Indonesian Journal of Global Health Research
Volume 7 Number 4, August 2025
e-ISSN 2715-1972; p-ISSN 2714-9749
http://jurnal.globalhealthsciencegroup.com/index.php/IJGHR

LITERATURE REVIEW: EFFECTIVENESS OF EARLY MOBILIZATION ON CLINICAL OUTCOMES OF MECHANICALLY VENTILATED PATIENTS IN THE INTENSIVE CARE UNIT

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ABSTRACT
Early mobilization of mechanically ventilated patients in the intensive care unit is an important intervention in preventing immobilization complications such as muscle weakness, decreased functional capacity, and prolonged length of stay. Despite its widely reported benefits, the implementation of early mobilization still faces various challenges, including limited resources, risk perception, and lack of systematic guidelines. Objectives: This study aimed to evaluate the effectiveness of early mobilization on clinical outcomes of mechanically ventilated patients in the intensive care unit through a literature review. Methods: This study used a systematic literature review approach by searching national and international scientific articles published in the last five years, 2020-2025. The search was conducted through three main databases: PubMed, Google Scholar, and SciSpace. The search strategy referred to the PICO (Population, Intervention, Comparison, Outcome) framework using keywords such as "early mobilization", "mechanical ventilation", "ICU outcomes", and "clinical outcomes". From a total of 108 articles found, an initial screening process eliminated duplicates and irrelevant articles, resulting in 32 articles for further review. After a selection process based on inclusion and exclusion criteria, only 9 articles met all criteria and were analyzed in depth. Results: The review showed that early mobilization positively contributed to various clinical outcomes, including increased muscle strength, reduced duration of ventilator use, decreased length of stay, and improved functional status of post-ICU patients. The success of this intervention was influenced by the involvement of a multidisciplinary team, clear mobilization protocols, and adequate training for health workers.

Keywords: clinical outcomes; early mobilization; icu patients; intensive care unit; mechanical ventilation

How to cite (in APA style)
Efikal, E., Wahyuni, S., Sulistyaningsih, D. R., & Suyanto, S. (2025). Literature Review: Effectiveness of Early Mobilization on Clinical Outcomes of Mechanically Ventilated Patients in the Intensive Care Unit. Indonesian Journal of Global Health Research, 7(4), 307-314. https://doi.org/10.37287/ijghr.v7i4.6348.

INTRODUCTION

Patients undergoing intensive care with mechanical ventilation are at high risk of various complications, such as muscle weakness due to bed rest, decreased functional capacity, nosocomial pneumonia, and delirium. In recent years, early mobilization has become a seriously considered intervention in the management of patients in the ICU (Pighin et al., 2022; Tanujiarso & Lestari, 2020; Moch. Gandung Satriya et al., 2024). Early mobilization refers to the gradual initiation of physical activity as early as possible during intensive care, including while the patient is still on a ventilator. Empirical evidence suggests that this approach has the potential to improve functional status, shorten ICU length of stay, and reduce the incidence of complications associated with mechanical ventilation (Gison et al., 2025). However, the implementation of early mobilization is often constrained by various factors, including the mindset of health workers, limited resources, and concerns about hemodynamic risks (Feng Y et al., 2024).This literature review aims to evaluate the effectiveness of early mobilization on various clinical outcomes of mechanically ventilated patients in the ICU, based on recent studies.

METHOD

This research uses a literature review design with a systematic approach to national and international scientific publications published within the time span of 2020 to 2025. Articles included in this review were selected based on availability in full-text and open access formats, to ensure transparency, ease of data verification, and quality of information obtained. Literature sources were searched through three major electronic databases widely used in the health field, namely PubMed, Google Scholar and SciSpace. The literature search process used the PICO (Population, Intervention, Comparison, Outcome) approach by entering keywords such as "early mobilization", "mechanical ventilation", "intensive care unit", and "clinical outcomes".The article selection stage followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, starting from the process of identifying articles through an initial keyword search, followed by screening based on the title and abstract, and evaluating the appropriateness of the article content as a whole. At the initial stage, 108 articles were found. After elimination of duplication and initial eligibility checks, 45 articles were selected for further review. A total of 36 articles were excluded because they did not fit the focus of the study, did not meet the inclusion criteria, or did not specifically discuss the relationship between early mobilization and clinical outcomes of patients with mechanical ventilation. Finally, 9 selected articles that met all selection criteria were further analyzed for review in this study. Articles included were those that explicitly addressed early mobilization interventions in intensively ventilated patients and measured their impact on various clinical parameters such as ventilator duration, length of stay, physical function, and complications. Articles that were irrelevant, published before 2020, or not available in open format were excluded from the analysis.

