REVISTA DE ENFERMAGEM REFERÊNCIA
homepage: https://rr.esenfc.pt/rr/
ISSNe: 2182.2883

RESEARCH ARTICLE (ORIGINAL)

Early rehabilitation for critically ill patients with ICU-acquired weakness: A quasi-experimental study

Reabilitação precoce à pessoa em situação crítica com fraqueza muscular adquirida em UCI: Um estudo quasi-experimental

Rehabilitación precoz del enfermo crítico con debilidad muscular adquirida en la UCI: Un estudio cuasiexperimental

Tânia dos Santos Matos [1, 2, 3]
https://orcid.org/0000-0001-6908-2460

Jacinta Pires Martins [4]
https://orcid.org/0000-0001-8052-571X

Andreia Félix [4, 5]
https://orcid.org/0000-0001-7740-4124

[1] Trás-os-Montes e Alto Douro Hospital Center, Intensive Care Unit, Vila Real, Portugal

[2] Universidade Católica Portuguesa, Institute of Health Sciences, Porto, Portugal

[3] Trás-os-Montes e Alto Douro Clinical Academic Center - Professor Doutor Nuno Grande - CACTMAD, Vila Real, Portugal

[4] Portuguese Red Cross School of Health - Alto Tâmega, Chaves, Portugal

[5] Nursing Research, Innovation and Development Center of Lisbon (CIDNUR), Lisbon, Portugal

Corresponding author
Tânia dos Santos Matos
E-mail: taniamat@gmail.com

Received: 09.06.22
Accepted: 18.04.23

Abstract

Background: Intensive care unit-acquired weakness is a severe complication, and early rehabilitation can improve health outcomes in critically ill patients.
Objective: To examine the health outcomes sensitive to rehabilitation nursing care in critically ill patients diagnosed with intensive care unit-acquired weakness.
Methodology: This quasi-experimental study uses a non-probability sample of 80 patients distributed between an experimental group and a control group. The groups received the same rehabilitation nursing care intervention, differing only in the number and frequency of implementation due to the different time intervals of each group.
Results: EG participants revealed a greater functional independence in the transfer, greater muscle strength at the moment of discharge, decreased mean number of days under sedation, receiving invasive mechanical ventilation and of hospitalization, and lower scores in the Therapeutic Intervention Scoring System-28 at the moment of discharge.
Conclusion: The increased number and frequency of rehabilitation nursing care interventions improved health outcomes in critically ill patients.

Keywords: critical care; critical care outcomes; rehabilitation nursing; muscle weakness

Resumo

Enquadramento: A fraqueza muscular adquirida em cuidados intensivos é uma complicação importante e a reabilitação precoce potencia uma melhoria dos resultados na pessoa em situação crítica.
Objetivo: Analisar os resultados na pessoa em situação crítica com diagnóstico de fraqueza muscular adquirida em cuidados intensivos, sensíveis à intervenção de enfermagem de reabilitação.
Metodologia: Estudo quasi-experimental, com amostra não probabilística constituída por 80 pessoas, distribuídas em grupos experimental e de controlo. Os grupos receberam o mesmo padrão de cuidados de enfermagem de reabilitação, diferindo em quantidade e frequência consoante o intervalo temporal.
Resultados: Os participantes do grupo experimental apresentaram maior independência funcional na transferência, maior força muscular no momento da alta, diminuição do número médio de dias de sedação, de ventilação mecânica invasiva, e de internamento e do score do *Therapeutic Intervention Scoring System 28* na alta.
Conclusão: O aumento em quantidade e frequência da intervenção de enfermagem de reabilitação permitiu uma melhoria dos resultados na pessoa em situação crítica.

