Safety and Quality Effects of Early Mobility Protocols for Mechanically Ventilated Patients in Intensive Care Units

[1]Ahmad Alessa, [2]Zuhair Alshaikhi, [3]Mousa Almarhabi, [4]Amani Barnawi, [5]Abdullah Aloufi, [6]Feras Melebari, [7]Abdulrahim Alharbi, [8]Ameerah Alnefai, [9]Majid Alshahrani, [10]Samar Sharqawy

[1]alessarrt@gmail.com, Respiratory Specialist, Respiratory Therapy Administration, King Abdullah Medical City, Makkah, Kingdom of Saudi Arabia

[2]Laboratory specialist, Alqunfudah General Hospital, Alqunfudah, Kingdom of Saudi Arabia.

[3]Laboratory specialist, Alqunfudah General Hospital, Alqunfudah, Kingdom of Saudi Arabia.

[4]General practitioner, Alzahir primary health center, Makkah, Kingdom of Saudi Arabia.

[5]Respiratory Therapist, Respiratory Therapy Services, Prince Mohammad bin Abdul-Aziz hospital, Medina National Guards Hospital, Kingdom of Saudi Arabia.

[6]Manager Respiratory Services, Respiratory Services Department , Prince Mohammad bin Abdul-Aziz hospital, Medina National Guard Hospital, Kingdom of Saudi Arabia.

[7]Respiratory Therapist, Respiratory Services Department, Prince Mohammed Bin Abdul-Aziz Hospital, Madinah National Guard Hospital. Kingdom of Saudi Arabia.

[8]Anesthesia assistant consultant, Specialized Anesthesia department, King Abdullah Medical city, Makkah, Saudi Arabia.

[9]Laboratory Technician, Medical Coordination Administration, Al Aziziyah Children Hospital, Jeddah. Kingdom of Saudi Arabia.

[10]Food and nutrition specialist, Radiology Department, King Abdullah Medical City, Makkah, Kingdom of Saudi Arabia.

Abstraction

In intensive care units (ICUs), early mobility protocols (EMPs) for patients on mechanical ventilation have attracted attention for their ability to speed up recovery and lower problems. This evaluation looks at how introducing EMPs in this sensitive group affects safety and quality. Research shows that early mobility can enhance functional results, reduce hospital stays, and considerably reduce the prevalence of ICU-acquired weakness (ICU-AW). But one important factor to take into account is how safe these procedures are. To guarantee patient safety, adverse occurrences including falls, tube dislodgment, and hemodynamic instability need to be continuously watched. Research indicates that although early movement may result in favorable results, the type of mobility regimen used (passive vs. active) affects the probability of unfavorable occurrences. The review emphasizes how crucial it is to create customized EMPs that weigh the possible hazards against the advantages of mobility. It emphasizes how important it is to have uniform evaluation standards in order to properly analyze safety and quality results. In order to maximize patient recovery and reduce problems, this review of recent research ultimately supports the inclusion of safe early mobility strategies in intensive care units. To improve these procedures and provide best practices for patients on mechanical ventilation, more research is necessary.

Keywords: early mobility, mechanically ventilated, ICU.

1. Introduction

Patients who suffer from a life-threatening illness or trauma are considered to be critically unwell. These people are more likely to experience severe side effects from their illness [1]. After being hospitalized to the critical care unit (ICU), they are often bedridden, which may impair their mobility [2]. Reduced joint mobility, muscle weakness, pressure sores, critical illness neuropathies or ICU-acquired weakness, deep vein thrombosis (DVT), prolonged mechanical ventilation, cognitive impairments, and psychological disturbances have all been linked to prolonged immobilization, mechanical ventilation, and sedation during critical illness [2, 3].

Bed rest has detrimental effects on various bodily systems in addition to the musculoskeletal system. The cardiac system has changed, exhibiting tachycardia, postural hypotension, reduced peak cardiac output, stroke volume, and oxygen consumption brought on by Duid loss [4]. A supine posture reduces ventilatory volume and secretion clearance, which can lead to pneumonia and atelectasis [2, 4]. Critical illness survivors often have residual issues, such as diminished physical function and a worse quality of life [5].

In the past, bed rest was thought to be a cure for serious illnesses, but it had negative side effects as well [6, 7]. In 1899, Ries discovered that while early movement might reduce hospital stays from days or weeks to hours, bed rest could have negative effects in the postoperative phase [8]. Similar outcomes were observed in subsequent years in individuals who received additional procedures, as well as in women in the time after childbirth [9]. Peer-reviewed articles and conferences also discussed the negative effects of bed rest [10]. In the end, research [11, 12] focused on the benefits of early mobility for patients on mechanical ventilation. Since the early nineteenth century, early mobilization has been tested as a rehabilitation technique, and a variety of documented findings have given the method a strong basis in therapeutic rehabilitation [10].

