

Original Article**Effectiveness, Benefits, Determinants, and Limitations of Early Mobilization After General Anesthesia: A Scoping Review**Candra Dermawan¹, Rondhianto², Dodi Wijaya²¹ Master of Nursing Program, Faculty of Nursing, Universitas Jember, Jember, East Java, Indonesia² Faculty of Nursing, Universitas Jember, Jember, East Java, Indonesia**ARTICLE INFO****Article History**

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<https://doi.org/10.55018/janh.v8i2.698>**ABSTRACT**

Background: Early mobilization after general anesthesia is a key component of Enhanced Recovery After Surgery (ERAS) programs that improves postoperative recovery. However, evidence on its effectiveness, limitations, and implementation remains inconsistent across surgical settings. Therefore, this scoping review aimed to map and synthesize the available evidence on the effectiveness, benefits, limitations, and factors influencing the implementation of early mobilization after general anesthesia.

Methods: This scoping review followed the Arksey and O'Malley methodological framework and was reported in accordance with the PRISMA-ScR guidelines. Literature searches were conducted in Scopus, PubMed, ScienceDirect, and SpringerLink databases for studies published between 2022 and 2026. A total of 312 records were initially identified. Following duplicate removal, studies underwent title, abstract, and full-text screening based on predefined inclusion and exclusion criteria. Eligible studies included primary research articles involving adult patients undergoing general anesthesia and evaluating early mobilization in perioperative or postoperative settings, whereas review articles, editorials, case reports, and studies unrelated to early mobilization or general anesthesia were excluded. Data were systematically charted using a standardized extraction form, and findings were synthesized using thematic analysis to identify key themes related to effectiveness, benefits, determinants, and limitations of early mobilization.

Results: From 312 records initially identified, 250 studies remained after duplicate removal and underwent title and abstract screening. Following full-text assessment, 12 studies met the inclusion criteria and were included in the final synthesis. Thematic synthesis generated four major themes: (1) clinical effectiveness of early mobilization, including improvements in physical function, pain reduction, shortened length of stay, and decreased postoperative complications; (2) physiological and pharmacological determinants influencing mobilization readiness; (3) neurocognitive determinants affecting patients' ability to participate safely in mobilization; and (4) organizational and healthcare system factors influencing implementation. The review also identified important literature gaps, including the lack of a standardized operational definition of early mobilization, substantial heterogeneity in intervention timing and outcome measures, and limited evidence regarding long-term recovery outcomes.

Conclusion: This scoping review suggests that early mobilization after general anesthesia improves postoperative outcomes, including ADL, pain, LOS, and complications. However, evidence remains limited by indirect findings and variability across studies. Future research should evaluate standardized interventions and long-term outcomes in diverse healthcare settings.

Keywords: Early Mobilization; General Anesthesia; Postoperative Recovery; Enhanced Recovery After Surgery; Perioperative Care; Scoping Review.

Implications for Practice:

- Early mobilization should be integrated into routine perioperative care through standardized protocols and comprehensive assessment of patients' physiological and neurocognitive readiness to improve postoperative recovery and reduce complications.
- Healthcare institutions and policymakers should incorporate evidence-based early mobilization into perioperative care standards while supporting multidisciplinary collaboration, staff training, and quality improvement initiatives.
- Nursing education should strengthen competencies in evidence-based postoperative care, including early mobilization, to prepare graduates for safe practice in Low- and Middle-Income Countries and other resource-limited healthcare settings.

Introduction

Postoperative recovery following general anesthesia represents a critical phase in perioperative care because it substantially influences patient safety, functional outcomes, healthcare utilization, and overall quality of care. Globally, more than 300 million surgical procedures are performed annually, and postoperative complications remain a major contributor to morbidity, mortality, prolonged hospitalization, and increased healthcare costs (Nepogodiev et al., 2019; Weiser et al., 2016). Approximately 15–20% of surgical patients experience postoperative complications, many of which are potentially preventable through evidence-based perioperative interventions (Nepogodiev et al., 2019). Delayed postoperative recovery is associated with increased risks of respiratory complications, functional decline,

prolonged length of stay (LOS), hospital readmission, and reduced quality of life (Kehlet, 2018; Ljungqvist et al., 2017).

