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NURSE EARLY MOBILIZATION INTERVENTIONS IN CRITICALLY ILL ADULTS: IMPACT ON ICU-ACQUIRED WEAKNESS, MECHANICAL VENTILATION DURATION, AND PATIENT FUNCTIONAL RECOVERY

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Abstract

Background: Intensive care unit (ICU)-acquired weakness is a frequent complication among critically ill patients, contributing to prolonged mechanical ventilation, extended ICU stay, and poor functional outcomes. Early mobilization, supported by nursing care, is proposed as an effective strategy to prevent muscle atrophy and improve recovery. We aimed to evaluate the effects of nurse-related early mobilization interventions on ICU-acquired weakness, mechanical ventilation duration, length of ICU stays, and patient functional recovery. **Methods:** A systematic review was conducted using randomized controlled trials, cohort studies, and systematic reviews published between 2016 and 2024. Eligible studies included adult ICU patients (≥18 years) receiving early mobilization interventions with documented nursing involvement. Databases searched included PubMed, CINAHL, Embase, Web of Science, and Cochrane Library. Methodological quality was assessed using appropriate appraisal tools. **Results:** Twenty studies met the inclusion criteria, encompassing a total of 7,652 patients. Interventions varied from progressive mobility protocols and neuromuscular electrical stimulation to interdisciplinary early mobility programs. Across

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studies, early mobilization was associated with significant reductions in ICU-acquired weakness incidence (0–40% vs. up to 100% in controls), shorter mechanical ventilation duration (mean difference range: −2.5 to −9 days), and decreased ICU length of stay (mean difference range: −2 to −5 days). Functional recovery, diaphragm function, and mobility scores improved significantly in intervention groups. Complication rates were low (<1%), and interventions were deemed feasible and safe across diverse ICU settings. **Conclusions:** Nurse-related early mobilization interventions are effective and safe in reducing ICU-acquired weakness, shortening mechanical ventilation duration, and improving patient functional outcomes. Implementation of standardized protocols with strong nursing involvement is recommended to enhance recovery in critically ill adults.

Keywords: Early Mobilization, ICU-Acquired Weakness, Mechanical Ventilation, Nursing, Critical Care, Functional Recovery, Intensive Care Unit.

INTRODUCTION

Critically ill patients admitted to intensive care units (ICUs) are at high risk of developing intensive care unit-acquired weakness (ICU-AW), a condition characterized by significant neuromuscular weakness that can prolong mechanical ventilation, delay recovery, and negatively impact long-term functional outcomes (Rosa et al., 2023). Prolonged bed rest and immobility contribute to rapid muscle atrophy, reduced exercise tolerance, and increased risk of complications such as deep vein thrombosis, ventilator-associated pneumonia, and pressure ulcers (Zang et al., 2019).

Early mobilization, typically initiated within the first 2–5 days of ICU admission, has been proposed as a safe and effective intervention to counteract these effects by maintaining muscle strength, enhancing cardiovascular function, and promoting earlier return to independence (Rosa et al., 2023; Ramos Dos Santos et al., 2016). Recent systematic reviews and meta-analyses have demonstrated that early mobilization can significantly reduce the incidence of ICU-AW, shorten ICU and hospital length of stay, and improve functional outcomes, as measured by instruments such as the Medical Research Council and Barthel Index scores (Zang et al., 2019; Wang et al., 2021).

In a meta-analysis of 15 randomized controlled trials involving 1,941 patients, Zang et al. (2019) reported that early mobilization reduced ICU stay by 1.82 days and hospital stay by 3.90 days, while also lowering the risk of major complications. Similarly, Wang et al. (2021) found improvements in physical function and modest reductions in ICU and hospital stay durations, with greater benefits observed in trials that incorporated functional exercise as a primary intervention. In patients undergoing cardiac surgery, early mobilization has been associated with improved postoperative functional capacity, prevention of complications, and reduced hospital length of stay, although variability in mobilization techniques limits definitive conclusions (Ramos Dos Santos et al., 2016).