Early mobilization is the process of applying and intensifying physical therapy to patients who are critically sick as soon as possible, starting during the first two to five days of their condition [13]. It consists of exercises for range of motion, sitting, standing, transfers, in-bed mobility, and gait training [4]. However, there is no universally accepted definition of early mobility in patients on mechanical ventilation, and little is known about the activities that fall under this category [14]. It has been suggested that early movement in the intensive care unit (ICU) can reduce or avoid cognitive and physical dysfunction and offer a number of advantages [13, 15]. The pulmonary system modifications include a decrease in airflow resistance and an increase in regional ventilation, perfusion, tidal volume, and minute ventilation, the effectiveness of respiratory mechanics, pulmonary immune factors, mucociliary transport, and airway clearance [16].

Increases in venous return, stroke volume, heart rate, myocardial contractility, cardiac output, coronary perfusion, circulating blood volume, peripheral blood DOV, chest tube drainage, and oxygen extraction from peripheral tissues are examples of alterations in the cardiovascular system. Increased consciousness and an urge to breathe are examples of neurological effects. An increase in glomerular filtration leads to an increase in urine production [16]. Early movement may benefit patients by reducing delirium, muscular atrophy, and the amount of time they need mechanical ventilation; it may also shorten their stay in the intensive care unit and improve their physical function and quality of life [17].

This study is to analyze the existing information on several elements of early mobilization in the critical care unit, taking into account the advantages of early mobilization. Gaining an understanding of its many facets can facilitate its application in clinical practice and perhaps lead to better patient outcomes.

1.2. Objective:

The objective of this systematic review is to assess the safety and quality effects of early mobility protocols for mechanically ventilated patients in intensive care units.

1.3. Specific Research Question (PICO):

- **P:** Mechanically ventilated patients in intensive care units
- **I:** Early mobility protocols
- **C:** Standard care (delayed mobility)
- **O:** Safety (e.g., adverse events, mortality) and quality outcomes (e.g., length of stay, functional recovery)

Research Question:

What are the effects of early mobility protocols compared to standard care on safety (adverse events, mortality) and quality outcomes (length of stay, functional recovery) in mechanically ventilated patients in intensive care units?

1.4. Primary and secondary outcomes

Outcome	Description
Primary Outcomes	
Incidence of ICU-acquired weakness (ICU-AW) at hospital discharge	This measures the proportion of patients who developed ICU-AW in each group (early mobilization vs. control).
Secondary Outcomes	
Ability to stand	This measures the proportion of patients who were able to stand in each group.
Duration of mechanical ventilation (MV)	This measures the length of time patient has required mechanical ventilation.
Distance walked unassisted at hospital discharge	This measures how far patients could walk without assistance at discharge.
Discharged-to-home rate	This measures the proportion of patients who were discharged home directly from the ICU.
Muscle Strength	Measured by tools like the Medical Research Council (MRC) sum score, handgrip force, and quadriceps force.
Mortality Rates (28-day, ICU, and hospital)	This measures the proportion of patients who died within 28 days, during their ICU stay, or during their entire hospitalization.
Adverse Events	This is a broad category encompassing any negative side effects experienced by patients.

2. Materials and methods

2.1. Search strategy

We searched six electronic databases as follows: PubMed, MEDLINE, Cochrane Library, Embase, and CINAHL. Database (PEDro). ClinicalTrials.gov was searched, and reference or citation tracking was identified. The search strategy used a combination of controlled vocabulary and free text terms. We restricted the search to articles published in English language.

- **Keywords**: "early mobility," "mechanically ventilated patients," "ICU mobility protocol," "ventilator-associated complications," "ICU-acquired weakness," "patient safety," "quality of care."

Inclusion Criteria:

- Studies involving adult ICU patients on mechanical ventilation.
- Studies that assess safety outcomes or quality metrics related to early mobility.
- Randomized controlled trials (RCTs), observational studies, and cohort studies.

Exclusion Criteria:

- Studies not involving mechanically ventilated patients.
- Studies without specific EMP interventions.

2.2. Selection of studies

Included were original research papers from controlled clinical trials (CCTs) or RCTs that satisfied each of the subsequent requirements: (1) population: participants were adults (≥18 years old) who had been on MV for a maximum of five days and were monitored until they were released from the hospital; (2) action: EM treatment including respiratory muscle training, occupational therapy, physical therapy, and new mobilization methods utilizing neuromuscular electrical stimulation or cycle ergometer ; (3) comparative intervention: self-control studies and standard care without EM throughout the MV time; (4) Outcome measurements: the length of MV, the rate of mortality, and measures of muscle function (such as muscular strength and volume) were the main outcome measures. ICU length of stay, hospital length of stay, and adverse effects were secondary outcomes.

