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EARLY MOBILIZATION FOR ICU-ACQUIRED WEAKNESS IN THE CRITICALLY ILL ON A VENTILATOR

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ABSTRACT
ICU-Acquired Weakness (ICU-AW) common in critically ill patient on ventilator. This can be caused by several factors, one of which is immobilisation. ICU-AW is at risk for increased ventilator duration and mortality. This literature review aims to evaluate the positive impact of early mobilization for ICU-AW in the critically ill on a ventilator. This study used a literature review of national and international journal in Indonesia and English published between 2020-2025. This research uses several available database sources in e-resources : Pubmed, ScinceDirect, Google Scholar and Sematic Scholar. The researchers searched the literature using the keywords ”early mobilization” and “intensive care unit-Acquired Weakness” with the PCC approach. The researchers identified 864 journals, analysed them using the PRISMA method and found 10 journals that met the inclusion criteria. Out of 83 journals, 10 journals showed results that early mobilisation was effective in reducing ICU-AW in ventilator-dependent patients. Based on journal analysis, early mobilization is effective in reducing ICU-AW in patients on ventilators

Keywords: early mobilization; icu-acquired weakness; ventilators

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INTRODUCTION

Intensive care unit (ICU) treatment often requires prolonged hospitalisation. An increase in length of stay (LOS) can lead to an increase in treatment costs and the risk of complications (Rachman & Muhtar, 2022). These complications can take the form of multidrug-resistant organism (MDRO) infections, which are at risk of transmission to other patients (Kristiningrum et al., 2023). Intensive Care Unit-Acquired Weakness (ICU-AW) is also a risk, leading to increased ventilator duration and mortality (Bickenbach et al., 2024; Chen & Huang, 2024). In addition, ICU-AW cause weakness of the skeletal and respiratory muscle, which is usually followed by late comp-lication such as sepsis, immobility and hyperglycaemia (Nazir & Anggraini, 2024; Wang et al., 2020). ICU-AW can be caused by several factors: sepsis, SIRS, multiorgan failure, hyperglycaemia, parenteral nutrition, medication use and immobilisation (Chen & Huang, 2024; Rawal & Bakhru, 2024; Sinha et al., 2024). ICU-AW can cause atelectasis, insulin resistance, muscle wasting, reduced cardiac output, impaired microvascular function and joint contractures. ICU-AW also causes prolonged ventilator use and ICU length of stay (Elsayed et al., 2020).

According to the World Health Organization (WHO), 304 million patients will be admitted to ICUs worldwide in 2019, and 13 - 14 million patients admitted to ICUs will use ventilators each year. Mortality rates also continue to rise, with 1.1 to 7.4 million patients dying from critical and chronic illnesses. Nearly 1 million ICU patients worldwide experience an AW. In fact, it can occur in 33% of ventilator-dependent patients and in 50% of patients treated in the ICU for 1 week (Sari et al., 2022). In the United States, 5 million patients are admitted to the

ICU each year, and 42% of patients admitted to the ICU are on a ventilator. In Asia, including Indonesia, 1,285 patients are placed on ventilators each year (Sofyan & Hamunung, 2022; Suyanti et al., 2019).Critical patients may experience inflammation and prolonged immobilisation (B. Wang et al., 2022). Immobilisation can cause hyperglycaemia due to insulin resistance, resulting in interacting microvascular, electrical, metabolic and bioenergetic changes (Sari et al., 2022). This condition can lead to muscle and neuromuscular weakness, resulting in ICU-AW (Matos et al., 2023). In its later stages, ICU-AW leads to prolonged ventilator use, increased length of stay in the ICU, lower quality of life and impaired function of various organs as well as increasing mortality (Hiser et al., 2025; Sari et al., 2022). In addition, loss of muscle mass begins in the first few weeks in critical patients (Matos et al., 2023).

