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Trabajo Original

Paciente crítico

Nutritional risk and clinical outcomes in critically ill adult patients with COVID-19

Riesgo nutricional y resultados clínicos de pacientes adultos críticamente enfermos con COVID-19

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Abstract

Introduction: the COVID-19 pandemic put the world's population at risk. As the relationship between nutritional risk and clinical outcomes in critically ill patients with COVID-19 is still poorly understood, a multidisciplinary research team of the Argentine Society of Intensive Care (SATI) conducted a multicenter study aimed to define nutritional features, and to evaluate the relationship between nutritional risk and relevant clinical outcomes for COVID-19 patients in an intensive care unit (ICU).

Methods: a multicenter, prospective, observational study including twelve Argentinian ICUs was conducted between March and October 2020. Inclusion criteria were: adult patients older than 18 years who were admitted to the ICU with a COVID-19 diagnosis were included. Clinical data included comorbidities scores, and nutritional screening tools such as the Subjective Global Assessment (SGA), the Nutritional Risk Screening (NRS) 2002, and the modified NUTRIC score (mNUTRIC SCORE) were used. In addition, clinical outcomes including overall mortality, mechanical ventilation (MV) days, and ICU and hospital length of stay (LOS) were recorded.

Results: a total of 285 ICU patients met our inclusion criteria. Mean age was 61.24 (SD = 14.6) years; APACHE-II, 14.2 (SD = 6.6); Charlson Comorbidity Index (CCI), 2.3 (SD = 2.3). Most patients were admitted from the emergency room to the ICU. Hypertension, obesity, and diabetes were the most common comorbidities. Nutritional assessment showed that 36.9 % were SGA B+C, and 46 % were obese. Mean ICU LOS was 22.2 (SD = 19.5), and hospital LOS was 28.1 (SD = 21.9) days. Of all patients, 90.2 % underwent MV, and MV days were 20.6 (SD = 15.6). The univariate and multivariate analyses showed that risk factors for COVID-19 mortality were (odds ratio [95 % confidence interval]): SGA score of B or C: 2.13 [1.11-4.06], and NRS 2002 ≥ 3: 2.25 [1.01-5.01].

Conclusions: in the present study, nutritional status (SGA) and NRS 2002 were major mortality risk factors for CODIV-19 patients in the ICU.

Keywords:

COVID-19. Nutritional risk. Malnutrition Mortality. Critically ill.

Resumen

Introducción: la pandemia de COVID-19 puso en riesgo a la población mundial. Dado que la relación entre el riesgo nutricional y los resultados clínicos en pacientes críticos con COVID-19 es aún poco conocida, un equipo de investigación multidisciplinario de la Sociedad Argentina de Cuidados Intensivos (SATI) realizó un estudio multicéntrico con el objetivo de definir las características nutricionales y evaluar la relación entre el riesgo nutricional y los resultados clínicos relevantes para los pacientes de la unidad de cuidados intensivos (UCI) de COVID-19.

Métodos: entre marzo y octubre de 2020 se realizó un estudio observacional prospectivo y multicéntrico que incluyó 12 UCI argentinas. Criterios de inclusión: se incluyeron pacientes adultos mayores de 18 años que habían ingresado en la UCI con diagnóstico de COVID-19. Se utilizaron datos clínicos que incluían *scores* de comorbilidades, herramientas de cribado nutricional como la Evaluación Global Subjetiva (EGS) y el Cribado de Riesgo Nutricional (NRS) 2002, y la puntuación NUTRIC. Además. Se registraron los resultados clínicos, incluida la mortalidad, los días de ventilación mecánica (VM) y la duración de la estancia en la UCI y hospitalaria en general.

Resultados: en total, 285 pacientes en UCI cumplieron nuestros criterios de inclusión. La edad media fue de 61,24 (DE = 14,6) años, la puntuación APACHE-II de 14,2 (DE = 6,6) y el índice de comorbilidad de Charlson (ICC) de 2,3 (DE = 2,3). La mayoría de los pacientes ingresaron desde la sala de emergencias a la UCI. La hipertensión, la obesidad y la diabetes fueron las comorbilidades más frecuentes. La evaluación nutricional mostró que el 36,9 % eran VGS B + C y el 46 % eran obesos. La estancia en la UCI fue de 22,2 (DE = 19,5) y la hospitalaria de 28,1 (DE = 21,9) días. El 90,2 % se sometieron a VM, siendo la media de días de VM de 20,6 (DE = 15,6). El análisis univariado y multivariado mostró que los factores de riesgo de mortalidad por COVID-19 eran (razón de posibilidades [intervalo de confianza del 95 %]): puntuación SGA de B o C: 2,13 [1,11-4,06], y NRS 2002 ≥ 3: 2,25 [1,01-5,01].

Conclusiones: en el presente estudio, el estado nutricional (EGS) y el NRS 2002 fueron los principales factores de riesgo de mortalidad para los pacientes con COVID-19 en la UCI.

Palabras clave:

COVID-19. Riesgo nutricional. Malnutrición. Mortalidad. Pacientes críticamente enfermos.