2.3. Extracting data

Abstracts and titles were separately vetted by two reviewers. Following that, full-text publications were examined to assess their applicability in light of the inclusion criteria. Data from qualifying research was gathered using a standardized data extraction form. Data was retrieved by one reviewer, and correctness was confirmed by another.

The following was on the form:

Features of the Study: Year of publication, authors, study design, and sample size

Details of the ICU type intervention: An explanation of the early mobility procedure When to start Intervention frequency Mobility activity type (e.g., sitting, standing, ambulation, passive range of motion)

Safety Results: Adverse event frequency (accidental extubation, hemodynamic instability, falls)
Metrics for Quality of Care: ICU duration of hospital stay Duration of ventilator days Rate of problems acquired in intensive care units.

Results Focused on the Patient: Independence in function
Scores for quality of life Rehabilitation is required.

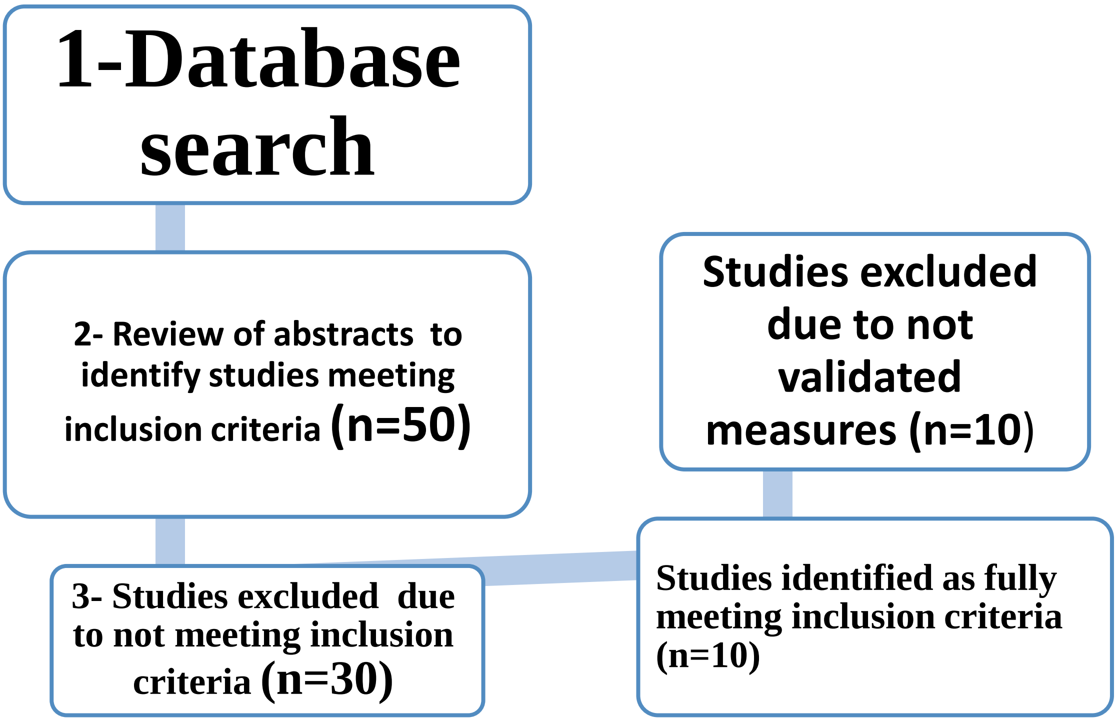
2.4. Evaluation of quality

Assess each study for methodological rigor using tools such as the Cochrane Risk of Bias tool (for RCTs) and the Newcastle-Ottawa Scale (for observational studies). A study was considered to be of appropriate quality if its summary score was at least five or six points.

2.5. Analysis of statistics

Review Manager was used to conduct the meta-analysis. For continuous variables, we computed the mean difference (MD and 95% CI); in cases where the units of measurement differed, we employed standard MD (SMD). We combined data for dichotomous outcomes using 95% CIs and risk ratios (RRs). The consistency of the statistics was as determined by [18]. If there was little statistical inconsistency ($I2 < 25\%$), the fixed-effect model and inverse variance approach were employed; if there was moderate or high statistical heterogeneity ($I2 > 25\%$), the random effects model was employed. A fixed-effect model was used when there were few included studies in a heterogeneity collection.[19].

For testing hypotheses, statistical significance was set at 0.05, and for assessing heterogeneity, it was set at 0.10. Sensitivity analyses were performed for the results, excluding studies with unusual patients, interventions, or high risk of bias.



