Review article

The Role of Interdisciplinary Teams in Preventing ICU-Acquired Weakness: A Systematic Review

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ABSTRACT

Background: ICU-Acquired Weakness (ICUAW) is a frequent complication among critically ill patients and is associated with prolonged mechanical ventilation, extended hospitalization, functional decline, reduced quality of life, and long-term disability. Various nursing and rehabilitation interventions have been implemented to prevent ICUAW; however, evidence regarding their effectiveness remains variable.

Objectives: To synthesize current evidence on nursing and interdisciplinary interventions for preventing ICU-Acquired Weakness in critically ill adult patients and to identify interventions associated with improved functional outcomes.

Method: A systematic review was conducted using PubMed, ProQuest, MEDLINE, ScienceDirect, and Google Scholar. Studies published between January 2014 and May 2024 were screened according to predefined inclusion and exclusion criteria. Eligible studies included adult ICU patients receiving nursing or interdisciplinary interventions aimed at preventing ICUAW. Study quality was assessed using the Joanna Briggs Institute Critical Appraisal Checklist.

Results: Of 693 records identified, seven studies met the inclusion criteria. The findings indicated that early mobilization consistently improved muscle strength, mobility, and functional recovery while reducing the incidence of ICUAW. Nutritional optimization, range-of-motion exercises, massage therapy, neuromuscular electrical stimulation, blood flow restriction-assisted mobilization, and structured rehabilitation programs demonstrated beneficial effects on muscle preservation and recovery. Multidisciplinary collaboration involving nurses, physiotherapists, nutritionists, rehabilitation specialists, and psychologists was associated with improved rehabilitation outcomes and functional independence.

Conclusion: Nursing and interdisciplinary interventions, particularly early mobilization and comprehensive rehabilitation strategies, may effectively reduce the risk of ICUAW and improve recovery among critically ill adults. Nurses play a central role in coordinating rehabilitation, monitoring patient safety, providing education, and facilitating patient engagement throughout the recovery process.

Keywords: Critical illness; Early mobilization; Functional recovery; Rehabilitation nursing; Muscle preservation; Intensive care rehabilitation.

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BACKGROUND

ICU-Acquired Weakness (ICUAW) is a common and serious complication among people experiencing critical illness, characterized by generalized muscle weakness that develops during intensive care treatment [1]. ICUAW contributes to prolonged mechanical ventilation, extended hospitalization, functional decline, reduced quality of life, and increased long-term disability among survivors of critical illness [2]. Beyond the acute care setting, ICUAW may negatively affect individuals' ability to return to work, participate in family and social roles, and reintegrate into their communities.

The development of ICUAW is multifactorial and commonly associated with prolonged immobilization, systemic inflammation, malnutrition, deep sedation, and neuromuscular blocking agents [1,2]. These factors contribute to muscle wasting, impaired mobility, and delayed recovery [1,2]. Consequently, preventing ICUAW has become an important priority in critical care practice.

Several interventions have been proposed to prevent or reduce ICUAW, including early mobilization, nutritional optimization, structured rehabilitation programs, range of motion exercises, electrical stimulation, and multidisciplinary rehabilitation strategies [3]. Nurses play a central role in implementing many of these interventions because they are continuously involved in patient monitoring, rehabilitation coordination, patient education, nutritional management, and communication with patients and families [4].

Although previous studies have reported promising outcomes, the effectiveness of specific interventions remains inconsistent. Some studies demonstrate significant improvements in muscle strength and functional outcomes, while others report limited or variable benefits. Furthermore, previous reviews have often focused on isolated rehabilitation strategies without adequately examining the collaborative role of nurses within interdisciplinary care teams.

Therefore, this systematic review aimed to synthesize current evidence regarding nursing and interdisciplinary interventions for preventing ICUAW among critically ill adult patients. The review also aimed to identify interventions with the strongest evidence and discuss their implications for long-term rehabilitation, functional independence, and quality of life.

METHODS

Literature Search Strategies and Databases

A systematic review was conducted to identify studies evaluating nursing and interdisciplinary interventions to prevent ICU-Acquired Weakness (ICUAW) in critically ill adult patients. Literature searches were performed in ProQuest, PubMed, ScienceDirect, MEDLINE, and Google Scholar for studies published between January 2014 and May 2024.