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Martinuzzi ALN, Manzanares W, Quesada E, Reberendo MJ, Baccaro F, Aversa I, Kecskes CE, Magnifico L, González V, Bolzicco D, Baraglia N, Navarrete P, Manrique E, Cascarón MF, Dietrich A, Asparch J, Peralta LB, Galletti C, Capria ML, Lombi Y, Rodríguez MC, Luna CE, Chapela SP. Nutritional risk and clinical outcomes in critically ill adult patients with COVID-19. Nutr Hosp 2021;38(6):1119-1125

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INTRODUCTION

The year 2020 began as a very stressful year because of a new potentially fatal disease called COVID-19, caused by a novel coronavirus named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (1), which was primarily detected in Wuhan, Hubei, China. After a brief period, many different retrospective and observational clinical studies were published trying to share some insights into the global pandemic and the infected patients (2). Over the past year, different guidelines and clinical recommendations from international critical care societies for the treatment and management of COVID-19 ICU patients were published (3). However, these international recommendations, aimed to guide healthcare professionals, were mostly based on weak and insufficient evidence (4). Furthermore, nutritional risk screening and early nutritional therapy have been widely recommended for seriously ill patients. So far, however, there is not enough evidence showing a clear relationship between nutritional risk and clinical outcomes.

As a part of the Argentine Society of Intensive Care (SATI), our Metabolic and Nutritional Support Committee (COSONUME) and the Dietician Section (CALINU) wanted to be prepared when the pandemic arrived in Argentina. That is why we participated in an initiative to collect and translate the information available, and transform it into recommendations for intensive care specialists working in Argentinian ICUs (5).

During this process, our committee acknowledged some inconsistencies in the evidence and lack of information regarding the nutritional characteristics of COVID-19 patients and their relationship with relevant clinical outcomes for the critically ill. As an example of that, according to current evidence there are conflicting data regarding obesity, illness severity, and mortality (6-8).

Most COVID-19 patients who are admitted to the ICU exhibit severe respiratory failure due to isolated viral pneumonia or acute respiratory distress syndrome (ARDS) (8,9). According to current knowledge, there is enough evidence showing a strong association between severe critical illness and malnutrition, muscle wasting, organ dysfunction, and poor clinical outcomes (10). Therefore, nutritional support (NS) and metabolic interventions are a crucial vital support for these patients. Based on these premises, we consider that an adequate assessment of nutritional risk and its relationship with clinical outcomes is necessary (4,6,12) to correctly select the patients who will benefit from NS (9,12).

Therefore, the aims of this study were to define the nutritional characteristics of critically ill patients with COVID-19, and to evaluate any associations between nutritional risk and clinical outcomes in seriously ill adult patients.

METHODS

This is a multicenter, prospective, observational trial that included 12 tertiary-level Argentinian hospitals belonging to the public and private health system.

Inclusion and exclusion criteria were:

- Patients older than 18 years who were admitted to the ICU with a diagnosis of COVID-19 (defined by a nucleic acid-positive nasopharyngeal test + symptoms), requiring MV for more than 48 hours, as well as nutritional support (enteral, parenteral, or both).
- In addition, those patients who received oral nutritional supplements, those with a limitation of care order, and those who refused care at inclusion were excluded.

The approval of each hospital's ethics committee was rapidly granted, and no consent was required due to the observational nature of the trial and the emerging crisis caused by the pandemic.

STATISTICAL ANALYSIS

Continuous data were expressed as mean and standard deviation, while categorical data were expressed as proportions (14). Wilcoxon's rank-sum test (Mann-Whitney U-test) was used for continuous data, and the χ^2 test or Fisher's exact test for categorical data. Univariate and multivariate analyses were made for mortality (15,16), and all variables with a significant difference were chosen for these tests. We considered a difference to be significant when $\alpha = 5\ \%$ ($p < 0.05$). The statistical analysis was carried out using the IBM-SPSS© 24 program (15).

RESULTS

In this study, 290 patients were initially recruited. However, 5 were excluded due to unavailable data. In the end, 285 patients (182 and 103 from the private and public healthcare systems, respectively) were finally analyzed (Fig. 1). Table I shows the baseline characteristics of the patient population. A total of 36.9 % were malnourished as defined by the SGA (B and C); mean NRS 2002 score was 3.2 (SD = 1.2), the modified NUTRIC score without Interleukin 6 (mNUTRIC) was 3.5 (SD = 1.8), and 46 % of patients were obese. The most widely used nutritional support form was enteral nutrition (96.84 % of patients). In all, 90.2 % underwent MV, and the mean of MV days was 20.2 (SD = 15.6); 67.2 % were pronated. The length of ICU stay was 22.2 (SD = 19.5) days, and the length of hospital stay was 28.1 (SD = 21.9) days. Finally, 44.9 % of patients died during the study, whereas 41.4 % were discharged, and 13.7 % of patients remained in hospital care.

Chemistry lab results for all patients are listed in table II; as a significant result, low albumin levels (under 3.5 g/dL) were found in 84.6 % of patients, with a mean of 3.0 g/dL (SD = 0.44).

