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ORIGINAL ARTICLE

Human and Clinical Nutrition

Evaluation of Nutritional Status Among COVID-19 Patients Admitted to the Intensive Care Unit in Jeddah, Saudi Arabia: A Cross-Sectional Observational Study

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ABSTRACT

Background: Patients with Coronavirus disease 2019 (COVID-19) frequently require admission to Intensive Care Units (ICUs) due to the vast range of severe clinical symptoms associated with the virus. Within this cohort, nutritional status has emerged as a critical determinant of clinical outcomes. Malnutrition is associated with a poor prognosis among hospitalized patients with COVID-19; an exacerbated inflammatory state combined with inadequate food intake often results in prolonged ICU stays and elevated mortality rates.

Aims: This study aimed to evaluate the nutritional status of COVID-19 patients admitted to the ICU and to identify correlations between nutritional indicators and clinical outcomes.

Materials and methods: A cross-sectional observational study was conducted over a six-month period at the National Guard Hospital in Jeddah. A total of 173 laboratory-confirmed COVID-19 patients admitted to the ICU were enrolled. Data were extracted from electronic medical records, encompassing demographic, comorbidities, and ICU length of stay (LOS). Clinical parameters included the route and timing of nutritional support (enteral, parenteral, or oral). Nutritional risk was quantified using the Malnutrition Universal Screening Tool (MUST). Statistical analyses were performed using IBM SPSS version 24, with the threshold for significance established at $p < 0.05$.

Results: The study population comprised 88 females (51%)) and 85 males (49%). A majority (59%) of the cohort were aged 66 years or older. Comorbidities were present in 94% of patients with hypertension, diabetes mellitus, and renal, cardiac, and respiratory disorders being the most prevalent. Furthermore, 34% of the participants were classified as obese and 25% as overweight. Base on MUST scores, 40% of patients were at low risk, 37% at moderate risk, and 40% at high risk of malnutrition. Significant reductions in serum albumin and hemoglobin levels were observed. The median ICU LOS was 8 days. Statistical analysis revealed that LOS was significantly correlated ($p < 0.05$) with age, nutritional status, feeding modality, and biochemical markers (serum albumin and hemoglobin). Notably, 100% of the patients initiated nutritional support within the first 48 hours of ICU admission.

Conclusion: Malnutrition is highly prevalent among COVID-19 patients in the ICU and is strongly associated with low serum albumin and hemoglobin levels. Patients with pre-existing hypertension and diabetes appear more susceptible to ICU admission. Given that ICU length of stay is significantly influenced by age, nutritional status, feeding method, and serum albumin and hemoglobin levels, the systematic evaluation of nutritional status and malnutrition management should be routinely integrated into the standard of care for COVID-19 patients the intensive care settings.

Keywords: COVID-19; Intensive Care Unit (ICU); Malnutrition; Nutrition Status; Length of Stay (LOS); Albumin; Hemoglobin.

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1 INTRODUCTION

Coronavirus disease 2019 (COVID-19), a novel respiratory pathology first identified in Wuhan, China, in December 2019, rapidly evolved into a global health crisis. Characterized by its high transmissibility, the pathogen spread extensively across diverse geographic regions, prompting the World Health Organization (WHO) to declare it a pandemic on March 11, 2020. While a significant proportion of infected individuals manifest mild to moderate symptoms, the disease can precipitate several clinical complications including multi-organ failure and death, particularly among the elderly and those with significant comorbidities (Jordan & Cheng, 2020).

The epidemiological trajectory of COVID-19 in the Kingdom of Saudi Arabia started with the confirmation of the first case by the Ministry of Health on March 2, 2020. Since then, the virus has demonstrated rapid community transmission, especially when individuals are unaware of their

infection status or neglect to apply preventative measures. The disease poses various risks, such as severe illness, organ failure, long-term health complications, and the possibility of long COVID, which may require admission to the Intensive Care Unit (ICU). The severity of the disease can vary significantly; while most cases experience mild symptoms and do not require hospitalization, those with severe cases may need mechanical ventilation and ICU care, with some even succumbing to the illness, leading to death. Consequently, COVID-19 serves as a substantial driver of global morbidity and mortality (WHO, 2020).

