



ORIGINAL

## Predictive value of the CONUT scale in the early detection of nutritional risk and its relationship with mortality in critically ill patients

### Valor predictivo de la escala CONUT en la detección precoz del riesgo nutricional y su relación con la mortalidad en pacientes críticos

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**Cite as:** Auza-Santivañez JC, Soneira Perez J, Diaz Lara Y, Orlando León D, Condori-Villca N, Alvarez Loaces JP. Valor predictivo de la escala CONUT en la detección precoz del riesgo nutricional y su relación con la mortalidad en pacientes críticos. Salud Cienc. Tecnol. 2023;3:339. <https://doi.org/10.56294/saludcyt2023339>

Submitted: 28-01-2023

Revised: 11-02-2023

Accepted: 23-03-2023

Published: 24-03-2023

Editor: Dr. William Castillo González 

#### ABSTRACT

**Introduction:** hospital malnutrition is a global health problem, and its prevalence has been estimated between 30 % y 60 %. Its early identification constitutes a pillar of the management and treatment of critically ill patients. Its usefulness has been shown both to improve the survival of these patients, as well as to reduce complications related to it, and reduce costs.

**Objectives:** apply the CONUT scale to assess nutritional risk and as a predictor of mortality. Relate it with causes of admission, stay in the ICU, time on mechanical ventilation, and the state at discharge from the ICU and determine the sensitivity and specificity of the CONUT scale as a predictor of mortality and its comparison with the APACHE II scale.

**Methods:** it was carried out in the ICU of the “Miguel Enríquez” Hospital for a period of 2 years. The variables applied were: age, sex, ICU stay, origin services, need for mechanical ventilation, discharge status, nutritional status classification according to CONUT and APACHE II.

**Results:** there was a predominance of males, the average stay was between 1-6 days, and mortality was low. More than 90 % of the patients were malnourished, the diagnosis at admission and the use of mechanical ventilation, and no association with mortality was demonstrated.

**Conclusions:** an association between nutritional status and ICU stay was demonstrated. According to the ROC curve, it was shown that the CONUT has a high sensitivity to predict nutritional risk and its relationship with mortality, compared to the APACHE scale it was low.

**Keywords:** Nutrition in Critically Ill Patients; CONUT Scale; Nutritional Risk; Mortality.

#### RESUMEN

**Introducción:** la desnutrición hospitalaria es un problema mundial de salud, y su prevalencia se ha estimado entre el 30 % y 60 %. Su identificación temprana, constituye un pilar del manejo y tratamiento de los pacientes críticos. Se ha demostrado su utilidad tanto para mejorar la sobrevida de estos pacientes, como para disminuir las complicaciones relacionadas con la misma, y disminuir los costos.

**Objetivos:** aplicar la escala CONUT para evaluar riesgo nutricional y como predictor de mortalidad. Relacionar la misma estadía en UCI, tiempo de ventilación mecánica, y el estado al egreso de UCI y determinar sensibilidad y especificidad de la escala CONUT como predictor de la mortalidad y su comparación con la

escala APACHE II.

**Métodos:** se realizó en la UCI del Hospital “Miguel Enríquez” durante un periodo de 2 años. Las variables aplicadas fueron: edad, sexo, estadía en UCI, servicios de procedencia, necesidad de ventilación mecánica, estado al egreso, clasificación del estado nutricional según CONUT y APACHE II.

**Resultados:** hubo un predominio del sexo masculino, la estadía, como promedio estuvo entre 1-6 días, y la mortalidad fue baja. Más del 90 % de los pacientes estaban desnutridos, el diagnóstico al ingreso y el uso de ventilación mecánica y no se demostró asociación con la mortalidad.

**Conclusiones:** se demostró asociación entre el estado nutricional con la estadía en UCI. De acuerdo a la curva ROC se demostró que el CONUT tiene una alta sensibilidad para predecir riesgo nutricional y su relación con la mortalidad, en comparación a la escala APACHE fue baja.

