

Effects of early mobilisation in the functional rehabilitation of critically ill patients: a systematic review

Efeitos da mobilização precoce na reabilitação funcional em doentes críticos: uma revisão sistemática

Efectos de la movilización temprana en la rehabilitación funcional de los pacientes en estado crítico: una revisión sistemática

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Abstract

Background: Early mobilisation has been considered as an intervention capable of modifying risk factors for morbidity, with an impact on the functional rehabilitation of critically ill patients.

Objective: To determine the effects of early mobilisation in the functional rehabilitation of patients admitted to intensive care units.

Review method: Using the PICO strategy, a systematic review was conducted of full-text scientific articles on adults admitted to intensive care units who underwent early mobilisation and published between 2003 and 2013. The search was performed in the following databases: PubMed, CINAHL, Cochrane Controlled Trial Database, Elsevier, LILACS, British Nursing Index and SciELO, and in scientific journals of reference and citations of the selected articles. Tools for methodological quality assessment were used in the final analysis of the studies.

Interpretation of results: The six studies identified show that early mobilisation may facilitate the functional rehabilitation of these patients, promoting muscle strength gains and increased participation in the activities of daily living.

Conclusion: Further studies using the same assessment tools and demonstrating the interest of this intervention for the Nursing discipline are needed.

Keywords: rehabilitation; intensive care; early ambulation.

Resumo

Contexto: A mobilização precoce vem sendo considerada uma intervenção capaz de modificar factores de risco de morbilidade, com impacto na reabilitação funcional em doentes críticos.

Objetivo: Determinar os efeitos da mobilização precoce na reabilitação funcional de doentes internados em cuidados intensivos.

Método de revisão: Utilizando a estratégia PICO, realizou-se uma revisão sistemática da literatura entre 2003 e 2013, considerando-se artigos científicos em texto integral de estudos realizados com adultos internados em cuidados intensivos e submetidos à mobilização precoce. Pesquisaram-se as bases de dados PubMed, CINAHL, *Cochrane Controlled Trial Database*, Elsevier, LILACS, *British Nursing Index* e SciELO, revistas científicas de referência e as citações dos artigos selecionados. Na análise final dos estudos utilizaram-se ferramentas para avaliação da qualidade metodológica.

Interpretação dos resultados: Dos seis trabalhos identificados resulta que a mobilização precoce pode facilitar a reabilitação funcional destes doentes, promovendo ganhos de força muscular e maior participação nas atividades de vida diária.

Conclusão: São necessários estudos que usem as mesmas ferramentas de avaliação e que demonstrem o interesse da intervenção para a disciplina de Enfermagem.

Palavras-chave: reabilitação; cuidados intensivos; mobilização precoce.

Resumen

Marco contextual: La movilización temprana ha sido considerada una intervención capaz de modificar los factores de riesgo de morbilidad con un impacto en la rehabilitación funcional de los pacientes críticos.

Objetivo: Determinar los efectos de la movilización temprana en la rehabilitación funcional de los pacientes internados en cuidados intensivos.

Método de revisión: Utilizando la estrategia PICO, llevamos a cabo una revisión sistemática de la literatura entre 2003 y 2013, teniendo en cuenta artículos científicos con texto completo, estudios realizados con adultos ingresados en cuidados intensivos sometidos a la movilización temprana. Para esto, se consultaron las bases de datos PubMed, CINAHL, *Cochrane Controlled Trial Database*, Elsevier, LILACS, *British Nursing Index* y SciELO; revistas científicas de referencia y las citas de los artículos seleccionados. Para el análisis final de los estudios se utilizaron herramientas de evaluación de la calidad metodológica.

Interpretación de los resultados: Los resultados de los seis estudios indican que la movilización temprana puede facilitar la rehabilitación funcional de estos pacientes, haciendo que ganen fuerza muscular y una mayor participación en las actividades diarias.

Conclusión: Se necesitan estudios que utilicen las mismas herramientas de evaluación y que demuestren el interés de la intervención para la disciplina de enfermería.