Emerging evidence suggests that the pathogenesis of COVID-19 induces systemic inflammation, reduced oral intake, and accelerated muscle proteolysis. These factors significantly elevate the risk of malnutrition, making the implementation of preventative measures and nutritional management essential components of therapeutic intervention (Høier *et al.*, 2021). Furthermore, survivors of critical COVID-19 illness often endure prolonged recovery periods characterized by persistent functional impairments. Given that extended ICU stays are intrinsically linked to muscle wasting and nutritional depletion, optimizing nutritional support is pivotal for enhancing both short- and long-term recovery for COVID-19 patients (Tolossa *et al.*, 2021).

Nutrition screening has proven to be an effective strategy during this pandemic (Song *et al.*, 2021). Focused nutritional research on COVID-19 patients is currently being initiated to enhance understanding of the disease's nutritional implications and to improve nutrition support and assessment strategies. Malnutrition is recognized as a significant risk factor for severe cases of COVID-19 requiring ICU admission. At present, there have been limited studies thoroughly investigating the prevalence of malnutrition among COVID-19 patients in the ICU and its potential impact on the severity and mortality of the disease (Thomas *et al.*, 2021). For COVID-19 patients admitted to the ICU, nutrition management is essential because prolonged ICU stays can lead to malnutrition and muscle loss, which increases mortality and morbidity and lowers quality of life for COVID-19 patients. Nutrition is vital for ICU survivors who stay for extended periods, and the recovery time of patients who survive COVID-19 is very important. Thus, it is anticipated that COVID-19 patients who survived the ICU could face severe malnutrition and muscle mass loss. As established, malnutrition has a substantial impact on the outcomes of COVID-19 patients; those who are malnourished, elderly, and have multiple comorbidities are more likely to have an increased risk of ICU admission and mortality (Handu *et al.*, 2021). Hence, enhancing the nutritional support of critically ill COVID-19 patients is key, and efforts should focus on recognizing and addressing malnutrition to prevent associated negative health effects. Therefore, in this research, we assessed the nutritional status of COVID-19 patients admitted to the ICU and identified the severity of nutritional status and patient outcomes. The impact of the COVID-19 virus on nutritional status remains unclear. Global epidemiological research has begun examining the prevalence of malnutrition upon ICU admission for COVID-19 and relating it to mortality rates; however, data on the nutritional status of ICU patients with confirmed COVID-19 remains inadequate. Indeed, with the considerable complications linked to COVID-19, it seems that nutritional status has received only minimal focus within the broader supportive care for patients. Additionally, further research is required to assess the nutritional status of COVID-19 patients admitted to the ICU. Nevertheless, there is little to no data available regarding the nutritional status of COVID-19 patients hospitalized in the ICU within the Saudi population, specifically in Jeddah. Our study seeks to assess the nutritional status of COVID-19 patients treated in the ICU at the National Guard Hospital in Jeddah, as this represents a significant data gap in existing research.

2 Patients and Methods

2.1 Study Design and Population

This cross-sectional observational study was conducted within the ICU of the National Guard Hospital (NGHA), in Jeddah, Saudi Arabia, over a six-month period from September 13, 2021, to February 13, 2022. The target population included all adult patients with laboratory-confirmed COVID-19 admitted to the ICU during the study interval.

The minimum required sample size was determined using the Raosoft online calculator (Raosoft, 2004), based on standard formulas for cross-sectional surveys. In the absence of prior localized prevalence data regarding malnutrition in COVID-19 ICU cohorts at this facility, a conservative expected prevalence 50% (p = 0.5) was utilized for the expected prevalence, maximizing the required sample size. With a 95% confidence level (Z = 1.96) and a 5% margin of error, the minimum required sample size was calculated to be 173. The reference value used to calculate the sample size was the 50% responses distribution. Key parameters for this calculation were a 95% confidence level, a 5% margin of error, and an assumed 50% expected responses distribution (prevalence), as no specific prior prevalence data was available. The estimated minimum required sample size was 173 participants. The actual number of all eligible COVID-19 patients admitted to the ICU during the study period was 180 patients, all of whom were screened for eligibility.

