Revista Brasileira de Saúde Funcional
ISSN on-line: 2358-8691.
DOI: 10.25194/rebrasf.v12i2.2115
UNIAENE | Revista Brasileira de Saúde Funcional

ANALYSIS OF STRENGTH AND FUNCTIONALITY OF CRITICAL PATIENTS IN A REFERRAL HOSPITAL

ANÁLISE DA FORÇA E FUNCIONALIDADE DE PACIENTES CRÍTICOS EM UM HOSPITAL DE REFERÊNCIA

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Abstract: Introduction: Functionality changes during hospitalization in the critical environment, so understanding it is essential for better guidance in the critical sector. Immobilization in these sectors has been increasing exponentially, as has the length of hospital stay for patients, due to the loss of muscle mass caused by the restriction to early mobilization and motor physiotherapy due to criticality. **Objective:** To characterize the functional and muscular strength profile of adult patients upon admission and discharge from the intensive care unit. **Methods:** A retrospective, cross-sectional and analytical study was carried out through analysis of medical records of patients hospitalized from January 2021 to December 2022. Medical records were selected that presented functional and muscular strength assessment using the Medical Reserach Council and Functional Status Score for the Intensive Care Unit, excluding those with incomplete records and who did not show functional decline. **Results:** 1,646 patients were selected, after analyzing the exclusion criteria, a total of 1,292

were selected. The functionality values at discharge doubled in relation to admission, thus being statistically significant (p=<0.0001*), as well as the significant gain in muscle strength (p=<0.0001*). The risk of intubation was higher in patients aged between 42 and 49 years (p=0.0450*) and 66 and 73 years (p=0.0048*), neurological dysfunctions were the most prevalent (p=<0.0001 *) which led to the need for intensive support. **Conclusion:** Hospitalization in this sector was capable of developing very high muscular and consequently functional impairment, however early mobilization and motor physiotherapy had a significant effect on resolving this situation.

Keywords: Intensive Care Unit; Functional Status; Muscle strength; Muscle Weakness.

INTRODUCTION

Immobility in Intensive Care Units (ICU) has been exponentially increasing the hospitalization time of patients within these sectors, due to the loss of muscle mass caused by the restriction of early mobilization and motor physiotherapy due to its criticality, thus impairing post-discharge functional independence(1). This impediment can have several complications for the patient leading to Post-Intensive Care Syndrome (PICS), subjecting the patient to greater problems during the treatment process and increased risk of mortality [(2)].

Early mobilization is characterized by motor stimulation in the first 48 hours after admission to the ICU, if started after this period, this conduct is now called motor physiotherapy. Exercises in bed and with sitting are examples of activities that have been attenuating the effects of immobility, thus the objective is to avoid the loss of mobility of the human being in a way that he can be dehospitalized with a lower level of functional impairment [(3,4)].

It has a great value minimizing sarcopenia, which in turn is a natural process of human senescence, but can also occur pathologically in patients who are in a state of muscle disuse due to some diseases(5,6). In this context, therapies have been adopted to favor the individual being able to be stimulated as early as possible and thus be able to reduce these deleterious effects [(7,8)].

PICS not only affects the physical but also the cognitive and mental, leading the individual to have negative consequences in their basic activities, directly affecting their quality of life. The patient's level of commitment, for the most part, is linked to the time he spent in hospital or the restriction to mobilization due to the criticality of the condition in which he was. Its sequelae can last up to approximately 5 years and in some cases can be permanent [(9,10)].

Because of this, there was a need to evaluate the size of the negative consequences that the patient suffers in the sector, thus evaluating scales of the functionality and muscle strength of critical patients were developed. Its applicabilities are varied, meeting the demand of the specificities of each service and as well as the profile of the evaluated public. The Functional

Status Score for the Intensive Care Unit (FSS-ICU) is one of these tools, in which it was adapted for Brazil, with the aim of evaluating this condition through basic activities, such as: rolling, transferring from the supine to sitting position, transferring from the sitting position to standing, sitting at the bedside and walking. To this end, the patient is evaluated according to the autonomy to exercise the task and his motor control and muscle strength, the score varies from 0 to 35 points, being considered a preserved functionality the highest score. In this way, it is possible to understand the level of commitment of the evaluated in order to set therapeutic goals [11].