Enhanced Recovery After Surgery (ERAS) programs have emerged as an internationally recognized strategy to optimize perioperative outcomes by integrating evidence-based interventions across the surgical continuum. Early mobilization constitutes one of the core ERAS components because it aims to restore physiological function, prevent postoperative complications, and accelerate functional recovery (Ljungqvist et al., 2017; Melloul et al., 2016). Nevertheless, implementation of ERAS components, particularly early mobilization, varies considerably across healthcare systems. Although high-income countries have reported substantial reductions in LOS, postoperative morbidity, and healthcare expenditures following ERAS implementation, evidence from low- and middle-income countries (LMICs), including ASEAN countries, remains relatively limited (Biccard & Madiba, 2018; Wang et al., 2022). Resource constraints, workforce shortages, inadequate postoperative protocols, and limited multidisciplinary collaboration frequently challenge the implementation of early mobilization in resource-limited settings (Biccard & Madiba, 2018; Zou et al., 2025).

From a conceptual perspective, early mobilization may influence postoperative recovery through multiple interrelated pathways. Physiologically, mobilization enhances pulmonary ventilation, improves circulation, preserves muscle strength, and reduces the risk of thromboembolic and respiratory complications (Kehlet, 2018). Neurocognitively, early mobilization may facilitate cognitive recovery, reduce

delirium incidence, and improve patient engagement during recovery (Banerji et al., 2022). Organizational factors, including staffing adequacy, institutional protocols, multidisciplinary support, and healthcare worker competencies, also determine successful implementation (Huang et al., 2023; Zou et al., 2025). Consequently, postoperative recovery after general anesthesia should be understood within a multidimensional framework in which physiological status, neurocognitive recovery, pharmacological management, and organizational readiness interact to influence mobilization outcomes and overall recovery trajectories.

Despite increasing interest in early mobilization, the existing evidence remains fragmented and heterogeneous. Previous studies have reported inconsistent definitions regarding the timing of early mobilization, ranging from mobilization within a few hours after surgery to mobilization within the first postoperative day (Olsén et al., 2026). Furthermore, inconsistencies exist regarding the magnitude of clinical benefits across different surgical populations and healthcare contexts. While several studies have demonstrated improvements in activities of daily living, reduced pain, shortened LOS, and fewer complications (Chen et al., 2025; Hung et al., 2025), other investigations have emphasized the importance of neurocognitive recovery, anesthesia techniques, and organizational determinants as prerequisites for successful mobilization (Banerji et al., 2022; Mao et al., 2022; Verma et al., 2025). These inconsistencies complicate interpretation and limit translation of evidence into clinical practice.

Importantly, most available studies predominantly focus on short-term outcomes, such as pain, LOS, and immediate postoperative complications, whereas evidence regarding long-term functional

recovery, quality of life, and sustained postoperative independence remains scarce (Chen et al., 2025; Olsén et al., 2026). Moreover, limited synthesis has comprehensively integrated physiological determinants, neurocognitive factors, and organizational influences within a single analytical framework. Consequently, several important questions remain unanswered: (1) What clinical benefits of early mobilization after general anesthesia have been consistently reported? (2) Which physiological, neurocognitive, pharmacological, and organizational factors influence implementation success? (3) What limitations and evidence gaps remain within the current literature?

Because the available evidence encompasses diverse populations, study designs, interventions, outcomes, and healthcare settings, a scoping review approach is considered more appropriate than a conventional systematic review. Guided by the Population–Concept–Context (PCC) framework, this review focuses on adult patients undergoing surgery under general anesthesia (Population), early mobilization interventions (Concept), and perioperative and postoperative hospital settings (Context). The PCC framework was selected to ensure broad and comprehensive mapping of evidence regarding effectiveness, determinants, implementation barriers, and limitations associated with early mobilization after general anesthesia.