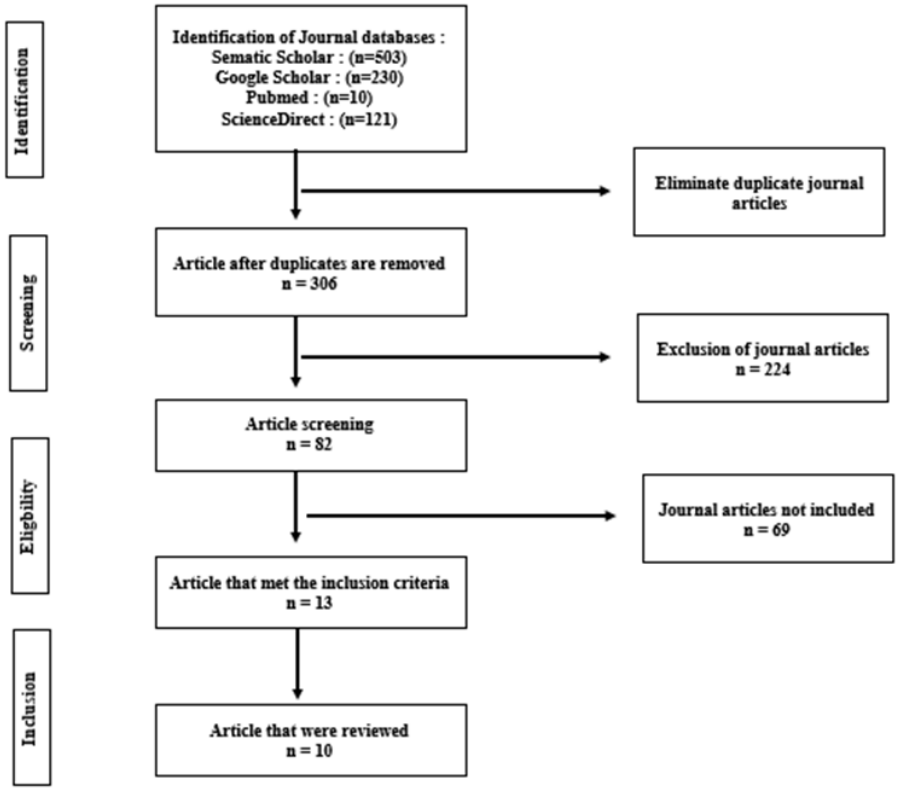
Early detection and intervention is critical in the management of ICU-AW(Khattar & Bou Sanayeh, 2024). ICU-AW can be reduced by early mobilisation (Aquim et al., 2019). Early mobilisation is feasible and safe for patients, reduces the length of stay in the ICU, reduces the duration of ventilator use, and helps to heal the decline in muscle function (Wang et al., 2021). Early mobilisation intervention is highly recommended because it can reduce the rate of ventilator-associated pneumonia (VAP), prevent venous thrombosis and reduce mortality (Zhang et al., 2024). In addition, early mobilisation is very effective in improving respiratory function, improving physical status, increasing lung capacity, increasing level of consciousness, improving cardiovascular status, decreasing ICU AW, improving psychology in ventilated patients and reducing length of stay (Das et al., 2021; Elsayed et al., 2020).This study aims to identify research articles that describe the effect of early mobilisation on preventing and reducing ICU-AW in ventilated patients admitted to the ICU.

METHOD

This research uses the literature review method, which is a research method used to examine previous research that is relevant to a topic. This literature review is carried out to provide a theoretical basis that can be used to solve the problem being studied. This research uses article searches from various database sources contained in e-resources: Pubmed, scienceDirect, Google Scholar, Sematic Scholar. The researchers searched for literature using the keywords early mobilisation, intensive care unit-acquired weakness. This literature review meets several requirements based on the criteria set by the researcher. The inclusion criteria for this study are as follows: 1) research on early mobilisation interventions 2) research on Intensive Care Unit-Acquired Weakness 3) research on patients using ventilators 4) articles in 2020-2024 5) literature using quasi-experimental methods or randomised controlled trial 6) full text articles (Indonesian or English) that are in accordance with the research topic. The exclusion criteria in this study are as follows: 1) the article is not full text 2) the article uses the literature review method or meta-analysis 3) the content of the research is not relevant. After collecting the articles, literature relevant to the topic under study was selected. The data collected was analysed descriptively to present a problem to be studied.

The following five steps have been taken for this review:
identifying research questions, 2) identifying relevant articles, 3) selecting relevant articles, 4) selecting literature related to the articles and data mining, and 5) collating, summarising and reporting the results.The researcher used the Population, Concept, Context (PCC) format to organise and define the focus of the review. In this review, P = ventilated patients, C = early mobilisation and C = ICU-AW. The research question was: 'How can early mobilisation prevent and reduce ICU-AW in ventilated patients?The literature search was conducted using Pubmed, scienceDirect, Google Scholar, Sematic Scholar databases and the Boolean operator 'AND'. The following keywords were used in the search 'early mobilization' AND 'ICU-AW'.