The Medical Research Council Scale - MRC aims to analyze the level of muscle strength of the patient's appendicular group, stratifying it into six categories; 0 = no contraction, 1 = oscillation or contraction trait, 2 = active movement with gravity eliminated, 3 = active movement against gravity, 4 = active movement against gravity and resistance and 5 = normal power. In this context, the muscles are analyzed: shoulder abduction, elbow flexion and wrist extension to upper limbs and hip flexion, knee extension and ankle dorsiflexion, and should be applied in both The hemibodies and added the score of each component. The individual must reach a total of 60 points to be considered the normal strength level, if it is less than or equal to 48 points it is considered significant muscle weakness and below 36, severe muscle weakness [12,13].

Given that the impact of the correct approach in this environment will not be limited only at this time, but also with regard to the entire life cycle of the human being after hospital discharge. Therefore, the present study aimed to determine the functional profile of adult patients on admission and discharge from the ICU.

METHODOLOGY

This is a retrospective, cross-sectional and analytical study through the analysis of semi-electronic medical records of patients who were hospitalized in the period from January 2021 to December 2022 in the adult ICUs of the Dr Aberlado Santos Regional Hospital in the city of Belém - PA/Brazil. The research was submitted to the Human Research Ethics Committee of the Maurício University Center of Nassau and approved with the opinion number 6.075.346/2023 and obeying the guidelines for studies with human beings of the National Health Council 466/12.

As inclusion criteria, we selected medical records of patients older than 18 years who presented functional evaluation calculated by the MRC and FSS-ICU scales and recorded in the professional evaluation document, as well as individuals who remained hospitalized in adult ICUs for more than 48 hours, who had a need for invasive ventilatory support throughout hospitalization and those who did not evolve to this condition, along with users of tracheostomy, postoperative and clinical emergencies. Medical records with incomplete records of the evaluations of the selected scales, which were in the billing period and of patients who did not present functional

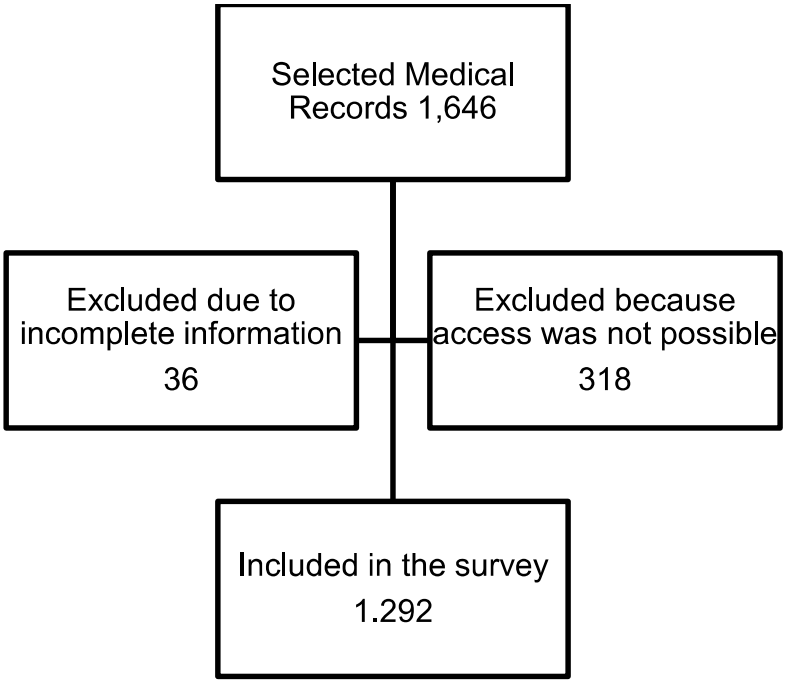
decline present in the physiotherapeutic evaluations were excluded from the study.

The data were treated by Student's parametric T test and non-parametric for analysis of paired samples through the Mann-Whitney and Wilcoxon tests and for sample design based on the characteristics that define them, the Relative Risk test of the Prevalence Ratio type was used. With a level of statistical significance of 5%.

RESULTS

1,646 medical records were selected from a universe of 2,000, according to the sample calculation applied(14) with a confidence interval of 99%, with 36 excluded for presenting incomplete information in the evaluation records and 318 for being in the billing period and access to them is not possible, totaling 1,292 as distributed in the figure below.