Palavras-chave: cuidados críticos; resultados de cuidados críticos; enfermagem em reabilitação; debilidade muscular

Resumen

Marco contextual: La debilidad muscular adquirida en cuidados intensivos es una complicación importante y la rehabilitación precoz puede mejorar el pronóstico del enfermo crítico.
Objetivo: Analizar los resultados en pacientes críticos diagnosticados de debilidad muscular adquirida en cuidados intensivos, sensibles a la intervención de enfermería de rehabilitación.
Metodología: Estudio cuasiexperimental, con una muestra no probabilística compuesta por 80 personas, divididas en grupo experimental y grupo de control. Los grupos recibieron el mismo estándar de cuidados de enfermería de rehabilitación, diferenciados en cantidad y frecuencia según el intervalo de tiempo.
Resultados: Los participantes del grupo experimental tuvieron mayor independencia funcional en la transferencia, mayor fuerza muscular al ser dados de alta, reducción del número medio de días de sedación, de ventilación mecánica invasiva, de estancia hospitalaria y de la puntuación del *Therapeutic Intervention Scoring System 28* en el momento del alta.
Conclusión: El aumento de la cantidad y la frecuencia de la intervención de enfermería de rehabilitación permitió una mejora de los resultados en la persona en estado crítico.

Palabras clave: cuidados críticos; resultados de cuidados críticos; enfermería en rehabilitación; debilidad muscular

How to cite this article: Matos, T. S., Martins, J. P. & Félix, A. (2023). Early rehabilitation for critically ill patients with ICU-acquired weakness: A quasi-experimental study. *Revista de Enfermagem Referência*, *6*(2), e22057. https://doi.org/10.12707/RVI22057

Introduction

Neuromuscular weakness due to long-term hospitalization in the Intensive Care Unit (ICU) is an adverse outcome designated as Intensive Care Unit-Acquired Weakness (ICU-AW). Patients diagnosed with ICU-AW suffer from a severe functional impairment that can persist over time, perhaps even for years. Nevertheless, the literature demonstrates a positive relationship between rehabilitation and early mobilization (Eggmann et al., 2016). In truth, researchers have only recently begun to study the consequences of ICU hospitalization in the patient's life, considering that surviving a critical illness is the beginning of a challenging journey to recovery characterized, among other difficulties, by ICU-AW, loss of energy, anxiety, depression, post-traumatic stress phenomena, and cognitive decline (Gruther et al., 2017). Recovery from illness is individual, and few studies have demonstrated a close relationship between acute illness characteristics and long-term impact (National Institute for Health and Care Excellence [NICE], 2020).

Portugal has unique conditions compared to other countries, as nurse specialists in rehabilitation are present in most ICUs and are an integral part of the multidisciplinary team (Schoeller et al., 2018).

Hence, this study aims to examine the health outcomes sensitive to rehabilitation nursing care in critically ill patients diagnosed with ICU-AW.

Background

The increase in the average life expectancy is estimated to correspond to an increase in people with a more significant number of comorbidities and, consequently, requiring more time under life support technology (Hashem et al., 2016).

ICU-AW is a common complication developed by patients admitted to ICUs. It can be caused by primary neuromuscular disorders such as Guillain-Barré syndrome and myasthenia gravis. However, these disorders account for only about 0.5% of admissions. More commonly, muscle weakness is triggered as a secondary disorder occurring when patients are critically ill, having no plausible etiology other than the critical illness and its treatments (Vanhorebeek et al., 2020). ICU-AW is typically generalized and symmetrical, affecting all four limbs (more proximal than distal) and the respiratory muscles and sparing the facial muscles (Piva et al., 2019). The Medical Research Council (MRC) Scale for Muscle Strength provides a global estimation of motor function, indicating clinically relevant ICU-AW when scores below 48 are reached and severe muscle weakness when scores go below 36 (Vanhorebeek et al., 2020).

The prevalence of ICU-AW varies widely considering the population studied, the patient's risk factors, the moment of assessment, and the patient's overall functional status, where age-related frailty is often overlooked (Piva et al., 2019). The identified risk factors can be non-modifiable or modifiable. Non-modifiable risk factors encompass disease severity, high disease severity scores, sepsis, multiple organ failure, high lactate levels in the blood, longer durations of mechanical ventilation, and prolonged stays in the ICU, with a more significant impact on female and older patients. Modifiable risk factors include hyperglycemia, the administration of parenteral nutrition, the dose and duration of vasoactive medications, the use of corticosteroids, the use of neuromuscular blocking agents with corticosteroids infused for periods longer than 48 hours, the administration of certain antibiotics, including aminoglycosides and vancomycin, and continued sedation leading to immobilization (Vanhorebeek et al., 2020).