RESULT

The process of searching and selecting scientific articles is carried out systematically using a literature review approach that refers to the PRISMA guidelines. The articles reviewed were obtained through three major scientific databases, namely Google Scholar, PubMed, and SciSpace, with a publication range of the last five years, namely 2020 to 2025. From a total of 108 articles found, a careful selection and screening process was carried out based on predetermined inclusion and exclusion criteria. The final result of this selection resulted in 9 journal articles that were eligible and relevant for further analysis in this review.

Table 1.
Article search results

Title	Author (Year)	Result
Effects of the High-Intensity Early Mobilization on Long-Term Functional Status of Patients with Mechanical Ventilation in the Intensive Care Unit	(Zhang et al., 2024)	Results patients' functional status improved (BI score 90.6 ± 18.0 in IG vs. 77.7 ± 27.9 in CG; p=0.005), and mobility capacity increased (Perme score 17.6 ± 7.1 in IG vs. 12.2 ± 8.5 in CG, p<0.001; IMS 4.7 ± 2.6 in IG vs. 3.0 ± 2.6 in CG, p<0.001). IG had higher muscle strength and a lower incidence of ICU-acquired weakness (ICUAW) than those in CG. The incidence of mortality and delirium was also lower than CG at discharge from ICU. However, there was no difference in terms of ICU length of stay, duration of IMV, ventilator-associated pneumonia, and venous thrombosis
Early mobilization in children with pneumonia in mechanical ventilation: randomized clinical trial	(Rocha et al., 2023)	The results showed a reduction in invasive mechanical ventilation time in the experimental group (p = 0.01). There was an improvement in heart rate variability in the experimental group in all indices (p < 0.01). Post-protocol analysis of the groups showed significant values in all variables (p < 0.05). Exercise-based physical therapy protocol improved autonomic heart rate modulation and reduced IMV time in children with ventilator-associated pneumonia.
Principals of Implementing Early Mobilization in Patients in Intensive Care Units	(Putri et al., 2024)	The results showed that early mobilization had an effect on physiological responses, reduced delirium scores, reduced the length of use of mechanical ventilation, reduced the length of stay in the ICU and hospital and reduced the cost of care, and prevented VAP. eraseereas One of the obstacles to early mobilization is the mindset of ICU staff.