Figure 01: Distribution of samples based on exclusion and inclusion criteria



Source: Authors themselves

In table 1, it is possible to observe the relationships between diseases, ages, sex, functionality correlating with the time of Invasive Mechanical Ventilation (IMV), and the relevant impact on the functionality and strength of the patient's admission and discharge. Table 01 - Variables of the characteristics found in the studied audience Source: Own authors; Absolute and relative frequency; *Mean and Standard Deviation; F: Female; M: Male; IMV: Invasive Mechanical Ventilation; ICU: Intensive Care Unit; FSS-ICU: Functional Status Score for the Intensive Care Unit; MRC: Medical Research Council.

Table 01 – Variables of the characteristics found in the studied public

Features	n	%
Sex		
F	754	56,917
M	538	43,083
Age range		
< 18 years	11	2,17
18 - 25 years	30	5,93
26 - 33 years	68	13,44
34 - 41 years	33	6,52
42 - 49 years	36	7,11
50 - 57 years	62	12,25
58 - 65 years	92	18,18
66 - 73 years	87	17,19
74 - 71 years	60	11,86
> 81 years	27	5,34
Diagnosis		
Kidney Disease	62	12,25
Diabetic Disease	133	26,28
Vascular Disease	173	34,19
Heart Disease	99	19,57
Stroke	83	16,40
Post-operative	152	30,04
Benign Neoplasm	128	25,30
Brain Aneurysms	138	27,27
Amputation	179	35,38
Intubation+IMV		
No	413	81,62
Yes	93	18,38
UTI*		
FSS-ICU (Admission)	14,62±12,36	
FSS-ICU (High)	22,13±13,16	
MRC (Admission)	34,32±17,60	
MRC (High)	41,27±21,57	
Length of hospital stay (days)	35,35±33,96	

Source: *Authors' own; Absolute and relative frequency; *Mean and Standard Deviation; F: Female; M: Male; IMV: Invasive Mechanical Ventilation; ICU:*

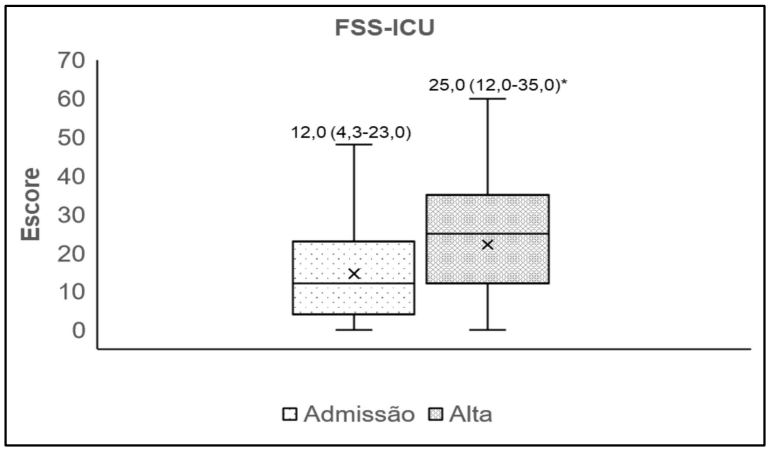
Intensive Care Unit; FSS-ICU: Functional Status Score for the Intensive Care Unit; MRC: Medical Research Council.

In this context, we can observe a quantity of 754 female and 538 male individuals. In relation to age, there was a prevalence of young adults between 26-33 years of the patient, which shows that more and more this population has been presenting some comorbidity that leads them to hospitalization for a critical condition. The diagnoses of the diseases presented in the medical records of the patients that drew attention by the number found were the amputations that had high rates being in first place, already in second place, the vascular diseases that in turn tend to have a relationship with the amputations increasing the quantity of this type of surgery.

When the functional profile of these individuals is analyzed, there is an increase in the total values of the FSS-ICU that demonstrates an improvement in this condition, although unfortunately this could not be a reality for everyone, because the multiple dysfunctions of the critical patient compromise the quality intensely and, most of the time, for a long time.

Figure 02 demonstrates the significant result of the functionality values of the patients analyzed through the Wilkoson test for non-parametric data by the median, first and third quartile of the variable, of the discharge that doubled in relation to admission ($p<0.0001$*) which could demonstrate a high impact of physiotherapy on the evolution of this condition in individuals. Not only that, they also showed a significant gain in muscle strength in this process, favoring better motor control and consequently better functional development as presented in figure 03 following the same statistical analysis as the previous one.