Table III shows the characteristics of patients who died and survived during the study. Patients who died were older (64.8 (SD, 14.02) vs 58.1 (SD, 14.9) years old, $p < 0.001$); had higher APACHE II scores (15.6 (SD, 6.8) vs 12.7 (SD, 6.1), $p < 0.001$), higher NRS 2002 acores (3.4 (1.1) vs 3 (1.35), $p = 0.0112$), and higher mNUTRIC scores (3.9 (1.9) vs 3.1 (1.7), $p \leq 0.001$); had more severe malnutrition (SGA C) (46.1 % vs 23.7 %, $p < 0.001$)

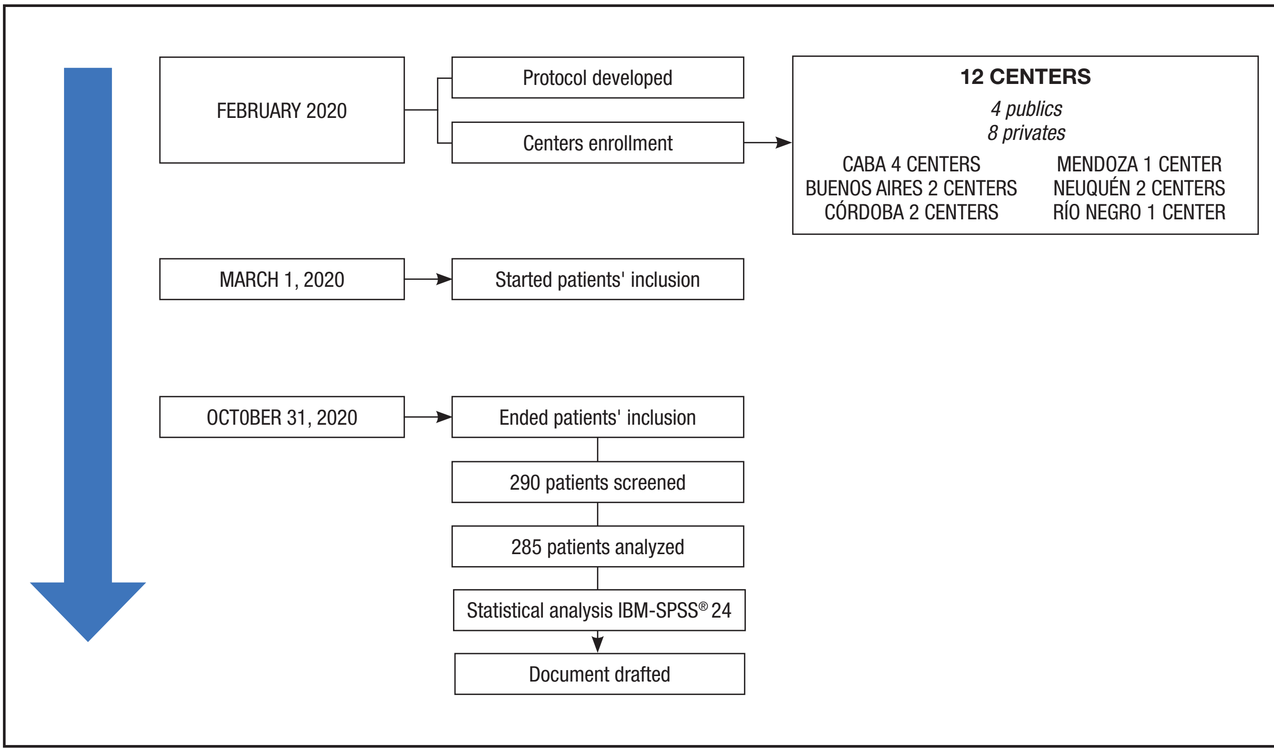

Figure 1.

Consort flow diagram; 5 excluded due to missing data; 285 patients were analyzed. CABA: Ciudad Autónoma de Buenos Aires.

and had more comorbidities as measured by CCI (2.5 (SD, 2.3) vs 1.9 (SD, 2.3), $p = 0.045$). Albumin presented significantly lower levels in the group of patients who died (2.9 (0.42) vs 3.1 (0.46), $p = 0.015$). These also had less mechanical ventilation (16.6 (SD, 11.6) vs 20.5 (SD, 16.8) days, $p = 0.034$) and shorter hospital lengths of stay (21.2 (SD, 21.5) vs 33.4 (SD, 20), $p < 0.001$). There was no difference in deaths between referring health care systems (private vs public), or when comparing obese vs non-obese patients.

Univariate and multivariate analyses were made for ICU mortality (Table IV). The variables for the analysis were chosen according to the results of the population study (Table III). Patients with APACHE II over 20 were more likely to die during their ICU stay (OR = 2.14; 95 % confidence interval (CI) = 1.09 to 4.23; $p = 0.027$); also patients older than 70 years (OR = 2.29; CI = 1.31 to 4; $p = 0.036$), patients admitted from the ER (OR = 1.76; CI = 1.00 to 3.09; $p = 0.048$), patients whose nutritional support was initiated after 48 h (OR = 1.16; CI = 1.04 to 1.3; $p = 0.008$), and patients with SGA B or C (OR = 2.83; CI = 1.63 to 4.9; $p \leq 0.001$), with NRS-2002 of 3 or more (OR = 2.14; CI = 1.15 to 3.99; $p = 0.0162$), and with a mNUTRIC score of 5 or more (without IL-6) (OR = 1.3; CI = 1.12 to 1.5; $p < 0.01$). After the multivariate analysis, SGA B or C was an independent factor for dying in the ICU (OR = 2.13; CI = 1.11 to 4.06; $p = 0.0221$), as was a NRS-2002 of 3 or more (OR = 2.25; CI = 1.01 to 5.01; $p = 0.046$).

