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**LITERATURE REVIEW**

# The Transition from Delayed Physiotherapy to Early Physiotherapy in Intensive Care Patients: A Bibliometric Analysis

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## ABSTRACT

**Introduction:** Critically ill patients in the Intensive Care Unit (ICU) require timely and comprehensive interventions to ensure safety and optimize recovery. Early physiotherapy serves as a vital component of critical care, contributing to patients' physical, psychological, and long-term functional recovery.

**Methods:** The study employed a bibliometric and systematic literature review to analyze research trends in early physiotherapy. Relevant articles were retrieved from SCOPUS-indexed journals, screened based on relevance, keywords, and abstracts, and analyzed using Mendeley for reference management and VOSviewer for bibliometric visualization

**Results:** The analysis delineated six thematic clusters: (1) pathological classification and therapeutic modalities, (2) patient compliance, (3) therapeutic approaches, (4) physiotherapy in critical care settings, (5) condition-specific therapeutic methods, and (6) safety procedures. These clusters encapsulate the predominant research trajectories and focal domain within the corpus of early physiotherapy literature.

**Conclusion:** Early physiotherapy in critical care substantially enhances patients' psychological well-being, physical functioning, and overall quality of life, while mitigating complications and reducing hospitalization costs. The findings highlight the importance of integrating early physiotherapy as an integral component of standardize ICU patient management.

**Keywords:** *Patient, disease critical care, intensive care unit, early physiotherapy, bibliometric analysis*

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# INTRODUCTION

The Intensive Care Unit (ICU) is a specialized hospital department that provides advanced, continuous care for critically ill patients with life-threatening conditions requiring constant monitoring, multidisciplinary management, and prompt intervention. These patients often present with severe illness or trauma that necessitates intensive, prolonged treatment. Consequently, ICU hospitalization frequently leads to prolonged immobilization, resulting in physical, psychological, and functional impairments. Bed rest lasting three weeks or more can cause marked muscle weakness and atrophy, with a 3–11% reduction in muscle mass.[1] Furthermore, immobility heightens the risk of complications such as ICU-acquired weakness, pneumonia, deep vein thrombosis, pulmonary embolism, pressure ulcers, and cardiovascular deconditioning.[2–4]

Recognizing these risks, modern hospitals have increasingly integrated physiotherapy as a vital component of ICU patient management.[2,5] Physiotherapy aim to preserve or restore physical function, enhance mobility, and support respiratory and musculoskeletal recovery once patients achieve medical stability. Evidence suggests that absent or delayed physiotherapy may lead to long-term complications such as neuromuscular weakness, cognitive dysfunction, and difficulty in weaning patients from mechanical ventilation.[6-8] Prolonged ventilator dependence further elevates the risk of respiratory infections, including ventilator-associated pneumonia.[9,10] Therefore, implementing early physiotherapy is critical for improving patient outcomes and accelerating recovery.

Early physiotherapy has demonstrated substantial benefits for critically ill patients by improving pulmonary function, increasing muscle strength, and enhancing psychological stability.[11,12] It also mitigates the risk of secondary complications, shortens ICU and hospital stays, and improves long-term quality of life.[13,14] Physiotherapists play an integral role in addressing the consequences of immobilization, restoring normal breathing patterns, and promoting overall functional recovery through individualized and progressive rehabilitation programs.[15]

In addition, early physiotherapy has been effectively implemented in patients with diverse critical conditions, such as pneumonia, coronary artery disease, malignancy, and post-COVID-19 respiratory complications.[16–19] Interventions such as active sitting, walking, and light exercise facilitate neuromuscular restoration, minimize pulmonary complications, and accelerate rehabilitation. Importantly, these interventions should be initiated as soon as the patient is clinically stable and be continued throughout ICU care and post-discharge recovery.[20]

Accordingly, to ensure safe and effective practice, physiotherapists must adhere to strict infection control protocols, including disinfectants use, personal protective equipment, or ultraviolet sterilization to prevent cross-contamination.[21] These precautions are particularly critical in high-risk settings such as the ICU, where exposure to pathogenic microorganisms is prevalent.