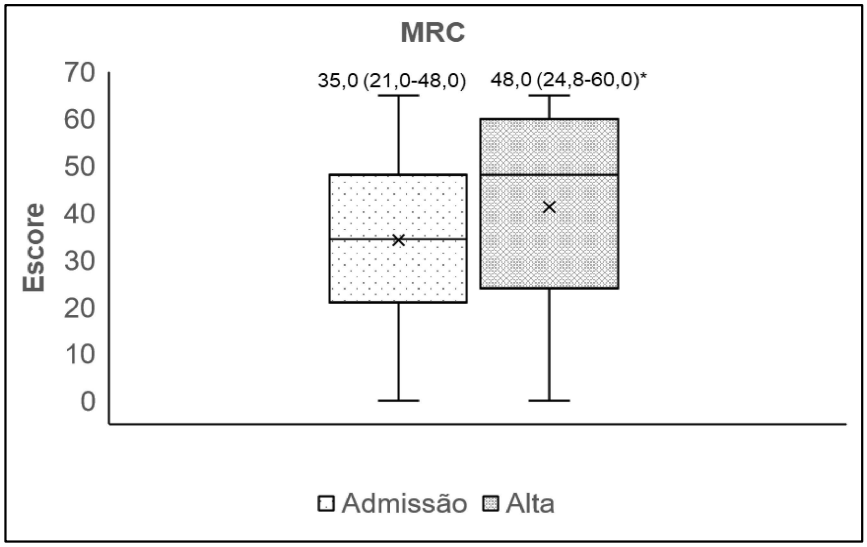
Figure 02 - FSS-ICU Bloxpot Gáfico evaluated on admission and discharge from the ICU.



Source: Own authors;

*Significant result of the Wilkoson test $p<0.0001$; MRC: Medical Research Council.

Figure 03 – MRC Bloxpot graph evaluated at ICU admission and discharge



Source: *Authors themselves; *Significant result of the Wilkoson test p<0.0001; MRC: Medical Research Council.*

Table 02 shows that muscle weakness on admission had an impact directly proportional to the length of hospitalization, that is, patients who had lower strength indices ended up having a longer stay in the sector, as well as in relation to sex, where men showed a more pronounced reduction in strength than women.

Table 02 - Distribution of motor variables correlated with hospitalization time.

Variables	Sex						p-value
	Feminine			Masculine			
	Med	1ºQ	3ºQ	Med	1ºQ	3ºQ	
FSS-ICU (admission)	12,0	3,8	28,0	12,0	5,0	21,0	0,2261
FSS-ICU (high)	25,0	10,0	35,0	25,0	13,0	35,0	0,1971
MRC (admission)	35,0	21,0	57,8	30,0	21,0	45,0	0,0227*
MRC (high)	49,5	24,0	60,0	48,0	30,0	60,0	0,3205
Length of hospital stay (days)	23,0	11,0	41,0	34,0	17,0	51,8	0,0001*

Source: *Authors themselves; *Significant Mann-Whitney test result; FSS-ICU: Functional Status Score for the Intensive Care Unit; MRC: Medical Research Council.*

While in table 03, the relationship between functionality and IMV time was observed, where the use of sedatives and dependence on mechanical ventilation were directly impactful in this patient's condition, but the discharge data showed that there was a functional improvement. In

this context, the patient who did not use IMV had a better value by the FSS-ICU at the time of discharge and the same relationship was found in the CRM.

Table 03 - Functional and strength analysis of patients who needed or did not need invasive ventilatory support.

Variables	VMI						p-value
	Yes			No			
	Med	1ºQ	3ºQ	Med	1ºQ	3ºQ	
FSS-ICU (admission)	5,0	0,0	11,0	15,0	5,0	28,0	< 0,0001*
FSS-ICU (high)	13,0	2,0	28,0	29,0	15,0	35,0	< 0,0001*
MRC (admission)	20,0	12,0	31,0	35,0	24,0	54,0	< 0,0001*
MRC (high)	27,0	0,0	55,0	51,0	36,0	60,0	< 0,0001*
Length of hospital stay (days)	38,0	24,0	59,0	24,0	12,0	41,0	< 0,0001*

Source: *Authors themselves; *Significant Mann-Whitney test result; FSS-ICU: Functional Status Score for the Intensive Care Unit; MRC: Medical Research Council.*