2.2 Sample Selection and Preparation

A comprehensive coverage technique was employed to ensure the representativeness of the sample. To be eligible for inclusion, patients were required to meet the following criteria: (1) aged 18 years or older, (2) confirmed COVID-19 diagnosis upon ICU admission; (3) absence of secondary acute infectious or inflammatory conditions unrelated to COVID-19; and (4) provision of informed consent. Patients were excluded if they were under 18 years of age, had unconfirmed COVID-19 status, presented with confounding inflammatory pathologies, or declined to participate. Of the 180 patients admitted during the study window, 173 met the full inclusion criteria and were enrolled in the study; seven patients were excluded.

The data collection was carried out using a data collection via secondary sources (patients' medical records). Electronic patient records data are reviewed for, patient demographics, comorbidities such as diabetes, hypertension, heart disease, renal disease, liver disease, and respiratory disease, anthropometric measurements include: weight by kilogram (kg), height by centimeter (cm), and body mass index (BMI); the Malnutrition Universal Screening Tool (MUST) (Lew *et al.*, 2017) was used to assess malnutrition, biochemical laboratory data, such as serum albumin and hemoglobin were reviewed (as both markers affect nutritional deficits and the intense inflammatory state, which are both important for assessing malnutrition status.), ways of nutrition feeding include (patient's route of feeding; oral, enteral, or parental feeding) (initiate of the feed started within or after 48 hours of ICU admission), and the length of stay in the intensive care unit was assessed by days.

The studied variables include:

Continuous variables: Age, anthropometric measurements, time of initiating the feed, length of stay in ICU

Categorical data: sex, co-morbidities, patient's nutrition status, the nutrition screening tool employed to assess malnutrition, biochemical laboratory results, patient's route of feeding.

Triangulation Method is used with some dietitians in NGHA to assure that the sheet is clear.

2.3 Statistical Analysis

All data were anonymized prior to statistical analysis to ensure confidentiality and ethical compliance. Statistical analysis was performed employing the statistical software package program, IBM SPSS for Windows, Version 24.0. The significance threshold was established as $p < 0.05$.

Continuous variables were assessed for normality; parametric data are presented as mean ± standard deviation (SD) and compared using the Student's *t*-test, while non-parametric data are expressed as median with interquartile range (IQR) and compared using the Mann-Whitney U test. Categorical variables are presented as absolute frequencies (*N*) and percentages (%) and were analyzed using the Chi-square test (χ^2) test.

3 Results

3.1 Baseline Characteristics of the Study Participants

The demographic and clinical characteristics of the study cohort are summarized in Table 1. The study included 173 participants, with a near-equal gender distribution of 85 (49 %) males and 88 (51 %) females. Age distribution analysis revealed that the majority of patients (102, 59%) were aged 66 years or older. Regarding Body Mass Index (BMI) classifications, 59 (34%) participants were within the normal weight range, while 58 (34%) were classified as obese. The remaining participants were categorized as overweight (44, 25%) or underweight (12, 7%). Biochemical assessment at admission indicated mean serum albumin and hemoglobin levels of 29.8 g/L and 10.7 g/dL, respectively)

3.2 Clinical Comorbidities

The prevalence of comorbidities among the study population is detailed in Table 1. A substantial majority of the cohort (94%) presented with at least one comorbidity in addition to COVID-19, while only 6% of patients exhibited no documented pre-existing conditions. Hypertension and diabetes mellitus were the most prevalent comorbidities, affecting 35% and 31% of the participants, respectively. Furthermore, renal disease was identified in 16% of the sample, while cardiac and respiratory diseases each accounted for 5%. Liver disease was the least common comorbidity, present in 2% of the participants.