**Palabras clave:** Nutrición en el Paciente Crítico; Escala CONUT, Riesgo Nutricional, Mortalidad.

## INTRODUCTION

Hospital malnutrition is a global health problem, with a prevalence estimated to be between 30 % and 60 %.<sup>(1,2)</sup> It has been reported to be present in 25 % and 60 % of patients at the time of admission, and its identification and therapeutic approach are essential to minimize its deleterious effects and healthcare costs.<sup>(3,4)</sup> The American Society for Parenteral and Enteral Nutrition (ASPEN) in its 2015 document on definition of terms, style, and conventions, defines malnutrition as an acute, subacute, or chronic state of nutrition in which a combination of various degrees of overnutrition or undernutrition, with or without inflammatory activity, has led to changes in body composition and diminished function.<sup>(5,6)</sup>

In the last decade, the increasing number of clinical studies has provided clinical evidence that optimal nutritional management can have a favorable effect on clinical outcome variables.<sup>(7)</sup> Early identification of malnutrition in the intensive care setting and its appropriate nutritional treatment is a cornerstone of management and treatment of critically ill patients. Its usefulness has been demonstrated both to improve the survival of these patients,<sup>(8,9)</sup> and to decrease complications related to malnutrition and reduce costs.<sup>(10,11)</sup>

The nutritional assessment of critically ill patients initially involves the application of risk indices, including the CONUT Nutritional Control Project,<sup>(12,13)</sup> the Nutrition Risk in the Critically ill (Nutric Score),<sup>(14)</sup> validated for critically ill patients, the Subjective Global Assessment (SGA), widely used in Cuban research, among others.<sup>(15)</sup> Therefore, the nutritional assessment of every patient admitted to an intensive care unit during the first 48 hours of their stay is of paramount importance.<sup>(16,17)</sup> In recent years, studies addressing the evaluation of nutritional status in hospitalized patients have led to the development of tools and risk scales capable of identifying malnourished patients and enabling appropriate nutritional interventions to improve their condition and avoid complications and increased mortality in this subgroup of patients.<sup>(18)</sup>

The authors believe that the estimation and early detection of nutritional risk in critically ill patients would be a useful tool, helping to direct nutritional support and determine short-term goals. Moreover, this is an area that has been little addressed by the scientific community, and there is a lack of knowledge about which method best stratifies the risk of malnutrition. Hence, there is a need to apply and determine whether the CONUT scale is beneficial for the early detection of nutritional risk and mortality in critically ill patients treated in the “Dr. Miguel Enríquez” Hospital Intensive Care Unit.

## METHODS

### Study Type

Observational, descriptive, cross-sectional (prospective) study conducted in the intensive care unit of the Dr. Miguel Enríquez Hospital, during the period from January 1, 2019 to January 31, 2021. Population: All consecutive male and female patients admitted to the Intensive Care Unit of the Dr. Miguel Enríquez Hospital between 2019 and 2021.

### Sample

The sample consisted of patients who met the inclusion and exclusion criteria.

### Inclusion criteria

Patients over 18 years of age. Survival/stay of more than 24 hours in the unit. CONUT score applied within the first 24 hours of patient admission to the ICU. Exclusion criteria: Insufficient data to complete the CONUT scale and other investigated variables. Patients who received exogenous albumin or any type of parenteral nutrition previously.

*Techniques and procedures*

All patients included in the study were treated according to the protocols of the ICU service of the "Dr. Miguel Enríquez" hospital. Blood samples were taken within the first 24-48 hours of admission to the ICU, from a peripheral vein for the determination of relevant laboratory studies. The CONUT screening system parameters from Ulíbarri (12) were integrated into a software, and applied within the first 24 hours of admission to the ICU, for nutritional assessment within the first 48 hours of admission.

*Biochemical variables*

Venous blood samples were taken from all patients, deposited in tubes with EDTA anticoagulant for hemogram, and in bullets with heparin anticoagulant for chemical parameter analysis. The determination of cholesterol, triglycerides, creatinine, and albumin was performed using the Hitachi 902 and Modular P-800 automated equipment, with serum obtained after centrifuging the samples, by the following methods: Cholesterol, triglycerides: enzymatic method. Albumin: colorimetric (bromocresol green).

*Immunological variables*

The overall count of leukocytes was performed using hematological counters, Pentra 120 Retic, MICROS 60 KX-21. The calculation of total lymphocytes was performed using the following formula: Total lymphocyte count = total leukocytes x % lymphocytes / 100 = number of lymphocytes.

*Limitations of the study*

Despite the benefits of the CONUT scale and its use as a method for evaluating nutritional status, it should not be the only element in this evaluation. In the specific case of the critically ill patient, albumin is one of the indicators of the scale, however, it should be noted that there are many factors that influence the decrease in albumin levels, which make its interpretation difficult, as they are not of nutritional origin. These elements to be taken into account are: rapid loss in surgeries, burns, poly-transfusions, and gastrointestinal disorders, which reduce plasma levels due to increased losses, which do not necessarily imply a reduction in cellular protein mass.