Given growing evidence of its efficacy, early physiotherapy requires systematic examination to identify research trends and gaps. The study presents a bibliometric analysis of research on early physiotherapy among critically ill ICU patients, aiming to deepen theoretical understanding and guide evidence-based physiotherapy practices to improve patient outcomes.

# METHOD

The study employed a systematic literature review with a bibliometric approach to explore research trends and thematic patterns in early physiotherapy for critically ill patients in the Intensive Care Unit (ICU). The review follows three primary stages: exploration, evaluation, and transcription of findings aligned with the study's objectives.[22,23]

## Search Strategy

The literature search was conducted using the SCOPUS database, selected for its extensive

coverage of peer-reviewed journals in the health sciences. Keywords combinations such as "early physiotherapy", "rehabilitation", and "critical care" were applied. Nonetheless, the search was restricted to English-language articles published between 2000 and 2025 to ensure the inclusion of recent and relevant evidence reflecting current physiotherapy practices.

## Inclusion and Exclusion Criteria

a. The inclusion criteria were:
   1) Peer-reviewed articles published between 2000–2025.
   2) Studies discussing the implementation, effects, or benefits of early physiotherapy in critically ill or ICU patients.
   3) Articles available in full-text and indexed in SCOPUS.
b. The exclusion criteria were:
   1) Non-English publications.
   2) Conference abstracts, editorials, or book reviews.
   3) Studies not directly related to physiotherapy in critical care contexts.

## Screening and Data Extraction

The initial search identified 325 SCOPUS-indexed articles related to physiotherapy in critical care. Titles and abstracts were screened using Mendeley software to exclude irrelevant studies. Subsequently, full-text screening was performed to ensure all included articles met the eligibility criteria. Duplicates and studies without sufficient methodological detail were also excluded at this stage.

## Data Analysis

The final dataset was analyzed using VOS viewer for bibliometric mapping and visualizing research trends related to early physiotherapy in critically ill patients. The analysis focused on keyword co-occurrence networks, employing author keywords set as the unit of analysis with full counting applied. A minimum threshold of five keywords occurrences was set to ensure the most relevant and frequently discussed topics. The association strength normalization method was used to cluster related terms into thematic groups. The mapping enabled the identification of major research domains, emerging themes, and interconnections among studies. Additionally, articles were further categorized by relevance, thematic substance, and citation frequency to strengthen the interpretive accuracy of the clusters. The complete analytical workflow, including literature search, selection criteria, and analytical procedures, is illustrated in Figure 1. The systematic process ensured a comprehensive, transparent, and replicable analysis of the existing literature on early physiotherapy for critically ill ICU patients.


**Figure 1. Stage scheme study**

The scheme in Figure 1 outlines the workflow, which includes defining objectives, conducting literature research, selecting and reviewing relevant articles, summarizing data, and analyzing the results. Each article was systematically reviewed to identify research objectives and strengthen the study's conceptual foundation. The bibliometric analysis using VOS viewer facilitated data visualization and pattern recognition.[24] VOS viewer generated visual maps of frequently occurring keywords, providing insights into the main themes of early physiotherapy research for critically ill patients.[25] The visualizations illustrate how key concepts interrelate and contribute to understanding the benefits of implementing early physiotherapy in ICU settings.[26]

# RESULTS

The bibliometric analysis was conducted using the VOS viewers. VOS viewers can generate three types of visualization that explain research development, publication volume, and bibliographic connection among studies. The results of VOS viewers analysis are as follows:

## Overlay visualization

Overlay visualization provides an effective means of illustrating research development over time.[27] The results of the overlay visualization analysis are as follows: Figure 2 shows that the study on the initiation physiotherapy became more prominent in 2019. During this year, numerous studies explore muscle mass and thickness, quadriceps, quadriceps femoris, and vastus lateralis muscles, exercise therapy, immobilization, bicycle ergometry, cycling, psychology, anxiety disorder, lousy rest, early mobilization, physical activity, respiratory track parameters, intensive care unit mobility, sleep disorders, ultrasonography, passive movement, range of motion, pathophysiology, patient discharge, and hand strength.