3.3 Prevalence of Malnutrition Risk

The nutritional status of participants upon ICU admission, as determined by the Malnutrition Universal Screening Tool (MUST), is presented in Table 1. The screening revealed that 69 (40%) patients were categorized as low risk for malnutrition. However, a significant proportion of the cohort demonstrated nutritional vulnerability, with 64 (37%) patients identified as medium risk and 40 (23%) classified as high risk of malnutrition.

3.4 Assessment of Feeding Route and Length of Stay

The associations between Intensive Care Unit (ICU) length of stay (LOS) and participant characteristics are detailed in Table 2 and Table 3. Statistical analysis revealed that ICU LOS was significantly correlated with patient age,

Table 1. Baseline Characteristics of Participants (N=173)

Characteristics	Frequency	(%)
Sex		
Male	85	49
Female	88	51
Age		
18 – 29	5	3
30 – 45	10	6
46 – 65	56	32
> 66	102	59
Anthropometric assessment		
Body Weight (kg)	70.4	-
Height (cm)	156.3	-
BMI (kg/m^2)		
Underweight (< 18.5)	12	7
Normal (18.5 - 24.9)	59	34
Overweight (25 - 29.9)	44	25
Obese (≥ 30)	58	34
Biochemical markers		
Serum Albumin (g/L) [1]	29.8	-
Hemoglobin (g/dL) [1]	10.7	-
Comorbidities		
Chronic Kidney Disease (CKD)	0	0
Diabetes	54	31
Hypertension	61	35
Acute Kidney Injury (AKI)	27	16
Respiratory diseases	9	5
Heart Diseases	9	5
Liver diseases	3	2
None[3]	10	6
Nutritional parameters using MUST		
Low Risk	69	39.9
Mild Malnutrition	40	23.1
Severe Malnutrition	64	37
Route of feeding		
Oral	144	83
Enteral	29	17
Parenteral	0	0
Length of stay [2]	8.0 **	-

Note: Results are expressed as number (n) and percentage (%), [1] Mean ± (SD); [2] Median (IQR), [3] None: free from medical history rather than COVID-19

Table 2. Correlations between the Length of Stay in the ICU and the Characteristics of the Participants (N=173)

Variable	Median	IQR	*p*-value
Sex			
Male	9.0	8.0	0.316
Female	7.0	12	
Age			
18 – 29	5.0	5.5	0.022
30 – 45	7.0	8.0	
46 – 65	7.0	7.5	
> 66	9.0	16.0	
BMI			
Underweight (< 18.5)	10.5	13.0	0.511
Normal (18.5 - 24.9)	8.0	16.0	
Overweight (25 - 29.9)	7.0	8.0	
Obese (≥ 30)	7.5	11.5	
Comorbidities			
Yes	8.0	11.0	0.221
None	6.0	11.0	
Nutritional status			
Mild	9.0	10.0	0.031
Normal	7.0	7.5	
Severe	9.0	14.3	
Route of feeding			
Oral	7.0	8.0	0.001
Enteral	9.0	26.5	

Note: IRQ: Interquartile Range

Table 3. LOS Correlation with Chemical Biomarkers of the study participants (n=173)

Variable	Correlation	*p*-value
Serum Albumin (g/L)	-0.214	0.004
Hemoglobin (g/dL)	-0.210	0.005

Note: IRQ: Interquartile Range

nutritional status, and the route of nutritional administration (p = 0.022, 0.031, and 0.001, respectively; p < 0.05). Conversely, no statistically significant correlations were observed between ICU LOS and gender, BMI, or the presence of comorbidities (all p > 0.05).

Furthermore, a significant correlation was identified between ICU LOS and the biochemical markers of serum albumin and hemoglobin levels (p = 0.004 and p = 0.005, respectively; p < 0.05). These findings suggest that both nutritional screening scores and biochemical indices are important predictors of the duration of stay for COVID-19 patients in critical care settings.