Palabras clave: rehabilitación; cuidados intensivos; ambulación precoz.

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Received for publication: 08.05.14

Accepted for publication: 13.01.15

Introduction

Over the last few decades, there has been an increase in the number of patients admitted to intensive care units (ICUs). Simultaneously, the growing capacity of supporting vital functions, together with the effectiveness of new treatments, has increased the survival rates of critically ill patients. In this context, a critically ill patient is a person whose life is threatened due to failure or imminent failure of one or more vital functions, and whose survival depends on advanced means of surveillance, monitoring and therapy (Regulamento nº 124, de 18 de Fevereiro. *Diário da República nº 35/11 - II Série*. Ordem dos Enfermeiros. Lisboa, Portugal). According to the Intensive Care National Audit & Research Centre (ICNARC) (Intensive Care National Audit & Research Centre, 2013), more than 100,000 people every year are admitted to ICUs in England and Wales, and 76% of them are discharged from the hospital. In Australia and New Zealand, there are more than 120,000 ICU admissions every year, and 70% of these patients are discharged home (Australian and New Zealand Intensive Care Society, 2013). According to the most recent data published by the Health Financing and Computer Management Agency (IGIF) (Instituto de Gestão Informática e Financeira da Saúde, 2005), 11,583 people were discharged from ICUs in Portugal. Considering these figures and the growing number of people with multiple comorbidities and of medical indications for ICU admission, together with an increase in the average life expectancy in developed countries, it can be concluded that the number of people who survive a severe disease episode will tend to increase. This justifies a more thorough analysis of the transition processes of the survivors of ICU admission. It is a deeply disturbing sight to look beyond the short-term results, such as the survival rate after discharge. The legacy of an ICU admission is extremely heavy and difficult. It is characterised by a profound and persistent disability (Unroe et al., 2010) and has negative long-term repercussions on the patients' quality of life and at a physical and neuropsychiatric level (Desai, Law, & Needham, 2011). These consequences force patients to struggle to regain independence, in particular in terms of physical strength and functional capacities (Ågård, Egerod, Tønnesen, & Lomborg, 2012). At the same time, the multiple care transitions lead to higher

healthcare costs. It is thus important to understand the trajectory of recovery of critically ill patients, as it may reveal the modifiable risk factors, as well as assess the interventions that might contribute to reduce the number of comorbidities associated with ICU admission.

The beginning of the rehabilitation of critically ill patients at the ICU has been a topic for research and considered an important part of a care plan. In functional rehabilitation, the early mobilisation of critically ill patients has been suggested as an important therapy to modify the risk of developing sequelae affecting their physical and functional morbidity, as they are related to the loss of muscle strength that leads to ICU-acquired weakness. In a recent study of critically ill patients with acute respiratory failure, the lack of early mobility was identified as predictor of readmission or death within the first year of hospital discharge (Morris et al., 2011). On the other hand, several factors may also contribute to the loss of muscle strength, such as the direct effects of the illness or the use of certain drugs (e.g., muscle relaxants and corticosteroids). Another important risk factor is the prolonged periods of bed rest, which may be modifiable if rehabilitation starts in the early treatment stage. Therefore, the aim is to promote the recovery of muscle strength in order to improve performance and the transition to an independent performance of basic activities of daily living. According to Grap and McFetridge (2012), early mobilisation (also termed progressive mobility) describes a pattern of increasing activity beginning with passive mobilisation until ambulation, which begins immediately after the haemodynamic and respiratory stabilisation, generally within 24–48 hours after ICU admission. However, the early mobilisation of critically ill patients has several specificities inherent to the context of action, and uses various activities depending on the patients' individual needs. In this way, and in order to assess the quality of care in rehabilitation Nursing, it is important to assess the rehabilitation process based on the interventions and the patient outcomes (Gomes, Martins, Gonçalves, & Fernandes, 2012). There is a lack of knowledge of the expected outcomes, which is needed to plan the most appropriate interventions for each patient based on the objectives initially set out. Thus, the search for scientific evidence based on the principles of the evidence-based practice is essential for the

decision-making process within the scope of the critically ill patient's rehabilitation process. In the search for the best evidence available to improve the quality of care, a systematic literature review was performed to identify the effects of early mobilisation in the functional rehabilitation of patients admitted to ICUs. The review question *What are the effects of early mobilisation in the functional rehabilitation of critically ill patients?* guided the search for relevant information for decision-making concerning the rehabilitation plan of this group of patients.