In 2020, research topics expanded to physical therapy modalities, critical care, critically ill patients, rehabilitation care, critical trials, traumatic brain injury, cognitive defects, prospective studies, multicenter studies, depression, mortality, pneumonia, exercise, body position, and rehabilitation care. Studies in 2021 further explored physiotherapy practices in relation to patient age, length of stay, early mobilization and ambulation, patient mobility, rehabilitation outcomes, and risk factors. Additional themes included occupational therapy, complications, respiratory training, delirium, hypertension, benzodiazepine use, and anxiety among ICU patients.

In 2022, research began to emphasize sepsis management, burn rehabilitation, range of motion exercises, activities of daily living, blood pressure control, mortality rates, body weight monitoring, and recovery from COVID-19. Additional topics included healthcare facility practices, physical function, electrotherapy, medical history, sedative use (midazolam), respiratory muscle training, and overall muscle strengthening. In 2023, research interests further diversified, covering renal replacement therapy, fraction of inspired oxygen, diabetes mellitus, exercise interventions, antibiotic efficacy and safety, albumin levels, headache management, agitation and sedation assessment (Richmond scale), auscultation techniques, bleeding risks, predictor variables, organ failure scoring, body mass and motor performance, blunt trauma, spinal cord injuries, decompression surgery, abdominal pain, coronary care, elevated blood pressure, in-bed exercise, neurosurgical procedures, self-care, and sleep hygiene.

Based on the analysis presented in Figure 2, research on physiotherapy in critical care began to emerge around 2019 and gained increasing attention from 2021 onward. The findings indicate that early physiotherapy remains a relatively recent and evolving research domain that warrants further investigation.[28,29]

## Density visualization

Density visualization depicts the extent to which specific clusters have been researched by researchers.[30] The result of the analysis is shown in Figure 3: Figure 3 presents the development of physiotherapy study. The color gradient, ranging from yellow to red, indicates the intensity of research activity where warmer colors represent areas with higher publication density. The analysis reveals that topics such as physiotherapy and heart failure exhibit strong research concentration, shown in yellow. In contrast, other areas appear in green, suggesting comparatively limited exploration. Overall, the findings indicate that studies specifically addressing early, and delayed physiotherapy remain underrepresented in the current literature.

## Network visualization

Network visualization shows a bibliographic connection between items in each cluster.[31] The network visualization analysis research as follows: Figure 4 illustrates the

connection between bibliometrics and items in physiotherapy. The analysis identified 11 clusters comprising a total of 323 items. The clusters are categorized as follows:

a. **Cluster 1**, represented in red, comprises 68 items primarily related to acute kidney failure, albumin blood level, antibiotic agent, anxiety, arterial gas, aspiration, assisted ventilation, auscultation, benzodiazepine, blood gas analysis, blood pressure, blood transfusion, body temperature, brain edema, breathing rate, burn, burn patient, burns, case report, chronic kidney failure, chronic obstructive lung, corticosteroid, creatine kinase, creatinine, depression, diabetes mellitus, disease severity, drug efficacy, drug safety, drug substitution, drug withdrawal, early diagnosis, electroencephalogram, fraction of inspired oxygen, headache, health care facility, heart rate, hydroxychloroquine, hypotension, immobility, immune response, immunosuppressive agent, lactate blood level, long term care, lorazepam, mean arterial pressure, medical history, mental disease, mortality, mortality rate, olanzapine, oxygen saturation, patient transport, practice guideline, procalcitonin, psychology, renal replacement therapy, resuscitation, Richmond agitation sedation, risk factors, sepsis, septic shock, sequential organ failure assessment score, sleep disorder, thorax radiography, training, valproic acid, vasoactive agents.

b. Cluster 2, represented in green, comprises 50 items from acute respiratory distress syndrome, acute respiratory failure, adult respiratory distress syndrome, breathing exercise, community acquired infection, comorbidity, continuous positive airway pressure, coronavirus, coronavirus disease 2019, coughing, disease assessment, disease exacerbation, early mobilization, early rehabilitation, emergency care, endurance training, fatigue, grip strength, high flow nasal cannula therapy, hyperinflation, hypertension, ICU, intensive care unit, lung auscultation, lung clearance, lung gas exchange, multiple trauma, muscle atrophy, muscle training, oxygen desaturation, oxygen therapy, pain intensity, patient positioning, physical therapy, pleural effusion, pneumonia, viral pneumonia, positive end expiratory pressure ventilation, pulmonary rehabilitation, respiratory control, respiratory distress, respiratory failure, six minute walk test , spirometry, surgical intensive care unit, tachycardia, tertiary health care, tracheotomy, treatment duration, and viral pneumonia.