4 Discussion

The present research assessed the nutritional status of COVID-19 patients admitted to the ICUs. Our findings indicate that the majority of the cohort (59%) comprised older adults over 66 years of age. Advanced age is widely recognized as a primary determinant of disease severity and clinical outcomes in COVID-19. Research suggests that individuals aged over 65 account for 80% of hospital admissions and face a 23-fold higher risk of mortality compared to younger cohorts (Mueller *et al.*, 2020). Furthermore, COVID-19 often exacerbates pre-existing comorbidities, including obesity, renal impairment, cardiovascular disease, diabetes mellitus, and hypertension. In the current investigation, 94% of participants presented with at least one comorbid condition, most frequently diabetes, hypertension, renal, cardiac, and respiratory disorders. This

This high prevalence aligns with existing literature identifying comorbidities as critical predictors of rapid disease progression and elevated mortality risk among patients affected by COVID-19 (Chatterjee *et al.*, 2023; Singh *et al.*, 2021).

BMI also emerged as a significant factor, with 34% of patients classified as obese and 25% as overweight. These findings are consistent with prior studies suggesting that elevated BMI significantly increases the risk of mortality and the incidence of delirium among critically ill COVID-19 patients (Gholi *et al.*, 2023; Ranjan *et al.*, 2020; Sanchis-Gomar *et al.*, 2020).

Malnutrition at the time of admission heightened the risk of ICU admission and subsequent mortality in COVID-19 patients (Jima *et al.*, 2024). To reduce the impact on patients and the healthcare system, it is essential to assess patients' nutritional status promptly after admission and to act swiftly to apply interventions. The current research assessed the nutritional status of COVID-19 patients in ICUs using the Malnutrition Universal Screening Tool (MUST). The study demonstrated that the overall risk of malnutrition was found to be Low Risk Score of malnutrition (40%), Medium Risk Score (37%), and (23%) of patients were identified to be at high-risk score of malnutrition. These findings confirmed that ICU patients suffering from COVID-19 face a primarily elevated risk of malnutrition. Our results agree with an additional study which indicated that during the stay in the ICU, malnutrition became prevalent, rising to 79% (Rives-Lange *et al.*, 2021). This prevalence varies between 37.5% and 52.7%, significantly exceeding that found in COVID-19 patients in further studies (Rouget *et al.*, 2021; Singer *et al.*, 2019). In a separate study, it was discovered that 66.7% of patients admitted to the ICU were malnourished, with over one third (38.9%) exhibiting signs of severe malnutrition (Bedock *et al.*, 2020). The literature indicates a notably high prevalence of malnutrition overall. A widely recognized risk factor is inadequate nutritional condition. Since malnutrition is predicted to exert a negative impact on the prognosis of COVID-19 disease, appropriate care is vital. This is crucial because malnutrition reduced prolonged hospital stays, elevates the likelihood of unexpected readmission, impairs the immune system, and increases mortality rates (Schaible & Kaufmann, 2007; Correia & Waitzberg, 2003).

A robust association was recorded between ICU length of stay (LOS) and malnutrition ($p < 0.05$) reinforcing the consensus that nutritional status is a primary driver of hospitalization duration (Gholi *et al.*, 2024). The correlation between malnutrition and prolonged hospitalization in the ICU is a well-established risk factor in critically ill patients (Gholi *et al.*, 2024). This study reinforces prior research, specifically a relevant finding that malnutrition significantly elevates ICU stay duration among critically ill older adult COVID-19 patients (Gholi *et al.*, 2024). Considered together, these results underscore the critical importance of early nutritional assessment and intervention strategies in managing COVID-19 patients to potentially improve outcomes and reduce the burden on healthcare resources.