The process of selecting articles in the preparation of the literature review begins at the identification stage. In the identification stage, articles were searched in four journal databases : Semantic Scholar (n= 503), Google Scholar (n= 230), Pubmed (n= 10) and ScienceDirect (n= 121) with a total of 864 articles. In addition, duplicate articles were removed at the screening stage, leaving 306 articles. Of the 306 articles, 224 were excluded because they were not relevant to the research topic. At the eligibility stage, 82 articles were identified as meeting the inclusion criteria. In addition, 69 articles were again excluded because they did not meet the criteria. Finally, the inclusion stage identified 10 articles that met the criteria and were included in the literature review.



RESULT

As a result of article screening, 10 articles were identified (Table 1). In addition, the researchers screened the articles by reading the titles and abstracts based on the inclusion criteria. The final stage of 10 articles selected for analysis (Table 1), are described as follows:

Table 1.
Article search results

No.	Title; Author; Year	Methods (Design, Sample, Variables, Instrument, Analysis)	Research results
1.	Role of early progressive mobilization protocol on outcomes of mechanically ventilated patients with pneumonia; Amr A. Elsayed, Amr H. Dahroug, Ahmed M. Halawa; 2020	Comparative randomized single-blinded study; 70 patients on ventilators; variabel independen early progressive mobilization and variabel dependen outcomes of MV patients; physical assessment, examination GCS, Medical Research Council (MRC) and radiology; uji Friedman with p-value 0,001	Early mobilisation interventions are feasible and safe and can improve the condition of patients with pneumonia, such as reducing the duration of ventilator use, length of stay in the ICU, improving muscle strength and reducing pulmonary complications.
2.	Influence of early multidisciplinary collaboration on prevention of ICU-acquired weakness in critically ill patients; Bolan Wang, Xiqiang	Comparation with Randomized Controlled Trial (RCT); 95 responden; variabel independen early mobilization and variabel dependen criticall ill patient; Barthel Index (BI), ICU Mobility Scale (IMS) and Medical Research Council (MRC);	Early multidisciplinary intervention can prevent Intensive Care Unit-Acquired Weakness (ICU-AW) and reduce the incidence of DVT