c. Cluster 3, represented in blue, comprises 49 items, which are assessment of humans, bicycle ergometry, body weight, clinical protocol, critical ill, critically ill patients, critically ill patients, daily life activity, diet therapy, early ambulation, early in bed cycling, echography, electric stimulation therapy, electrostimulation, electrotherapy, enteric feeding, exercise therapy, hand strength, heart failure, ICU mobility scale, immobilization, intensive care unit mobility, kinesiotherapy, muscle mass, muscle strength, muscle thickness, muscle weakness, nervous system diseases, neuromuscular electrical stimulation, passive movement, pathophysiology, physical function, physical performance, physiology, quadriceps femoris muscle, quadriceps muscle, randomized controlled trials as topic, recovery of function, rehabilitation care, scoring system, sensitivity analysis, stroke, stroke rehabilitation, systematic review, treatment outcome, ultrasonography, upper limb, vastus lateralis muscle.

d. Cluster 4, represented in yellow, comprises 37 items, centered on anxiety disorder, cardiovascular disease, cognitive defect,

coma, correlation analysis, critical care, delirium, double-blind procedure, early mobility, electronic medical record, family relations, health personnel attitude, home care, hospital discharge, injury, intensive care, intensive care units, length of stay, long-term outcomes, male, multicenter study, neurologic disease, patient care bundles, patient discharge, patient safety, pediatric intensive care unit, physician, placebo, post-intensive care syndrome, posttraumatic stress disorder, prevalence, prospective studies, respiratory track disease, sleep hygiene, sleep quality, tertiary care center, traumatic brain injury.

e. Cluster 5, represented in purple, comprises 36 items primarily on adult, aerobic exercise, bacterial pneumonia, bed rest, bleeding, breathing muscle, cardiac surgical procedure, clonidine, coronary artery bypass graft, coronary artery disease, coronary care unit, dexmedetomidine, disease course, dobutamine, dyspnea, exercise tolerance, extubation, fever, heart rehabilitation, heart surgery, inotropic agent, lactic acid, midazolam, middle-aged, nonsteroidal anti-inflammatory agent, outpatient care, physical activity, postoperative complications, postoperative complications, postoperative period, respiratory tract parameters, soothing agent, systolic blood pressure, tramadol, treatment failure, valvular heart disease.

f. Cluster 6, represented in light blue, comprises 24 item of birth injury, body position, clinical examination, conservative treatment, coping behavior, Delphi study, early intervention, female, newborn infant, premature infant, motor development, mouth hygiene, movement (physiology), neonatal intensive care unit, neuroimaging, physical examination, physical therapy modalities, physiotherapy, prematurity, preterm infant, qualitative research, stretching exercise, therapy effect, ventilator-associated pneumonia.

g. Cluster 7, represented in orange, comprises 21 items: abdominal pain, blunt trauma, body mass, clinical trial, complications, cycling, decompression surgery, early mobilization, early physiotherapy, elevated blood pressure, hypertensive factor, in-bed exercise, motor performance, neurosurgery, occupational therapy, outcome assessment, preliminary data, range of motion, spinal cord injuries, traumatology, and very early activity-based theory.

h. Cluster 8, represented in chocolate, comprises 13 items: assessment, cardiorespiratory physiotherapy, chronic patient, gas exchange, interrater reliability, mechanical ventilation, mobilization, multidisciplinary team, physiotherapist, rehabilitation, artificial respiration, respiratory care, and treatment.

i. Cluster 9, represented in pink, purple, comprises 13 items: exercise, extracorporeal life support, extracorporeal membrane oxygenation, extracorporeal oxygenation, ICU rehabilitation, motor activity, questionnaire, respiratory distress syndrome, respiratory physiotherapy, sedation, splinting, surveys and questionnaires, and walking.

j. Cluster 10, represented in pinks-orange items, comprises nine items related to chronic lung disease, clinical features, incidence, joint mobilization, neuromuscular blocking agent, predictor variable, articular range of motion, shoulder, and wakefulness.

k. Cluster 11, represented in green, comprises three items, such as hospital patients, patient mobility, and self-care.