The primary search terms included "ICU-Acquired Weakness," "Nursing Interventions," "Critical Care," "Early Mobilization," "Rehabilitation," and "Muscle Weakness in ICU." Boolean operators (AND/OR) were used to combine keywords. Example search strategies included "ICU-Acquired Weakness AND Nursing Interventions" and "Early Mobilization OR Physical Therapy AND Critical Care." Hand-searching and grey literature searches were not conducted, and this has been acknowledged as a limitation of the review..This strategies comes from the PICO format (table 1):

Table 1. PICO Format

Population	Adult ICU patients
Intervention	Nursing and interdisciplinary interventions
Comparation	Usual care
Outcomes	Prevention or reduction of ICU-Acquired Weakness

Eligibility Criteria

Inclusion Criteria

Studies were included if they:

- Were peer-reviewed original research articles;
- Were published in English between January 2014 and May 2024;
- Included adult ICU patients;
- Evaluated nursing or interdisciplinary interventions aimed at preventing ICUAW;
- Used randomized controlled trial, intervention, cohort, or observational study designs.

Exclusion Criteria

Studies were excluded if they:

- Focused on pediatric populations;
- Included animal or laboratory studies;
- Were review articles, editorials, commentaries, conference abstracts, or protocols without original data.

Quality Appraisal of Studies

The quality of included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Randomized Controlled Trials. Some items were classified as "Not Applicable" because several included studies used observational or non-randomized designs in which blinding or randomization procedures were not feasible [5]. The possible score range was 0 to 13 (Table 2).

Table 2. Results of Critical Appraisal

Critical Appraisal Tool for RCTs	6	7	8	9	10	11
Was true randomization used for assignment of participants to treatment groups?	NA	Y	Y	NA	NA	NA
Was allocation to treatment groups concealed?	Y	Y	Y	Y	Y	Y
Were treatment groups similar at the baseline?	Y	Y	Y	Y	Y	Y
Were participants blind to treatment assignment?	NA	Y	Y	NA	NA	NA
Were those delivering treatment blind to treatment assignment?	NA	N	N	NA	NA	NA
Were outcomes assessors blind to treatment assignment?	NA	N	N	NA	NA	NA
Were treatment groups treated identically other than the intervention of interest?	Y	Y	Y	Y	Y	Y
Was true randomization used for assignment of participants to treatment groups?	NA	Y	Y	NA	NA	NA

Were participants blind to treatment assignment?	NA	Y	Y	NA	NA	NA
Were those delivering treatment blind to treatment assignment?	NA	N	N	NA	NA	NA
Were outcomes assessors blind to treatment assignment?	NA	N	N	NA	NA	NA
Were treatment groups treated identically other than the intervention of interest?	Y	Y	Y	Y	Y	Y
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Y	Y	Y	Y	Y	Y
Were participants analyzed in the groups to which they were randomized?	NA	Y	Y	NA	NA	NA
Were outcomes measured in the same way for treatment groups?	Y	Y	Y	Y	Y	Y
Were outcomes measured zin a reliable way?	Y	Y	Y	Y	Y	Y
Were treatment groups treated identically other than the intervention of interest?	Y	Y	Y	Y	Y	Y
Was the trial design appropriate, and any deviations from the standard RCT accounted for in the conduct and analysis of the trial?	NA	U	U	NA	NA	NA
Total Score	7	10	10	7	7	7

Note :Y: Yes; N: No; U: Unclear; NA: Not Applicable

Study Selection

A total of 693 records were identified. After removing duplicates and screening titles and abstracts, 35 studies were reviewed in full text. Seven studies met the inclusion criteria and were included in the final analysis.

Data Extraction and Synthesis

Data extracted from the included studies included study characteristics, intervention type, outcome measures, and major findings. Because of substantial heterogeneity across interventions, study designs, and outcome measures, a quantitative meta-analysis was not feasible. Therefore, findings were synthesized narratively using descriptive comparison.

Ethical Considerations

As this study was a systematic review using previously published literature, ethical approval and informed consent were not required.

Data Availability Statement

The data supporting the findings of this review are available within the article and through the cited references included in the review.

Risk of Bias

We utilized the free software RevMan (version 5.4.1) to evaluate the risk of bias. High risk was associated with blinding of participants and personnel (performance bias). Nevertheless, the risk of bias in our review was generally similar and low in most of the studies. The results of the bias assessment are shown in Figures 1 and 2.