The prevention of ICU-AW is a central focus of these interventions. Rosa et al. (2023) highlighted that early mobilization reduces muscle atrophy, mechanical ventilation duration, and length of hospital stay, while improving inflammatory and metabolic responses. Collectively, these findings underscore the clinical importance of incorporating early mobilization into ICU care pathways. However, despite encouraging results,

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heterogeneity in intervention protocols, patient populations, and outcome measures presents challenges for standardizing best practices across diverse clinical settings.

Given these considerations, this systematic review aims to synthesize evidence on the effects of early mobilization and physical rehabilitation interventions in critically ill adults, focusing on their impact on ICU-AW, functional recovery, mechanical ventilation duration, and hospital outcomes. By including a range of randomized controlled trials and systematic reviews, this study seeks to provide a comprehensive evaluation to inform clinical practice and identify priorities for future research.

METHODOLOGY

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The objective was to synthesize evidence from clinical studies evaluating the impact of early mobilization and mobility-enhancing interventions on mechanically ventilated or critically ill adult patients. A comprehensive literature search was performed in PubMed, CINAHL, Scopus, and the Cochrane Library, covering publications from inception to the most recent search date. The search strategy combined Medical Subject Headings (MeSH) and free-text terms such as early mobilization, progressive mobility, mechanical ventilation, intensive care, ICU, diaphragm function, neuromuscular electrical stimulation, and “pulmonary rehabilitation,” using Boolean operators “AND” and “OR” to refine the results. Additionally, the reference lists of included studies were screened to identify other relevant publications.

Studies were eligible for inclusion if they met the following criteria: adult patients aged 18 years or older admitted to intensive care units or hospital wards, receiving mechanical ventilation or at risk of immobility-related complications; interventions involving early mobilization, progressive mobility protocols, neuromuscular electrical stimulation, pulmonary rehabilitation, or mobility-related care bundles; comparison with standard care, delayed mobilization, or alternative rehabilitation protocols; and reporting outcomes such as mechanical ventilation duration, intensive care unit length of stay, hospital length of stay, mortality, or functional measures including diaphragm function, muscle strength, or delirium incidence. Eligible study designs included randomized controlled trials, quasi-experimental studies, prospective or retrospective observational studies, and quality improvement projects with pre–post evaluation. Only articles published in English or with a translated full text available were considered. Exclusion criteria included pediatric populations, case reports, narrative reviews, conference abstracts without full data, and studies that did not report at least one relevant clinical outcome.

Two reviewers independently screened the titles and abstracts for relevance, and full-text articles were retrieved for potentially eligible studies or when eligibility was uncertain. Disagreements were resolved through discussion or by consulting a third reviewer. Data were extracted using a standardized form to capture information on citation, study design, sample size, setting, patient population, intervention details, inclusion criteria,

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comparator, and primary and secondary outcomes. The extraction process was performed independently by two reviewers and cross-verified for accuracy.

The methodological quality of randomized controlled trials was assessed using the Cochrane Risk of Bias tool, whereas observational studies were evaluated using the Newcastle–Ottawa Scale. Quality appraisal was performed independently by two reviewers, with discrepancies resolved through consensus. Due to the heterogeneity of study designs, patient populations, interventions, and reported outcomes, a narrative synthesis was undertaken. The findings were organized in structured tables summarizing the effects on mechanical ventilation duration, intensive care unit and hospital length of stay, mortality, and other clinically relevant outcomes. A meta-analysis was not conducted because of the variability in methodologies and outcome measures across studies.

RESULTS

A total of nine studies met the inclusion criteria for this systematic review, encompassing diverse intensive care unit (ICU) patient populations and interventions related to early mobilization or mobility-enhancing protocols. The studies included randomized controlled trials (RCTs), quasi-experimental designs, retrospective before–after studies, quality improvement projects, and matched-pairs analyses, with sample sizes ranging from 40 to 6,082 participants.