Despite the large number of individuals in the study, there was no statistically significant difference when it comes to the prevalence of sex in this sector (Table 4), in this context, it was surprising that the risk of intubation was higher in patients aged between 42 and 49 years (p=0.0450*), being something unusual compared to what we see in the general context in sectors with similar characteristics, where older individuals present this type of result, as we also found in those who were between 66 and 73 years old (p=0.0048*). Because it is a general profile unit, it was satisfactory to be able to demonstrate through the data presented that kidney disease had a higher prevalence than heart disease. However, the expressive demand of patients with neurological dysfunctions in need of intensive support showed a higher prevalence than the others (p=<0.0001*), however, it was more than the authors expected, which leads the individual to a longer time of use of IMV, as well as vasoactive drugs, sedatives and continuous analgesics and together with the sequelae of central nervous system injury.

Table 04 – Sampling distribution based on the age and pathological profile of the patients studied

Variables	Use of Intubation +VMI	Total	TP%	RP	IC95%	p-value
Sex						
Masculine	42	218	19,3%	1,09	0,75-1,57	0,3699

Feminine	51	288	17,7%	-	-	-
Age range						
< 18 years	3	11	27,3%	-	-	-
18 - 25 years	1	30	3,3%	-	-	-
26 - 33 years	1	68	1,5%	-	-	-
34 - 41 years	4	33	12,1%	-	-	-
42 - 49 years	11	36	30,6%	1,75	1,03-2,98	0,0415*
50 - 57 years	7	62	11,3%	-	-	-
58 - 65 years	20	92	21,7%	-	-	-
66 - 73 years	25	87	28,7%	1,77	1,19-2,63	0,0048*
74 - 71 years	15	60	25,0%	-	-	-
> 81 years	6	27	22,2%	-	-	-
Diagnostic						
Kidney Disease	20	62	32,3%	1,96	1,29-2,98	0,0023*
Diabetic Disease	31	133	23,3%	-	-	-
Vascular Disease	32	173	18,5%	-	-	-
Heart Disease	26	99	26,3%	1,60	1,07-2,37	0,0173*
Stroke	30	83	36,1%	2,43	1,68-3,35	< 0,0001*
Post-operative	21	152	13,8%	-	-	-
Benign Neoplasm	16	128	12,5%	-	-	-
Brain Aneurysms	19	138	13,8%	-	-	-
Amputation	34	179	19,0%	-	-	-

Source: Own authors; VMI: Invasive Mechanical Ventilation; *Significant result of the Relative Risk test of the Prevalence Ratio type; TP%: Prevalence Time; PR: Prevalence Ratio; 95%CI: Incidence.

DISCUSSION

From the data found, it was evident that patients who were hospitalized in the ICU, for a long period, presented decline and functional deficit, as well as muscle strength. In this context, this research corroborates with studies[14,15,16] that demonstrate that prolonged immobilization generates both motor and respiratory muscle weakness, which in turn contributes to hospitalization for a longer time, and may develop temporary sequelae that can extend for up to 5 years after discharge, as well as definitive, increasing the risk of mortality of the patient by often making them more susceptible to hospital infections[17,18]. However, it is important to emphasize that adequate nutrition is of paramount importance in order to minimize these risks, which leads us to analyze the level of criticality of the individual who often forces him to remain fasting, only with volume support and maintenance of the hydroelectrolytic balance, as described in the literature[19] emphasizing that the reduction of macronutrients in the critical patient was directly responsible for the change in

functionality at hospital discharge[20,21]. Despite this fact, another study also shows that parenteral nutrition, even when applied after 3 days of hospitalization, could not reduce the mortality rate in the first 28 days and could not influence the length of hospitalization [22].

Muscle weakness is a potential factor for functional loss, given that in the case of critically ill patients, the individual has several factors that can cause these two impairments, when analyzing the impact of prolonged use of intensive support such as mechanical ventilation on the patient's functionality, presenting a worse prognostic outcome [23].The underlying pathology was one of the main factors that led to the need for hospitalization in the ICU, putting the patient at risk of death and being forced to remain at rest for a longer period of time, corroborating another study[24], where it was possible to determine that the level of oxidative stress caused by the disease was responsible for reducing muscle trophism by 40-70% of its total mass, leading to a condition of demyelination and change in the characteristics of muscle contraction fibers, as well as through biomarkers of both peripheral and respiratory muscles, together with the reduction in energy metabolism and the formation of muscle fibers, accelerating the patient's death process[25,26]. Based on this, if there is an increase in the criticality of the patient's condition, which requires that he or she be subjected to invasive ventilatory support where this is possible, the patient needs to be sedated or even receive neuromuscular blockers, which can be depolarizing or non-depolarizing, favoring the reduction of even involuntary contractions, making sarcopenia an inevitable consequence of both axial and appendicular muscles, making the time of use of IMV longer. Not only that, the injury induced by mechanical ventilation, very commonly found in patients who use this support for a long time, causes a change in gene/protein expression at the skeletal muscle level, often contributing to the emergence of critically ill myopathy. [27,28].