Figure 1. Risk of bias graph: review authors' decisions about each risk of bias item used RevMan 5.4.1

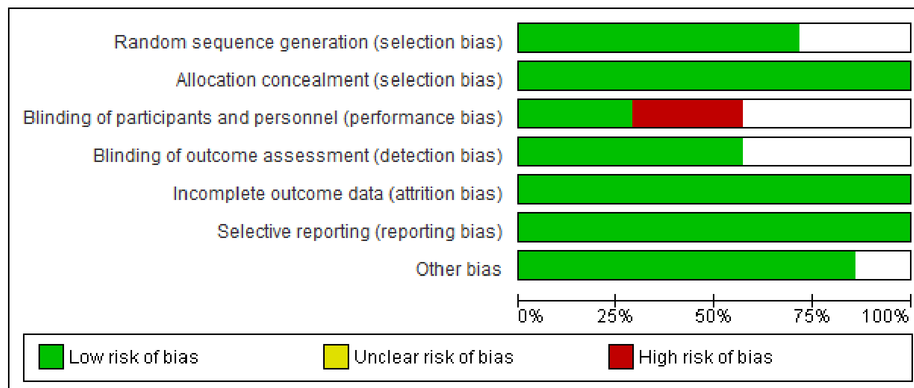
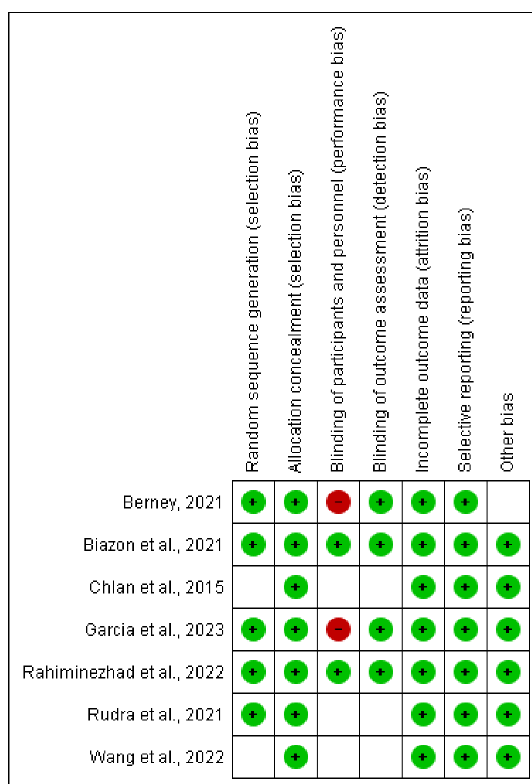


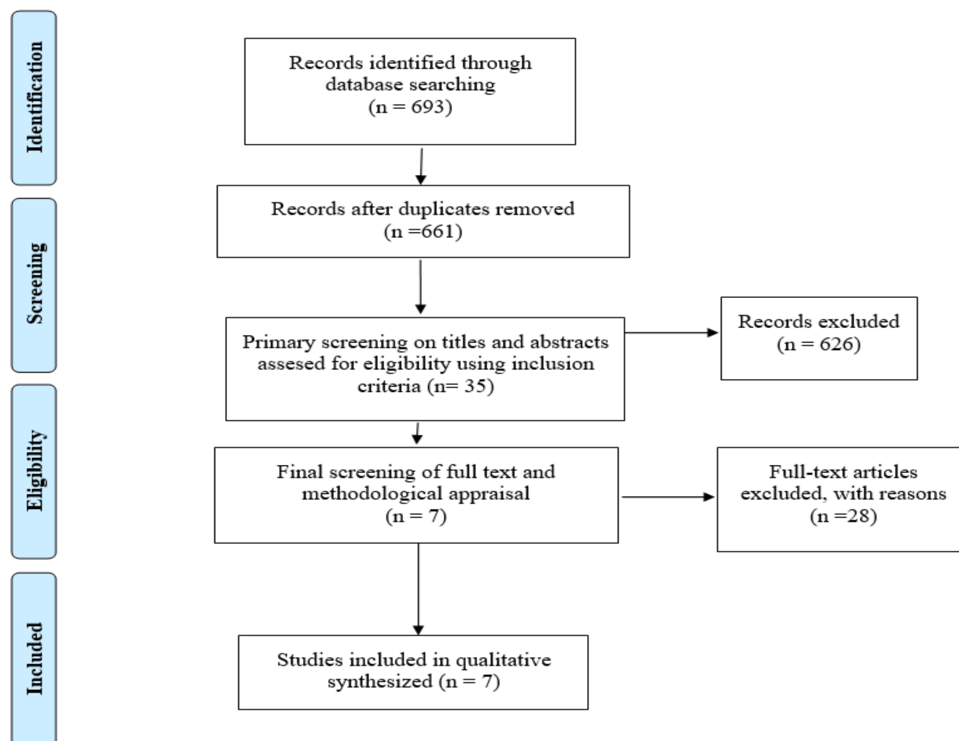
Figure 2. Risk of bias summary used RevMan 5.4.1



