically ill patients score is recommended screening tool which is specifically developed for ICU patients [15]. Another reliable prognostic tool is SOFA score which was developed in 1996 is used in this study to evaluate performance of major organs to predict severity of disease [16, 17]. Among NUTRIC and SOFA score, APACHE II screening index used to find accurate description of disease [18, 12]. The current situation of COVID-19 little is known about nutrition related risk assessment of these patients; however, the aim of our study was to determine the nutritional status of critically ill covid-19 patients admitted in ICU at Shifa International Hospital, Islamabad Pakistan. Our study will provide help in better management and predicting outcomes in critically ill COVID-19 patients.

Materials and Methods

Ethical considerations

This retrospective observational study was given approval by Ethical review committee of Shifa International Hospital Islamabad Pakistan.

Study population and protocol

The data of COVID-19 patients were collected in Shifa hospital, Islamabad from 24th November 2020 to May 31th 2021. Out of 578 COVID-19 confirmed cases, 162 severe patients of COVID-19 were selected and admitted in Shifa hospital. The data of these confirmed COVID-19 patients was obtained from Intensive Care Unit (ICU) of Shifa hospital from which nutritional health assessment and clinical outcome of effected patients were evaluated. The sample size was determined by using World health organization (WHO) guideline.

Data collection

Baseline data was obtained at the time of admission during initial assessment, standard nutrition care process was followed, which included demographic and anthropometric parameters i.e. age, weight, Height and Body Mass Index (BMI). The

ranges of BMI are categorized in to four classes for both gender groups (Class 1: BMI < 18.5, Class2: BMI 18.5-24.9, Class 3: BMI 25-29.9, Class 4: BMI >30) as accepted by WHO **[19, 20]**.

Glasgow coma scale is calculated by patient response to certain stimuli. Certain scoring is followed: Severe (GCS <8), Moderate (GCS 9-12) and Mild (GCS>12) **[21]**.

Smoking record was also accounted. The weight of critically ill patient cannot be assessed by routine weighing scale therefore ICU bed weighing scale was used and equation was followed to measure knee height of patients **[22]**.

For Assessment of height of men unable to stand: 64.19- (0.04 x ages) + (0.02 x knee height)

For Assessment of height of women unable to stand: 84.88- {0.24 x age} + {1.83 x knee height}

Each patient was evaluated according to, APACHE II and SOFA scoring criteria within 24 h of their ICU admission. The nutritional risk of each patient was assessed at ICU admission using NUTRIC score (0-9 points) **[23].** Patients were excluded from the study if they were: 1) <18 years, 2) no nutritional risk, 3) stayed in ventilator > 72 h and 4) had a length of ICU stay < 48 h.

The inflammation levels such as C-reactive protein (CRP), HbA1C, glycosylated haemoglobin, Haemoglobin (Hb), Creatinine, Total bilirubin, Albumin, haematocrit (hCT) and baseline immune status such as white blood cell (WBC) count and platelet count were determined by laboratory examination.

Statistical analysis

Categorical data was described as percentages. Statistical analysis of data was performed using the IBM statistical package for social sciences (SPSS) Statistics 22 software (SPSS Inc., Chicago, IL, USA). Multivariate logistic regression models were used to identify the risk factors associated with the severity of COVID-19. Graphs were plotted using the Graph Pad Prism 8.0 (San Diego, CA, USA). The *P* value of <0.05 was considered statistically significant.

Results

Characteristics of study participants

The study consisted of 162 COVID-19 patients, including 105 (65%) males and 57 (35%) females. The age of patient was ranging from 30 years with median age of 64 years (IQR: 56-74). The (51%) critical patients were directly admitted to ICU while 49% were shifted later to provide emergency care. Out of total COVID-19 confirmed patients the BMI of 27(44%) were normal, 46 (28%) overweight, 71 (44%) obese and 1 of them was underweight (Table1).

On taking smoking history we have found 108 (66.7%) non-smokers, 19 (11.7%) ex-smokers and 35 (21.6%) actively smokers. One or more comorbidities were frequently seen, hypertension (59.2%) was the most common, followed by diabetes (46.2 %), coronary kidney disease (14.8%), decompensated chronic liver disease (DCLD) (3.7%), chronic obstructive pulmonary disease (COPD) (3.7%) while asthma (3.1%) and cancer 1.2% (Table 1).

It was observed that on admission fever (54.9%) and hypoxia (43.8%) were the most common symptoms followed by cough (17.3%), chest pain (6.2%) constipation, diarrhoea and body ache (3.1%) (Table 2).