**RESULTS**

This research included 200 consecutively admitted patients. Regarding the characteristics of the study population, it is worth noting a predominance of male gender, with 54,5 % and an age range of 50-79 years, with a mean age of 62 years. Most patients had a stay of less than 7 days, with 142 patients for a mean of 3,35 days. 61 % of the patients came from clinical services and mortality was 18 %.

The distribution of nutritional status of the patients studied according to the results of the application of the CONUT scale showed a high frequency of malnutrition, with moderate malnutrition predominating in 47 % and severe malnutrition in 31 % of patients. Only 9 % of the sample was not malnourished.

Regarding nutritional status and ICU stay, a significant relationship was found ( $p = 0,0001$ ) in table 1. It was observed that 47 % presented moderate malnutrition with a stay of 1-6 days. Patients with a longer ICU stay of 19 or more days had a higher degree of severe malnutrition.

**Table 1.** Relationship of nutritional status with ICU stay

CONUT	Length of stay in ICU								Total (%)
	1- 6 days		7 - 12 days		13 - 18 days		19 o + days		
	n	%	n	%	N	%	n	%	
Normal	2180,8 % RT 14,8 % CT 10,5 % GT	80,8	415,4 % RT 8,5 % CT 2,0 % GT	15,4	13,8 % RT 12,5 % CT 0,5 % GT	3,8	0,0 % RT 0,0 % CT 0,0 % GT	0,00	26 (13 %)
Mild malnutrition	4266,7 % RT 29,6 % CT 21,0 % GT	66,7	1828,6 % RT 38,3 % CT 9,0 % GT	28,6	34,8 % RT 37,5 % CT 1,5 % GT	4,8	0,0 % RT 0,0 % CT 0,0 % GT	0,00	63 (31,5 %)
Moderate malnutrition	6973,4 % RT 48,6 % CT 34,5 % GT	73,4	2223,4 % RT 46,8 % CT 11,0 % GT	23,4	33,2 % RT 37,5 % CT 1,5 % GT	3,2	0,0 % RT 0,0 % CT 0,0 % GT	0,00	94 (47 %)
Severe malnutrition	1058,8 % RT 7,0 % CT 5,0 % GT	58,9	317,6 % RT 6,4 % CT 1,5 % GT	17,4	15,9 % RT 12,5 % CT 0,5 % GT	5,9	317,6 % RT 100,0 % CT 1,5 % GT	17,4	17 (8,5 %)
Total (%)	142 (71 %)		47 (23,5 %)		8 (40 %)		3 (1,5 %)		200 (100 %)

The relationship between the CONUT scale and the duration of mechanical ventilation was observed, where 45,2 % presented moderate malnutrition. 90 % of these patients with moderate malnutrition according to CONUT had a ventilation time of less than 7 days. Nutritional status significantly influenced ventilation time ( $p=0,0117$ ). Furthermore, the relationship between nutritional status according to CONUT and status at discharge, although mortality was low, of the 36 deceased patients, only 5 were not malnourished, although there was no statistical association ( $p=0,8864$ ).

The APACHE II and CONUT scales have been used to measure mortality risk, each with its specificities. In the case of CONUT, it is used for nutritional risk. The ROC curve resulting from the application of the APACHE II scale is shown in figure 1.

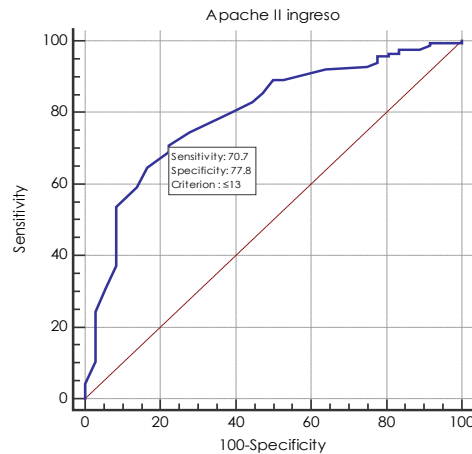


Figure 1. ROC curve. APACHE II

Figure 1 shows the APACHE II ROC curve. This curve has a sensitivity of 70,7 and a specificity of 77,8, with the optimal cutoff point being APACHE II score less than or equal to 13. The area under the curve is 0,795 for the APACHE II ROC curve, with a Z value of 7,336. At the optimal cutoff point, the positive predictive value is 93,5 and the negative predictive value is 36,8.