RESULTS

Using the search strategies, 693 articles were initially identified. After removing 32 duplicates, 661 articles remained. Following a review of their titles and abstracts, 35 articles were chosen for further consideration. Ultimately, seven studies met the inclusion criteria and were included in the analysis, while 28 were excluded. The excluded articles were not intervention studies, focused on pediatric populations, were long-term programs, or were study protocols (Figure 3).

Figure 3. PRISMA Flow Diagram



The seven included studies demonstrated that both nurse-led and interdisciplinary interventions may reduce the incidence and severity of ICUAW and improve functional outcomes among critically ill patients.

Early mobilization was consistently associated with improved muscle strength, mobility, and reduced ICUAW incidence across multiple studies. Nutritional interventions focusing on adequate caloric and protein intake were also associated with improved muscle preservation and recovery. Range of motion exercises and massage therapy demonstrated beneficial effects on muscle strength and circulation among critically ill individuals.

More advanced rehabilitation strategies, including passive mobilization combined with blood flow restriction and neuromuscular electrical stimulation, as well as functional electrical stimulation cycling, demonstrated promising effects on muscle mass and muscle quality. However, these interventions were evaluated in smaller studies and require further validation through larger randomized controlled trials.

Interdisciplinary collaboration involving nurses, physiotherapists, nutritionists, rehabilitation therapists, and psychologists demonstrated positive effects on functional independence, mobility, rehabilitation progress, and patient recovery. Importantly, these collaborative interventions highlighted the role of nurses as coordinators of rehabilitation, patient educators, and facilitators of patient and family engagement.

Despite positive findings, heterogeneity among study designs, intervention protocols, and outcome measures limited direct comparison across studies and prevented quantitative meta-analysis.The research presented in the table encompasses diverse investigations into interventions aimed at mitigating muscle weakness in critically ill patients across different regions and methodologies. Studies conducted in various countries, including Spain, Iran, Brazil, the United States, and China, explored interventions ranging from enteral nutrition management to passive mobilization combined with blood flow restriction and electrical stimulation. These interventions were assessed through randomized controlled trials, retrospective cohort studies, and prospective nationwide multicenter cohort studies. Key findings suggest that early mobilization, specific nutritional targets, range of motion exercises, massage, and passive mobilization combined with

innovative techniques such as blood flow restriction and neuromuscular electrical stimulation significantly contribute to improving muscle strength and quality among ICU patients. Additionally, rehabilitation programs, multidisciplinary collaboration, and alternatives to sedative medications emerge as effective strategies for promoting functional independence and enhancing peripheral muscle strength in critically ill individuals undergoing mechanical ventilation.

A study conducted by Zaragoza-García et al. (2023) in Madrid, Spain, explored enteral nutrition management in critically ill adult patients and its impact on intensive care unit-acquired muscle weakness (ICUAW). This prospective, nationwide, multicentre cohort study involved 316 patients from a network of 80 ICUs. Using the Medical Research Council Scale (MRC-Sum score), the study emphasized early mobilization and specific nutritional targets, recommending an energy intake of 25–30 kcal/kg/day and protein intake of 1.2–2 g/kg/day. For patients with a BMI over 30 kg/m^2, the energy target was 11–14 kcal/kg/day and protein 2 g/kg ideal body weight/day. The results showed that early mobilization and nutrition management significantly reduced the incidence of ICUAW. Similarly, Rahiminezhad et al. (2022) conducted a single-blinded randomized controlled trial in Kerman, Iran, involving 90 ICU patients. This study assessed the effects of range of motion (ROM) exercises and massage on muscle strength, finding that both interventions significantly enhanced muscle strength in critically ill patients.