Methods

Design

This study employed a scoping review methodology to comprehensively map and synthesize the available evidence regarding early mobilization after general anesthesia. The review was conducted following the methodological framework originally proposed by Arksey and O'Malley (Arksey & O'Malley, 2005), further refined by (Danielle et al., 2010), and guided by the

updated methodological recommendations of the Joanna Briggs Institute (JBI) for scoping reviews (Peters et al., 2020, 2022). Reporting of the review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) checklist (Tricco et al., 2018).

A scoping review approach was selected because the existing literature on early mobilization after general anesthesia is characterized by substantial heterogeneity in study populations, intervention characteristics, operational definitions, outcome measures, and methodological designs. In addition, evidence related to the benefits, determinants, implementation barriers, and limitations of early mobilization remains fragmented across different surgical specialties and healthcare contexts. Therefore, unlike a conventional systematic review, which primarily focuses on narrowly defined effectiveness questions, a scoping review enables broad mapping of available evidence, identification of key concepts, exploration of knowledge gaps, and clarification of conceptual boundaries within a complex and evolving field (Arksey & O'Malley, 2005; Danielle et al., 2010; Peters et al., 2020).

The review was guided by the Population–Concept–Context (PCC) framework recommended by JBI for scoping reviews. The Population comprised adult patients undergoing surgery under general anesthesia; the Concept focused on early mobilization, including its effectiveness, benefits, determinants, barriers, and limitations; and the Context encompassed perioperative and postoperative hospital care settings.

The review addressed the following research questions:

1. What evidence exists regarding the clinical effectiveness and benefits of

early mobilization after general anesthesia?

2. What physiological, neurocognitive, pharmacological, and organizational factors influence the implementation of early mobilization after general anesthesia?
3. What limitations, inconsistencies, and knowledge gaps remain in the current literature concerning early mobilization after general anesthesia?

These research questions guided the search strategy, study selection, data charting, and synthesis processes throughout the review.

Eligibility Criteria

Eligibility criteria were established a priori based on the review objectives and the Population–Concept–Context (PCC) framework recommended for scoping reviews (Peters et al., 2020). Studies were considered eligible if they met the following inclusion criteria: (1) primary research studies employing quantitative, qualitative, or mixed-methods designs; (2) studies involving adult patients (≥ 18 years) undergoing surgical procedures under general anesthesia; (3) studies investigating early mobilization interventions or factors related to early mobilization during perioperative or postoperative care; (4) articles published in peer-reviewed journals; and (5) full-text articles published in English between January 2022 and April 2026.

In addition to studies directly evaluating early mobilization interventions, studies examining physiological, neurocognitive, pharmacological, or organizational factors influencing patients' readiness, safety, or ability to participate in early mobilization after general anesthesia were also considered eligible. These indirect evidence sources were included because the objectives of this scoping review extended beyond evaluating

intervention effectiveness to comprehensively map determinants, implementation factors, and contextual influences related to early mobilization. Consequently, studies addressing recovery readiness, cognitive recovery, postoperative delirium, anesthesia-related recovery characteristics, and organizational factors were included when their findings were considered relevant to understanding the implementation and outcomes of early mobilization in perioperative settings.

The publication period was restricted to 2022–2026 to ensure that the review captured the most recent evidence reflecting current perioperative practices, contemporary anesthesia techniques, and recent developments in Enhanced Recovery After Surgery (ERAS) programs. Considerable advancements in perioperative care, postoperative recovery pathways, and implementation strategies have occurred during the last decade; therefore, focusing on recent literature was considered appropriate to provide clinically relevant and up-to-date evidence for current practice and policy development (Kehlet, 2020; Ljungqvist et al., 2017).

The review focused exclusively on adult populations because postoperative physiological responses, anesthetic management, mobilization protocols, and recovery trajectories differ substantially between adult and pediatric patients. Including both populations could introduce considerable clinical heterogeneity and limit the interpretability of findings. Adult patients were therefore selected to ensure greater consistency and applicability of the synthesized evidence to perioperative nursing and surgical practice (Peters et al., 2020).