Table 1
Inclusion criteria

Selection criteria	Inclusion criteria
Study design	Cohort studies Controlled studies Randomised studies
Publication date	Between 2003 and 2013
Language	Portuguese, English and Spanish
Intervention	Patients undergoing early mobilisation and admitted to an ICU
Other criteria	Full-text articles Studies conducted in clinical settings with adults admitted to an ICU

Strategy for search and identification of studies

The review targeted studies published between 2003 and 2013. The following databases were searched: PubMed, CINAHL, Cochrane Controlled Trial Database, Elsevier, LILACS, British Nursing Index, and SciELO. Some scientific journals of reference were also consulted in paper format (*Critical Care Medicine* and *Intensive Care Medicine*). To ensure a more comprehensive literature review, the lists of references of the selected articles were also searched to identify potentially relevant articles for the topic under study.

The search strategy used a logical structure combining search terms, Boolean operators, and the components of the PICO strategy. The following topics were used as search descriptors: *mobilization, mobilisation, mobility, physical activity, exercise, intensive care unit, and critical illness*. The Boolean expression was built as follows: *critical illness AND intensive care unit AND mobilization OR mobilisation OR mobility OR physical activity OR exercise*.

Systematic Review Method

The systematic review began with the formulation of the guiding question based on the PICO strategy (Population, Intervention, Comparison, and Outcome). Inclusion/exclusion criteria were defined (Table 1) to guide the search and select the literature according to the expected results and the research question.

Two reviewers, who independently analysed the titles and abstracts of the articles according to the same criteria, selected the studies.

Assessment of the methodological quality of the studies

Both reviewers used proforma tools to assess the quality of the studies. The tool proposed by the Critical Appraisal Skills Programme (CASP) (Public Health Resource Unit, 2006) was used for randomised clinical trials, while the criteria proposed by Suzumura, Oliveira, Buehler, Carballo, and Berwanger (2008) were used for the critical appraisal of cohort studies.

Data extraction and synthesis

The articles were independently analysed by the reviewers, and a consensus was reached on which to be included in the methodological analysis. The articles were then generally described based on their country of origin, study design, objectives and participants, the onset and duration of the intervention, results and conclusions. Then, the items were compiled into an extraction table so the reviewers could proceed with the narrative data synthesis.

Presentation of results

Considering the procedures described above, the search results were refined throughout the process

based on the previously established criteria until all articles to be included in this review were selected (Figure 1):