DISCUSSION

To our knowledge, this is the first Latin American observational study aiming to evaluate the nutritional status of 285 COVID-19 critically ill patients. The main finding of our study was that malnutrition as assessed with SGA, and risk of malnutrition as assessed with the NRS-2002 are independent factors for in-hospital mortality. Similarly to several other works, we showed that ICU patients with malnutrition have the worst outcome (11,12). Also, sarcopenic patients have the worst outcome in the ICU (13-19). But this work is the first one assessing nutritional risk and malnutrition in COVID-19 patients. The mNUTRIC score was also calculated in this study, and showed significant differences between surviving vs non-surviving patients. These findings, after running the univariate and multivariate analyses, lost their significance.

Another important finding was that the higher the Apache II score (> 20), the higher the mortality among COVID-19 ICU patients, as is observed in non-COVID-19 patients (15-20). Unfortunately, we were unable to determine the SOFA score as a tool to assess organ dysfunction.

Also, CCI was found to be significantly higher in non-surviving patients, meaning that this group of patients had more chronic diseases than surviving patients. In the same way, when comparing comorbidities, we found that non-surviving patients were more likely to have 2 or more comorbidities.

Table I. Baseline characteristics of the population

	All cases (n = 285)
Age (SD), years	61.24 (14.6)
APACHE II	14.2 (6.6)
Origin	
Ward	47.1 %
Emergency room	33.5 %
Other center	19.4 %
Gender (male), n %	N 67.0 %
Charlson Comorbidity Index	2.3 (2.3)
Health care system	
Private	63.9 %
Public	36.1 %
COPD/asthma	10.9 %
Oncologic	8.1 %
HBP	51.2 %
DM	25.3 %
CKD	9.1 %
2 comorbidities or more	28.4 %
HBP	92.4 %
Obesity/overweight	84.8 %
DM	63.3 %
CKD	27.8 %
COPD/asthma	25.3 %
Oncologic	22.8 %
NRS 2002 (SD)	3.2 (1.2)
mNUTRIC score (SD)	3.5 (1.8)
SGA	
ND	7.4 %
Category A	55.8 %
B	35.8 %
C	1.1 %
Weight, kg	89.6 (22.2)
Height, cm	169.4 (8.4)
BMI, $kg \cdot m^{-2}$	31.2 (7.4)
BMI condition	
Low weight	-
Normal	13.7 %
Overweight	40.4 %
Obese	46.0 %
MV	90.2 %
MV days	20.6 (15.6)
Quartile MV days	
0-14 days	44.2 %
15-28 days	32.5 %
29-42 days	12.0 %
43 days or more	11.2 %
Prone	67.2 %
Type of NS	
TPN	1.85 % (n = 5)
CPN + EN	1.41 % (n = 4)
EN	96.84 % (n = 276)
Time to NS (days)	2.58 ± 3.92
ICU NS days	20.11 ± 19.65
ICU LOS	22.2 (19.5)
Hospital LOS	28.1 (21.9)
28-day mortality	36.5 %
Results	
Death	44.9 %
Discharged	41.4 %
Rehabilitation center	3.5 %
Continued in ICU	10.2 %

SD: standard deviation; HBP: high blood pressure; DM: diabetes mellitus; CKD: chronic kidney disease; COPD: chronic obstructive pulmonary disease; SGA: subjective global assessment; ND: no data; BMI: body mass index; MV: mechanical ventilation; NS: nutritional support; TPN: total parenteral nutrition; CPN: complementary parenteral nutrition; EN: enteral nutrition; LOS: length of stay; MV: mechanical ventilation; ICU: intensive care unit; cm: centimeters; kg: kilograms.

Table II. Lab test results on admission

	n	Mean (SD)
C-reactive protein (mg/dL)	90	42.6 (70.7)
Albumin (g/dL)	136	3.0 (0.44)
Albumin < 3.5 g/dL	136	84.6 %
Total cholesterol (mg/dL)	86	170.3 (58.3)
Triglycerides (mg/dL)	83	237.6 (137.5)
AST (U/L)	184	77.9 (297)
ALT (U/L)	184	83.9 (139)
ALP (alkaline phosphatase) (U/L)	175	144.2 (111.2)
Total bilirubin (mg/dL)	157	0.74 (0.76)
Conjugated bilirubin (mg/dL)	127	0.55 (0.75)
Urea (mg/dL)	214	41.5 (46.5)
Creatinine (mg/dL)	211	1.2 (1.04)
Plasma phosphorus (mg/dL)	136	3.6 (1.5)
Plasma magnesium (mg/L)	146	2.2 (0.42)