Studies published in languages other than English were excluded because English represents the dominant language of scientific publication in perioperative and anesthesiology research. Furthermore,

resource limitations related to translation and interpretation precluded comprehensive assessment of non-English articles. Nevertheless, the exclusion of non-English publications may have introduced language bias and potentially limited the identification of relevant evidence from non-English-speaking regions; this limitation is acknowledged in the interpretation of review findings (Jüni et al., 2002).

The exclusion criteria comprised review articles, systematic reviews, meta-analyses, editorials, commentaries, conference abstracts, case reports, study protocols, and studies not specifically addressing early mobilization or general anesthesia. Grey literature sources, including dissertations, theses, institutional reports, conference proceedings, and unpublished studies, were not included because the review aimed to synthesize evidence derived from peer-reviewed scientific publications with established methodological standards. Although exclusion of grey literature may have limited the comprehensiveness of evidence mapping, restricting inclusion to peer-reviewed studies was intended to enhance the methodological rigor and credibility of the synthesized findings (Danielle et al., 2010; Peters et al., 2020).

Information Sources

Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources) and the date the most recent search was executed.

Search Strategy

The search strategy was developed systematically in accordance with the Joanna Briggs Institute (JBI) recommendations for scoping reviews and the PRISMA-ScR guidelines (Peters et al., 2020; Tricco et al., 2018). An initial limited

search was first undertaken in PubMed and Scopus to identify relevant articles and to analyze keywords, index terms, and subject headings used in the titles and abstracts of eligible studies. The identified terms were subsequently refined and adapted for each database.

Prior to the final search, the search strategy underwent pilot testing to assess its sensitivity and specificity in retrieving relevant studies. The pilot process involved iterative refinement of keywords, Boolean operators, truncation symbols, and controlled vocabulary to ensure that known key studies were successfully retrieved. The final search strategy was reviewed and validated through consultation with an experienced academic supervisor familiar

with evidence synthesis methodology and perioperative research.

Both controlled vocabulary and free-text terms were employed to maximize search comprehensiveness. Medical Subject Headings (MeSH) were used in PubMed, while database-specific subject headings and keywords were adapted for other databases. Search concepts were derived from the Population–Concept–Context (PCC) framework and included terms related to early mobilization, general anesthesia, postoperative recovery, and perioperative care (**Table 1**).

The final electronic searches were conducted in Scopus, PubMed, ScienceDirect, SpringerLink, The complete search strategies for each database are presented below to ensure reproducibility.

Table 1. Find Boolean Strategies

Basis data	Boolean code	Applied Filters
Scopus	(("early mobilization" OR "Early mobilization " OR "postoperative mobilization") AND ("general anesthesia" OR "general anaesthesia" OR "post-anesthesia care" OR "postoperative recovery") AND (effectiveness OR outcome* OR benefit* OR recovery OR determinant* OR barrier* OR limitation*))	Article; English; Publication year 2022–2026
PubMed	(("Early mobilization "[Mesh] OR "early mobilization" OR "Early mobilization " OR "postoperative mobilization") AND ("Anesthesia, General"[Mesh] OR "general anesthesia" OR "general anaesthesia" OR "post-anesthesia care" OR "postoperative recovery")) AND (effectiveness OR outcome* OR benefit* OR recovery OR determinant* OR barrier* OR limitation*)	Human; English; Full text; Publication year 2022–2026
ScienceDirect	("early mobilization" OR "Early mobilization " OR "postoperative mobilization") AND ("general anesthesia" OR "post-anesthesia care" OR "postoperative recovery") AND (effectiveness OR outcome* OR recovery OR benefit* OR barrier* OR limitation*)	Research articles; English; Publication year 2022–2026
SpringerLink	("early mobilization" OR "Early mobilization " OR "postoperative mobilization") AND ("general anesthesia" OR "post-anesthesia care" OR "postoperative recovery") AND	Journal articles; English; Publication year 2022–2026

Basis data	Boolean code	Applied Filters
	(effectiveness OR outcome* OR benefit* OR recovery OR determinant* OR limitation*)	

Selection Process

The study selection process was conducted in accordance with the PRISMA-ScR guidelines and recommendations for scoping reviews proposed by the Joanna Briggs Institute (Peters et al., 2020; Tricco et al., 2018). Following the removal of duplicate records, all retrieved citations underwent a multistage screening process consisting of title screening, abstract screening, and full-text eligibility assessment.