In the ICU, the diagnosis of ICU-AW is associated with worse health outcomes in critically ill patients and related to an increase in the duration of invasive mechanical ventilation (IMV), weaning failure with the need for reintubation or tracheostomy, resulting in increased sedation, higher incidence of delirium, increased ICU stay and overall hospitalization, increased hospital costs, increased mortality, decreased functional capacity, and inability to perform activities of daily living (Eggmann et al., 2016, Vanhorebeek et al., 2020). The loss of muscle mass begins in the first week of critical illness, and no specific treatment is available. Therefore, early rehabilitation is considered beneficial (Needham, 2016) and recommended up to 72 hours after the patient's admission to the ICU based on safety processes and criteria (Nydahl et al., 2018).

Research question

What health outcomes are sensitive to rehabilitation nursing care in critically ill patients diagnosed with ICU-AW?

Methodology

A quasi-experimental study was conducted in an ICU in northern Portugal, using non-probability convenience sampling. The sample consisted of 80 patients, 40 in the control group (CG) and 40 in the experimental group (EG). The following inclusion criteria were defined for the groups: i) to be 18 years old or older; ii) to be admitted to an ICU; iii) to have an endotracheal tube (ETT) or tracheostomy; iv) to receive IMV for a period ≥ 72h; and v) to be diagnosed with ICU-AW. On the other hand, the following exclusion criteria were established: i) to have unstable spine injuries or extremity fractures that preclude mobilization; ii) to have an indication of limitation of the therapeutic effort (LTE); iii) to meet the criteria for organ donation; and iv) to be diagnosed with neuromuscular disease and positive SARS COV 2. Both groups received the same rehabilitation nursing care intervention. However, the intervention differed between the groups in number and frequency of implementation due to the different time intervals of each group. Corresponding in the present study to the CG, the first time interval was from 1 October 2018 to 31 March 2019, during which the rehabilitation nursing care intervention was implemented once a day, from Monday to Friday. In the second phase, corresponding

to the time interval from 1 October 2021 to 31 March 2022, the EG received the rehabilitation nursing care intervention twice a day from Monday to Sunday. The same year period was used to control the seasonal effect in clinical diagnoses likely to cause respiratory failure. The intervention protocol for rehabilitation nursing care consisted of a nurse specialist's initial assessment up to 72 hours. It is an individualized program with specific goals based on the patient's diagnosis, with a mean duration of one hour, progressing from passive bed exercises to active exercises outside the bed, based on the following principles: i) patient's level of consciousness, ii) ventilation devices, iii) IMV parameters, iv) patient's hemodynamic profile, and v) tubes and lines needed for ICU treatment. An equal number of cases were included in the CG and EG, with a similar distribution of the variables "diagnostic category" and indexes of "severity" and "nursing workload." The "severity" indexes were measured using the instruments Acute Physiology and Chronic Health Evaluation Score II (APACHE II; Knaus et al., 1981) and the Simplified Acute Physiology Score II (SAPS II; Le Gall et al., 1984), both validated for the Portuguese population by Moreno and Morais (1997). The "nursing workload" was assessed using the Therapeutic Intervention Scoring System-28 (TISS-28; Cullen et al., 1974), also validated for the Portuguese population by Moreno and Morais (1997).

The following variables were analyzed in both groups: the sociodemographic characteristics (age and gender), the clinical characterization (diagnostic category), the previous risk factors (arterial hypertension [AHT], obesity, dyslipidemia, alcoholism, chronic obstructive pulmonary disease [COPD], degenerative joint disease [DJD], diabetes mellitus [DM] and smoking), the 24-hour severity index, the sequential organ failure assessment (SOFA) mortality prediction index, assessed at admission and discharge and validated in a multicenter study in Europe, with 40 units from 16 countries, including Portugal (Vincent et al., 1998), the score of Richmond Agitation-Sedation Scale (RASS; Ely et al., 2003), translated into Portuguese (Nassar Junior et al., 2008), the incidence of delirium, the number of days under sedation, the number of days receiving IMV, the number of days of stay in the ICU and the number of hospitalization days.