In São Carlos, Brazil, de Campos Biazon et al. (2021) performed a double-blind randomized controlled trial to evaluate the impact of passive mobilization, blood flow restriction (BFR), and neuromuscular electrical stimulation (BFRpE) on muscle mass and quality in ICU patients. Thirty-nine patients were randomly assigned to different intervention groups, and muscle measurements were obtained using ultrasound. The study concluded that BFRpE notably improved muscle mass and quality. Rudra et al. (2022) in Hershey, Pennsylvania, conducted a retrospective cohort study on 270 adult patients to investigate rehabilitation outcomes in those with ICUAW. The study found that patients with ICUAW showed significant improvements in functional independence measures (FIM) and had a higher home discharge rate following inpatient rehabilitation. Additionally, Chlan et al. (2015) in Minnesota, US, demonstrated that mobility programs and alternatives to sedative medications significantly enhanced peripheral muscle strength in mechanically ventilated patients, highlighting the benefits of such interventions in ICU settings.

The collective results underscore the importance of early intervention and a comprehensive approach to managing muscle weakness in the intensive care unit. These findings offer valuable insights into the potential efficacy of various interventions, providing clinicians with evidence-based strategies to optimize patient outcomes and reduce the incidence of ICU-acquired weakness. Moreover, the diversity in study designs and geographical locations highlights the global relevance and applicability of these interventions, emphasizing the need for tailored approaches based on patient demographics, clinical context, and available resources. Overall, these studies contribute to advancing our understanding of muscle weakness in critical illness and inform the development of targeted interventions to enhance rehabilitation outcomes and improve the quality of life for ICU patients.

DISCUSSION

This systematic review identified several nursing and interdisciplinary interventions that may contribute to preventing ICU-Acquired Weakness among critically ill patients. The findings demonstrate that early mobilization, nutritional management, rehabilitation strategies, electrical stimulation therapies, and multidisciplinary collaboration may improve muscle strength, mobility, and functional independence.

Among the included interventions, early mobilization demonstrated the most consistent evidence for reducing ICUAW and improving functional outcomes. Early mobilization helps counteract muscle wasting associated with prolonged immobilization and mechanical ventilation while also improving circulation, respiratory function, and psychological well-being. Nurses play a critical role in assessing patient readiness, monitoring safety during mobilization, and coordinating rehabilitation activities with physiotherapists and physicians.

The intervention was categorized as early mobilization, enteral nutrition management, range of motion exercises, massage, collaboration with physiotherapists to conduct passive mobilization with blood flow restriction and neuromuscular electrical stimulation (BFRpE), functional electrical stimulation, inpatient rehabilitation, and early multidisciplinary collaborative team. The incorporation of early mobilization into nursing interventions for preventing ICU-Acquired Weakness (ICUAW) is supported by its potential to counteract muscle wasting and weakness associated with prolonged bed rest. By initiating early mobilization protocols, nurses facilitate the restoration of muscle function and prevent the onset of ICUAW 13. Furthermore, early mobilization improves physical outcomes and enhances patient comfort and psychological well-being, thereby promoting overall recovery 14. Nurses are pivotal in implementing and overseeing early mobilization programs, ensuring patient safety and adherence to prescribed protocols.

Adequate nutrition is essential for maintaining muscle integrity and preventing ICUAW 6. Nurses oversee enteral nutrition management, ensuring patients receive appropriate caloric and protein intake to support muscle function and prevent catabolism. By closely monitoring nutritional status and collaborating with dietitians and healthcare teams, nurses optimize nutritional support tailored to individual patient needs, thereby mitigating the risk of muscle weakness and promoting recovery 15.

Range of motion exercises and massage therapy are valuable adjuncts to nursing interventions for preventing ICUAW 7,9. These interventions help maintain joint flexibility, improve circulation, and alleviate muscle stiffness and discomfort associated with prolonged immobility. In collaboration with physiotherapists, nurses can guide patients through appropriate range of motion exercises and administer massage therapy, promoting muscle relaxation and preventing contractures. Additionally, massage therapy contributes to patient comfort and relaxation, enhancing the overall effectiveness of rehabilitation efforts 16.

Passive mobilization combined with blood flow restriction and neuromuscular electrical stimulation (BFRpE) represents an innovative approach to preventing ICUAW 8. This intervention aims to stimulate muscle contraction and improve muscle mass and strength in critically ill patients. Nurses collaborate closely with physiotherapists to administer BFRpE safely and effectively, ensuring proper technique and patient monitoring. By integrating BFRpE into multidisciplinary care plans, nurses contribute to optimizing patient outcomes and reducing the incidence of ICUAW 8.