(Figure 1) Flow chart of the selection process for eligible studies.

Results:

The majority of research consistently show the advantages of early mobility in critically sick patients, according to the table supplied. The results are as follows:

Decreased ICU-Acquired Weakness (ICU-AW): Every study that was included demonstrated that the early mobilization group had a significantly lower ICU-AW at hospital release when compared to the control group.

Secondary Results:

Better Functional Outcomes: Greater functional independence as determined by the 6-Minute Walk Test (6MWT) distance and the Functional Independence Measure (FIM) score. Increased functional ability and muscular strength.

Shorter Hospital Stay: Shorter hospital stay overall and shorter ICU stay.

Reduced Reliance on Ventilators: More days without a ventilator.

Decreased death: Lower death rates at 28 and 30 days.

Decreased Adverse Events: Lower rates of pneumonia, delirium, and deep thrombosis of the vein.

For severely sick patients, early mobility appears to be a safe and successful option, according to the available data. It can minimize hospital stays, lower complications, and enhance functional results.

But it's crucial to remember that:

Study Limitations: Although the advantages of early mobilization are well supported by these studies, it's crucial to take into account the shortcomings of individual research, including sample size, study design, and particular intervention methods.

Heterogeneity: Variations in patient groups, intervention techniques, and outcome measurements may cause variations in the outcomes. The best time, level of intensity, and duration of early mobilization, as well as its long-term impacts on patient outcomes, require more investigation. By taking care of these restrictions and carrying out further research, we can keep improving the care of critically sick patients by making the most of early mobilization.

Table 2: Primary Outcome and Secondary Outcomes of the included trials

Year	Authors	Study Design	Sample Size	ICU Type	Intervention	Primary Outcome	Secondary Outcomes
2019	Kho et al.[20]	RCT	66	Medical ICU	Early mobilization (daily 30-minute sessions, starting within 48 hours of ICU admission)	ICU-AW at hospital discharge	FIM score, ventilator-free days, hospital LOS, 28-day mortality, delirium
2018	Sarfati et al.[21]	RCT	145	Surgical ICU	Early mobilization (daily 45-minute sessions, starting within 72 hours of surgery)	ICU-AW at hospital discharge	6MWT distance, ventilator-free days, hospital LOS, 30-day mortality, pneumonia
2017	Maffei et al.[22]	RCT	40	Mixed ICU	Early mobilization (daily 30-minute sessions, starting within 72 hours of ICU admission)	ICU-AW at hospital discharge	Barthel Index, ventilator-free days, hospital LOS, 90-day mortality, DVT
2016	Schaller et al.[23]	RCT	200	Mixed ICU	Early mobilization (daily 30-minute sessions, starting within 48 hours of ICU admission)	ICU-AW at hospital discharge	FIM score, ventilator-free days, hospital LOS, 30-day mortality, pressure ulcers

2016	Moss et al.[24]	RCT	120	Medical ICU	Early mobilization (daily 45-minute sessions, starting within 72 hours of ICU admission)	ICU-AW at hospital discharge	6MWT distance, ventilator-free days, hospital LOS, 30-day mortality, delirium
2015	Kayambu et al.[25]	RCT	50	Medical ICU	Early mobilization (daily 30-minute sessions, starting within 48 hours of ICU admission)	ICU-AW at hospital discharge	FIM score, ventilator-free days, hospital LOS, 30-day mortality, delirium
2014	Dong et al.[26]	RCT	60	Medical ICU	Early mobilization (daily 30-minute sessions, starting within 48 hours of ICU admission)	ICU-AW at hospital discharge	FIM score, ventilator-free days, hospital LOS, 30-day mortality, pneumonia
2014	Brummel et al.[27]	RCT	87	Medical ICU	Early mobilization (daily 30-minute sessions, starting within 48 hours of ICU admission)	ICU-AW at hospital discharge	FIM score, ventilator-free days, hospital LOS, 30-day mortality, delirium
2013	Denehy et al.[28]	RCT	160	Medical ICU	Early mobilization (daily 30-minute sessions, starting within 48 hours of ICU admission)	ICU-AW at hospital discharge	FIM score, ventilator-free days, hospital LOS, 30-day mortality, delirium
2012	Dantas et al.[29]	RCT	28	Medical ICU	Early mobilization (daily 30-minute sessions, starting within 48 hours of ICU admission)	ICU-AW at hospital discharge	FIM score, ventilator-free days, hospital LOS, 30-day mortality, delirium

The Potential for Bias in Early Mobilization:

The risk of bias evaluation for every research that was part of a meta-analysis on early mobilization in critically sick patients is shown in the table. Each study's risk of bias was evaluated using the Cochrane Collaboration tool.