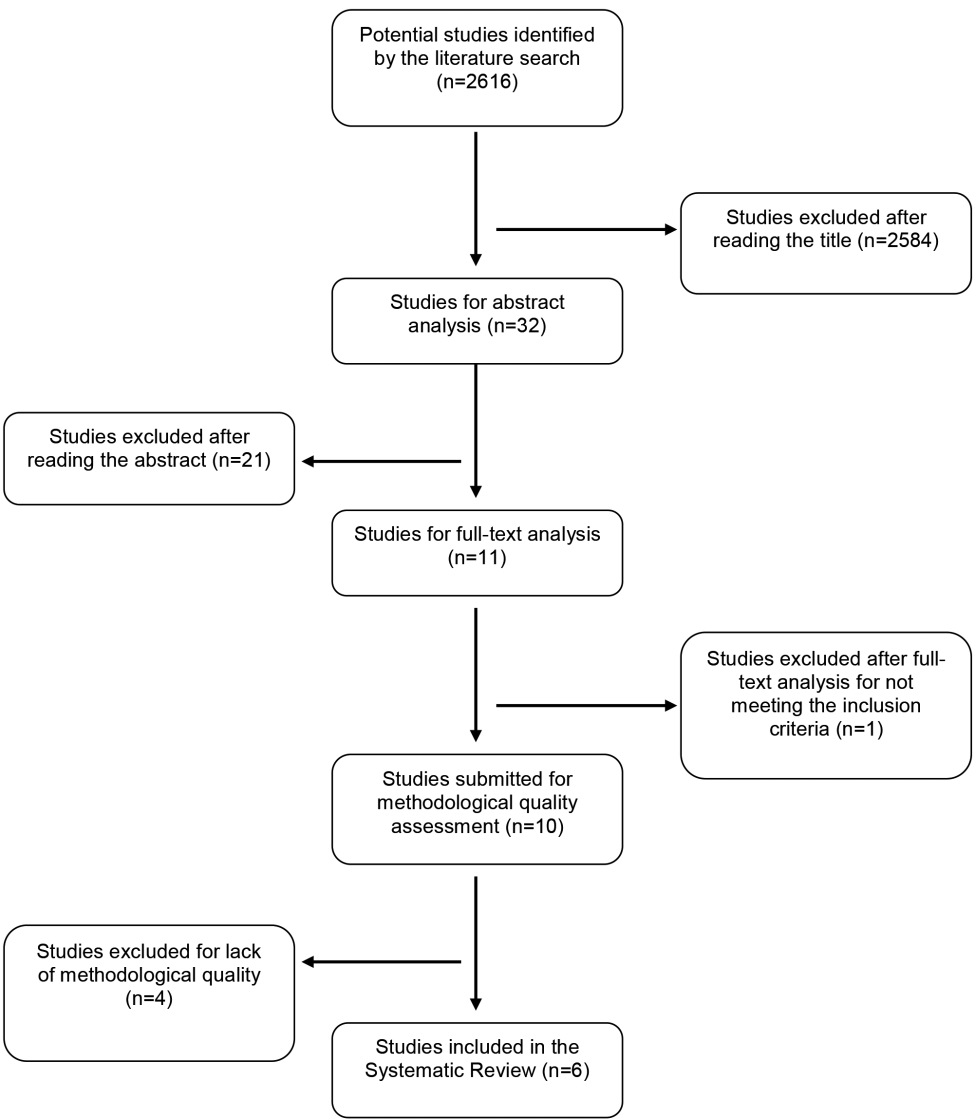


Figure 1. Study selection process.

Six studies (two cohort studies and four randomised controlled studies) were selected

for final analysis, which are summarised in the following table (Table 2):

Table 2

Identification of studies for final analysis

Study identification number	Authors	Year	Type of study
S1	Thomsen, Snow, Rodriguez, and Hopkins	2008	Cohort
S2	Morris et al.	2008	Cohort
S3	Schweickert et al.	2009	Randomised controlled
S4	Burtin et al.	2009	Randomised controlled
S5	Dantas et al.	2012	Randomised controlled
S6	Denchy et al.	2013	Randomised controlled

After the methodological assessment of the quality of cohort studies, it can be concluded that they have some limitations. The results of S1 can only be considered with respect to patients with respiratory conditions. In this study, without a control group, there is a potential for bias in patient selection since only those patients who were more likely to ambulate were selected. In addition, the statistical power of the study is not indicated. No mention was made to possible factors influencing the results, such as the administration of corticosteroids and neuromuscular agents. As for S2, the possible confounding factors arising from drug administration were controlled for and the study has an adequate statistical analysis. However, although the level of significance was reported, the power of the study regarding the calculation of the sample size was not referred. A possible bias of this study is the discrepancy between groups concerning rehabilitation, which was lower in the control group.