In our cohort of COVID-19 patients, those who were obese did not show an increased mortality rate in the ICU. As of now, there is conflicting evidence regarding obese patients in the ICU and mortality (21,26). The prevalence of obesity in critically ill patients reported by different cohort studies in Argentina ranges from 10 % to 25 % (27,29). In the present study, the prevalence of obesity is 46 %, indicating that obese patients may be more likely to have a severe form of COVID-19, but we did not find any statistically higher mortality associated with obesity. In a recently published study, obese COVID-19 patients have more commonly fever than non-obese patients, but there were no differences in inflammatory markers, ICU stay, length of mechanical ventilation, or mortality (30). Also, as described by Akinnussi (31), we found that, paradoxically, critically ill obese patients had lower mortality, fewer days in MV, and shorter ICU stay when compared to non-obese patients. In contrast, the meta-analysis made by Jun Yang et al. (7) analyzed 6 retrospective observational studies, only using the BMI tool to determine obesity; however, body composition is perhaps more important than weight and its relation to height squared in determining nutritional risk. None of the published papers described if those COVID-19 obese patients were sarcopenic or not, but this does not prevent meta-analyses on BMI from affirming (32) a relationship between nutritional risk and mortality in association with this poor tool for describing body composition (33,34).

The main laboratory finding in our study was that 84.7 % of COVID-19 patients had low plasma albumin levels (< 3.5 g/dL) (35), and that patients who died had lower levels when compared to those who survived (2.9 (SD = 0.42) vs 3.1 (SD = 0.46), p = 0.015). As we know from previous data related to the critical care general population, albumin is more closely associated with inflamma-

Table III. Results of the comparison between patients who died and who were discharged

	Discharged alive (n = 118)	Death (n = 26)	p-value
Age (SD), years	58.1 (14.9)	64.8 (14.02)	< 0.001
APACHE II	12.7 (6.1)	15.6 (6.8)	< 0.001
Origin			
Ward	52.4 %	40.5 %	0.061
Emergency room	28.2 %	40.5 %	0.043
Other center	19.4 %	19%	0.936
Male	64.4 %	66.4 %	0.767
Female	35.6 %	33.6 %	0.742
Charlson Comorbidity Index	1.9 (2.3)	2.5 (2.3)	0.045
Health care system			
Private (n = 150)	49.4 %	50.6 %	0.64
Public (n = 94)	46.2 %	53.2 %	
COPD/asthma	11 %	10.2 %	0.831
Oncologic	6.8 %	10.2 %	0.181
HBP	46.6 %	56.3 %	0.129
DM	25.4 %	22.7 %	0.621
CKD	6.8 %	11.7 %	0.188
2 comorbidities or more	35.4 %	49.4 %	0.0269
NRS 2002	3 (1.35)	3.4 (1.1)	0.0112
mNUTRIC score	3.1 (1.7)	3.9 (1.9)	< 0.001
SGA			
A	9.4 %	6.2	0.348
B	66.9 %	47.7 %	0.0024
C	23.7 %	46.1 %	< 0.001
Weight, kg	86.6 (16.2)	90.2 (25.3)	0.182
Height, cm	168.7 (7.9)	169 (9.1)	0.78
BMI, kg·m^{-2}	30.4 (5.4)	31.3 (8.6)	0.33
BMI condition			
Low weight	-	-	0.314
Normal	11.9 %	16.4 %	0.495
Overweight	44.1 %	39.8 %	0.962
Obese	44.1 %	43.8 %	
Albumin, g/dL	3.1 (0.46)	2.9 (0.42)	*0.015*
MV needs (requirement)	80.5 %	97.7 %	*< 0.001*
MV days	20.5 (16.8)	16.6 (11.6)	*0.034*
Quartile MV days			
0-14 days	46.3	51.6	0.407
15-28 days	33.7	34.7	0.869
29-42 days	7.4	9.7	0.52
43 days or more	12.6	4	*0.0138*
Prone position	57.9 %	69.4 %	0.061
ICU LOS	22.4 (16.8)	20.1 (20.7)	0.34
Hospital LOS	33.4 (20)	21.2 (21.5)	*< 0.001*

SD: standard deviation; HBP: high blood pressure; DM: diabetes mellitus; *CKD: chronic kidney disease; COPD: chronic obstructive pulmonary disease; SGA: subjective global assessment; ND: no data; BMI: body mass index; MV: mechanical ventilation; LOS: length of stay; MV: mechanical ventilation; ICU: intensive care unit; cm: centimeters; kg: kilograms.*

tion than nutrition (35). Also, in surgical patients in the ICU this finding is related to higher mortality (35-39). In a recent study with COVID-19 hospitalized patients it was shown that hypoalbuminemia occurred on admission in 38.2 %, 71.2 %, and 82.4 % of patients in the non-critically ill, critically ill, and death groups, respectively (40).

ICU and hospital LOS were higher in surviving patients when compared to patients who died; also MV length was higher in surviving patients, and most of the COVID-19 patients died during MV. This suggests that surviving COVID-19 patients require more chronic care, and after initial illness they are prone to suffer from complications; also that deaths are directly associated with COVID-19 and its consequences.