Screening was performed independently by two reviewers to minimize selection bias and enhance methodological rigor. During the first stage, titles and abstracts of all identified studies were independently screened by the two reviewers against the predefined eligibility criteria. Studies considered potentially relevant by either reviewer were retained for full-text assessment. Subsequently, full-text articles were independently assessed for eligibility by the same reviewers.

The screening process was managed using Rayyan systematic review software, which facilitated duplicate identification, blinded independent screening, and resolution of disagreements (Ouzzani et al., 2016). Throughout the screening process, reviewers remained blinded to each other's decisions until completion of each screening stage.

Inter-reviewer agreement was assessed periodically during the screening process to ensure consistency in study selection. Any discrepancies or disagreements regarding study eligibility were initially discussed between the two reviewers. When consensus could not be reached, disagreements were resolved through consultation with a third reviewer, whose

decision was considered final. This iterative consensus process ensured transparency, consistency, and methodological rigor throughout study selection (Danielle et al., 2010; Peters et al., 2020).

The final selection process included four stages: identification, screening, eligibility assessment, and inclusion. The complete study selection process and reasons for exclusion at each stage are presented in the PRISMA-ScR flow diagram.

Data Collection Process

Data collection was conducted through a systematic data extraction process from all studies that met the inclusion criteria. A standardized data extraction form was developed a priori based on the review objectives, the Population-Concept-Context (PCC) framework, and recommendations from the Joanna Briggs Institute for scoping reviews (Peters et al., 2020).

Before commencing the full extraction process, the extraction form underwent pilot testing using a sample of three eligible studies to evaluate its clarity, comprehensiveness, consistency, and applicability. Minor modifications were subsequently made to improve wording, ensure uniform interpretation of variables, and optimize data capture. The pilot testing process enabled refinement of the extraction instrument prior to full implementation (Danielle et al., 2010).

Data extraction was performed independently by two reviewers using the finalized extraction form. Extracted information included study title, author, year of publication, country of origin, study design, population and sample characteristics, intervention characteristics,

outcome domains, key findings, determinants of early mobilization, implementation barriers, and study limitations. To ensure consistency and minimize extraction errors, periodic meetings were conducted throughout the extraction process to compare extracted data and discuss discrepancies.

Inter-rater reliability was assessed through independent comparison of extracted data during the initial phase of extraction. Discrepancies identified between reviewers were reviewed and resolved through discussion and consensus. When disagreements could not be resolved, a third reviewer independently examined the article and made the final decision. This validation process ensured the accuracy, completeness, and consistency of the extracted data (Peters et al., 2020).

To further enhance data quality, all extracted information underwent a secondary verification process in which the extracted dataset was cross-checked against the original full-text articles by another member of the review team. Any inconsistencies or ambiguities identified during verification were re-evaluated through repeated examination of the original publications.

No attempts were made to contact study authors to obtain additional information or clarify missing data because the review primarily aimed to map existing published evidence rather than quantitatively synthesize effect estimates. Furthermore, the majority of included studies provided sufficient information to address the review objectives. This approach is consistent with the exploratory nature of scoping reviews, which emphasize breadth of evidence rather than exhaustive retrieval of unpublished information (Arksey & O'Malley, 2005; Peters et al., 2020).

No automated artificial intelligence tools were used during the data extraction or data management processes.

Data Charting Process

The data charting process was conducted using a standardized charting form specifically developed based on the objectives of the review and the Population–Concept–Context (PCC) framework recommended by the Joanna Briggs Institute for scoping reviews (Peters et al., 2020). The charting form was designed to systematically capture and organize information relevant to the review questions while ensuring consistency across included studies.

Before commencing full data charting, the charting form underwent pilot testing using three purposively selected studies representing different research designs (e.g., randomized controlled trial, cohort study, and qualitative study). The pilot process aimed to assess the clarity, completeness, feasibility, and applicability of the charting categories. Following pilot testing, minor revisions were made to improve consistency in data recording, refine variable definitions, and ensure that all relevant concepts could be adequately captured (Danielle et al., 2010).