Most of the critically ill patients were provided nutrients through nasogastric route (61.7%) while 37.7% and 0.6 % were nutritionally assisted through oral and total parenteral nutrition (TPN) route. During the ICU stay to avoid hypoxia and respiratory failure patients were given oxygen therapies (42%) and mechanical ventilator support (13.6%) while (2.5%) were given bi-level Positive Airway Pressure (bipap) treatment to push pressurize air to open their lungs. Majority of patients (72.2%) had mild Glasgow comma score (GCS>12) (Table 2).

Laboratory characteristics of study population

The (Table 3) summarizes laboratory findings of patients. Normal means values of haemoglobin, creatinine, total bilirubin, platelets, albumin and haematocrit (hct) was found whereas creatinine, white blood cell count, C-reactive protein CRP C, and glycosylated haemoglobin HbA1c level were high.

Analysis of nutritional risks and outcomes

Regression analysis of SOFA score are significantly affected by feeding route and respiratory support ($p<0.05$), however other variables were non-significant (Table 4). Predominantly SOFA score <6 indicated low malnutrition risk (Fig. 1A) while 14 % of total population presented maximum SOFA score (≥10).

Assessed by regression analysis, APACHE score of age, comorbidities and smoking has shown significant impact (Table 5). Maximum patients (84.9 %) showed low APACHE score (<15) (Fig. 1B).

NUTRIC score regression analysis revealed that age ($p = .007$) and comorbidities ($p =.006$) have a positive relationship, showing that increase in age and number of comorbidities increase the risk of malnutrition in patients (Table 6). However, 72.2% patients were at low risk of malnutrition while NUTRIC score (5-9 points) of 27.8 % patients have high nutritional risk (Fig. 1C).

Table 1. Baseline and demographic characteristics of study participants

Age	**Number (n)**	**Percentage (%)**
30-44	13	80.2
45-59	51	31.4
60-74	62	38.4
75-89	34	20.9
90-104	2	1.2
Gender		
Male	105	65
Female	57	35
Admission status		
Direct	83	51
Shifted	79	49
BMI		
Underweight	1	1
Normal	44	27
Overweight	46	28
Obese	71	44
Smoking		
Non smoker	108	66.7
Ex-smoker	19	11.7
Active smoker	35	21.6
Comorbidities		
Hypertension	96	59.2
Diabetes mellitus	75	46.2
Coronary kidney disease	24	14.8
DCLD	6	3.7
COPD	6	3.7
Asthma	5	3.1
Cancer	2	1.2

Abbreviations: BMI, Body mass index; DCLD, Decompensated chronic liver disease; COPD, Chronic obstructive pulmonary disease

Table 2. Symptoms and Complications of COVID-19 patients

Patient condition	N	%
Signs & Symptoms		
Fever	89	54.9
Hypoxia	71	43.8
Cough	28	17.3
Constipation	5	3.1
Diarrhea	5	3.1
Chest pain	10	6.2
Body ache	5	3.1
Feeding Route		
Oral	61	37.7
Nasogastric	100	61.7
TPN	1	0.6
Respiratory Support		
Nill	68	42.0
Oxygen Therapy	68	42.0
Ventilator	22	13.6
Bipap	4	2.5
Glasgow Coma Scale (GCS)		
Severe (GCS <8)	6	3.7
Moderate (GCS 9-12)	39	24.1
Mild (GCS>12)	117	72.2

Abbreviations: TPN, Total parenteral nutrition; Bipap, Bi-level Positive Airway Pressure

Table 3. Laboratory findings of COVID-19 patients

Laboratory Findings	Normal Range	All patients (n = 162)
Haemoglobin (mg/dl)	13.0 – 18.0M, 11.6 – 16.5F	12.1 ± 2.9
Creatinine (mg/dl)	0.72-1.25M, 0.57-1.11F	1.8 ± 2.2
Total bilirubin (mg/dl)	0.2-1.2	1.0 ± 1.8
Platelets (µL)	150,000- 4,00,000	232596.27 ± 120118.71
White blood cells (µL)	4000-11000	13979.1 ± 9358.26
Albumin (g/dl)	3.5-5.1	3.88 ± 12.07
CRP (mg/L)	5	133.43 ± 169.10
HbA1c (%)	4.0-6.0	7.49 ± 2.66
hCT (%)	40-54	35.11 ± 8.94

Abbreviations: CRP, C-reactive protein; HbA1c, glycosylated haemoglobin; hCT, *haematocrit* M, Male; F, Female

Analysis of nutritional risks and outcomes

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=.006) have a positive relationship, showing that increase in age and number of comorbidities increase the risk of malnutrition in patients (Table 6). However, 72.2% patients were at low risk of malnutrition while NUTRIC score (5-9 points) of 27.8 % patients have high nutritional risk (Fig. 1C).