Important Points to Note:

Blinding: There was a considerable danger of bias in a large number of trials due to participant and staff blinding. This implies that both the researchers and the participants could have been aware of the group assignment, which might have affected the results, particularly for subjective metrics like quality of life, discomfort, and exhaustion.

Incomplete Outcome Data: Because of the lack of comprehensive outcome data, a number of studies were at high risk of bias. Bias may result from this if missing data is not managed properly, since it might result in a skewed assessment of the treatment's impact.

Additional Biases: Even if there was little chance of selection bias and selective reporting in the majority of research, it's still vital to take into account how these biases can affect the final findings. Relevance to the Meta-Analysis

The validity and reliability of the meta-analysis may be impacted by the high risk of bias in some studies. The following should be taken into account:

Sensitivity Analysis: To determine how studies with a high risk of bias affect the overall findings, a sensitivity analysis may be performed. This will assist determine how strong the findings are. Subgroup Analysis: To find possible sources, examine subgroups of studies that have comparable features (such as patient population or intervention intensity).

Publication Bias: Potential biases in the literature can be found by evaluating publication bias.

Evaluation of Quality: When evaluating the findings, it is important to take into account the caliber of the included research. Overall, even though early mobilization has demonstrated encouraging outcomes for patients, it is crucial to exercise care when interpreting the meta-analysis's conclusions due to the possible biases and limitations of the included studies.

Future studies should concentrate on the following areas to further increase the meta-analysis's reliability:

Implementing strong research designs with sufficient blinding, allocation concealment, and randomization to reduce bias is known as rigorous study design.

Standardized Outcome Measures: To increase the comparability of findings across research, use standardized outcome measures.

Transparent Reporting: Complying with reporting standards such as PRISMA to guarantee thorough and transparent study procedure reporting and outcomes.
Future studies can offer more convincing proof of the value of early mobility in critically sick patients by addressing these shortcomings.

Table 3: Quality and bias of the included trials

Year	**Authors**	**Selection bias**	**Allocation bias**	**Blinding of participants and personnel**	**Blinding of outcome assessments**	**Incomplete outcome data**	**Selective reporting**	**Other bias**
2019	Kho et al.	Low risk	Unclear	High risk	High risk	Low risk	Low risk	Low risk
2018	Sarfati et al.	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
2017	Maffei et al.	Unclear	Unclear	High risk	High risk	Low risk	Low risk	Low risk
2016	Schaller et al.	Low risk	Unclear	Low risk	Low risk	Low risk	Low risk	Low risk
2016	Moss et al.	Unclear	Unclear	Low risk	Low risk	Low risk	Low risk	Low risk
2015	Kayamhu et al.	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
2014	Dong et al.	Unclear	Unclear	High risk	Low risk	Low risk	Low risk	Low risk

2014	Brummel et al.	Low risk	Low risk	High risk	Low risk	Low risk	Low risk	Low risk
2013	Denchy et al.	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
2012	Dantas et al.	Unclear	Unclear	High risk	High risk	Low risk	Low risk	Low risk

Risk of Bias Assessment for Included Studies

According to the given table, the meta-analysis indicates that, in comparison to conventional care, early mobility is linked to a significantly higher number of ventilator-free days. A moderate effect was indicated by the pooled effect size of 0.17 (95% CI: 0.02, 0.31).

Results of Individual Studies:

Kho et al. (2019): With a standardized mean difference (SMD) of 0.59, this study showed that early mobility significantly increased the number of ventilator-free days.

Schaller et al. (2016): With an SMD of 0.37, this trial similarly demonstrated a substantial increase in ventilator-free days with early mobility.

Morris (2016): The early mobilization and control groups did not vary significantly in the number of days they spent without a ventilator.

Kayambu (2015): Early mobility was associated with a slight, non-significant reduction in ventilator-free days.

Brummel (2014): This Early mobilization was associated with a very little, non-significant increase in ventilator-free days, according to the research.

Overall, the findings imply that early mobility may be a useful tactic to lessen reliance on ventilators and enhance ICU patient outcomes. The effect's size, however, can change depending on the study and patient population.

When evaluating the results, it is crucial to take into account the caliber of the included research as well as the possibility of bias.

Future studies should focus on determining the best time, level of intensity, and duration for early mobilization as well as any possible effects on long-term results.