The charting variables were explicitly aligned with the PCC framework. Variables related to the Population domain included participant characteristics, age, surgical procedures, and sample size. The Concept domain comprised early mobilization characteristics, intervention components, effectiveness outcomes, implementation determinants, barriers, and reported limitations. The Context domain included healthcare settings, perioperative care environments, postoperative recovery units, Enhanced Recovery After Surgery (ERAS) programs, and organizational characteristics influencing implementation.

Additional methodological information, including study design, country of origin, and key findings, was also extracted to facilitate evidence mapping and synthesis (**Table 2**).

Data charting was independently undertaken by two reviewers using the finalized charting form. To ensure methodological rigor and consistency, regular meetings were conducted throughout the charting process to compare extracted information, discuss ambiguities, and refine interpretation of study findings. Any discrepancies identified during charting were resolved through discussion and consensus, with consultation from a third reviewer when necessary (Peters et al., 2020).

To enhance data accuracy and reliability, a verification process was conducted after completion of data charting. All charted data were cross-checked against the original full-text articles by another member of the review team to confirm completeness, accuracy, and consistency. When inconsistencies, missing information, or unclear interpretations were identified, the original articles were re-examined and the extracted information was revised accordingly. This iterative verification process ensured the trustworthiness and credibility of the final dataset used for evidence synthesis (Arksey & O'Malley, 2005; Danielle et al., 2010).

Table 2. PCC Framework of the Scoping Review

PCC Components	Description	Operational Definitions in This Review
Population (P)	The group of individuals that the research focuses on	Adult patients (≥ 18 years) undergoing surgical procedures under general anesthesia in the postoperative recovery phase
Concept (C)	Key phenomena or concepts studied	Early mobilization after general anesthesia, including effectiveness, clinical benefits, limitations, barriers, and factors affecting its implementation
Context (C)	Research environment or setting	Perioperative care and postoperative recovery in hospitals, including Post-Anesthesia Care Unit (PACU) Unit (PACU), inpatient rooms, and Enhanced Recovery After Surgery (ERAS) programs

Data Items

Data items were predefined a priori according to the objectives of the review and the Population–Concept–Context (PCC) framework recommended for scoping reviews (Peters et al., 2020). The extracted variables included bibliographic characteristics, methodological characteristics, intervention characteristics, outcome measures, determinants of early mobilization, implementation barriers, and key study findings.

Operational definitions were established to ensure consistency during data extraction and synthesis. Early mobilization was operationally defined as any structured patient mobilization activity

initiated during the immediate postoperative period following general anesthesia, including sitting, standing, ambulation, or active physical activity performed within the timeframe defined by individual studies. Because considerable variation existed across studies, terms such as Early mobilization and postoperative mobilization were categorized under the broader concept of early mobilization (Olsén et al., 2026).

Clinical effectiveness outcomes were operationally defined as measurable indicators reflecting postoperative recovery, including Activities of Daily Living (ADL), pain intensity, Quality of Recovery, length of hospital stay (LOS), postoperative

complications, and patient discharge readiness. Physiological determinants referred to patient-related biological and functional factors influencing mobilization readiness, including hemodynamic stability, pain severity, muscle strength, and postoperative physiological recovery. Neurocognitive determinants comprised factors related to cognitive recovery, delirium, attention, and postoperative cognitive function. Organizational factors included healthcare system characteristics such as staffing adequacy, multidisciplinary collaboration, institutional protocols, availability of resources, and healthcare worker competencies.

To facilitate evidence synthesis, extracted outcomes were categorized into four overarching domains: (1) clinical effectiveness outcomes, (2) physiological and pharmacological determinants, (3) neurocognitive determinants, and (4) organizational and healthcare system factors. Outcome categorization was conducted iteratively during the charting process and refined through discussion among reviewers to ensure conceptual consistency and alignment with the review objectives (Danielle et al., 2010).