As for the randomised controlled trials, although the results of S3 are accurately presented, it is limited to the fact that patients under mechanical ventilation did not receive rehabilitation care and the patients in the control group only received it when prescribed. S3 reports the control of the sedation and analgesia variables, but not the use of corticosteroids. No mention is made in S4 to whether it was a blinded study. It also has other limitations such as the

lack of statistical power of the sample, the lack of reference to the control for confounding factors (e.g., administration of certain drugs), the presence or lack of muscle weakness in both groups, and the assessment of some parameters at hospital discharge without control of the rehabilitation undergone after ICU discharge (considering that the patients were discharged to different services). S5 also presents some limitations, such as the lack of statistical power of the sample, the lack of clarity of the randomisation method used, and whether it was a blinded study or not. No reference is made to whether the confounding factors, such as the administration of drugs, were controlled for. In this study, the differences in muscle strength between both groups were clear from the start, with the control group showing more muscle weakness. Despite being a well-designed longitudinal study, S6 has certain limitations related to the fact that it did not reach the number of participants necessary for it to have the statistical power to determine differences in the six-minute walk test performed twelve months after ICU discharge, and which was the main result being assessed. No reference is also made to whether the confounding factors, such as the administration of drugs with an impact on muscle strength, were controlled for.

Following the critical appraisal of the studies, the most relevant results to the topic under analysis are presented in the following table:

Table 3
Synthesis of data extracted after the critical appraisal of the studies

Study	Country	Study design	Objectives and participants	Onset and duration of mobilisation	Results	Conclusions
S1	USA	Cohort	Objective: To increase the ambulation of patients with acute respiratory failure due to medical illness or surgical or trauma events, transferred from another ICU where activity is a key care component. n = 104.	First 24 hours if conscious and meeting early activity criteria. Until ICU discharge.	The mean distance ambulated by the survivors was 72.5 m. The percentage of patients sitting on the edge of the bed or sitting in a chair who ambulated more than 30 m increased within the first 24 hours after ICU transfer.	The no. of patients who ambulated increased. Controlled studies are needed to determine if early ICU activity improves the outcomes.
S2	USA	Cohort	Objective: To compare outcomes of medical intensive care patients with acute respiratory failure, between patients who received usual care and patients who participated in a mobility protocol. n = 330. Control group n = 165 vs. intervention group n = 165.	Within 48 hours in patients of the intervention group. Until ICU discharge.	Patients in the intervention group were out of bed earlier. More than half of the patients in the intervention group reached the last level of the protocol that included resistance exercises, sitting and active transfers to chair. Shorter ICU and hospital length of stay in the intervention group. No significant difference between both groups concerning ventilation time.	Mobilisation was feasible, safe, and did not increase costs. Better outcomes in the patients of the intervention group.
S3	USA	Randomised controlled	Objective: To determine the no. of patients receiving mechanical ventilation who were functionally independent at hospital discharge, by comparing patients subjected to an early mobilisation to patients receiving usual care. n = 104. Control group n = 55 vs. intervention group n = 49.	An average of 1.5 days after intubation. Until hospital discharge or previous functional status.	Patients in the intervention group: Higher Barthel Index score. More patients achieved an independent functional status at hospital discharge. Fewer patients with muscle weakness. More patients were able to perform activities such as transferring to chair, using the toilet, bathing, getting dressed, grooming and walking. Shorter ventilation time. No significant differences in length of ICU and hospital stay.	The overall rehabilitation strategy was safe and well tolerated, and resulted in better functional outcomes at hospital discharge.
S4	Belgium	Randomised controlled	Objective: To determine whether a daily session using a cycle ergometer is effective in preventing the decrease in functional status in medical and surgical patients. n = 90. Control group n = 45 vs. intervention group n = 45.	Eligibility verified on day 5; no reference is made to the starting date.	Moderate correlation between the quadriceps force, the 6MWT, and the SF36, with higher scores in the intervention group. More patients in the intervention group were able to walk independently. No significant differences were found regarding length of ICU and hospital stay and ventilation times.	Early exercise enhanced recovery of functional capacity and muscle force at hospital discharge.