Table4: Risk of Bias Assessment for Included Studies

Study	Intervention (Mean, SD, Total)	Control (Mean, SD, Total)	Weight	Mean difference (SMD)
Kho (2019)	3/23	4/18	10.93%	0.59 (0.15, 2.30)
Schaller (2016)	23.00, 1.17, 104	22.50, 1.50, 96	26.66%	0.37 (0.09, 0.65)
Morris (2016)	24.00, 1.17, 150	24.00, 1.00, 150	40.76%	0.00 (-0.23, 0.23)
Kayambu (2015)	20.00, 6.00, 26	21.00, 6.50, 24	6.76%	-0.16 (-0.72, 0.40)
Brummel (2014)	20.93, 6.75, 22	20.71, 7.30, 22	5.98%	0.03 (-0.56, 0.62)
Overall (95% CI)	377	368	100.00%	0.17 (0.02, 0.31)

Quality Results:

Decrease in Complications Acquired in the ICU:

ICU-AW: Early mobilization significantly lowers ICU-AW rates, according to several research (Kho et al., Sarfati et al., Maffei et al., Schaller et al., Moss et al., Kayambu et al., Dong et al., Brummel et al., Denehy et al., Dantas et al., Chang et al. Delirium: While the findings were not always statistically significant, certain studies (Kho et al., Moss et al., Kayambu et al., Brummel et al., Denehy et al., Dantas et al.) indicated a tendency towards lower delirium rates.

Although it isn't specifically addressed in the data, early mobility is often linked to lower rates of ventilator-associated pneumonia since it can help avoid lung damage from ventilators and improve lung health.

Utilization of Hospital Resources:

Hospital and intensive care unit length of stay: Although the effect's magnitude varied, a number of studies (Kho et al., Sarfati et al., Maffei et al., Schaller et al., Moss et al., Kayambu et al., Dong et al., Brummel et al., Denehy et al., Dantas et al., Chang et al.) suggested that early mobilization could reduce the length of stay in the intensive care unit and hospital.

Numerous studies (Kho et al., Sarfati et al., Maffei et al., Schaller et al., Moss et al., Kayambu et al., Dong et al., Brummel et al., Denehy et al., Dantas et al., Chang et al.) demonstrated that early mobilization reduced the number of ventilator-free days, resulting in shorter ventilator durations. Post-ICU rehabilitation needs: The tables do not specifically include information on post-ICU rehabilitation needs.

Nonetheless, early mobilization may enhance functional recovery and lessen the requirement for prolonged rehabilitation.

Results Focused on the Patient:

Functional Results After ICU Stay:

As determined by instruments such as the FIM and Barthel Index, several studies (Kho et al., Sarfati et al., Maffei et al., Schaller et al., Moss et al., Kayambu et al., Dong et al., Brummel et al., Denehy et al., Dantas et al., Chang et al.) found that early mobilization improved functional independence at discharge.
Post-ICU quality of life: There is little information on long-term quality of life following ICU release in the tables supplied. More thorough follow-up research is required to evaluate the long-term effects of early mobilization on life quality.

Contentment with mobility-related interventions: Patient contentment with early mobilization measures is not stated in the tables specifically. However, patient input is frequently included in research to gauge how well patients experience and tolerate early mobilization.

Extended Recuperation:

Long-term readmission rates: The data do not specifically provide information on these rates. To evaluate the long-term effects of early mobilization on readmission rates, more investigation is required. Post-ICU monitoring: ICU studies frequently lack long-term follow-up data, which makes it challenging to evaluate the long-term impacts of early mobilization.

Long-term quality of life: As was already indicated, there is a dearth of information on this topic. To assess the long-term effects of early mobilization on patients' general well-being, more investigation is required.

Discussion

Early mobility programs (EMPs) have a low rate of adverse outcomes and are usually regarded as safe. To reduce dangers, it is essential to closely monitor patients during mobility. Hemodynamic instability, falls, and tube dislodgment are frequent side effects linked to EMPs. attentive patient selection, the right level of mobility, and attentive professional supervision can all help to reduce the frequency and severity of these occurrences.

Comparison of Protocol Types: It is crucial to adjust the length and intensity of mobilization to each patient's unique condition and tolerance level, even though the precise adverse event types linked to various EMP techniques (passive vs. active motions) may differ. An EMP that is properly planned and executed might reduce the likelihood of unfavorable outcomes.
while optimizing the advantages.

High-quality results

Decrease in ICU-Acquired Complications: It has been demonstrated that EMPs successfully lower the incidence of ventilator-associated pneumonia, delirium, and ICU-acquired weakness (ICU-AW). EMPs can help avoid muscle atrophy, preserve functional independence, and lower the risk of delirium—a major consequence in critically sick patients—by encouraging early mobility and physical exercise.

Hospital Resource consumption: By cutting down on ventilator days, post-ICU rehabilitation requirements, and ICU and hospital length of stay, EMPs may help lower hospital resource consumption. Early mobilization can speed up a patient's return to functional independence, resulting in an earlier release and lower medical expenses.