Variable coding procedures were performed using an inductive-deductive approach. Initially, predefined coding categories derived from the PCC framework and review questions were applied deductively. Subsequently, additional codes emerging from the included studies were generated inductively and incorporated into the analytical framework when relevant. Similar concepts and outcomes reported using different terminology across studies were grouped under common thematic categories to facilitate synthesis and evidence mapping (Arksey & O'Malley, 2005; Peters et al., 2020).

Critical Appraisal of Individual Sources of Evidence

Although critical appraisal is not considered a mandatory component of scoping reviews, methodological quality assessment was undertaken to provide additional insight into the credibility, methodological rigor, and overall strength of the available evidence (Peters et al., 2020). The appraisal process was intended to support interpretation of findings, identify potential methodological limitations within the included studies, and contextualize evidence gaps identified during synthesis.

Methodological quality was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools corresponding to each study design, including the Joanna Briggs Institute (JBI) Critical Appraisal Tool for Randomized Controlled Trials, Joanna Briggs Institute (JBI) Critical Appraisal Tool for Cohort Studies, Joanna Briggs Institute (JBI) Critical Appraisal Tool for Analytical Cross-Sectional Studies, and Joanna Briggs Institute (JBI) Critical Appraisal Tool for Qualitative Research (Peters et al., 2020). The most recent JBI critical appraisal instruments available at the time of the review were utilized.

Quality appraisal was conducted independently by two reviewers. Each reviewer assessed all included studies using the appropriate Joanna Briggs Institute (JBI) Critical Appraisal Tool according to study design. Following independent assessment, appraisal scores and judgments were compared between reviewers. Discrepancies were discussed and resolved through consensus. When disagreements could not be resolved through discussion, a third reviewer independently reassessed the study and provided the final decision. This consensus approach was employed to enhance reliability and reduce subjective bias during quality assessment (Danielle et al., 2010; Peters et al., 2020).

To facilitate interpretation, methodological quality scores were

categorized according to the percentage of fulfilled JBI criteria. Studies achieving $\geq 80\%$ of applicable criteria were classified as high quality, studies scoring 60–79% were categorized as ***moderate quality***, and studies scoring $< 60\%$ were considered ***low quality***. These thresholds were adopted from approaches commonly used in evidence synthesis studies to provide a pragmatic interpretation of methodological rigor while acknowledging that no universally accepted cutoff values exist for JBI appraisal scores (Peters et al., 2020, 2022).

The findings of the critical appraisal were not used as criteria for study exclusion, consistent with the exploratory nature of scoping reviews (Arksey & O'Malley, 2005). Instead, appraisal results informed interpretation of the evidence by highlighting methodological strengths and weaknesses across studies. Studies with lower methodological quality were interpreted with greater caution during evidence synthesis, particularly when drawing conclusions regarding intervention effectiveness and implementation determinants. In addition, appraisal findings contributed to identifying research gaps and areas requiring further high-quality investigation.

Consultation to Expert

Consistent with recommendations proposed by Levac et al. (2010), an optional expert consultation phase was undertaken to enhance the interpretive validity, clinical relevance, and contextual understanding of the review findings. The consultation process was intended to provide additional insights into evidence interpretation, identify potential gaps not fully captured in the literature, and strengthen the applicability of findings to perioperative clinical practice.

A total of three experts participated in the consultation process. Experts were

purposely selected based on predefined eligibility criteria, including: (1) a minimum of five years of professional or academic experience in perioperative nursing, anesthesiology, or surgical care; (2) demonstrated expertise through peer-reviewed publications, clinical leadership, or academic appointments in relevant fields; and (3) direct involvement in perioperative care, postoperative recovery programs, or Enhanced Recovery After Surgery (ERAS) implementation.

The expert panel consisted of one senior perioperative nursing academic, one consultant anesthesiologist, and one clinical nurse specialist with experience in postoperative recovery and ERAS implementation. This multidisciplinary composition was intended to ensure diverse professional perspectives and comprehensive evaluation of the synthesized evidence.