Our research indicated decreased levels of serum albumin (SA) and hemoglobin (Hb) in COVID-19 patients admitted to the ICU, which revealed significant associations with the duration of their hospital stay in the ICU. This discovery aligns with other research indicating that SA and Hb levels were lower in ICU patients with COVID-19. (Özmen Süner *et al.*, 2022; Ramadori, 2020). Decreased SA levels, particularly during inflammation or illness, can suggest malnutrition or certain diseases, significantly influencing nutritional status. This may lead to swelling, an increased likelihood of infections and complications, and prolonged hospital admissions. Another study investigated the relationship between SA levels and hospital stays in COVID-19 patients. The study demonstrated that patients with lower SA levels exhibited prolonged hospital stays. These findings agree with our results. Additional studies indicate that low SA levels in COVID-19 patients in the ICU correspond with increased mortality rates and extended hospital stays (Huang *et al.*, 2020; Paliogiannis *et al.*, 2021). In ICU patients, low SA levels correlate with poorer outcomes and higher mortality rates. Hypoalbuminemia can result from malnutrition and several other conditions. Low SA constitutes a significant indicator of inadequate nutritional status and is associated with several adverse clinical results. Understanding the causes and impacts of hypoalbuminemia is vital for effective treatment and improved patient care (Eckart *et al.*, 2020; de la Rica *et al.*, 2020).

In a study conducted on COVID-19 patients in the ICU, similarly, hemoglobin levels were significantly reduced in non-survivors when contrasted with survivors (Sayed, 2024). Previous studies (Chen *et al.*, 2020a; Chen *et al.*, 2020b) indicated that almost 50% of patients notice a decrease in hemoglobin (Hb). In severe cases of COVID-19, Hb levels were observed to be lower compared to those with milder cases. Anemia serves as an isolated risk factor for severe COVID-19 infection. In COVID-19 patients, Hb levels were observed to be lower in the group with comorbidities compared to the group without (Akman & Bakırdöğen, 2021; Danwang *et al.*, 2020). In our study, 94% of COVID-19 patients exhibited comorbid conditions. The obtained results indicate that Hb levels in confirmed COVID-19 patients were statistically significant in relation to the duration of their ICU hospital stay. Reduced Hb levels, frequently a sign of anemia, can significantly affect an individual's health and well-being. Anemia can lead to fatigue, weakness, and specially breathlessness, primarily dependent on hemoglobin levels. Consequently, individuals with anemia might experience insufficient oxygen transport to tissues, even with normal

PaO_2 and SpO_2 levels. The concentration of Hb is a key indicator of the blood's oxygen-carrying capacity. Anemia, a widespread global condition, is associated with adverse outcomes in various clinical illnesses, including respiratory diseases such as COVID-19. (Taneri *et al.*, 2020; Jha *et al.*, 2022). In severe respiratory illnesses including COVID-19, patients often experience varying degrees of respiratory impairment and elevated oxygen demand. Concurrent anemia in these patients can further compromise peripheral oxygen delivery (Hariyanto & Kurniawan, 2020).

Among critically ill older adult COVID-19 patients, malnutrition is associated with a higher risk of delirium and extended ICU stays. Consequently, preventing, diagnosing, and treating malnutrition is crucial role for improving clinical outcomes in this population (Gholi *et al.*, 2024; Rebora *et al.*, 2021).

In the current study, the median ICU length of stay (LOS) for COVID-19 patients was eight (8) days. This finding is consistent with recent investigations conducted in the Kingdom of Saudi Arabia, which reported a median ICU LOS of six (6) days (Bedock *et al.*, 2020). Additional research highlights significant variability in ICU durations, with one reporting a mean of 9.89 days (SD = 25.4) and a median of four (4) days (IQR = 8, 2), highlighting significant variability in ICU durations among the population (Alzahrani *et al.*, 2025; Khalifa *et al.*, 2022). Patients with COVID-19 in the ICU typically present longer LOS compared to non-COVID-19 ICU patients (Zangrillo *et al.*, 2020). For instance, a U.S. study reported a LOS of five (5) days for mild cases and 15 days for severe cases requiring ICU admission (Suleyman *et al.*, 2020).