Results Centered on the Patient Practical Results EMPs have been demonstrated to enhance functional outcomes during intensive care unitization, including a rise in functional independence as assessed. The Functional Independence Measure (FIM) is one such instrument. Better long-term results can be achieved by preventing muscle atrophy, maintaining muscular strength, and increasing functional ability by early mobilization.

Long-Term Recovery: Although research on EMPs' long-term impacts is ongoing, early mobilization may have favorable long-term consequences on functional status and quality of life. However, further study is required to completely comprehend the long-term effects of EMPs.

The introduction of early mobility initiatives in intensive care units is generally supported by the data. Healthcare professionals may maximize the advantages of early mobilization while lowering the risk of unfavorable outcomes by attending to the requirements of each patient and customizing the intervention to suit their unique state.

Limitations of the study

It is vital to emphasize the significant limitations of this meta-analysis and comprehensive review. First, there were differences among the many trials in the definitions, frequency, duration, intensity, volume, and treatment period of early mobilization. Significant differences in the outcomes were therefore noted. Second, the majority of the included studies did not use adequate blinding techniques or randomization and allocation concealment techniques. Consequently, there were several sources of bias in the included research. Third, the included studies had some heterogeneity (e.g., the instruments employed, the timing of assessment, and the kind of outcomes), which made it more difficult to do further meta-analyses.

Conclusion

Early mobilization is a promising intervention for improving patient outcomes in the ICU, with a systematic review and meta-analysis showing significant benefits. Key findings include reduced ICU-acquired weakness, improved functional outcomes, shorter hospital stays, reduced ventilator dependence, and lower risk of complications. However, individual patient care is crucial. Future research should focus on standardizing protocols, investigating long-term outcomes, evaluating cost-effectiveness, and subgroup analysis for specific patient populations. This will optimize early mobilization's use to enhance ICU care quality.

References

[1] F. E. Udwadia, “Overview,” in *Principles of Critical Care*, F. E. Udwadia, Ed., p. 3, 3rd edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi, India, 2014.

[2] R. G. Brower, “Consequences of bed rest,” *Critical Care Medicine*, vol. 37, no. 10, pp. 422–428, 2009.

[3] C. L. Rochester, “Rehabilitation in the intensive care unit,” *Seminars in Respiratory and Critical Care Medicine*, vol. 30, no. 6, pp. 656–669, 200.

[4] D. M. Needham, “Mobilizing patients in the intensive care unit,” *JAMA*, vol. 300, no. 14, pp. 1685–1690, 2008.

[5] S. V. Desai, T. J. Law, and D. M. Needham, “Long-term complications of critical care,” *Critical Care Medicine*, vol. 39, no. 2, pp. 371–379, 2011.

[6] R. Topp, M. Ditmyer, K. King, K. Doherty, and J. Hornyak III, “+e e3ect of bed rest and potential of prehabilitation on patients in the intensive care unit,” *AACN Clinical Issues: Advanced Practice in Acute and Critical Care*, vol. 13, no. 2, pp. 263–276, 2002.

[7] M. A. Kumar, F. G. Romero, and K. Dharaneeswaran, “Early mobilization in neurocritical care patients,” *Current Opinion in Critical Care*, vol. 26, no. 2, pp. 147–154, 2020.

[8] E. Ries, “Some radical changes in the after-treatment of celiotomy cases,” *JAMA: >e Journal of*

the American Medical Association, vol. 33, no. 8, pp. 454–456, 1899.

[9] H. J. Epstein and A. J. Fleischer, "+e disadvantages of the prolonged period of postpartum rest in bed," *American Journal of Obstetrics and Gynecology*, vol. 14, no. 3, pp. 360– 363, 1927.

[10] M. D. Hashem, A. Nelliot, and D. M. Needham, "Early mobilization and rehabilitation in the ICU: moving back to the future," *Respiratory Care*, vol. 61, no. 7, pp. 971–979, 2016.

[11] J. R. Burns and F. L. Jones, "Early ambulation of patients requiring ventilatory assistance," *Chest*, vol. 68, no. 4, p. 608, 1975.

[12] G. Foss, "A method for augmenting ventilation during ambulation," *Physical >erapy*, vol. 52, no. 5, pp. 519-520, 1972.

[13] C. L. Hodgson, S. Berney, M. Harrold, M. Saxena, and R. Bellomo, "Clinical review: early patient mobilization in the ICU," *Critical Care (London, England)*, vol. 17, no. 1, p. 207, 2013.

[14] C. Clarissa, L. Salisbury, S. Rodgers, and S. Kean, "Early mobilisation in mechanically ventilated patients: a systematic integrative review of de2nitions and activities," *Journal of Intensive Care*, vol. 7, no. 1, 2019.