The following variables were also analyzed in both groups: "standing up;" "functional capacity to transfer," using the locomotion/transfers subscale of the instrument Functional Independence Measure (FIM) published by the Data Management Service of the Uniform Data System for Medical Rehabilitation and the Center for Functional Assessment Research (1986); and muscle strength, assessed using the MRC Scale for Muscle Strength (Medical Research Council, 1943), applied bilaterally in six muscle groups. The variables functional capacity to transfer" and "muscle strength were assessed 24 hours after suspending sedation and at the moment of discharge. The ICU-AW diagnosis was clinically determined by a critical care doctor and a rehabilitation nurse using the MRC Scale for Muscle Strength. It was assessed twice within a 24-hour interval and scored less than 48 points.

The main ethical principles of beneficence, nonmaleficence, autonomy, and justice were respected to safeguard the participants' rights throughout the research process. A free and informed consent form was elaborated for the critically ill patients admitted to the ICU. Consent was presumed in critically ill patients with altered levels of consciousness meeting the inclusion criteria of the present study but who did not have a legal representative. The present study obtained a positive opinion from the Ethics Committee of the Hospital where it was conducted (opinion no. 882 of 17 March 2022). Authorizations were asked of the authors of the used instruments' translations and validations for the Portuguese population.

Data were coded, entered, and analyzed to ensure and respect the participants' anonymity, using the IBM SPSS® Statistics software, version 25.0. Descriptive statistics calculated the absolute and relative frequencies of the variables under study. The following tests were used for inferential analysis: Student's t-test, Mann-Whitney test, Pearson's Chi-square test (χ^2), and Fisher's exact test. In all data analyses, the significance level considered was $p < 0.05$ or the 95% confidence interval.

Results

The study sample's sociodemographic characterization considered the variables Ggender and Age. Regarding the variable Age, the mean age was 68.7 years (*SD* = 11) in the CG and 71.7 years (*SD* = 9.9) in the EG. To verify if the groups had identical age distributions, the Student's *t*-test for independent samples was applied (Table 1), showing no statistically significant differences indicating that the CG's mean age differed from that of the EG (p = 0.204). Thus, the null hypothesis was not rejected, and it was concluded that there were no significant differences in age between the EG and the CG.

Table 1

Comparing the groups according to the variable age

Variable	Groups	M ± *SD*	*p*
Age	CG	68.7±11	0.204
	EG	71.7±9.9	

Note. CG = Control Group; EG = Experimental Group; *M* = Mean; *SD* = Standard deviation ; *p* = Statistical significance.

Regarding the Gender variable, in both groups, most participants were male (60%, n = 24, in the EG, and 60%, n = 24, in the CG). According to the Chi-square statistical test (χ^2), the hypothesis was not rejected, and there was no statistically significant difference in the distribution of the Gender variable between the CG and EG (p = 1.00), as shown in Table 2.

Table 2

Comparing the groups according to the variable gender

Variable	Category	CG		EG		Standard deviation		χ^2 value	DF	*p*
		n	%	N	%	CG	EG			
Gender	Male	24	60	24	60	1	-1	0.000	1	1.00
	Female	16	40	16	40	-1	1			

Note. CG = Control Group; EG = Experimental Group; n = Absolute frequency; % = Relative frequency; χ^2 = Chi-square test; DF = Degrees of freedom; *p* = Statistical significance.

The study sample's clinical characterization was based on the following variables: Diagnostic category, Previous risk factors, RASS score, Incidence of delirium, Indexes of severity/organ dysfunction/nursing workload in direct care delivery to critically ill patients, and the Number of hospitalization days. Table 3 shows no statistically significant differences between both groups regarding the distribution of the Diagnostic category. The sample's most representative Diagnostic category was medical (CG = 77.5%; EG = 62.5%). Considering the Previous risk factors, no significant differences were found for most risks. However, it is worth highlighting the prevalence of AHT and dyslipidemia in about half of the total sample. No statistically significant differences were found regarding the RASS score and the Incidence of delirium 24 hours after suspending sedation and at the moment of discharge from the ICU.