Our analysis revealed a significant association between patient characteristics and ICU LOS. The duration of ICU stay revealed a significant correlation ($p < 0.05$) with age, nutritional status, feeding method, and biochemical markers, including serum albumin and hemoglobin levels. Extended ICU admissions might relate to various long-term health outcomes in contrast to brief stays. These prolonged stays have been associated with malnutrition and may signify the severity of the condition while being related to mortality rates as reported by previous studies (Philipson *et al.*, 2013; Pirlich *et al.*, 2006). In line with this, the current study demonstrated a significant correlation ($p < 0.05$) between malnutrition and increased ICU LOS.

Given that malnutrition represents a prevalent and serious issue for COVID-19 patients in the ICU, nutritional support is a cornerstone of recovery. Integrating systematic nutritional assessment and early intervention into the comprehensive treatment plan is essential. Adherence to global ICU nutrition standards is primordial and must be followed. In the present study, all COVID-19 patients initiated feeding within the first 48 hours of ICU admission, consistent with European Society of Parenteral and Enteral Nutrition (ESPEN) guidelines (Singer *et al.*, 2019), which recommended prompt enteral feeding for critically ill patients. Data from the initial pandemic wave indicate that the majority of ICU patients received enteral nutrition within this timeframe, with one study reporting a rate of 92%. The prompt commencement of feeding is deemed crucial for addressing the nutritional requirements of critically ill patients, as stated by the National Institutes of Health (NIH). Initiating enteral feeding (EEF) within 48 hours of ICU admission greatly enhances patient outcomes, such as lower infection rates, improved gastrointestinal function, and reduced mortality rates. Research, including investigations on COVID-19 patients, has demonstrated that this method can a shortening of ICU stay by up to 38% (Evans *et al.*, 2022). A previous study indicated that critically ill patients with COVID-19 related respiratory failure who required mechanical ventilation and died in ICU presented lower caloric and protein intake compared to survivors. An early nutritional support improves the likelihood of meeting intake targets (Chapela *et al.*, 2023).

An adequate nutritional status is fundamental for supporting an optimal immune response to fight infection. Therefore, ensuring sufficient nutrient intake for COVID-19 ICU patients is paramount to reduce the incidence and detrimental effects of malnutrition.

A key strength of our study is the use of the validated Malnutrition Universal Screening Tool (MUST) to assess malnutrition risk. We concurrently collected a range of phenotypic (e.g., BMI, feeding route) and biological (e.g., serum albumin, hemoglobin) parameters to describe nutritional status concurrently with COVID-19 clinical signs in a consecutive sample, 59% of whom were over 65 with various comorbidities.

Several limitations must be acknowledged. As a single-center study, there is a potential for selection bias. Patients were admitted to our ICU directly from the emergency department, which may not generalize to other settings. The virus may cause severe malnutrition while simultaneously negatively impacting a patient's prognosis, suggesting a possible bidirectional relationship between malnutrition and COVID-19. Our investigation does not fully address important confounding factors such as inflammation, disease severity, and steroid use. Future multi-center prospective studies with standardized protocols for collecting data on inflammatory markers and treatments are required to elucidate these complex interactions. Additionally, comparative studies with control groups are necessary to confirm these findings and establish causal relationships.

5 Conclusion

In conclusion, this observational study demonstrates a high prevalence of malnutrition among COVID-19 patients admitted to the Intensive Care Unit (ICU) in our setting. Common comorbidities among these patients included hypertension (most prevalent), followed by diabetes mellitus, renal, cardiac, respiratory, and hepatic diseases.

Malnutrition was consistently associated with adverse clinical indicators, specifically low serum albumin and hemoglobin levels. Furthermore, our findings indicate that patient age, nutritional status, feeding method, and serum albumin and hemoglobin levels were significantly correlated with the duration of ICU stay.

These results underscore the critical role of nutritional status in clinical outcomes for critically ill COVID-19 patients. We therefore recommend the systematic integration of routine nutritional screening, evaluation, screening, and early intervention into standard ICU care protocols. To validate these associations and establish causality, future prospective and comparative studies with control groups are required.

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