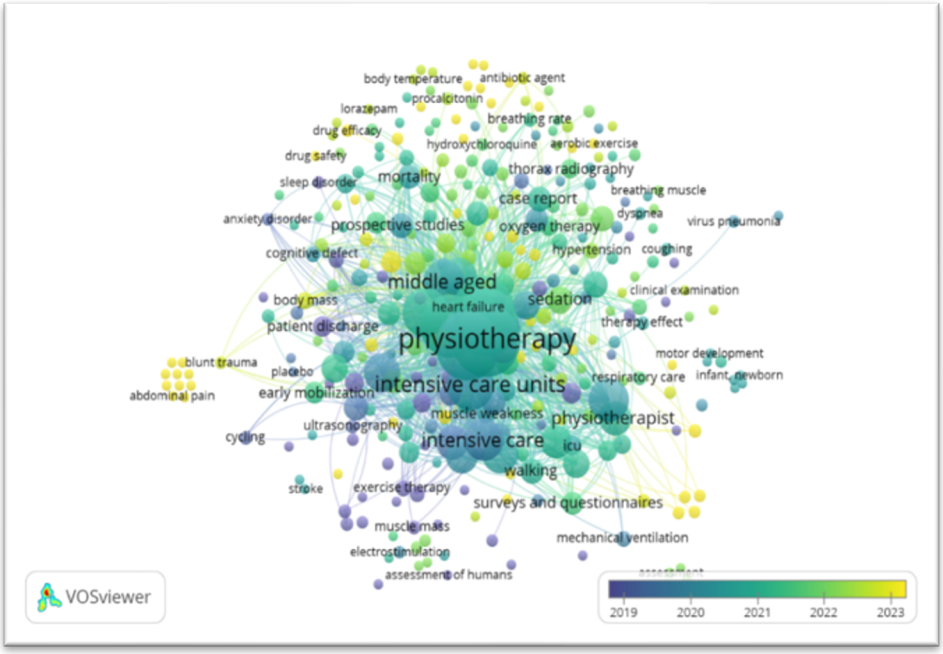


**Figure 2. The Results of Overlay Visualization Analysis**

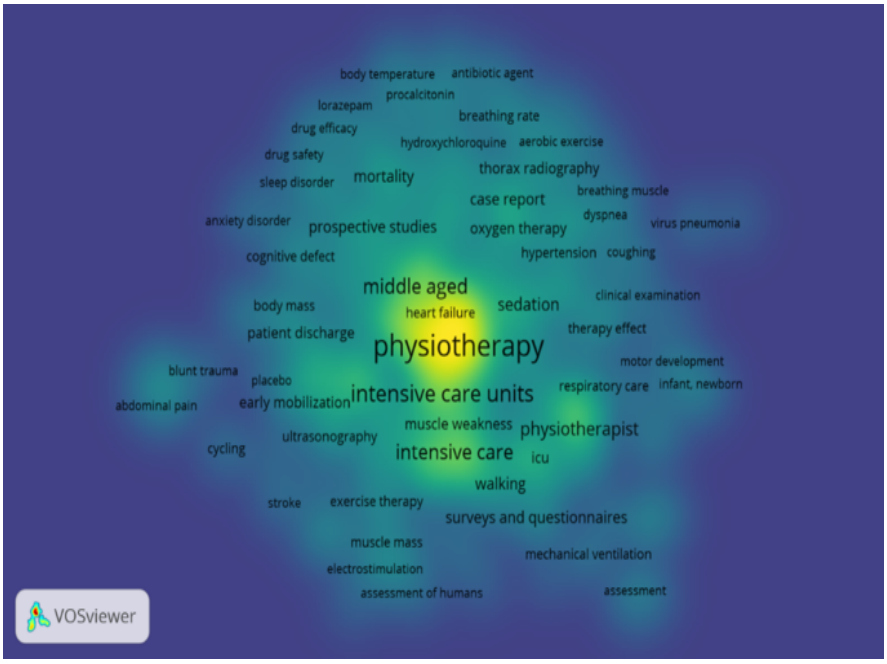


**Figure 3. The Results of Density Visualization Analysis**

## Discussion

Physiotherapy supports the maintenance and restoration of health following disease or injury.[37,38] It is applicable to patients with musculoskeletal or systemic disorders, autoimmune or cardiovascular diseases, chronic conditions, post-surgical recovery, or respiratory impairments.[39,40] The study examines the evolution from delayed to early physiotherapy. Historically, physiotherapy was initiated only after patients achieved full stability, based on the belief that early intervention offered limited benefit.[41] However, advances in science and technology have demonstrated that early physiotherapy can yield significant benefits for ICU patients.