Even those who only use continuous sedative-analgesia often have to use vasoactive drugs due to the high hemodynamic instability caused by these drugs, such as dexmedetomidine, which causes both bradycardia and hypotension, leading to an increase in vasoactive drugs and causing mobilization to be suspended, which limits the role of the physiotherapist in this context. [29].

Contractures, muscle shortening and joint dehydration are very common characteristics in these patients, although physiotherapy has passive mobilization as an alternative to prevent these consequences, being a prevalent technique in this type of sector. [30].

CONCLUSION

Therefore, the authors conclude that ICU admission, even for a relatively short period of time, can lead to muscular and consequently functional impairment. As a result, professionals in the multidisciplinary team need to work on mechanisms to prevent this type of impairment, returning the patient to the most autonomous social environment possible so that they can have

the minimum quality of life, avoiding readmissions and reducing the risk of mortality.

Not only that, it was possible to demonstrate that physiotherapy had a positive and satisfactory impact on the two factors evaluated, being an adjuvant to avoid prolonged and even permanent sequelae.

REFERENCES

1. Jung HE, Han DH, Koo BN, Kim J. Effect of sarcopenia on postoperative ICU admission and length of stay after hepatic resection for Klatskin tumor. Front Oncol. 2023;13:1136376. doi: 10.3389/fonc.2023.1136376. PMID: 36969080; PMCID: PMC10034314. Acesso em: 17 ago 2024.

2. Okada K, Ohde S, Yagi T, Hara Y, Yokobori S. Development and validation of prediction scores for the outcome associated with persistent inflammation, immunosuppression, and catabolism syndrome among patients with trauma. Trauma Surg Acute Care Open. 2023;8(1):e001134. doi: 10.1136/tsaco-2023-001134. PMID: 37484838; PMCID: PMC10357651. Acesso em: 17 ago 2024.

3. Wang L, Hua Y, Wang L, Zou X, Zhang Y, Ou X. The effects of early mobilization in mechanically ventilated adult ICU patients: systematic review and meta-analysis. Front Med (Lausanne). 2023;10:1202754. doi: 10.3389/fmed.2023.1202754. PMID: 37448799; PMCID: PMC10336545. Acesso em: 17 ago 2024.

4. Yang X, Zhang T, Cao L, Ye L, Song W. Early Mobilization for Critically Ill Patients. Respir Care. 2023;68(6):781-95. doi: 10.4187/respcare.10481. Epub 2023 Apr 11. PMID: 37041029; PMCID: PMC10209006. Acesso em: 17 ago 2024.

5. Kim HB, Chun SY, Kim GW, Lim H, Cho YS. Can sarcopenia predict poor prognosis of sepsis due to acute cholecystitis? Am J Emerg Med. 2023;73:69-74. doi: 10.1016/j.ajem.2023.08.014. Epub 2023 Aug 10. PMID: 37619445. Acesso em: 17 ago 2024.

6. Dams K, De Meyer GR, Jacobs R, Schepens T, Perkisas S, Moorkens G, et al. Combined ultrasound of m. quadriceps and diaphragm to determine the occurrence of sarcopenia and prolonged ventilation in a COVID-19 ICU cohort: The COVID-SARCUS trial. Nutrition. 2023; 117:112250. doi: 10.1016/j.nut.2023.112250. Epub ahead of print. PMID: 37918311. Acesso em: 17 ago 2024.

7. Thiolliere F, Allaouchiche B, Boyer H, Marie M, Friggeri A, Vacheron CH; AZUREA Study group. Association between out-of-bed mobilization during the ICU stay of elderly patients and long-term autonomy: A cohort study. J Crit Care. 2022;68:10-5. doi: 10.1016/j.jcrc.2021.11.007. Epub 2021 Nov 26. PMID: 34844035. Acesso em: 17 ago 2024.