Title	Author (Year)	Result
Early Active Mobilization during Mechanical Ventilation in the ICU	(Carol L. Hodgson et al., 2022)	The mean number of days patients were alive and discharged from hospital was 143 (interquartile range, 21 to 161) in the early mobilization group and 145 days (interquartile range, 51 to 164) in the usual care group (absolute difference, -2.0 days; 95% confidence interval [CI], -10 to 6; P=0.62). The mean (±SD) daily duration of active mobilization was 20.8±14.6 minutes and 8.8±9.0 minutes in the two groups, respectively (difference, 12.0 minutes per day; 95% CI, 10.4 to 13.6). A total of 77% of patients in both groups survived with a mean interval of 3 days and 5 days, respectively (difference, -2 days; 95% CI, -3.4 to -0.6). On day 180, death occurred in 22.5% of patients in the early mobilization group and in 19.5% of patients in the usual care group (odds ratio, 1.15; 95% CI, 0.81 to 1.65). Among survivors, quality of life, activities of daily living, disability, cognitive function, and psychological function were similar in both groups. Serious adverse events were reported in 7 patients in the early mobilization group and in 1 patient in the usual care group. Adverse events potentially due to mobilization (arrhythmias, blood pressure changes, and desaturation) were reported in 34 of 371 patients (9.2%) in the early mobilization group and in 15 of 370 patients (4.1%) in the usual care group (P = 0.005).
Effect of Early Mobilization on Respiratory Parameters in Patients with Respiratory Failure Using Mechanical Ventilation	(Alhazmi Fatimah, 2022)	This article reports the results of a randomized clinical trial study in intensive care unit patients receiving mechanical ventilation. The findings of this study confirmed that a 4-step protocol for early mobilization can improve Pao2, O2 saturation, Pao2/Fio2 ratio (fraction of inspired oxygen), and pulmonary compliance. The value of interdisciplinary collaboration supporting early mobilization was confirmed.
Effect of early out-of-bed mobility on diaphragm function in intensive care unit patients undergoing mechanical ventilation	(Yang S et al., 2023)	Among 147 patients, there were 4 cases of discharge in the control group and 5 cases of discharge in the observation group. Finally, 138 patients were enrolled, 69 cases in the control group and 69 cases in the observation group. There were no significant differences in gender, age, ICU diagnosis, sedation, muscle strength, ventilator model, acute physiology and chronic health evaluation II (APACHE II) score and DTei, DTee, DTF before intervention between the two groups. The values of DTei, DTee and DTF in both groups increased gradually with the extension of intervention time especially in the observation group [DTei (cm) at 24, 48, 72 and 96 hours of intervention in the observation group were 0.247±0.014, 0.275±0.016, 0.300±0.013 and 0.329±0.013 respectively while in the control group were 0.242±0.015, 0.258±0.013, 0.269±0.014 and 0.290±0.017 respectively, the effect of time: F = 993.825, P = 0.000, effect of intervention: F = 82.304, P = 0.000, interaction effect between intervention and time: F = 84.457, P = 0.000; DTee (cm) of observation group was 0.213±0.014, 0.227±0.013, 0.243±0.016, 0.264±0.010 respectively, while that of control group was 0.213±0.016, 0.218±0.013, 0.224±0.013, 0.234±0.014, time effect: F = 385.552, P = 0.000, effect of intervention: F = 28.161, P = 0.000, interaction effect between intervention and time: F = 45.012, P = 0.000; DTF of observation group were (15.98±4.23)%, (21.35±4.67)%, (24.09±4.44)% and (25.24±3.74)% respectively, while those of control group were (14.17±4.66)%, (18.11±3.92)%, (20.22±4.19)% and (20.98±4.12)% respectively, effect of time: F = 161.552, P = 0.000, effect of intervention: F = 49.224, P = 0.000, interaction effect between intervention and time: F = -4.507, P = 0.000]. The duration of mechanical ventilation and length of ICU stay in the observation group were significantly shorter than the control group [duration of mechanical ventilation (hours): 112.68±12.25 vs. 135.32±22.10, ICU length of stay (days): 7.84±1.78 vs. 10.23±2.43, both P < 0.01]. However, there was no significant difference in the 24-hour re-intubation rate between the observation and control groups (0% vs. 2.90%, P > 0.05).
Effect of early pulmonary rehabilitation training	(Feng Y et al., 2024)	A total of 50 of which 25 cases received the traditional training after weaning, 25 cases received the early PR training after weaning. There was no significant difference in gender, age, acute physiology and chronic