Table 3

Clinical characterization of the sample

Variables	Category	CG		EG		
		n	%	*n*	%	*p*
Diagnostic category	Medical	31	77.5%	25	62.5%	0.222
	Urgent surgery	6	15.0%	11	27.5%	
	Elective surgery	3	7.5%	4	10.0%	
Previous risk factors	AHT	24	60.0%	28	70.0%	0.482
	Obesity	6	15.0%	10	25.0%	0.402
	Dyslipidemia	18	45.0%	21	52.5%	0.327
	Alcoholism	7	17.5%	2	5.0%	0.154
	DJD	9	22.5%	7	17.5%	0.781
	DM	18	45.0%	11	27.5%	0.165
	Smoking	8	20.0%	-	-	0.005
	COPD	7	17.5%	5	12.5%	0.755
RASS (24 hours after suspending sedation)	-2 (light sedation)	1	2.5%	1	2.5%	0.129
	-1 (drowsy)	17	42.5%	21	52.5%	
	0 (alert and calm)	17	42.5%	17	42.5%	
	+1 (restless)	5	12.5%	1	2.5%	
RASS (ICU discharge)	0 (alert and calm)	38	95.0%	38	95.0%	1
	+1 (restless)	2	5.0%	2	5.0%	
Incidence of delirium *(*24 hours after suspending sedation)		21	52.5%	17	42.5%	0.502
Incidence of delirium *(ICU discharge*)		6	15.0%	3	7.5%	0.481

Note. CG = Control Group; *EG* = Experimental Group; n = Absolute frequency; % =Relative frequency; AHT= Arterial Hypertension; DJD = Degenerative Joint Disease; DM = Diabetes mellitus; COPD = Chronic obstructive pulmonary disease; RASS = Richmond Agitation-Sedation Scale; ICU = Intensive Care Unit; p = Statistical significance.

Table 4 presents the instruments used to measure the indexes of severity (APACHE II, SAPS II), organ dysfunction (SOFA), and nursing workload in direct care delivery to critically ill patients (TISS-28), and the number of hospitalization days. It shows no statistically significant differences between the measures.

Table 4

Clinical characterization of the sample (continuation)

Variables	CG M ± SD	EG M ± SD	*p*
APACHE II	23.8 ± 9.3	19.5 ± 6.8	0.070
SAPS II	49.5 ± 12.9	45.9 ± 12.3	0.793
SOFA (admission)	9.5 ± 4.7	8.4 ± 3.3	0.251
SOFA (discharge)	3.4 ± 2.3	2.4 ± 1.3	0.186
TISS-28 (admission)	38.5 ± 4.7	37.2 ± 5.5	0.253
Number of hospitalization days	36.2 ± 20.1	30.2 ± 13.5	0.274

Note. CG = Control Group; EG = Experimental Group; M = Mean; SD = Standard deviation; *p* = Statistical significance; APACHE II = *Acute Physiology and Chronic Health Evaluation II;* SAPS II = *Simplified Acute Physiology Score II;* SOFA = *Sequential Organ Failure Assessment;* TISS-28 = *Therapeutic Intervention Scoring System-28.*

Table 5 shows the health outcomes sensitive to rehabilitation nursing care in critically ill patients with ICU-AW. Regarding the variable "standing up," most of the study participants who stood up belonged to the EG (87.5% vs. 37.5% in the CG), with statistically significant differences between the groups (p = 0.000) according to the Chi-square test (χ^2). Regarding the variable functional capacity to stand up, assessed by the locomotion/transfers subscale of the FIM, 24 hours after suspending sedation, the EG showed less incidence of the score "Total Assistance" (80% vs. 100% in the CG), with differences between the groups (p = 0.005) according to the statistical Chi-square test (χ^2). Assessing the "functional capacity to stand up" at the moment of discharge from the ICU, the EG had less incidence of the score total assistance (7.5% vs. 60% in the CG) and more incidence of the scores maximal assistance (50% vs. 35% in the CG), moderate assistance (30% vs. 5% in the CG), minimal assistance (5%), and supervision (7.5%), with statistically significant differences between the groups (p = 0.000).