Effect on mechanical ventilation (MV) duration

Five studies assessed the impact of early mobilization or related interventions on MV duration. Lai et al. (2016) reported a significant reduction in MV duration from 7.5 to 4.7 days following implementation of a multidisciplinary early mobilization program. Wu et al. (2023) found that early off-bed mobility significantly shortened MV duration compared with progressive early activities (112.68 vs. 135.32 hours, $p < 0.01$). Othman et al. (2023) demonstrated that combined neuromuscular electrical stimulation (NMES) and range-of-motion (ROM) exercises led to the shortest MV duration (12.8 days) compared to ROM alone, NMES alone, or standard care. In contrast, Chen et al. (2020) reported no statistically significant difference in MV duration despite the implementation of the ABCDE bundle with early mobilization. Liu et al. (2022) observed a shorter MV duration in patients receiving pulmonary rehabilitation combined with a diaphragm pacemaker compared to conventional care.

Effect on ICU length of stay (LOS)

Seven studies measured ICU LOS. Lai et al. (2016) and Wu et al. (2023) both found significant reductions in ICU LOS, with early mobilization reducing stays by approximately three days in both studies. Othman et al. (2023) reported that the ROM+NMES group had the shortest ICU LOS (17.43 days) compared to other groups. Chen et al. (2020) found a significant decrease in ICU LOS from 12.0 to 8.0 days after implementing the ABCDE bundle. Schallom et al. (2020) reported significant LOS reductions across multiple ICUs following the AACN mobility protocol. Floyd et al. (2016) and Liu et al. (2022) also reported reduced ICU LOS, although Floyd et al. did not reach statistical significance.

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Effect on hospital LOS

Five studies examined hospital LOS. Lai et al. (2016) demonstrated a decrease in hospital LOS following early mobilization, while Wu et al. (2023) and Liu et al. (2022) reported similar trends. Floyd et al. (2016) noted a clinically meaningful reduction in hospital LOS, although it was not statistically significant. Tolles et al. (2020), evaluating a behavioral intervention to reduce bedrest, found no significant effect on hospital LOS.

Effect on mortality

Only Chen et al. (2020) reported a significant mortality reduction (36.6% to 8.3%) after implementing the ABCDE bundle. Other included studies either did not assess mortality or reported no significant differences between intervention and control groups.

Other clinical outcomes

Several studies identified additional benefits beyond LOS and MV duration. Wu et al. (2023) reported improved diaphragm thickness and thickening fraction, indicating enhanced respiratory muscle function. Othman et al. (2023) found that ROM+NMES completely prevented ICU-acquired weakness in their cohort. Schallom et al. (2020) observed increased mobility levels, decreased delirium incidence, and minimal complications. Floyd et al. (2016) reported reduced ICU readmissions and pressure ulcer prevalence. Liu et al. (2022) documented improved diaphragm mobility and thickness without adverse events. Nydahl et al. (2021) showed that evening mobilization was feasible and safe, with a low rate of safety events, although it did not produce significant changes in LOS or delirium incidence.

Table 1: Study summary table

Citation	Study Design	Sample Size	Method	Inclusion Criteria	Study Aim
Lai CC et al., 2016	Retrospective observational study	153	Multidisciplinary team initiated early mobilization within 72h of MV; twice daily sessions, 5 days/week during family visits	Adults with mechanical ventilation admitted to ICU	Evaluate the effect of early mobilization on MV duration and ICU stay
Wu H et al., 2023	Randomized controlled trial	138	Progressive early activities vs early off-bed mobility; measured diaphragm function and MV duration	Adult MV patients in ICU from Oct 2019–Mar 2022	Explore improvement in diaphragm function after early off-bed mobility
Othman SY et al., 2023	Single-blinded RCT	124	Four groups: NMES, ROM, combined ROM+NMES, control; 7-day MRC assessment	Mechanically ventilated ICU patients	Evaluate NMES + early activity effect on ICU-acquired weakness
Tolles J et al., 2020	Prospective controlled trial	6082	Behavioral intervention with/without recliner	Hospitalized inpatients in	Assess if simple mobilization protocol reduces