The main strength of our study is based on the fact that it was a prospective, multicenter trial focused on nutritional features and relevant clinical outcomes in the critically ill. Moreover, all researchers are ICU physicians and dietitians trained in the nutritional assessment of ICU patients using different tools such as the NRS 2002, SGA, and anthropometric data. Nonetheless, we are aware that our study has several limitations. Ultrasonography or other methods to evaluate muscle mass were not used, and therefore body composition could not be analyzed. Also, caloric and protein intake were not assessed and were not related to clinical outcomes.

CONCLUSION

In the present study, critically ill patients with COVID-19 at risk of malnutrition, and those who were malnourished, had a higher mortality rate. Moreover, these patients showed worse outcomes when compared to those who were not at risk or well nourished. Also, obese patients had a higher risk of more severe forms of COVID-19, although obesity was not associated with increased mortality. Finally, the NSR-2002 and the SGA scores were the most accurate tools to establish nutritional risk and status in critically ill patients with COVID-19. Therefore, according to our findings, patients at nutritional risk require an early and adequate nutritional support intervention. Finally, large scale, well designed randomized controlled trials aimed at evaluating nutrition therapy in high-risk patients are warranted.

CONFLICT OF INTEREST

Following our ethical obligation as researchers, we must report that Sebastián Chapela has performed as a speaker for NUTRICIA and FRESENIUS KABI, and participated in Advisory Boards for FRESENIUS-KABI. Andrés Martinuzzi works as Medical Director of NUTRIHOME-SA, and has performed as a speaker for FRESENIUS-KABI Argentina. Claudia Elisabeth Kecskes has performed as speaker for NUTRICIA and FRESENIUS KABI. No potential competing interests were reported by the rest of the authors.

Table IV. Univariate and multivariate analysis of ICU mortality

	Univariate			Multivariate		
Variable	**Odds ratio**	**95 % CI**	**p-value**	**Odds ratio**	**95 % CI**	**p-value**
APACHE II > 20	2.14	1.09 to 4.23	*0.027*	1.44	0.59 to 3.54	0.42
70 years or more	2.29	1.31 to 4	*0.036*	1.97	0.97 to 4.01	0.06
Gender male	1.06	0.63 to 1.8	0.8	0.84	0.45 to 1.57	0.58
Origin ER	1.76	1.00. to 3.09	*0.048*	1.7	0.89 to 3.23	0.1
Health system	0.90	0.54 to 1.51	0.7	0.72	0.37 to 1.4	0.33
Time to initiate nutrition greater than 48 h	1.16	1.04 to 1.3	*0.008*	1.11	0.59 to 2.09	0.74
SGA B or C	2.83	1.63 to 4.9	*< 0.001*	2.13	1.11 to 4.06	*0.0221*
NRS 2002: 3 or more	2.14	1.15 to 3.99	*0.0162*	2.25	1.01 to 5.01	*0.046*
mNUTRIC score: 5 or more	1.3	1.12 to 1.5	*< 0.001*	1.15	0.38 to 3.44	0.79
Obese	1.05	0.63 to 1.74	0.85	1.38	0.76 to 2.53	0.29
Diabetes	1.04	0.67 to 1.6	0.85	0.62	0.34 to 1.16	0.13
COPD	0.99	0.58 to 1.66	0.96	0.77	0.35 to 1.69	0.52
Hypertension	1	0.65 to 1.55	0.98	1.07	0.58 to 1.99	0.82
Chronic kidney injury	0.95	0.55 to 1.64	0.85	1.12	0.48 to 2.6	0.78
Oncologic	0.79	0.46 to 1.36	0.39	0.94	0.39 to 2.23	0.89

CI: confidence interval; SGA: subjective global assessment; ER: emergency room; COPD: chronic obstructive pulmonary disease.