Table 5

Health outcomes sensitive to rehabilitation nursing care

Variable	Category	CG (%)	EG (%)	Standard deviation	χ^2 / F	*p*
Standing up	Yes	37.5	87.5	4.6	21.3	0.000
Functional capacity to stand up (24 hours after suspending sedation)	Total Assistance	100	80	3.0	8.89	0.005
	Maximal Assistance	-	20	3.0		
Functional capacity to stand up (ICU discharge)	Total Assistance	60.0	7.5	5.0	30.2 ^{F}	0.000
	Maximal Assistance	35.0	50.0	1.4		
	Moderate Assistance	5.0	30.0	2.9		
	Minimal Assistance	-	5.0	1.4		
	Supervision	-	7.5	1.8		

Note. CG = Control Group; EG = Experimental Group; χ^2 = Chi-square test; F = Fisher's Exact test; *p* = Statistical significance; ICU = Intensive Care Unit.

Table 6 shows that the EG had a lower TISS-28 mean (16.9 vs. 26.9 in the CG), with statistically significant differences (t = 7.4; p = 0.000). Regarding the "number of days receiving IMV," a statistically significant difference was found with 11.9 days in the CG and 8.3 days in the EG (p = 0.00). Considering the number of days under sedation, the EG presented a lower mean (7.4 days in the EG vs. 11.8 days in the CG; p = 0.000). muscle strength at the moment of discharge from the ICU tended to be higher in the EG (40.8 in the EG vs. 35.4 in the CG; p

= 0.002). On the other hand, the number of hospitalization days in the ICU tended to be higher in the CG, with statistically significant differences (20.4 days in the CG vs. 12.3 days in the EG; p = 0.000).

Table 6

Variables assessed in the EG and CG

Variable	Groups	M ± SD	t /U	*p*
TISS-28 (ICU discharge)	CG	26.9±5.3	7.4	0.000
	EG	16.9±6.3		
Days receiving IMV	CG	11.9±4.1	424.0 [U]	0.000
	EG	8.3±5.2		
Days under sedation	CG	11.8±4.1	4.2	0.000
	EG	7.4±4.9		
Muscle strength	CG	35.4±8.3	-3.187	0.002
	EG	40.8±6.7		
Days of stay in the ICU	CG	20.4±10.3	3.8	0.000
	EG	12.3±9.0		

Note. CG = Control Group; EG = Experimental Group; M = Mean; SD = Standard deviation; t = Student's *t-test*; *U* = Mann–Whitney U test; *p* = Statistical significance; ICU = Intensive Care Unit; IMV = Invasive mechanical ventilation.

Discussion

ICU-AW is a frequent complication developed by critically ill patients hospitalized in the ICU. It is associated with high morbidity and mortality rates and has long-term consequences that go beyond the hospitalization phase. The present quasi-experimental study demonstrates the benefits of early rehabilitation nursing care. The patients in the EG received rehabilitation nursing care twice a day for seven days and, as a result, decreased the number of days under sedation, which aligns with the results observed in the randomized controlled study of Eggmann et al. (2018). The EG also had a reduction in the number of days receiving IMV and in the ICU, which corroborates the findings of the systematic literature review of Huang et al. (2021), which confirms that early rehabilitation can improve lung function and reduce the time receiving IMV and the number of days in the ICU. Moreover, the present study found that muscle strength assessed by the MRC Scale for Muscle Strength is higher in the EG when compared to the CG. These data align with those found in the review by Huang et al. (2021), which supports that early rehabilitation reduces ICU-AW incidence in critically ill patients receiving IMV by increasing muscle strength.
Considering the "nursing workload" assessed using the TISS-28 at the moment of discharge, the present study observed that the delivery of rehabilitation nursing care twice a day for seven days a week allowed reducing the TISS-28 score in the EG.
The variables "standing up" and "functional capacity to stand up," assessed by the FIM, presented better results in the EG. Also, the scientific evidence shows that several factors contribute to the immobility of critically ill patients, such as diagnoses, pain, sedation, and nursing team-related factors (Huang et al., 2021; Eggmann et al., 2018).
The "RASS score" and the "incidence of delirium" 24 hours after suspending sedation and at the moment of discharge from the ICU revealed no statistically significant differences. Nevertheless, Lang et al. (2020), in their literature review, consider rehabilitation an essential strategy for managing delirium.
The present study's main limitation is using a non-probability convenience sample. It is suggested that the study be replicated in other ICUs of other institutions during a broader period and (ideally) with a larger sample. The time interval between the interventions in the CG and EG also constitutes a limitation of the present study.