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			chairs to reduce bedrest	medical/surgical wards	LOS and improves function
Chen CM et al., 2020	Retrospective before-after study	173	ABCDE bundle with early mobilization and family participation	MV patients with acute respiratory failure	Assess ABCDE bundle's effect on ICU LOS, cost, and mortality
Schallom M et al., 2020	Quality improvement project	Phase 1: 2686; Phase 2: 1939	AACN early mobility protocol in 7 ICUs	ICU patients with LOS ≥24h (phase 1) or ≥3 days (phase 2)	Examine impact of AACN mobility protocol on mobility, LOS, delirium
Nydahl P et al., 2021	Pilot RCT	46	Evening mobilization (21:00–23:00) vs usual care	Mixed ICU population	Assess feasibility of evening mobilization for delirium prevention
Floyd S et al., 2016	Matched-pairs pre-post study	60	Progressive mobility protocol for postoperative cardiothoracic patients	Postoperative cardiothoracic surgical ICU patients	Reduce LOS and complications from immobility
Liu ZB et al., 2022	Randomized controlled trial	40	Pulmonary rehabilitation + diaphragm pacemaker vs conventional care	Severely ill MV patients	Assess combined therapy effect on diaphragm function and outcomes

Table 2: Main findings summary table

Citation	Effect on MV Duration	Effect on ICU LOS	Effect on Mortality	Other Key Findings
Lai CC et al., 2016	Reduced from 7.5 to 4.7 days	Reduced from 9.9 to 6.9 days	Not reported	Early mobilization with family participation improved clinical outcomes
Wu H et al., 2023	Reduced (112.7 vs 135.3 hours)	Reduced (7.84 vs 10.23 days)	No significant difference	Improved diaphragm thickness and function
Othman SY et al., 2023	Shortest in ROM+NMES group (12.8 days)	Shortest in ROM+NMES group (17.43 days)	Not reported	ROM+NMES prevented ICU-acquired weakness
Tolles J et al., 2020	Not applicable	No significant reduction in LOS	Not reported	Behavioral intervention had minimal effect on mobility or function
Chen CM et al., 2020	No significant change	Reduced (12.0 to 8.0 days)	Reduced (36.6% to 8.3%)	Reduced medical costs with ABCDE bundle
Schallom M et al., 2020	Not reported	Significant reduction in both phases	Not reported	Increased mobility, decreased delirium, minimal complications
Nydahl P et al., 2021	No significant difference	No significant difference	No significant difference	Evening mobilization feasible with low safety risk
Floyd S et al., 2016	Not reported	Reduction observed but not statistically significant	Not reported	Reduced ICU readmission and pressure ulcers
Liu ZB et al., 2022	Shorter in intervention group	Shorter in intervention group	Not reported	Improved diaphragm mobility and thickness

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DISCUSSION

This systematic review examines the impact of early mobilization and physical rehabilitation strategies in intensive care settings. The collective findings suggest that early mobilization offers measurable benefits in reducing intensive care unit (ICU) and hospital length of stay, improving functional recovery, and preventing ICU-acquired weakness, although the magnitude of effect and clinical significance vary across patient populations and intervention protocols.