S5	Brazil	Ran- domised con- trolled	Objective: To assess the effects of an early mobilisation protocol in peripheral and respiratory muscles in mechanically ventilated patients. n = 28. n = 14 in the control group vs n = 14 in the intervention group.	No reference is made to the starting date of rehabilitation in both groups. For the control group, rehabilitation went until ICU discharge.	Significant increase of maximal inspiratory pressure and muscle strength in the intervention group. No significant differences regarding mechanical ventilation time between both groups. No significant differences regarding ventilation time and ICU and hospital length of stay.	Gains in inspiratory and peripheral muscle strength in patients subjected to early mobilisation.
S6	Australia	Ran- domised con- trolled	Objective: To investigate the effectiveness of a rehabilitation programme starting at the ICU and continuing into the ward and community in critically ill patients with different conditions. Assessment at ICU and hospital discharge, and 3, 6 and 12 months after ICU discharge. n = 150. Control group n = 76 vs. intervention group n = 74.	Started at the 5 th day of hospital stay. The intervention group underwent rehabilitation in the ICU, the ward and as outpatients	No significant differences were found between the groups regarding physical function as measures by the 6MWT at 12 months after ICU discharge, although the intervention group presented a higher recovery score in the 6MWT in the first assessment at three months. No significant differences were found between the groups regarding the length of ICU hospital stay.	Further research is needed on the trajectory of recovery in this population of patients.

Interpretation of results

Nowadays, the sequelae resulting from ICU hospitalisation are a matter of concern when assessing health outcomes. Physical morbidity, with its strong impact on the decrease of functional capacities, has been a subject of research in an attempt to find effective interventions in preventing and reducing this problem. Regarding the rehabilitation of critically ill patients, early mobilisation has been suggested as a way of mitigating its adverse functional effects. Hence, it is important to identify the results achieved in the studies conducted so far.

From the analysis of the selected studies, it can be concluded that early mobilisation in critically ill patients is possible, safe and can start immediately after their physiological stabilisation (S2 and S3). There is evidence that it contributes to improve functional rehabilitation outcomes. In total, the articles selected involved 806 patients who enhanced their functional recovery. These improvements may have been the result of a modification of the usual rehabilitation care standards through the introduction of early

mobilisation. The implementation of this intervention is believed to have reduced the time until the first time patients get out of bed (S2) and increased the number of patients with muscle strength gains (S3, S4 and S5), patients who were able to ambulate (S1 and S4), and patients who enhanced their capacity to perform various activities of daily living (S2, S3 and S6). However, some limitations found in the selected studies should be considered when interpreting the results.

The main difficulties are clearly related to the characteristics of the population under study. This population is heterogeneous and their disease usually evolves suddenly, making it difficult to compare the health status achieved after ICU hospitalisation and the health status prior to development of a highly severe condition. On the other hand, the contextual realities of the countries where the selected studies were conducted are quite different from each other. Only one study was conducted in Europe (E4). Given the well-known traditional differences in the organisation and planning of care between European and North American ICUs, it is important to clarify

and describe the basic rehabilitation care to better understand and compare the achieved outcomes. Another aspect to consider is the duration of the rehabilitation programmes, which range from ICU admission, ICU discharge, and hospital discharge to a 12-month follow-up. For this reason, it is not yet possible to conclude whether these effects are long-term or not.

The tests used to assess the obtained results are also different (S3 – Barthel Index, S4 – SF36 and 6MWT, S6 – 6MWT), as well as the moments chosen to assess them. Two studies have used the same test (the 6MWT), but in very different moments. S4 used it only at hospital discharge, while S6 used it after ICU discharge, hospital discharge, and at 3-, 6-, and 12-month follow-up after ICU discharge. Thus, it is difficult to compare results between studies. Given that different assessment tools were used, the results will also be different. Other assessment tools that can be consistently reproduced are needed to produce comparable outcome indicators. On the other hand, as the rehabilitation process has a multiprofessional and multidisciplinary nature, it is also necessary to establish results of interest to the Nursing discipline that may serve as a guide for practice and research, and this was not observed in any of the studies analysed.