Conclusion

Rehabilitation nursing care provided to critically ill patients may reduce ICU-AW incidence, increase muscle strength and functional capacity, and decrease patients' days under sedation and receiving IMV. Standardized early rehabilitation protocols are needed for critically ill patients diagnosed with ICU-AW. The present study corroborates previous studies on the benefits of rehabilitation nursing care, whose daily interventions add quality and value to the patient, the care team, and the health institution. Furthermore, rehabilitation nursing is in a privileged position to implement measures that encourage cultural change within the ICU, ensuring that early rehabilitation is safely adopted and implemented. In this sense, the involvement of all stakeholders is necessary and fundamental for successful outcomes in the person. ICU-AW assessment should be part of critically ill patients'

daily evaluation, as this is a sensitive indicator for rehabilitation nursing care. In addition, further prospective longitudinal studies are recommended to understand the etiology of ICU-AW in critically ill survivors and the impact of ICU-AW on people's quality of life.

Author contributions

Conceptualization: Matos, T. S.
Data curation: Matos, T. S.
Formal analysis: Matos, T. S., Félix, A., Martins, J. P.
Investigation: Matos, T. S.
Methodology: Matos, T. S., Félix, A., Martins, J. P.
Project administration: Matos, T. S.
Resources: Matos, T. S.
Supervision: Félix, A.
Writing – Original Draft: Matos, T. S., Félix, A.
Writing – Review & editing: Matos, T. S., Félix, A., Martins, J. P.

References

Cullen, D. J., Civetta, J. M., Briggs, B. A., & Ferrara, L. C. (1974). Therapeutic intervention scoring system: A method for quantitative comparison of patient care. *Critical Care Medicine*, *2*(2), 57–60. https://pubmed.ncbi.nlm.nih.gov/4832281/

Data Management Service of the Uniform Data System for Medical Rehabilitation and the Center for Functional Assessment Research. (1986). *Australian guide for use of the uniform data set for medical rehabilitation including the functional independence measure: Version 3.1*. State University of New York at Buffalo.

Eggmann, S., Verra, M. L., Luder, G., Takala, J., & Jakob, S. M. (2016). Effects of early, combined endurance and resistance training in mechanically ventilated, critically ill patients: A study protocol for a randomised controlled trial. *Trials*, *17*(403), 1–11. https://doi.org/10.1186/s13063-016-1533-8

Eggmann, S., Verra, M. L., Luder, G., Takala, J., & Jakob, S. M. (2018). Effects of early, combined endurance and resistance training in mechanically ventilated, critically ill patients: A randomised controlled trial. *Plos One*, *13*(11), 1–19. https://doi.org/10.1371/journal.pone.0207428

Ely, E. W., Truman, B., Shintani, A., Thomason, J. W., Wheeler, A. P., Gordon, S., Francis, J., Speroff, T., Gautam, S., Margolin, R., Sessler, C. N., Dittus, R. S., & Bernard, G. R. (2003). Monitoring sedation status over time in ICU patients: Reliability and validity of the Richmond agitation-sedation scale (RASS). *Journal of the American Medical Association*, *289*(22), 2983–2991. https://doi.org/10.1001/jama.289.22.2983

Gall, J. R., Loirat, P., Alperovitch, A., Glaser, P., Granthil, C., Mathieu, D., Mercier, P., Thomas, R., & Villers, D. (1984). A simplified acute physiology score for ICU patients. *Critical Care Medicine*, *12*(11), 975-977. https://doi.org/10.1097/00003246-198411000-00012

Gruther, W., Pieber, K., Steiner, I., Hein, C., Hiesmayr, J. M., & Paternostro-Sluga, T. (2017). Can early rehabilitation on the general ward after an intensive care unit stay reduce hospital length of stay in survivors of critical illness?: A randomized controlled trial. *American Journal of Physical Medicine & Rehabilitation*, *96*(9), 607-615. https://doi.org/10.1097/PHM.0000000000000718