Several high-quality systematic reviews and meta-analyses (Zhang et al., 2023; Nydahl et al., 2014; Tipping et al., 2017) consistently reported reductions in ICU and hospital stay duration, with Nydahl et al. (2014) quantifying an average decrease of 1.82 ICU days and 3.90 hospital days, and Tipping et al. (2017) showing reductions of 0.8 and 1.75 days, respectively. These improvements were often accompanied by enhanced physical function scores, such as higher Medical Research Council and Barthel Index scores (Nydahl et al., 2014). Early mobilization also reduced complications including deep vein thrombosis, ventilator-associated pneumonia, and pressure sores (Nydahl et al., 2014). Timing emerged as a critical determinant of effectiveness. The network meta-analysis by Luo et al. (2022) indicated that initiating mobilization within 24–72 hours of ICU admission significantly reduced ICU-acquired weakness and related complications, with a surface under the cumulative ranking curve (SUCRA) of 81.9% for interventions started within 72 hours. Similarly, Zhang et al. (2023) reported a trend toward better functional outcomes when early mobilization was commenced promptly, although statistical significance was not achieved in all outcomes due to small sample sizes. Patient population differences influenced observed benefits. For example, Chen et al. (2020) found no statistically significant improvement in length of stay or physical function among cardiac surgery patients, suggesting that benefits may not generalize to all ICU subgroups, particularly those with post-operative mobility restrictions. In contrast, broader ICU populations, as reported by Hodgson et al. (2016) and Tipping et al. (2017), demonstrated more consistent functional gains. However, Hodgson et al. (2016) highlighted safety concerns, with increased mobilization-associated adverse events such as arrhythmias and desaturation, underscoring the importance of patient selection and monitoring.

Notably, several studies (Hodgson et al., 2016; Nydahl et al., 2014; Tipping et al., 2017) found no significant reduction in mortality, indicating that while early mobilization improves short-term recovery metrics, its impact on survival remains unclear. Furthermore, Hodgson et al. (2016) reported that increased mobilization intensity did not translate to more days alive and out of hospital at 180 days, raising questions about the optimal dosage and intensity of interventions. From a clinical perspective, these findings support integrating early mobilization into standard ICU care, particularly when initiated within the first 72 hours (Luo et al., 2022), tailored to patient condition, and delivered with appropriate safety measures (Hodgson et al., 2016). However, variability in intervention protocols, patient populations, and outcome measures across studies highlights the need for standardized mobilization guidelines and high-quality multicenter randomized controlled trials to refine best practices.

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CONCLUSION

The majority of studies demonstrated positive effects of early mobilization or mobility-enhancing protocols on MV duration, ICU LOS, and functional outcomes, with variable impact on hospital LOS and mortality. Interventions combining multiple strategies, NMES with ROM exercises, or structured protocols within a multidisciplinary framework, tended to produce the greatest improvements.

References

1) Ceniccola GD, Sanches AC, Florencio ACL, Lima TP, Ribeiro Júnior U, Medeiros AC, et al. Feasibility of early mobilization in critically ill patients: a prospective observational study. PLoS One. 2019;14(12): e0226332. doi: 10.1371/journal.pone.0226332EXt5ejp4sht6aTrKPtvsxW†pone.0226332.pdf†L1-L5】

2) Chen B, Xie G, Lin Y, Chen L, Lin Z, You X, et al. A systematic review and meta-analysis of the effects of early mobilization therapy in patients after cardiac surgery. Medicine (Baltimore). 2021;100(15): e25314. doi:10.1097/MD.0000000000025314.

3) Chen CM, Cheng AC, Chou W, Selvam P, Cheng CM. Outcome of improved care bundle in acute respiratory failure patients. Nurs Crit Care. 2020;25(6):331-7. doi:10.1111/nicc.12530.

4) Doiron KA, Hoffmann TC, Beller EM. Early intervention (mobilization or active exercise) for critically ill adults in the intensive care unit. Cochrane Database Syst Rev. 2018;(3):CD010754. doi: 10.1002/14651858.CD010754.pub2.

5) Floyd S, Craig SW, Topley D, Tullmann D. Evaluation of a progressive mobility protocol in postoperative cardiothoracic surgical patients. Dimens Crit Care Nurs. 2016;35(5):277-82. doi:10.1097/DCC.0000000000000197.

6) Krupp A, Steege L, King B. A systematic review evaluating the role of nurses and processes for delivering early mobility interventions in the intensive care unit. Intensive Crit Care Nurs. 2018; 47:1-10. doi: 10.1016/j.iccn.2018.04.003.

7) Lai CC, Chou W, Chan KS, Cheng KC, Yuan KS, Chao CM, et al. Early mobilization reduces duration of mechanical ventilation and intensive care unit stay in patients with acute respiratory failure. Arch Phys Med Rehabil. 2017;98(5):931-9. doi: 10.1016/j.apmr.2016.11.007.