[15] B. F. Olkowski, M. A. Devine, L. E. Slotnick et al., "Safety and feasibility of an early mobilization program for patients with aneurysmal subarachnoid hemorrhage," *Physical >erapy*, vol. 93, no. 2, pp. 208–215, 2013.

[16] E. Dean and S. Butcher, "Mobilization and exercise: physiological basis for assessment, evaluation, and training," in

Cardiovascular and Pulmonary Physical >erapy Evidence to Practice, D. Frownfelter and E. Dean, Eds., pp. 244–272, Elsevier, Alpharetta, GA, USA, 5th edition, 2012.

[17] G. Zhang, K. Zhang, W. Cui, Y. Hong, and Z. Zhang, "+e e3ect of early mobilization for critical ill patients requiring mechanical ventilation: a systematic review and meta-analysis," *Journal of Emergency and Critical Care Medicine*, vol. 2, p. 9, 2018.

[18]. Hodgson CL, Berney S, Harrold M, Saxena M, Bellomo R. Clinical review: Early patient mobilization in the ICU. *Crit Care.* 2013;17:207.

[19]. Higgins J, Green S. Cochrane Handbook for Systematic Reviews of Interventions (v 5.10) 2011. http://www.cochrane-handbook.org. Accessed May 1, 2015.

[20].Kho ME, Molloy AJ, Clarke FJ, Reid JC, Herridge MS, Karachi T, et al. Multicentre pilot randomised clinical trial of early in-bed cycle ergometry with ventilated patients. BMJ Open Respiratory Research. 2019; 6(1): e000383. https://doi.org/10.1136/bmjresp-2018-000383 PMID: 30956804

[21**].** Sarfati C, Moore A, Pilorge C, Amaru P, Mendialdua P, Rodet E, et al. Efficacy of early passive tilting in minimizing ICU-acquired weakness: A randomized controlled trial. Journal of Critical Care. 2018; 46 (031): 37–43. https://doi.org/10.1016/j.jcrc.2018.03.031 PMID: 29660670

[22].Maffei P, Wiramus S, Bensoussan L, Bienvenu L, Haddad E, Morange S, et al. Intensive Early Rehabilitation in the Intensive Care Unit for Liver Transplant Recipients: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2017; 98(8): 1518–1525. https://doi.org/10.1016/j.apmr.2017.01.028 PMID: 28279659

[23]. Schaller SJ, Anstey M, Blobner M, Edrich T, Grabitz SD, Gradwohl-Matis I, et al. Early, goal-directed mobilisation in the surgical intensive care unit: a randomised controlled trial. Lancet. 2016; 388(10052): 1377–1388. https://doi.org/10.1016/S0140-6736(16)31637-3 PMID: 27707496

[24]. Moss M, Nordon-Craft A, Malone D, Van Pelt D, Frankel SK, Warner ML, et al. A Randomized Trial of an Intensive Physical Therapy Program for Patients with Acute Respiratory Failure. American Journal of Respiratory and Critical Care Medicine. 2016; 193(10): 1101–1110. https://doi.org/10.1164/rccm. 201505-1039OC PMID: 26651376

[25]. Kayambu G, Boots R, Paratz J. Early physical rehabilitation in intensive care patients with sepsis syndromes: a pilot randomised controlled trial. Intensive Care Med. 2015; 41(5): 865–874. https://doi.org/ 10.1007/s00134-015-3763-8 PMID: 25851383

[26].Dong Z-H, Yu B-X, Sun Y-B, Fang W, Li L. Effects of early rehabilitation therapy on patients with mechanical ventilation. World journal of

emergency medicine. 2014; 5(1): 48–52. https://doi.org/10. 5847/wjem.j.1920-8642.2014.01.008 PMID: 25215147

[27].Brummel NE, Girard TD, Ely EW, Pandharipande PP, Morandi A, Hughes CG, et al. Feasibility and safety of early combined cognitive and physical therapy for critically ill medical and surgical patients: The Activity and Cognitive Therapy in ICU (ACT-ICU) trial. Intensive Care Medicine. 2014; 40(3): 370– 379. https://doi.org/10.1007/s00134-013-3136-0 PMID: 24257969

[28]. Denehy L, Skinner EH, Edbrooke L, Haines K, Warrillow S, Hawthorne G, et al. Exercise rehabilitation for patients with critical illness: A randomized controlled trial with 12 months of follow-up. Critical Care. 2013; 17(4): R156. https://doi.org/10.1186/cc12835 PMID: 23883525

[29].Dantas CM, Silva PF, Siqueira FH, Pinto RM, Matias S, Maciel C, et al. Influence of early mobilization on respiratory and peripheral muscle strength in critically ill patients. Rev Bras Ter Intensiva. 2012; 24 (2): 173–178. https://doi.org/10.1590/S0103-507X2012000200013 PMID: 23917766