REFERENCES

1. Andersen KG, Rambaut A, Lipkin WI, Holmes EC, Garry RF. The proximal origin of SARS-CoV-2. Nat Med 2020;26(4):450-2. DOI: 10.1038/s41591-020-0820-9
2. Yu C, Lei Q, Li W, Wang X, Liu W, Fan X, et al. Clinical Characteristics, Associated Factors, and Predicting COVID-19 Mortality Risk: A Retrospective Study in Wuhan, China. Am J Prev Med 2020;59(2):168-75. DOI: 10.1016/j.amepre.2020.05.002
3. Zhang L, Liu Y. Potential interventions for novel coronavirus in China: A systematic review. J Med Virol 2020;92(5):479-90. DOI: 10.1002/jmv.25707
4. Zhang H, Liao YS, Gong J, Liu J, Xia X, Zhang H. Clinical characteristics of coronavirus disease (COVID-19) patients with gastrointestinal symptoms: A report of 164 cases. Dig Liver Dis 2020;52(10):1076-9. DOI: 10.1016/j.dld.2020.04.034
5. Martinuzzi A, Magnífico L, Asus N, Cabana L, Kecskes C, Lipovestky F. Recomendaciones respecto al manejo nutricional de pacientes COVID-19 admitidos a Unidades de Cuidados Intensivos. Rev Argetina Ter Intensiva 2020;38(Supl 1):28-35.
6. Li X, Xu S, Yu M, Wang K, Tao Y, Zhou Y, et al. Risk factors for severity and mortality in adult COVID-19 inpatients in Wuhan. J Allergy Clin Immunol 2020;146(1):110-8. DOI: 10.1016/j.jaci.2020.04.006
7. Yang J, Hu J, Zhu C. Obesity aggravates COVID-19: A systematic review and meta-analysis. J Med Virol 2020;93(1):257-61. DOI: 10.1002/jmv.26237
8. Puthucheary ZA, Astin R, McPhail MJW, Saeed S, Pasha Y, Bear DE, et al. Metabolic phenotype of skeletal muscle in early critical illness. Thorax 2018;73(10):926-35. DOI: 10.1136/thoraxjnl-2017-211073
9. Thibault R, Seguin P, Tamion F, Pichard C, Singer P. Nutrition of the COVID-19 patient in the intensive care unit (ICU): A practical guidance. Crit Care 2020;24(1):1-8. DOI: 10.1186/s13054-020-03159-z
10. Caccialanza R, Laviano A, Lobascio F, Montagna E, Bruno R, Ludovisi S, et al. Early nutritional supplementation in non-critically ill patients hospitalized for the 2019 novel coronavirus disease (COVID-19): Rationale and feasibility of a shared pragmatic protocol. Nutrition 2020;74:110835. DOI: 10.1016/j.nut.2020.110835
11. Mogensen KM, Horkan CM, Purtle SW, Moromizato T, Rawn JD, Robinson MK, et al. Malnutrition, Critical Illness Survivors, and Postdischarge Outcomes: A Cohort Study. J Parenter Enter Nutr 2018;42(3):557-65. DOI: 10.1177/0148607117709766
12. Lew CCH, Yandell R, Fraser RJL, Chua AP, Chong MFF, Miller M. Association between Malnutrition and Clinical Outcomes in the Intensive Care Unit: A Systematic Review. J Parenter Enter Nutr 2017;41(5):744-58. DOI: 10.1177/0148607115625638
13. Jaitovich A, Dumas CL, Itty R, Chieng HC, Khan MMHS, Naqvi A, et al. ICU admission body composition: Skeletal muscle, bone, and fat effects on mortality and disability at hospital discharge - A prospective, cohort study. Crit Care 2020;24(1):566. DOI: 10.1186/s13054-020-03276-9
14. DeAndrade J, Pedersen M, Garcia L, Nau P. Sarcopenia is a risk factor for complications and an independent predictor of hospital length of stay in trauma patients. J Surg Res 2018;221:161-6. DOI: 10.1016/j.jss.2017.08.018
15. Ji Y, Cheng B, Xu Z, Ye H, Lu W, Luo X, et al. Impact of sarcopenic obesity on 30-day mortality in critically ill patients with intra-abdominal sepsis. J Crit Care 2018;46:50-4. DOI: 10.1016/j.jcrc.2018.03.019
16. Looijaard WGPM, Dekker IM, Stapel SN, Girbes ARJ, Twisk JWR, Oudemans-van Straaten H, et al. Skeletal muscle quality as assessed by CT-derived skeletal muscle density is associated with 6-month mortality in mechanically ventilated critically ill patients. Crit Care 2016;20(1):386. DOI: 10.1186/s13054-016-1563-3
17. Matsubara Y, Matsumoto T, Aoyagi Y, Tanaka S, Okadome J, Morisaki K, et al. Sarcopenia is a prognostic factor for overall survival in patients with critical limb ischemia. J Vasc Surg 2015;61(4):945-50. DOI: 10.1016/j.jvs.2014.10.094
18. Weijs PJM, Looijaard WGPM, Dekker IM, Stapel SN, Girbes AR, Oudemans-van Straaten HM, et al. Low skeletal muscle area is a risk factor for mortality in mechanically ventilated critically ill patients. Crit Care 2014;18(1):1-7. DOI: 10.1186/cc13189
19. Puthucheary ZA, Rawal J, McPhail M, Connolly B, Ratnayake G, Chan P, et al. Acute skeletal muscle wasting in critical illness. JAMA - J Am Med Assoc 2013;310(15):1591-600. DOI: 10.1001/jama.2013.278481
20. Wagner D, Draper E. APACHE II, and Medicare reimbursement. Health Care Financ Rev 1984:92-105.
21. Pepper DJ, Sun J, Welsh J, Cui X, Suffredini AF, Eichacker PQ. Increased body mass index and adjusted mortality in ICU patients with sepsis or septic shock : a systematic review and meta-analysis. Crit Care 2016;20(1):181. DOI: 10.1186/s13054-016-1360-z
22. Pickkers P, De Keizer NF, Dusseljee J, Weerheim D, Hoeven JG Van Der, Peek N. Body Mass Index Is Associated With Hospital Mortality in Critically Ill Patients: An Observational Cohort Study. Crit Care Med 2013;41(8):1878-84. DOI: 10.1097/CCM.0b013e31828a2aa1