The bibliometric findings underscore the critical role of physiotherapy in improving recovery outcomes following critical illness. Evidence indicates that early physiotherapy enhances muscle strength, respiratory function, mobility, and overall quality of life.[42,43] Interventions such as neuromuscular electrical stimulation and whole-body vibration have been shown to prevent muscle atrophy and reduce anxiety in ICU patients.[44] Early mobilization through sitting, standing, or ambulation can shorten ICU stay, accelerate recovery, and improve post-discharge independence.[45,46] Additionally, physiotherapy supports pulmonary and cardiac function by enhancing breathing capacity and preventing postoperative complications.[47,48] Beyond physical benefits, early physiotherapy also promotes psychological well-being and cognitive recovery among critically ill patients.[49,50] Overall, the reviewed literature reflects a growing recognition of physiotherapy as an integral component of early ICU rehabilitation.

Based on the literature, many countries have implemented physiotherapy as an essential component of treatment for patients with diverse conditions, ranging from COVID-19–related organ injury to post-transplant recovery.[51,52] Evidence shows that physiotherapy in intensive care settings offers multiple benefits, including improved mobility and muscle strength, reduced anxiety and sleep disturbances, shorter treatment duration, and even lower ICU mortality rates.[53,54] These findings emphasize physiotherapy as a vital intervention to accelerate recovery and enhance physical and psychological outcomes during and after critical care. Network visualization analysis (Figure 4), further categorizes physiotherapy for ICU patients into two types: early physiotherapy and delayed physiotherapy.

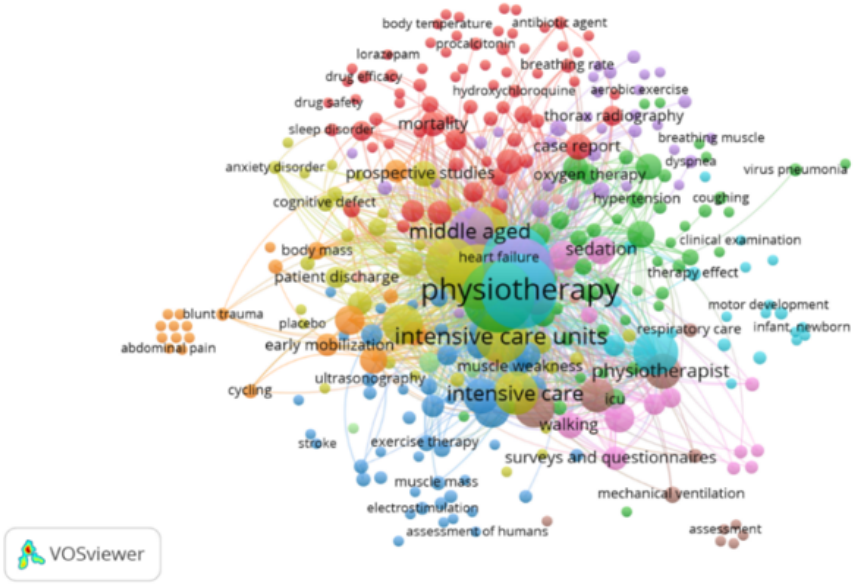


**Figure 4. The Results of Network Visualization Analysis**

The following table summarizes key information from the selected studies, including authors, publication year, research objectives, main findings, and relevance to early physiotherapy in critically ill ICU patients. The overview highlights research trends, focus areas, and contributions of previous studies, providing the foundation for the present bibliometric analysis.