Table 4. Regression Table, DV: Sofa Score

Variables	Coefficients	t-stat	Significance level
(Constant)		2.265	.025
Age	-.039	-.521	.603
Gender	-.217	-1.485	.140
BMI	-.094	-1.250	.213
Adm.Status	-.097	-1.210	.228
CoMob	.106	1.351	.179
Smoking	-.129	-1.766	.079
Feed Rout	.171	2.118	.036
Sign. Sym	-.019	-.264	.792
Respsprt	.258	3.240	.001
Hb	-.157	-1.061	.290
Albumin	-.098	-1.287	.200

a. Dependent Variable: Sofa Score

Table 5. Regression Table, DV: Apatchi Score

Variables	Coefficients	t-stat	Significance level
(Constant)		.951	.343
Age	.239	3.146	.002
Gender	.253	1.706	.090
BMI	-.080	-1.046	.297
Adm.Status	-.147	-1.815	.072
CoMob	.180	2.258	.025
Smoking	-.149	-2.011	.046
Feed Rout	.061	.750	.454
Sign. Sym	.026	.344	.731
Respsprt	.029	.360	.719
Hb	.181	1.205	.230
Albumin	-.042	-.545	.587

a. Dependent Variable: Apatchi Score

Table 6. Regression Table, DV: Nutric Score

Variables	Coefficients	t-stat	Significance level
(Constant)		1.868	.064
Age	.208	2.722	.007
Gender	-.116	-.782	.436
BMI	-.043	-.564	.573
Adm.Status	-.084	-1.031	.304
CoMob	.222	2.785	.006
Smoking	-.117	-1.571	.118
Feed Rout	.070	.850	.397
Sign. Sym	-.036	-.478	.633
Respsprt	.077	.945	.346
Hb	-.169	-1.122	.264
Albumin	-.076	-.983	.327

a. Dependent Variable: Nutric Score

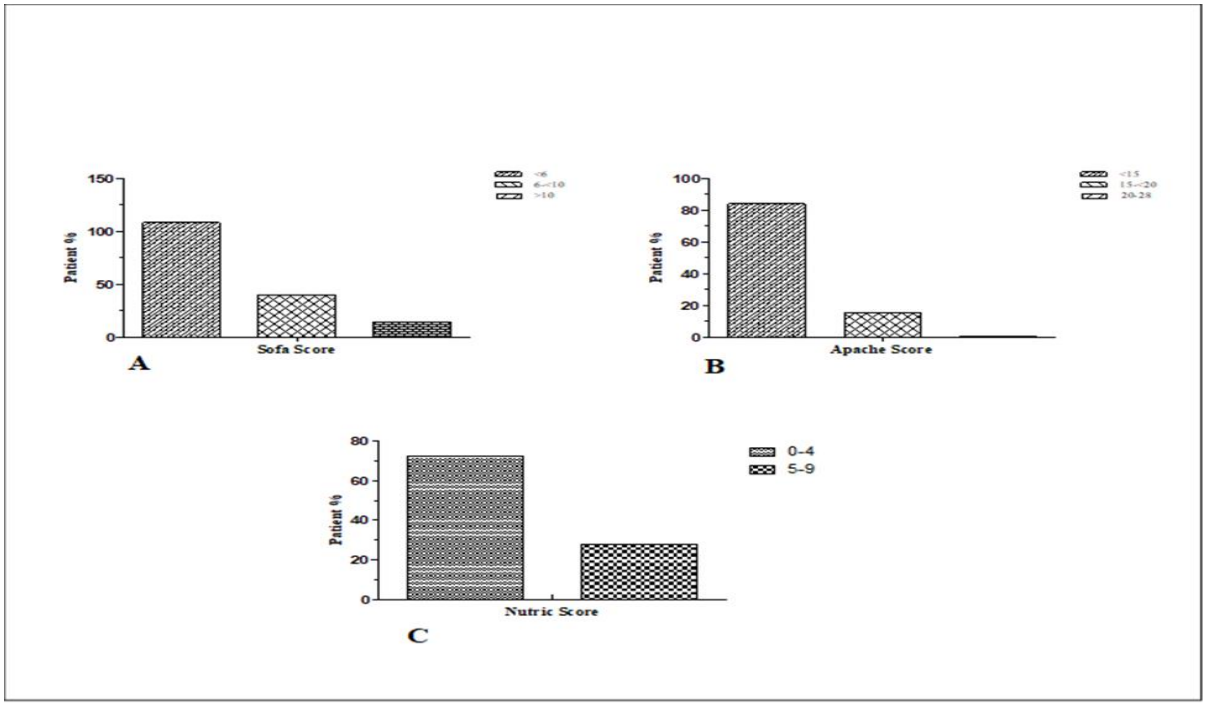

Figure 1. Sofa Score (A), Apache Score (B), Nutric score (C)