23. Martino JL, Stapleton R, Wang M, Day AG, Cahill NE, Dixon AE, et al. Extreme Obesity and Outcomes in Critically Ill Patients. Chest 2011;140(5):1198-206. DOI: 10.1378/chest.10-3023
24. Kumar C, Majumdar T, Jacobs E, Danesh V, Dagar G, Deshmukh A, et al. Outcomes of Morbidly Obese Patients Receiving Invasive Mechanical Ventilation. Chest 2013;144(1):45-54. DOI: 10.1378/chest.12-2310
25. Wardell S, Wall A, Bryce R, Gjevre JA, Laframboise K, Reid JK. The association between obesity and outcomes in critically ill patients. Can Resp 2015;22(1):23-30.
26. Papadimitriou-olivgeris M, Aretha D, Zotou A, Koutsileou K, Zbouki A, Lefkaditi A, et al. The Role of Obesity in Sepsis Outcome among Critically Ill Patients: A Retrospective Cohort Analysis. Biomed Res Int 2016;2016:5941279. DOI: 10.1155/2016/5941279
27. Jiwani SS, Carrillo-Larco RM, Hernández-vásquez A, Barrientos-Gutiérrez T, Basto-Abreu A, Gutiérrez L, et al. The shift of obesity burden by socioeconomic status between 1998 and 2017 in Latin America and the Caribbean : a cross-sectional series study. Lancet Glob Heal 2019;7(12):e1644-54. DOI: 10.1016/S2214-109X(19)30421-8
28. Zapata ME, Bibiloni MDM, Tur JA. Prevalence of overweight, obesity, abdominal-obesity, and short stature of the adult population of Rosario, Argentina. Nutr Hosp 2016;33(5):580. DOI: 10.20960/nh.580
29. Arbex AK, Rocha DRTW, Aizenberg M, Ciruzzi MS. Obesity Epidemic in Brazil and Argentina: A Public Health Concern. J Heakth Popul Nutr 2014;32(2):327-34.
30. Kooistra EJ, Nooijer AH De, Claassen WJ, Grondman I, Janssen NAF, Netea MG, et al. A higher BMI is not associated with a different immune response and disease course in critically ill COVID-19 patients. Int J Obes (Lond) 2021;45(3):687-94. DOI: 10.1038/s41366-021-00747-z
31. Akinnusi ME, Pineda LA, El Solh AA. Effect of obesity on intensive care morbidity and mortality: A meta-analysis. Crit Care Med 2008;36(1):151-8. DOI: 10.1097/01.CCM.0000297885.60037.6E
32. Popkin BM, Du S, Green WD, Beck MA, Algaith T, Herbst CH, et al. Individuals with obesity and COVID-19: A global perspective on the epidemiology and biological relationships. Obes Rev 2020;21(11):1-17. DOI: 10.1111/obr.13128
33. Martinuzzi A, Chapela S. Pérdida de masa muscular en el paciente críticamente enfermo: ¿caquexia, sarcopenia y/o atrofia? impacto en la respuesta terapéutica y la supervivencia. Rev Cuba Aliment y Nutr 2018;28(2):1-24.
34. Akirov A, Masri-Iraqi H, Atamna A, Shimon I. Low Albumin Levels Are Associated with Mortality Risk in Hospitalized Patients. Am J Med 2017;130(12):1465.e11-e19. DOI: 10.1016/j.amjmed.2017.07.020
35. Basile-Filho A, Lago AF, Menegueti MG, Nicolini EA, Rodrigues LAB, Nunes RS, et al. The use of APACHE II, SOFA, SAPS 3, C-reactive protein/albumin ratio, and lactate to predict mortality of surgical critically ill patients. Medicine (Baltimore) 2019;98(26):e16204. DOI: 10.1097/MD.0000000000016204
36. Xu WZ, Li F, Xu ZK, Chen X, Sun B, Cao JW, et al. Preoperative albumin-to-globulin ratio and prognostic nutrition index predict prognosis for glioblastoma. Onco Targets Ther 2017;10:725-33. DOI: 10.2147/OTT.S127441
37. Liu Y, Chen S, Zheng C, Ding M, Zhang L, Wang L, et al. The prognostic value of the preoperative c-reactive protein/albumin ratio in ovarian cancer. BMC Cancer 2017;17(285):4-11. DOI: 10.1186/s12885-017-3220-x
38. Miura K, Hamanaka K, Koizumi T, Kitaguchi Y, Terada Y, Nakamura D, et al. Clinical significance of preoperative serum albumin level for prognosis in surgically resected patients with non-small cell lung cancer –comparative study of normal lung, emphysema, and pulmonary fibrosis. Lung Cancer 2017;111:88-95. DOI: 10.1016/j.lungcan.2017.07.003
39. Truong A, Hanna MH, Moghadamyeghaneh Z, Stamos MJ. Implications of preoperative hypoalbuminemia in colorectal surgery. World J Gastrointest Surg 2016;8(5):353-62. DOI: 10.4240/wjgs.v8.i5.353
40. Chapple LS, Mbbs ACC, Collins P. Nutrition management for critically and acutely unwell hospitalized patients with coronavirus disease 2019 (COVID-19) in Australia and New Zealand. Nutr Diet 2020;77(4):426-36. DOI: 10.1111/1747-0080.12636