Functional electrical stimulation and inpatient rehabilitation are integral to nursing interventions for preventing ICUAW. These interventions promote muscle activation, enhance motor function, and facilitate recovery of physical independence 12. Nurses are crucial in coordinating and facilitating functional electrical stimulation sessions and inpatient rehabilitation programs, ensuring patient safety and adherence to prescribed protocols. Through their expertise and collaborative efforts with other healthcare professionals, nurses contribute significantly to maximizing the effectiveness of these interventions in preventing ICUAW and promoting overall patient recovery 12.

The integration of early multidisciplinary collaboration represents a comprehensive approach to preventing ICUAW and promoting patient recovery 11,17. Nurses play a central role in this collaborative effort, utilizing their communication skills to engage patients

in understanding the importance of rehabilitation training 11. By patiently explaining the necessity of exercise and rehabilitation, nurses empower patients to actively participate in their recovery process. Moreover, nurses closely monitor patients' vital signs and overall condition, promptly addressing any signs of distress or maladjustment to ensure optimal safety and comfort during rehabilitation sessions.

Compared with previous systematic reviews, this review specifically highlights the central role of nurses within multidisciplinary rehabilitation efforts. Nurses not only implement rehabilitation strategies but also facilitate communication, empower patients through education, monitor safety, and support patient-centered recovery.

Study limitation

Several limitations should be acknowledged in this systematic review. First, substantial heterogeneity existed across study designs, interventions, rehabilitation protocols, and outcome measures, limiting direct comparison among studies and preventing quantitative meta-analysis. Consequently, the findings should be interpreted cautiously when developing standardized clinical guidelines.

Second, the quality of evidence varied among included studies, with some studies using small sample sizes or non-randomized designs. Third, the review included only English-language studies, which may have introduced language bias.

Fourth, hand-searching and grey literature searches were not conducted, potentially limiting the identification of additional relevant studies. Additionally, although this review focused on nursing and interdisciplinary interventions, the specific contributions of individual healthcare professionals were not consistently differentiated across studies.

Finally, most included studies lacked long-term follow-up data. Therefore, the long-term impact of these interventions on quality of life, return to work, community participation, social reintegration, and caregiver burden remains unclear. Future research should include standardized outcome measures, larger randomized controlled trials, and long-term follow-up assessing functional independence and quality of life among ICU survivors.

CONCLUSION

This systematic review demonstrates that early mobilization, nutritional management, rehabilitation exercises, electrical stimulation therapies, and interdisciplinary rehabilitation programs may contribute to preventing ICU-Acquired Weakness among critically ill adult patients. The findings highlight that prevention of ICUAW requires comprehensive interdisciplinary collaboration involving nurses, physiotherapists, nutritionists, rehabilitation therapists, psychologists, patients, and families. Nurses play a central role as coordinators of care, patient educators, rehabilitation facilitators, and patient safety advocates.

Beyond improving short-term muscle strength and mobility, these interventions may support long-term functional independence, quality of life, and successful reintegration into family and community life among ICU survivors. Healthcare institutions should prioritize early rehabilitation programs, standardized mobilization protocols, nutritional optimization, and collaborative multidisciplinary care models to reduce ICUAW incidence and improve patient outcomes.

Future research should focus on larger high-quality randomized controlled trials, standardized outcome measurements, and long-term evaluation of rehabilitation outcomes, including quality of life, social participation, and return-to-work outcomes.

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Ethics Approval: Ethical approval was not required for this study because it is a systematic review based exclusively on previously published literature and does not involve human participants, animals, or identifiable personal data.

Consent to Participate: Not applicable.

Consent for Publication: Not applicable.

Availability of Data and Material: All data generated or analyzed during this study are included in this published article and its referenced sources. Additional information is available from the corresponding author upon reasonable request.

Code Availability: Not applicable. No custom code or software was developed or used for data analysis in this systematic review.

Authors' Contributions

Amelia Ganefianty: Conceptualization, study design, literature review, data extraction, data interpretation, manuscript drafting, and critical revision of the manuscript.

Ardi Zulfariansyah: Literature screening, quality appraisal, data analysis, interpretation of findings, and manuscript revision.

Titin Mulyati: Methodological supervision, critical review of the manuscript, interpretation of results, and final approval of the manuscript.

All authors read and approved the final manuscript.

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