8. Kosinski S, Mohammad RA, Pitcher M, Haezebrouck E, Coe AB, Costa DK, et al. What Is Post-Intensive Care Syndrome (PICS)? Am J Respir Crit Care Med. 2020;201(8):P15-P16. doi: 10.1164/rccm.2018P15. PMID: 32293204. Acesso em: 17 ago 2024.

9. Hiser SL, Fatima A, Ali M, Needham DM. Post-intensive care syndrome (PICS): recent updates. J Intensive Care. 2023;11(1):23. doi: 10.1186/s40560-023-00670-7. PMID: 37221567; PMCID: PMC10202754. Acesso em: 17 ago 2024.

10.Dos Santos JSF, Silva GAG, Lima NMFV, Gualdi LP, Dantas DS, Lima ÍNDF. Linking Intensive Care Unit functional scales to the International Classification of Functioning: proposal of a new assessment approach. BMC Health Serv Res. 2023;23(1):871. doi: 10.1186/s12913-023-09787-9. PMID: 37587469; PMCID: PMC10433595. Acesso em: 17 ago 2024.

11.McGillivray MK, Haldane C, Doherty C, Berger MJ. Evaluation of muscle strength following peripheral nerve surgery: A scoping review. PM R. 2022;14(3):383-94. doi: 10.1002/pmrj.12586. Epub 2021 May 5. PMID: 33751851. Acesso em: 17 ago 2024.

12.Holm-Yildiz S, Krag T, Witting N, Pedersen BS, Dysgaard T, Sloth L, Pedersen J, et al. Hypokalemic periodic paralysis: a 3-year follow-up study. J Neurol. 2023;270(12):6057-63. doi: 10.1007/s00415-023-11964-z. Epub 2023 Sep 1. PMID: 37656291; PMCID: PMC10632268. Acesso em: 17 ago 2024.

13.Miot HA. Sample size in clinical and experimental trials. J vasc bras [Internet]. 2011;10(4):275–8. Available from: https://doi.org/10.1590/S1677-54492011000400001. Acesso em: 17 ago 2024.

14.Moonen HPFX, Van Zanten ARH. Bioelectric impedance analysis for body composition measurement and other potential clinical applications in critical illness. Curr Opin Crit Care. 2021;27(4):344-53. doi: 10.1097/MCC.0000000000000840. PMID: 33967207; PMCID: PMC8270506. Acesso: 17 ago 2024.

15.Lopez-Ruiz A, Kashani K. Assessment of muscle mass in critically ill patients: role of the sarcopenia index and images studies. Curr Opin Clin Nutr Metab Care. 2020;23(5):302-11. doi: 10.1097/MCO.0000000000000673. PMID: 32657790. Acesso em: 17 ago 2024.

16.Khan S, Benjamin J, Maiwall R, Tripathi H, Kapoor PB, Shasthry V, et al. Sarcopenia is the independent predictor of mortality in critically ill patients with cirrhosis. J Clin Transl Res. 2022;8(3):200-8. PMID: 35813898; PMCID: PMC9260346. Avaliable from: https://pubmed.ncbi.nlm.nih.gov/35813898/. Acesso em: 19 mai 2024.

17.Steinle EC, Pinesso JAM, Bellançon LB, de Paula Ramos S, Seixas GF. The association of oral health with length of stay and mortality in the intensive care unit. Clin Oral Investig. 2023;27(7):3875-84. doi: 10.1007/s00784-023-05008-z. Epub 2023 Apr 5. PMID: 37017755. Acesso em: 17 ago 2024.

18.Lu SY, Otero TMN, Yeh DD, Canales C, Elsayes A, Belcher DM, et al. The association of macronutrient deficit with functional status at discharge from the intensive care unit: a retrospective study from a single-center critical illness registry. Eur J Clin Nutr. 2022;76(4):551-6. doi: 10.1038/s41430-021-01001-5. Epub 2021 Aug 30. PMID: 34462556. Acesso em: 17 ago 2024.

19.Grund S, Bauer JM. Malnutrition and Sarcopenia in COVID-19 Survivors. Clin Geriatr Med. 2022;38(3):559-64. doi: 10.1016/j.cger.2022.04.001. Epub 2022 Apr 21. PMID: 35868673; PMCID: PMC9021037. Acesso em: 17 ago 2024.