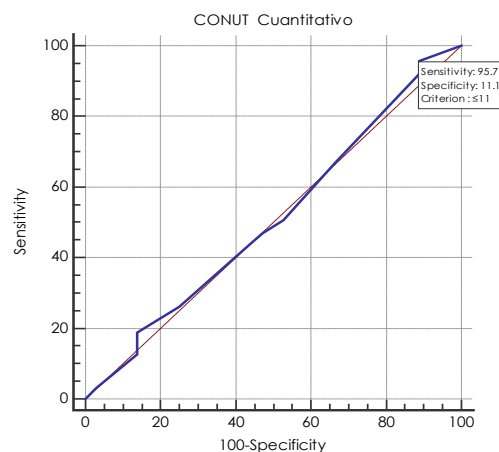


Figure 2. ROC curve. CONUT

In figure 2, the ROC curve resulting from the application of the CONUT scale to the studied sample is shown, with a sensitivity of 95,7 and a specificity of 11,1, and the optimal cutoff point being a CONUT score less than or equal to 11.

The homogeneity test for areas provided sufficient evidence to state, from a statistical point of view, that the two curves are not homogeneous. The difference between the areas under the curve of both scales is 0,285 with a confidence interval of 0,154 to 0,416 for a Z-score of 4,252. The difference between the areas was highly significant with a p-value of less than 0,0001.

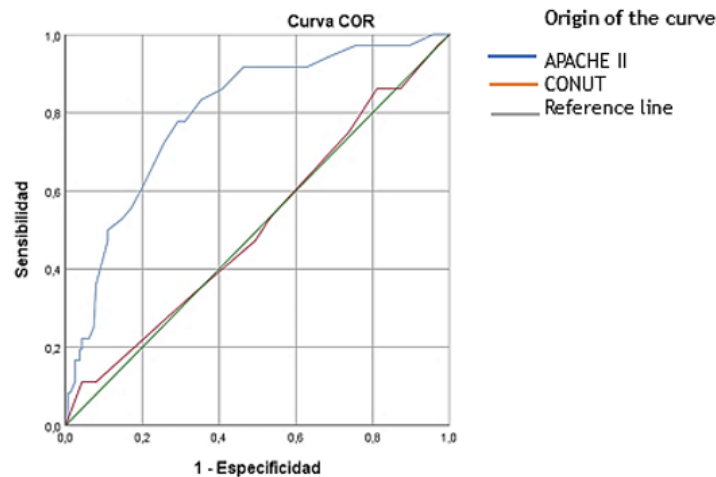


Figure 3. Comparison of the ROC curves of the APACHE II and CONUT scales

Test result variables	Area down the curve				
	Área	Desv. Error <sup>a</sup>	asymptotic significance <sup>b</sup>	95% symptotic confidence interval	
				lower limit	upper limit
APACHE II	0,795	0,040	0,000	0,717	0,874
CONUT	0,510	0,054	0,849	0,404	0,616

a. Under the non-parametric assumption      b. Null hypothesis: True area = 0,5

**DISCUSSION**

The topic of nutrition in critically ill patients is relevant, and it has sparked the growing interest of various researchers. The use of specific indicators and tools for the early identification of nutritional risk in intensive care units will allow for early intervention, cost reduction, and the prevention of complications and increased mortality in this patient population.

In this study, patients from clinical services predominated, which is expected because our hospital is a reference in the care of polytraumatized patients. Similar results were observed by Swagata T in a series with a predominance of patients from clinical services. The mortality rate in our sample was around 18 %, a finding that is consistent with that described by other authors.

However, mortality can vary depending on the patient series studied and the type of ICU. Using the nutritional control index CONUT, we found that 26 patients (13 %) were within the range of non-malnourished or normal, mild malnutrition was present in 63 patients (31 %), moderate in 74 %, and severe malnutrition in 17 patients (9 %).

As shown, the majority of patients had some degree of malnutrition (91 %) according to the screening method applied in our unit and in this study.

Molina Soria et al.<sup>(21)</sup> studied 244 patients with the CONUT nutritional screening tool and detected 22,5 % of patients without nutritional risk at admission, 39,8 % had mild malnutrition, moderate malnutrition was present in 29,5 %, and severe malnutrition in 8,2 %. Our study coincides with these results with a decreasing index of nutritional alterations from mild to severe.

Regarding the relationship between nutritional status and ICU stay, we found a significant relationship (p=0,0001) in our study, with 47 % having moderate malnutrition and a short stay of 1-6 days.

The CONUT score was associated with hospital stay, meaning that the longer the stay in the ICU, the higher the degree of malnutrition, which can be explained by different reasons such as decreased intake, the presence or absence of comorbidities, the reason for admission, and the occurrence of complications, among other situations.