| No | Author(s) & Year | Country | Journal | Study Type / Design | Main Focus / Keywords | Key Findings |
|---|---|---|---|---|---|---|
| 1 | (32) | UK | *Journal of Critical Care* | Observational study | Early mobilization; ICU recovery | Structured early rehabilitation for mechanically ventilated ICU patients is feasible and significantly accelerates mobility recovery. |
| 2 | (33) | UK | *Pilot and Feasibility Studies* | Experimental | High-risk ventilated patients | Early and intensified rehabilitation is feasible and may improve recovery outcomes. |
| 3 | (34) | USA | *Supportive Care in Cancer* | Survey | Cancer patients; early mobility | Ventilated cancer patients had positive early mobility experiences but exhibited memory impairment, requiring more patient-centered ICU care. |
| 4 | (35) | Australia | *Burns* | Retrospective observational cohort (5 years) | Burn survivors; sedation; mobilization | Optimal sedation and reduced sedative/inotropic use enhance early mobilization, supporting physiotherapy's role in functional recovery. |
| 5 | (12) | Australia | *Australian Critical Care* | Prospective observational study | Early mobilization; invasive mechanical ventilation | Early activity improves psychological well-being and muscle strength in ICU patients. |
| 6 | (15) | Italy | *Monaldi Archives for Chest Disease* | Review | COVID-19; early rehabilitation | Early physiotherapy in severe COVID-19 ICU patients is safe, feasible, and beneficial even when initiated later. |
| 7 | (3) | USA | *Annals of the American Thoracic Society* | Cross-sectional telephone survey | Early physiotherapy; physical activity | Early physiotherapy is more effectively implemented in large academic hospitals with established mobility protocols. |
| 8 | (17) | USA | *Chest* | Clinical trial | ICU-acquired weakness; early physiotherapy | Early mobilization may reduce ICU-acquired weakness and promote euglycemia as an alternative to intensive insulin therapy. |
| 9 | (18) | China | *International Heart Journal* | Experimental study | Coronary artery disease; rehabilitation | Early rehabilitation significantly reduces mechanical ventilation duration. |
| 10 | (29) | Brazil | *Fisioterapia em Movimento* | Observational study | Mobility; functional recovery; cardiac surgery | Early physiotherapy improves mobility from IMS 0 to IMS 7–10 by ICU discharge, even with 54.6% patients on vasoactive drugs. |
| 11 | (36) | Switzerland | *Swiss Medical Weekly* | Cross-sectional survey | Quality of life; psychological effects | Early physiotherapy improves physical function, accelerates recovery, and reduces negative effects of immobility during ICU stay. |

## Early physiotherapy

Early physiotherapy is a form of maintenance physical therapy provided shortly after ICU admission with specific clinical objective.[26] Early physiotherapy is divided into two, early mobilization and early ambulation. Early mobilization involves therapeutic interventions administered within hours after surgery,[50] whereas early ambulation focuses on guiding patients to sit, stand, and walk as soon as medically feasible.[1] The literature indicates that early physiotherapy offers multiple benefits, including shortened ICU and hospital stays for patients with pneumonia and improved activities of daily living (ADL) outcomes.[55] Early rehabilitation using a cycle ergometer helps preserve knee extensor and diaphragm morphology in ICU patients with neuromuscular complications.[1] In post-operative cardiac patients, early physiotherapy can prevent respiratory complications by improving dyspnea, respiratory rate, and oxygen saturation.[47] It may also reduce the duration of mechanical ventilation and limit functional dependence in critically ill patients.[56] Overall, early physiotherapy has been demonstrated to be safe in ICU settings. In patients receiving Veno venous extracorporeal membrane oxygenation (ECMO), early initiation of therapy was associated with shorter ICU stays.[57] Early physiotherapy in the ICU has been shown to reduce both physical and psychological complications.[11] Among COVID-19 patients, early physiotherapy improved pulmonary secretion clearance, enhancing gas exchange, respiratory mechanics, and respiratory muscle function without adverse effects.[58] ICU patients receiving early physiotherapy were able to discontinue ventilatory support and supplemental oxygen sooner, improving functional outcomes and reducing ICU length of stay.[59] Additionally, early cardiac rehabilitation incorporating non-invasive ventilation and aerobic exercise accelerated recovery and reduced hospitalization in patients with heart failure.[60]