Title	Author (Year)	Result
on the prognosis of patients with acute respiratory distress syndrome after weaning of invasive mechanical ventilation in the intensive care unit		health evaluation II (APACHE II), oxygenation index upon admission, etiological diagnosis of ARDS upon admission, time of invasive ventilation, mode of invasive mechanical ventilation, pulmonary function indicators at discharge, and other baseline data of the two groups. The SPPB questionnaire scores and respiratory muscle strength in both groups were increased gradually with the extended offline training time, the serum level of IL-6 in both groups were descend gradually with the extended offline training time, especially in the observation group [SPPB questionnaire score in the observation group were 7.81±0.33, 8.72±0.53, 9.44±0.31, 10.57±0.50, while in the control group were 7.74±0.68, 8.73±0.37, 8.72±0.40, 9.33±0.26, effect of time: $F = 192.532$, $P = 0.000$, effect of intervention: $F = 88.561$, $P = 0.000$, interaction effect between intervention and time: $F = 24.724$, $P = 0.000$; respiratory muscle strength (mmHg, 1 mmHg≈0.133 kPa) in the observation group were 123.20±24.84, 137.00±26.47, 149.00±24.70, 155.40±29.37, while in the control group were 129.00±20.34, 126.00±24.01, 132.20±25.15, 138.60±36.67, effect of time: $F = 5.926$, $P = 0.001$, effect of intervention: $F = 5.248$, $P = 0.031$, interaction effect between intervention and time: $F = 3.033$, $P = 0.043$; serum level of IL-6 in the observation group were 80.05±6.81, 74.76±9.33, 63.66±10.19, 56.95±4.72, while in the control group were 80.18±7.21, 77.23±9.78, 71.79±10.40, 66.51±6.49, effect of time: $F = 53.485$, $P = 0.000$, effect of intervention: $F = 22.942$, $P = 0.000$, interaction effect between intervention and time: $F = 3.266$, $P = 0.026$]. Compared with the control group, the number of aspirations of sputum after weaning of patients in the observation group significantly decreased (number: 22.46±1.76 vs. 27.31±0.90), the length of ICU stay after weaning significantly became shorter (days: 6.93±0.95 vs. 8.52±2.21), and the rehospitalization rate within 6 months after discharge significantly decreased [20.00% (5/25) vs. 48.00% (12/25)]. There were significant differences. The pulmonary function indicators 3 months after discharge of two groups of patients significantly increased compared with those at discharge and those of the observation group were significantly higher than those of the control group [PEF (L/min): 430.20±95.18 vs. 370.00±108.44, FEV1/FVC ratio: 0.88±0.04 vs. 0.82±0.05, VC (L): 3.22±0.72 vs. 2.74±0.37, all $P < 0.05$]. The Kaplan-Meier survival curve showed that the cumulative survival rate of patients 6 months after discharge of patients in the observation group was significantly higher than that of patients in the control group [76.9% vs. 45.5%, hazard ratio (HR) = 0.344, $P = 0.017$].
Feasibility of Combining Functional Mobilisation with Resistance and Endurance Training for Mechanically Ventilated Patients in Intensive Care Unit Setting—A Pilot Study	(Jayachandran et al., 2024)	The primary outcomes were training eligibility, muscle strength, hand grip strength, quadriceps strength, and Functional Status Score-Intensive Care Unit (FSS-ICU) collected at the first assessment in the ICU, at the time of discharge from the ICU, and at hospital discharge. Secondary outcomes were functional capacity (6-Minute Walk Distance) and quality of life measure, EQ-5D, at hospital discharge and at 3 months. Results: Of the 11 patients, 6 (54.54%) patients achieved level 2 functional mobilization, 2 (18.18%) patients achieved level 2 resistance exercise, and 1 (9.09%) patient achieved level 2 resistance exercise. There were no significant differences in medical research council (MRC) scores, quadriceps strength, and hand grip strength between the first assessment in the ICU, at discharge from the ICU, and at hospital discharge. However, there was a significant difference in FSS_ICU ($p < 0.008$) from the first assessment in the ICU to hospital discharge. The EQ-5D visual analog scale also showed a change of 8.5% at the 3-month follow-up. 6MWD showed a significant difference ($p < 0.043$) at the 3-month follow-up compared to that at hospital discharge.
Effect of Level 1 Progressive Mobilization on Hemodynamic Status in Ventilator-Attached	(Rezalina Sri et al., 2024)	There are changes in the patient's hemodynamic status consisting of indicators of systolic blood pressure, diastolic blood pressure, MAP, HR, and SPO2. So it can be concluded that there is an effect of level 1 progressive mobilization on hemodynamics in critical patients attached to ventilators.