Table 6. Regression Table, DV: Nutric Score

Variables	Coefficients	t-stat	Significance level
(Constant)		1.868	.064
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Hb	-.169	-1.122	.264
Albumin	-.076	-.983	.327

a. Dependent Variable: Nutric Score

Discussion

Coronavirus (COVID-19) after badly effecting China was considered pandemic for world [24]. The COVID-19 caused serious respiratory infection with hypoxia and death. In Pakistan rapid spread of such a pandemic, it was an hour of need to explore the nutrition interventions and management of COVID-19 patients.

The current study identified the confirmed COVID-19 patients and assessed associated nutritional risks. According to recent studies the mortality rate is higher among old age patients suffering with other comorbidities such as cardiovascular disease hypertension, chronic respiratory disease, diabetes, and chronic kidney disease (CKD) [25]. As COVID-19 is a respiratory disease so smoking can be another risk factor that causes worse outcomes.

In the current data median age of 64 years has confirmed these results; immediate supplementary oxygen and nutritional support was given to critical patients admitted to ICU. Among the COVID-19

patients with normal BMI we observed a maximum number of increased BMI. Several studies on COVID-19 found that there is a possible association between positive risk of COVID-19 and obesity as adipose tissues facilitate virus entry resulting in increased cytokine release [26, 27]. However, the prevalence of obesity is increasing day by day [28].

In addition to several studies our data also revealed similar findings that some patients are known to be asymptomatic while in others COVID-19 may accompany a wide spectrum of sign and symptoms including most commonly cough, fever, fatigue, hypoxia, diarrhoea and nausea/vomiting. However, during ICU stay of COVID-19 patients, it is important to provide adequate provision of oxygen and nutritional support to ensure efficient life support [29].

Although less data is available on level of consciousness assessment in COVID-19 patents. However, Glasgow comma score in our study (GCS>12) suggested that most of the patients were awake and inattentive with normal vital signs.

Factors regarding laboratory findings present concerns about the characteristics for developing severe outcomes among patients infected by the COVID-19 [30]. In our study increased creatinine, white blood cell count, C-reactive protein CRP C, and glycosylated haemoglobin HbA1c is more frequently identified indicating inflammation which is in accordance with other researches [31, 32].

At present, published studies summarized the clinical characteristics of COVID-19 which could not only cause severe lung injury but also damage other major organs of body. In critically ill patients the SOFA score originally used to diagnose severity of COVID-19 through multiple organ dysfunctions [33]. In our study, Multivariable regression analysis showed that the SOFA score, feeding route and respiratory support were directly associated with the risk of severe COVID-19. SOFA score <6 explained nutritional risk of host in response to infection. Therefore, the SOFA score can reflect not only multiple organ failure but also the degree of inflammation and can accurately predict the severity of the patient's disease [34]. Point base APACHE score used to identify severity of disease [35]. At present, in our study the significant relationship of APACHE score explained with such a viral condition increase in age and other comorbidities among with smoking habit can made nutritional status even worse. Some of the patients with increased APACHE scoring index showed malnutrition risk.

Together with SOFA and APACHE, NUTRIC score used to quantify risk of adverse outcome of COVID-19. Similar to other studies [36], we found that critically ill COVID-19 patients with (5-9 Points) NUTRIC score were at high nutritional risk. One explanation may be that increased catabolism in these critically ill patients with multiple organ failure cause poor nutritional uptake.

Conclusion

In summary to overcome this outbreak, numerous researches are being conducted including diagnosis and treatment. Early nutritional risk screening is very important for better and effective management of COVID-19 patients.

Authors' contributions

Conceived and designed the experiments: Z Bibi & M Safdar, Performed the experiments: Z Bibi, MT Saeed & R Khan, Analyzed the data: Z Hussain, AZ Naqvi & M Gazanfar, Contributed materials/ analysis/ tools: Z Bibi, MT Saeed & OA Shah, Wrote the paper: Z Bibi, Z Hussain & MMN Qayyum.

Acknowledgements

The authors thank the financial support from the Shifa hospital Islamabad and Department of environmental design, Health and Nutritional Sciences. Allama Iqbal University, Islamabad Pakistan.

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