No.	Title; Author; Year	Methods (Design, Sample, Variables, Instrument, Analysis)	Research results
	He, Shujun Tian, Can Feng, Wenbin Feng, Limin Song; 2022	independent t-test and paired t-test with p-value 0,001	
3.	Early rehabilitation for critically ill patients with ICU-acquired weakness: A quasi-experimental study; Tania dos Santos Matos, Jacinta Pires Martins, Andreia Felix; 2023	Quasy-experimental; 80 responden; variabel independen early rehabilitation and variabel dependen ICU-AW; Acute Physiology and Chronic Health Evaluation (APACHE II), Sequential Organ Failure Assessment (SOFA), Medical Research Council (MRC); T-test, Mann-Whitney, Chi-square and Fisher's with p-value 0,002	improving the health of critical patients by increasing the rate and frequency of early rehabilitation interventions
4.	Effect of early mobilisation on long-term cognitive impairment in crtical illness: A randomised clinical trial; Bhakti K. Patel et al; 2024	Randomized Controlled Trial (RCT); 200 responden; variabel independen early mobilisation and variabel dependen cognitive; Richmond Agitation Sedation Scale (RASS), Confusion Assessment Method for the ICU (CAM-ICU), Montreal Cognitive Assesment (MoCA), Medical Research Council (MRC), Functional Independence Measure (FIM); Fisher, Wilcoxon, Mann-Whitney with p-value 0,008	Early mobilization is an early intervention to improve the cognitive function of people with cognitive impairment
5.	Effect of early mobilization combined with early nutrition on acquired weakness in critically ill patient (EMAS): A dual-center, randomized controlled trial; Wendie Zhou et al; 2022	Randomized Controlled Trial (RCT); 150 responden; variabel independen early mobilization and early nutrition, variabel dependen ICU-AW; Barthel Index (BI) and Medical Research Council (MRC); MANOVA with p-value 0,005	Early mobilization and early nutrition improve muscle strength and improve nutritional status
6.	Efficacy of conventional rehabilitation, transcuntaneous electrical nerve stimulation, or early mobilization to reverse acquired weaknesss in the intensive care unit; Bueno-Ardariz et al; 2023	Randomized Controlled Trial (RCT); 18 responden; variabel independen conventional rehabilitation, transcutaneous electrical nerve stimulation and early mobilization while variabel dependen ICU-AW; Medical Research Council (MRC); one-way ANOVA with p-value 0,01	Early mobilisation is more significant than conventional rehabilitation and trascutaneous electrical nerve stimulation.
7.	Effect of early mobility protocol on physical function, muscle strength and delirium among mechanically ventilated patients; Samar S. Amin, Naglaa M. El Mokadem, Nagwa M. Doha, Shaimaa E. Abdullah; 2023	Quasy-experimental; 60 responden; varibel independen early mobility and variabel dependen physical function, muscle strength and delirium; Physical Function ICU Test-scored (PFIT-s), Medical Research Council Manual Muscle Testing (MRC-MMT), Confusion Assessment Method in the ICU (CAM-ICU), Acute Physiology and Chronic Health Evaluation II (APACHE II) and The Charlson Co-morbidity Index; corelation product moment with p-value 0,001	Early mobility protocol can improve physical function and muscle strength and reduce rates of delirium in ventilator patients
8.	Effect of early progressive mobilization on intensive care unit-acquired weakness in mechanically ventilated patients An observational study; Jing Zhou, Chao Zhang, Ji-dong Zhou, Cheng-kai Zhang; 2022	Observational study; 320 responden; variabel independen early progressive mobilization and variabel dependen ICU-AW; Medical Research Council (MRC), Barthel Index (BI); Paired t-test with p-value 0,001	Early progressive mobilisation is effective in increasing muscle strength, improving functional status and reducing the risk of ICU-AW in critically ill patients on ventilators
9.	Effect of the high-intensity early mobilization on long-term functional status of patients with mechanical ventilation in the intensive care unit; Chuanlin Zhang et al; 2024	Randomized Controlled Trial (RCT); 96 responden; variabel independen the high-intensity early mobilization and variabel dependen functional status; Barthel Index (BI), Medical Research Council (MRC), ICU mobility Scale (IMS); T-test, Mann-Whitney and Chi-square with p-value 0,001	High-intensity early mobility can improve functional status and increase mobilisation capacity in ventilator patients
10.	Effects of early mobilization (EM) in patients with noninvasive positive pressure ventilation (NIPPV) in intensive care unit (ICU) : a randomized controlled trial; Yanhao Wang et al; 2021	Randomized Controlled Trial (RCT); 41 responden; variabel independen early mobilization, variabel dependen noninvasive positive pressure ventilation; Medical Research Council (MRC), Acute Physiology and Chronic Health Evaluation II (APACHE II); Independent t-test, Mann-Whitney and wilcoxon with p-value 0,026	Early mobilisation is feasible and safe in patients with NIPPV. In addition, it can reduce the incidence of ICU-AW, length of ICU stay, duration of ventilator use and improve muscle strength in patients with NIPPV.

DISCUSSION

ICU-Acquired Weakness (ICU-AW) is a clinical syndrome characterised by muscle weakness caused by critical illness (Sari et al., 2022). Critically ill patients often experience complications, one of which is ICU-AW (Matos et al., 2023). This condition affects prognosis, increases the risk of prolonged treatment, prolongs healing, reduces quality of life, and is part of the development of sepsis and/or injury (Zhang et al., 2024; J. Zhou et al., 2022). The incidence of ICU-AW is 25-31% in critically ill patients worldwide (Zhou et al., 2022). The diagnosis of ICU-AW is made using the Medical Research Council (MRC) tool (Bueno-Ardariz et al., 2023). The MRC is an instrument used to assess muscle weakness caused by critical illness (Elsayed et al., 2020). There are 6 muscle groups used in the measurement. The 6 muscle groups are: shoulder abduction, elbow flexion, wrist extension, thigh flexion, knee extension and ankle dorsiflexion. If the total score is <48 out of 60, a diagnosis of ICU-AW can be made. ICU-AW syndrome is associated with disturbances in body structure and function that result in activity limitations (Sari et al., 2022). Structural and functional disturbances may include atelectasis, insulin resistance, muscle fibre atrophy, reduced cardiac output, impaired microvascular function and the risk of contractures (Elsayed et al., 2020). These conditions increase mortality, duration of ventilator use and length of stay in the ICU. Increased duration of ventilator use may be due to weaning failure, increased incidence of delirium, use of high doses of sedation, and decreased lung capacity (Matos et al., 2023).