Title	Author (Year)	Result
Critical Patients		

DISCUSSION

Early mobilization is a form of early rehabilitation provided to critical patients by considering hemodynamic stability, respiratory function, and the patient's level of consciousness. This intervention can include passive exercises, position changes, sitting on the edge of the bed, to walking with assistance (Carol L. Hodgson et al., 2022; Rocha et al., 2023; Rezvani et al., 2022).Physiologically, early mobilization stimulates tissue perfusion, improves circulation, maintains muscle strength, and improves gas exchange. Positive effects also include improved heart rate variability, increased respiratory muscle strength (including the diaphragm), and reduced levels of inflammatory biomarkers such as IL-6. The principle of implementing early mobilization must consider safety aspects and be carried out in an interdisciplinary manner by the ICU team, including nurses, physiotherapists, and doctors. Its implementation also contributes to the reduction of hospitalization costs because it accelerates recovery and reduces complications. (Li et al., 2025; Feng Y et al., 2024).

The results of this literature review show that early mobilization has a significant positive impact on various clinical outcomes of patients undergoing mechanical ventilation in the ICU. Research by Zhang et al. (2024) stated that patients who received early mobilization intervention showed significant improvement in functional status and mobility capacity compared to the control group. This is shown through higher Barthel Index (BI), Perme Score, and ICU Mobility Scale (IMS) scores. In addition, early mobilization also reduced the incidence of ICU-acquired weakness, which is a common complication in patients with prolonged bed rest (Zang et al., 2020).Another study by Rocha et al. (2023) in children with pneumonia showed that early mobilization can shorten the duration of mechanical ventilation use and improve heart rate variability, which is an indicator of autonomic nervous system stability. Similar findings were also presented by Putri et al. (2024), who found that early mobilization contributed to decreasing the duration of ventilator use, ICU length of stay, and preventing ventilator-associated pneumonia (VAP). This reinforces that early mobilization plays a role in accelerating recovery and reducing the risk of complications.

In terms of respiratory function, Alhazmi (2022) and research on diaphragm function stated that early mobilization improved respiratory parameters such as PaO2, oxygen saturation, PaO2/FiO2 ratio, and increased diaphragm thickness and contractility. This suggests that early mobilization not only improves functional capacity but also supports the stability of the respiratory system which is vital in ventilated patients (Tanujiarso & Lestari, 2020; Paton et al., 2024).Research by Feng et al. (2024) showed the effect of early mobilization after ventilator weaning on reducing IL-6 levels (an inflammatory marker), increasing respiratory muscle strength, and improving post-hospital lung function. Furthermore, the rehospitalization rate within 6 months decreased significantly and the survival rate increased in the early mobilization group. This confirms that early mobilization not only has a short-term impact, but also supports long-term clinical outcomes.Although the benefits are statistically and clinically proven, it should be noted that some studies have also shown the risk of side effects such as arrhythmias, hypotension, and desaturation when mobilization is performed (Hodgson et al., 2022). Therefore, close monitoring and risk assessment should be an integral part of early mobilization implementation. In addition, mindset change and interprofessional cooperation in the ICU remains a challenge in its implementation (Wang, 2020; Wu Hualian et al., 2023; Li et al., 2025).Overall, this discussion confirms that early mobilization is an effective and safe intervention when performed with the precautionary principle, clear protocols, and solid team collaboration. Its implementation in critical nursing practice has great potential to improve the quality of care and overall patient outcomes.

CONCLUSION

Based on the results of a literature review of nine scientific articles analyzed, it can be concluded that early mobilization has significant effectiveness in improving the clinical outcomes of patients with mechanical ventilation in the intensive care unit. This intervention is proven to accelerate ventilator disconnection, shorten the length of stay in the ICU and hospital, and reduce the risk of complications such as muscle weakness due to prolonged bed rest. In addition, early mobilization also contributes to improving the functional status of patients after discharge from intensive care. The successful implementation of early mobilization is greatly influenced by the collaboration of a multidisciplinary team, the implementation of structured protocols, and the readiness of resources and training of health workers. Therefore, systematic integration of early mobilization into critical nursing practice should be considered as part of efforts to improve service quality and patient safety in the intensive care setting.

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