According to Casanova et al.<sup>(22)</sup> 62,5 % of patients had an ICU stay between 7 and 14 days, with this group having the highest incidence of malnutrition, demonstrating that severely malnourished patients tend to have longer stays when admitted to the ICU.

The relationship between the CONUT scale and the duration of mechanical ventilation in our study shows that 45,2 % of patients presented with moderate malnutrition. Of these patients, 90 % had a ventilation time



of less than 7 days. The authors consider that the nutritional status significantly influenced the ventilation time ( $p=0,0117$ ), since in malnourished patients there is atrophy of respiratory muscles secondary to starvation or inherent subnutrition in critical patients, which causes a delay in weaning from mechanical ventilation.

Additionally, the loss of respiratory muscle mass is proportional to the loss of body weight. Therefore, the deterioration of respiratory muscles can lead to rapid onset of muscle fatigue, dyspnea, decreased effective ventilation, occurrence of atelectasis, retention of respiratory secretions, and severe tissue perfusion, which can compromise the patient's life and require recourse to mechanical ventilation.<sup>(23,24)</sup>

A study conducted by Manon<sup>(25)</sup> using another nutritional screening method, the modified Nutric Score, detected an association between the scale and the duration of mechanical ventilation. In other words, the higher the Nutric score, the greater the risk of prolonged mechanical ventilation. This study differs in the nutritional screening method used, although both are consistent in their results.

In a study by Mogensen et al.<sup>(26)</sup> 56,06 % of the patients admitted to the ICU had some degree of malnutrition, concluding that patients with severe malnutrition had a higher mortality rate.

Magallanes Gamboa et al.<sup>(27)</sup> applied the CONUT in their study where they included 270 patients and found that 13,7 % had a high risk of malnutrition and mortality was 11,5 % without reaching statistical significance, similar to our study. In this research, the mortality rate in the sample was 18 % and there was no statistical association between mortality and nutritional status ( $p=0,8864$ ).

Although the mortality rate was low, of the 36 deceased patients, only 5 were not malnourished. In relation to this aspect, the author considers that the nutritional status of patients may influence as an additional variable in relation to mortality, however, it is not the only factor that affects the outcome, since other variables such as the presence of comorbidities, the occurrence of complications including sepsis, patient age, the presence of tumor processes, the use of ventilation and prolonged stays, among other causes, may also influence mortality.

The APACHE II and CONUT scales have been used to measure mortality risk, each with its own specificities, and in the case of the CONUT, it is used for nutritional risk. Therefore, to determine the degree of sensitivity and specificity of this marker in the evaluation of these variables, it is necessary to interpret the ROC curves for each of them, which have shown multiple advantages in screening methods.

The objective of the study was to evaluate the CONUT scale as a predictor of mortality and for this purpose, it was compared with the APACHE II scale used as the "gold standard". It was evidenced that the APACHE II scale outperformed the CONUT scale in terms of predicting mortality, since the former was designed for this purpose.

However, the CONUT scale showed its advantages in achieving a higher sensitivity of 92,1 %, which means that the proportion of true positives, with respect to the discharge criteria, was very high, even though its sensitivity is lower than that of the APACHE II, designed precisely for this purpose.

For several authors, the CONUT scale behaves as a predictor of mortality, including Álvarez Álvarez et al.<sup>(28)</sup> in their study of patients with cardiovascular diseases, where they found that 49 % had a normal nutritional status, 32,8 % had mild malnutrition, and 18,2 % had moderate to severe malnutrition.

These results contrast with ours, although in the clinical order, the author has noticed an increase in mortality in patients with high CONUT scores and lower in patients with normal or mildly malnourished CONUT scores. It may be necessary to expand the sample or conduct further research to demonstrate this assertion.

The results of this research showed the importance of having adequate screening and nutritional evaluation methods in the critical care environment to carry out effective and timely nutritional interventions, which can mitigate possible complications in critically ill patients.<sup>(29)</sup>

## CONCLUSIONS

Males predominated, age category between 50-79 years, and ICU stay within 1-6 days. According to the CONUT, the vast majority of patients were malnourished. There was an association between CONUT score and ICU stay and mechanical ventilation. No association was found between CONUT and the discharge status. CONUT demonstrated high sensitivity to predict nutritional risk and low sensitivity to predict mortality, unlike APACHE II, which outperformed it in terms of mortality prediction.

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#### **FINANCING**

No external financing.

#### **CONFLICT OF INTEREST**

The authors declare that there are no conflicts of interest.

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