There are several risk factors for ICU-AW, both non-modifiable and modifiable. Non-modifiable risk factors include: women and elderly patients. While modifiable risk factors such as: hyperglycaemia, malnutrition status, parenteral nutrition /, vasoactive drugs, corticosteroids, neuromuscular blocking drugs, sedation and prolonged immobilisation (Bueno-Ardariz et al., 2023; Matos et al., 2023).Early mobilization can improve several body system functions, such as the respiratory system. In the respiratory system, it can improve the airways and strengthen the respiratory muscles. Airway obstruction can occur in the trachea, bronchi and bronchioles due to a build-up of secretions. Early mobilisation can help reduce the build-up of secretions. This can improve lung compliance, lung capacity and gas exchange with well-developed alveoli. This may reduce the risk of alveolar atelectasis (Elsayed et al., 2020). In addition, early mobilisation can increase respiratory muscle strength by training the upper extremities (Matos et al., 2023).

Muscle weakness and wasting are caused by several factors, one of which is the inflammatory process. The body will stimulate pro-inflammatory mediators, namely tumour necrosis factor-alpha (TNF-alpha), interleukin-1 (IL-1) and interleukin-6 (IL-6), and cytokines. It also induces growth and differentiation factor-15 (GDF-15), which causes muscle wasting during critical illness. In addition to inflammatory factors, muscle weakness and atrophy are caused by protein metabolism disorders. This condition results in increased protein breakdown compared to protein synthesis, which is regulated by anabolic and catabolic pathways. The dysregulation leads to increased protein breakdown (Sari et al., 2022).The onset of muscle atrophy can be assessed by the reduction in muscle protein, strength and endurance. Limbs that have not been exercised for several weeks will cause increased protein destruction compared to its formation, resulting in a decrease in muscle contractile protein and in its development will experience atrophy (Rohman, 2019). The mechanism of early mobilisation may reduce inflammatory mediators in ICU-AW syndrome. This may be related to exercise training in patients can improve blood circulation, improve muscle tissue metabolism, increase myohemoglobin binding and reduce neuromuscular dysfunction in (Wang et al., 2021; Zhou et al., 2022).

Frailty in critically ill patients can be caused by the use of sedation and prolonged ventilator use. In general, patients on ventilators experience decreased consciousness and prolonged periods of inactivity. This condition can lead to reduced muscle strength. Early mobilisation allows patients to move from passive to active. Exercise can effectively activate joint contraction-extension and maintain muscle flexibility through twisting and flexion-extension movements in the limb joints (Zhou et al., 2022).In cognitive function, it can improve long-term cognitive impairment, such as improving patient interaction, increasing strength and range of motion (ROM) of extremities used for activities in a stable state, and reducing delirium / increasing level of consciousness in patients. Physical activity is an anti-inflammatory that can increase myokine secretion to properly regulate brain function metabolism. In addition, physical activity suppresses cognitive function by combining executive function, psychomotor and thinking patterns (Amin et al., 2023; Patel et al., 2023).

Early mobilisation may also improve cardiovascular status and reduce complications of immobilisation (Elsayed et al., 2020). In patients immobilised for long periods, cardiac output may be reduced. This is due to a decrease in volume and weight in both ventricles. When cardiac output is reduced, blood flow is reduced. This leads to thrombus formation due to impaired venous return to the heart, hypercoagulability of the blood and damage to the blood vessel wall. Early mobilisation can increase coronary blood flow in direct proportion to the increased myocardial demand for nutrients and oxygen and reduce metabolism. It will also increase venous return to the heart, resulting in an increase in volume in the right atrium, which will then circulate to the right ventricle and left atrium. left ventricle and an increase in cardiac output (Suyanti et al., 2019)

CONCLUSIONS

Based on the results of the literature review in accordance with the research objectives, namely to determine the effect of early mobilisation on ICU-AW in critically ill patients. From the results of 10 journals, it was found that early mobilisation intervention in ventilator patients can be a preventive effort and reduce ICU-AW and can improve the functional status of several organs such as respiratory status, cardiovascular, neuromuscular and muscle strength. From the results of the review of 10 journals, it is hoped that it can increase knowledge for researchers about early mobilisation of ICU-AW patients who use ventilators, which can be used as an intervention to improve the cardiovascular system, respiratory system, muscle weakness and/or atrophy, so it is expected to reduce the length of stay in the ICU and reduce the length of ventilator use. The researcher hopes that the results of this study can be used as an additional reference for use in the clinic or for other researchers working on the same topic

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