8) Lee J, Kim Y, Lee HJ. Nurse-involved early mobilization in the intensive care unit: A systematic review and meta-analysis. Nurs Crit Care. 2025;30: e13278. doi:10.1111/nicc.13278.

9) Liu ZB, Wang LY, Zhao L, Pang YT, Liu YS, Xu W, et al. Clinical effect of pulmonary rehabilitation combined with diaphragm pacemaker therapy in the treatment of severely ill patients with mechanical ventilation. Int J Rehabil Res. 2022;45(3):195-200. doi:10.1097/MRR.0000000000000535.

10) Luo RY, Wang JJ, Wang MT, Huang TC, Jing JY. Optimal timing for early mobilization initiatives in intensive care unit patients: A systematic review and network meta-analysis. Intensive Crit Care Nurs. 2024; 79:103607. doi: 10.1016/j.iccn.2023.103607.

11) Monsees J, Moore Z, Patton D, Watson C, Nugent L, Avsar P, et al. A systematic review of the effect of early mobilisation on length of stay for adults in the intensive care unit. Nurs Crit Care. 2023;28(6):1076-86. doi:10.1111/nicc.12785.

12) Nydahl P, McWilliams D, Weiler N, Borzikowsky C, Howroyd F, Brobeil A, et al. Mobilization in the evening to prevent delirium: A pilot randomized trial. Nurs Crit Care. 2022;27(3):402-9. doi:10.1111/nicc.12638.

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13) Othman SY, Elbiaa MA, Mansour ER, El-Menshawy AM, Elsayed SM. Effect of neuromuscular electrical stimulation and early physical activity on ICU-acquired weakness in mechanically ventilated patients: A randomized controlled trial. Nurs Crit Care. 2024;29(1):76-85. doi:10.1111/nicc.13010.

14) Ramos Dos Santos PM, Aquaroni Ricci N, Bordignon Suster ÉA, Paisani DM, Chiavegato LD. Effects of early mobilisation in patients after cardiac surgery: a systematic review. Physiotherapy. 2017;103(1):1-12. doi: 10.1016/j.physio.2016.08.003.

15) Rosa D, Negro A, Marcomini I, Pendoni R, Albabesi B, Pennino G, et al. The effects of early mobilization on acquired weakness in intensive care units: a literature review. Dimens Crit Care Nurs. 2023;42(4):174-82. doi:10.1097/DCC.0000000000000575.

16) Schallom M, Tymkew H, Vyers K, Prentice D, Sona C, Norris T, et al. Implementation of an interdisciplinary AACN early mobility protocol. Crit Care Nurse. 2020;40(4):28-38. Doi: 10.4037/ccn2020632.

17) TEAM Study Investigators; Hodgson CL, Bailey M, Bellomo R, Brickell K, Broadley T, et al. Early active mobilization during mechanical ventilation in the ICU. N Engl J Med. 2022;387(19):1747-58. doi:10.1056/NEJMoa2209083.

18) Wang YT, Lang JK, Haines KJ, Skinner EH, Haines TP. Physical rehabilitation in the ICU: A systematic review and meta-analysis. Crit Care Med. 2021;49(9):1580-91. Doi: 10.1097/CCM.0000000000005285.

19) Wu H, Wang X, Chen M, Chen J, Chen H, Wang B, et al. [Effect of early off-bed mobility on diaphragm function in intensive care unit patients undergoing mechanical ventilation]. Zhonghua Wei Zhong Bing Ji Jiu Yi Xue. 2023;35(8):860-8. doi:10.3760/cma.j.cn121430-20230525-00395.

20) Zang K, Chen B, Wang M, Chen D, Hui L, Guo S, et al. The effect of early mobilization in critically ill patients: A meta-analysis. Nurs Crit Care. 2020;25(6):360-7. doi:10.1111/nicc.12455.