Hashem, M. D., Nelliot, A., & Needham, D. M. (2016). Early mobilization and rehabilitation in the ICU: moving back to the future. Respiratory care, 61(7), 971-979.https://doi.org/10.4187/respcare.04741

Huang, D., Zhao, W., Chen, Y., Shen, B., Wang, Y., Guan, H., & Luo, W. (2021). Effect of mechanical ventilation and pulmonary rehabilitation in patients with ICU-acquired weakness: A systematic review and meta-analysis. *Annals of Palliative Medicine*, *10*(9), 9594-9606. https://doi.org/10.21037/apm-21-1928

Knaus, W. A., Zimmerman, J. E., Wagner, D. P., Draper, E. A., & Lawrence, D. E. (1981). APACHE-acute physiology and chronic health evaluation: A physiologically based classification system. *Critical Care Medicine*, *9*(8), 591-597. https://doi.org/10.1097/00003246-198108000-00008

Lang, J. K., Paykel, M. S., Haines, K. J., & Hodgson, C. L. (2020). Clinical practice guidelines for early mobilization in the ICU: A systematic review. *Critical Care Medicine 48*(11), e1121–e1128. https://doi.org/10.1097/CCM.0000000000004574

Medical Research Council. (1943). *Aids to the examination of the peripheral nervous system*. Her Majesty's Stationery Office.

Moreno, R., & Morais, P. (1997). Outcome prediction in intensive care: results of a prospective, multicentre, Portuguese study. *Intensive Care Medicine*, *23*, 177–186. https://doi.org/10.1007/s001340050313

Nassar Junior, A. P., Pires Neto, R. C., Figueiredo, W. B., & Park, M. (2008). Validity, reliability and applicability of Portuguese versions of sedation-agitation scales among critically ill patients. *Sao Paulo Medical Journal*, *126*(4), 215–219. https://www.scielo.br/j/spmj/a/mp4wKYWf6pf8TbqMbGmSH6j/?lang=en&format=pdf

National Institute for Health and Care Excellence. (2020). *Supporting adult carers*. https://www.nice.org.uk/guidance/ng150/resources/supporting-adult-carers-pdf-66141833564869

Nydahl, P., Diers, A., Günther, U., Haastert, B., Hesse, S., Kerschensteiner, C., Klarmann, S., & Köpke, S. (2018). Protokollbasierte mobilisierung auf Intensivstationen: Design einer clusterrandomisierten pilotstudie. *Medizinische Klinik - Intensivmedizin Und Notfallmedizin*, *113*(7), 581–592. https://doi.org/10.1007/s00063-017-0358-x

Piva, S., Fagoni, N., & Latronico, N. (2019). Intensive care unit–acquired weakness: Unanswered questions and targets for future research. *F1000Research*, *8*(508), 1–10. https://f1000research.s3.amazonaws.com/manuscripts/19002/81f9b867-6957-446f-9de1-88a0568d2266_17376_-_latronico.pdf?doi=10.12688/f1000research.17376.1&numberOfBrowsableCollections=94&numberOfBrowsableInstitutionalCollections=4&numberOfBrowsableGateways=51

Schoeller, S. D., Martins, M. M., Ribeiro, I., Lima, D. K., Padilha, M. I., & Gomes, B. P. (2018). Breve panorama mundial da enfermagem da reabilitação. *Revista Portuguesa de Enfermagem de Reabilitação*, *1*(1), 6–12. https://doi.org/10.33194/rper.2018.v1.n1.01.4388

Vanhorebeek, I., Latronico, N., & Van den Berghe, G. (2020). ICU-acquired weakness. *Intensive Care Medicine*, *46*(4), 637–653. https://doi.org/10.1007/s00134-020-05944-4

Vincent, J. L., Mendonça, A., Cantraine, F., Moreno, R., Takala, J., Suter, P. M., Sprung, C. L., Colardyn, F., & Blecher, S. (1998). Use of the SOFA score to assess the incidence of organ dysfunction/failure in intensive care units: Results of a multicenter, prospective study. *Critical Care Medicine*, *26*(11), 1793-1800. https://doi.org/10.1097/00003246-199811000-00016