20.Kida K, Miyajima I, Suzuki N, Greenberg BH, Akashi YJ. Nutritional management of heart failure. J Cardiol. 2023;81(3):283-91. doi: 10.1016/j.jjcc.2022.11.001. Epub 2022 Nov 9. PMID: 36370995. Acesso em: 17 ago 2024.

21.Zou B, Xi F, Yu W. Early parenteral nutrition comparing to enteral nutrition cannot reduce

28-day mortality in critically ill patients: a retrospective comparative cohort study based on the MIMIC IV database. Ann Transl Med. 2023;11(2):77. doi: 10.21037/atm-22-6408. PMID: 36819575; PMCID: PMC9929832. Acesso em: 17 ago 2024.

22.Paranhos DB, Annoni R, Schujmann DS, Fernandes LFRM. Functional Dependence Prior to ICU Admission is Associated with Worse Clinical and Functional Outcomes in Individuals with COVID-19: A Prospective Observational Study. J Intensive Care Med. 2023:39(5):439-46. doi: 10.1177/08850666231211754. Epub ahead of print. PMID: 37915228. Acesso em: 17 ago 2024.

23.Yoshihara I, Kondo Y, Okamoto K, Tanaka H. Sepsis-Associated Muscle Wasting: A Comprehensive Review from Bench to Bedside. Int J Mol Sci. 2023;24(5):5040. doi: 10.3390/ijms24055040. PMID: 36902469; PMCID: PMC10003568. Acesso em: 17 ago 2024.

24.Ozdemir M, Bomkamp MP, Hyatt HW, Smuder AJ, Powers SK. Intensive Care Unit Acquired Weakness Is Associated with Rapid Changes to Skeletal Muscle Proteostasis. Cells. 2022;11(24):4005. doi: 10.3390/cells11244005. PMID: 36552769; PMCID: PMC9776723. Acesso em: 17 ago 2024.

25.Kobara S, Rad MG, Grunwell JR, Coopersmith CM, Kamaleswaran R. Bioenergetic Crisis in ICU-Acquired Weakness Gene Signatures Was Associated With Sepsis-Related Mortality: A Brief Report. Crit Care Explor. 2022;4(12):e0818. doi: 10.1097/CCE.0000000000000818. PMID: 36567787; PMCID: PMC9760600. Acesso em: 17 ago 2024.

26.Cacciani N, Skärlén Å, Wen Y, Zhang X, Addinsall AB, Llano-Diez M, et al. A prospective clinical study on the mechanisms underlying critical illness myopathy-A time-course approach. J Cachexia Sarcopenia Muscle. 2022;13(6):2669-82. doi: 10.1002/jcsm.13104. Epub 2022 Oct 12. PMID: 36222215; PMCID: PMC9745499. Acesso em: 17 ago 2024.

27.Damanti S, Cristel G, Ramirez GA, Bozzolo EP, Da Prat V, Gobbi A, et al. Influence of reduced muscle mass and quality on ventilator weaning and complications during intensive care unit stay in COVID-19 patients. Clin Nutr. 2022;41(12):2965-72. doi: 10.1016/j.clnu.2021.08.004. Epub 2021 Aug 16. PMID: 34465493; PMCID: PMC8364854. Acesso em: 17 ago 2024.

28.Lewis K, Alshamsi F, Carayannopoulos KL, Granholm A, Piticaru J, Al Duhailib Z, et al; GUIDE group. Dexmedetomidine vs other sedatives in critically ill mechanically ventilated adults: a systematic review and meta-analysis of randomized trials. Intensive Care Med. 2022;48(7):811-40. doi: 10.1007/s00134-022-06712-2. Epub 2022 Jun 1. PMID: 35648198. Acesso em: 17 ago 2024.

29.Raurell-Torredà M, Arias-Rivera S, Martí JD, Frade-Mera MJ, Zaragoza-García I, Gallart E, et al; MOviPre group. Variables associated with mobility levels in critically ill patients: A cohort study. Nurs Crit Care. 2022;27(4):546-57. doi: 10.1111/nicc.12639. Epub 2021 May 18. PMID: 34008238. Acesso em: 17 ago 2024.

30.Koussou A, Dumas R, Desailly E. Common modelling assumptions affect the joint moments measured during passive joint mobilizations. Sci Rep. 2023;13(1):17782. doi: 10.1038/s41598-023-44576-8. PMID: 37853085; PMCID: PMC10584879. Acesso em: 17 ago 2024.