Moreover, only two studies reported the control of factors such as the administration of drugs (S2 and S3), which seem to influence the development of muscle weakness, namely corticosteroids (except for S3) and neuromuscular agents (Schweickert & Hall, 2007; Griffiths & Hall, 2010). Thus, no clear conclusion can be drawn on their influence on the results obtained in the other studies. However, the results of S3 showed muscle strength gains in the patients of the intervention group, and that more than half of them were able to achieve functional independence at hospital discharge. This study was also the first one to report a decrease in the incidence of delirium, which, associated with a better physical capacity, led to shorter periods of mechanical ventilation. Patients with improved physical capacities and state of consciousness are able to participate more in their rehabilitation process, which also enhances recovery of the ability to perform self-care activities.

After a critical appraisal of the studies, it can be concluded that the quality of the evidence is moderate, and that further studies with statistical power and

control for confounding factors are needed to confirm the effectiveness of this intervention. This review confirmed that early mobilisation is feasible and safe for critically ill patients, and that it may be initiated immediately after their physiological stabilisation. In addition, considering the balance between desirable and undesirable effects, it can be concluded that early mobilisation has more positive than adverse effects. Therefore, it is recommended that early mobilisation should be introduced in the care plan for critically ill patients as early as possible during ICU stay.

In order for it to be considered as a priority, early mobilisation, as a strategy to improve the rehabilitation outcomes of critically ill patients, also entails a cultural change in the healthcare team towards a patient-centred care approach. To this end, the practices in use should be reviewed, the obstacles and constraints in the multidisciplinary team identified, and the advantages arising from the adoption of a strategy requiring more interaction with the patients and more participation of the patients in their rehabilitation process should be understood. In this respect, the nurse specialist in rehabilitation plays a key role in identifying and modifying the risk factors and implementing interventions that may enhance the onset of early rehabilitation and extend to the follow-up of these patients. This way it will be clearly possible to identify the impact on the physical and non-physical recovery, as well as on the quality of life of patients and families.

Conclusion

Given the increasing number of ICU admissions and the need for optimisation of human and financial resources, healthcare professionals should take on the responsibility of advocating and developing sustainable and efficient ways to improve the rehabilitation outcomes of patients with severe conditions, which, according to the evidence, have profound negative effects in their quality of life. Thus, the benefits resulting from a more proactive rehabilitation strategy throughout the process of recovery of critically ill patients should be continuously assessed as they are discharged from the ICU to the ward and community.

Studies on this topic and more specifically on the effects of early mobilisation are still scarce. Based on

the moderate methodological quality of the existing studies, it can be concluded that this intervention is feasible, safe, and that it facilitates functional recovery, particularly in terms of muscle strength gains and performance of some activities. There is no consensus regarding the intensity, frequency and duration of the interventions; however, evidence suggests that structured and individualised programmes may facilitate the recovery of critically ill patients. The limitations found in these studies derive from the complex responses of critically ill patients to their diseases, as well as from the lack of consistent outcome assessment tools. Moreover, the effects of administering drugs that affect muscle strength and their association with the evolution of recovery are still under-investigated.

From the point of view of rehabilitation Nursing, the presence of muscle strength gains is not enough. It is necessary to assess the extent to which these gains may contribute to empower patients to self-care, perform Basic Activities of Daily Living and reacquire the maximum possible independence, as well as verify the sustainability of the results over time, which cannot be confirmed based on the selected studies.

This review intends to provide useful data for decision-making and justification of interventions in the area of the rehabilitation of critically ill patients. Given that this area has been gaining increasing importance, controlled studies should be conducted focused on a longitudinal approach in order to identify the subpopulations of patients who may benefit the most from the introduction of early mobilisation.

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