Early physiotherapy has been shown to be effective in addressing foot deformities such as calcaneal valgus, significantly improving leg alignment, leg length discrepancy (LLD), and gross motor development.[61] However, limitations exist; for example, a single session of early physiotherapy did not significantly affect spontaneous movement in infants aged 12–16 weeks.[62] Early resilience training showed no measurable improvements in capacity, function, or independence, though it was associated with enhanced mental health up to six months' post-intervention.[63] Types of early physiotherapy in ICU settings include ventilator-assisted breathing exercises for pneumonia patients, cycle ergometer therapy to enhance muscle strength and rehabilitation, and physiotherapy for patients on venovenous extracorporeal membrane oxygenation (VV-ECMO) to reduce ICU stay. Additional interventions include positioning, active and passive exercises, breathing exercises, and chest percussion.

## Delayed physiotherapy

Delayed physiotherapy refers to interventions initiated after a patient has been admitted to the ICU but postponed until the patient achieves a certain level of clinical stability.[64] It is generally categorized into two aspects: functional status and muscle weakness. Functional status refers to a patient's ability to perform activities of daily living independently and safely[65], which can be assessed through self-care, mobility, and overall independence during hospitalization. Muscle weakness, common among critically ill patients, including those recovering from stroke which represents a reduction in muscle strength and functional capacity.[66] The review indicates that physiotherapy enhances physical function and mitigates muscle weakness in critically ill patients. Available interventions include whole-body vibration therapy to stimulate muscle activity, as well as practical exercises designed to reduce muscle wasting.[67] Early sitting and upright training in ICU patients can accelerate stabilization and functional recovery.[40] Physiotherapy also promotes muscle activation during both active movement and rest.[68] Therapy using neuromuscular electrical stimulation (NMES) media helps increase patient muscle-critical abilities.[50] Intensive care physical therapy given to critically patient treated in the ICU can help improve muscle strength, muscle breathing, and functional parameters for patients during the treatment period.[69] Progressive mobility physiotherapy in patients can increase the activity level and its benefits in the

respiratory system, the system muscles, and the functionality of ICU patients.[65]

Functional status can be observed and analyzed through method analysis. Quantitative data can be collected through a questionnaire which is based on the results analysis in Figure 5. Meanwhile, exercise breathing and physical therapy modalities can improve the patient's muscle weakness. Breathing exercises for patients can increase cleaning channel respiration, alveolar recruitment, and maximization of gas exchange in the alveoli.[70] Therapists use physical therapy modalities to relieve pain or meditation in patients.[71] Research shows that mobilization physiotherapy can improve patients' functional status after leaving the ICU.[72] As for weaknesses in the application of delayed physiotherapy for critical patients in the ICU found in several cases, there was no significant comparison between patients who were given physiotherapy and those who were not given physiotherapy regarding forever-time maintenance patients.[73] Physique therapy with bad cycling does not reduce muscle reduction in patients' critical maturity. However, it still positively affects patients.[74] Types of physiotherapy that can be given to patients include exercising movement muscles with movement vibration all over the body in place sleep patient, giving therapy cycling in place sleep, until sitting and upright training for post-treatment critical patients.

Previous research indicates that physiotherapy remains underutilized in healthcare, particularly in Indonesia. Evidence demonstrates that physiotherapy can accelerate recovery, enhance physical function, and reduce mortality among critically ill patients in the ICU.[75,76] Although some studies report minimal differences between patients receiving physiotherapy and those who do not,[77] early physiotherapy generally provides greater benefits by promoting mobility and functional improvement. Advances in health technology have further supported this shift, showing that early physiotherapy leads to shorter ICU stays and fewer complications compared to delayed interventions.[12] These findings highlight the growing importance of adopting early physiotherapy as a standard approach in critical care management.

## CONCLUSION

The bibliometric analysis highlights the significant role of early physiotherapy in improving physical function, mental well-being, and overall recovery among critically ill patients in intensive care. The analysis identified six thematic clusters related to disease types, therapy methods, patient compliance, safety procedures, and recovery approaches, illustrating the broad and interdisciplinary scope of early physiotherapy research. The findings support initiating early physiotherapy upon ICU admission and continuing it throughout treatment and recovery to enhance long-term outcomes. Nonetheless, as this study is limited to bibliometric analysis with VOSviewer and lacks empirical validation, further clinical and quantitative research is needed to confirm its effectiveness and inform practical implementation.

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