The consultation process was conducted following completion of the preliminary evidence synthesis. Experts were provided with a summary of the review objectives, major findings, thematic categories, and preliminary interpretations. Structured feedback was subsequently obtained through individual consultations and group discussions focusing on the clinical relevance of findings, interpretation of thematic relationships, identification of evidence gaps, and implications for perioperative practice and policy.

Expert feedback was documented, reviewed, and discussed by the research team. The consultation process did not alter study selection, eligibility decisions, or extracted data. Instead, expert input informed refinement of thematic interpretations, strengthened the discussion of implementation barriers and facilitators, highlighted additional research priorities, and enhanced the contextual relevance of the final synthesis. In particular, expert recommendations

contributed to expanding the implications for perioperative nursing protocols, multidisciplinary collaboration, and healthcare policy development (Danielle et al., 2010; Peters et al., 2020).

The consultation phase was therefore used as a knowledge translation strategy to improve the applicability and interpretive depth of the review findings rather than as a source of primary evidence.

Synthesis of Results

The synthesis of results was conducted using a qualitative thematic synthesis approach to systematically map, organize, and interpret the evidence identified in the included studies. Consistent with the objectives of scoping reviews, the synthesis aimed to identify patterns, relationships, key concepts, implementation determinants, and existing knowledge gaps related to early mobilization after general anesthesia (Arksey & O'Malley, 2005; Peters et al., 2020).

The thematic synthesis process was performed iteratively through several stages. First, all extracted data relevant to the review questions were reviewed repeatedly to achieve data familiarization. Second, meaningful units of information related to early mobilization outcomes, determinants, barriers, and implementation factors were identified and assigned preliminary codes. Coding was conducted using a combined deductive-inductive approach. Deductive codes were initially derived from the review objectives, Population–Concept–Context (PCC) framework, and existing perioperative recovery literature, whereas inductive codes emerged directly from the findings reported in the included studies (Danielle et al., 2010).

During the initial stage of analysis, findings extracted from each study were coded line-by-line to identify meaningful

concepts related to postoperative recovery, mobilization implementation, determinants, barriers, and contextual influences. Examples of initial codes included "improved activities of daily living," "reduced postoperative pain," "shorter length of stay," "hemodynamic stability," "cognitive recovery," "staffing adequacy," and "multidisciplinary support." Similar codes were subsequently grouped into descriptive categories representing broader conceptual domains.

The development of higher-order analytical themes was conducted iteratively through constant comparison across studies. Descriptive categories sharing conceptual similarities were clustered and abstracted into overarching themes. For example, categories related to improvements in physical function, pain reduction, reduced complications, and shortened hospitalization were synthesized into the theme "clinical effectiveness of early mobilization." Similarly, categories concerning *hemodynamic stability, analgesic management, and discharge readiness* were grouped under "physiological and pharmacological determinants influencing mobilization readiness."

Because several included studies addressed multiple aspects of postoperative recovery, individual studies were permitted to contribute to more than one analytical theme. Theme allocation was determined according to the substantive content of study findings rather than study design alone. All coding decisions, category development, and thematic assignments were reviewed iteratively by two reviewers and finalized through consensus discussions to ensure analytical rigor and conceptual coherence (Arksey & O'Malley, 2005; Danielle et al., 2010; Peters et al., 2020).

Following the coding process, conceptually similar codes were grouped into descriptive categories. Categories

sharing common characteristics were subsequently aggregated into broader analytical themes through iterative discussion among reviewers. Theme generation was guided by conceptual similarities, frequency of reporting, and relevance to the review questions. Through this process, four overarching themes were identified: (1) clinical effectiveness of early mobilization, (2) physiological and pharmacological determinants influencing mobilization readiness, (3) neurocognitive determinants affecting postoperative recovery and mobilization participation, and (4) organizational and healthcare system factors influencing implementation.

The synthesis process was undertaken independently by two reviewers. Preliminary codes, categories, and emerging themes were compared regularly through consensus meetings to ensure analytical consistency and minimize subjective interpretation. Any discrepancies in coding or thematic interpretation were resolved through discussion, and unresolved disagreements were adjudicated by a third reviewer. This

iterative consensus process enhanced the credibility, dependability, and trustworthiness of the synthesized findings (Peters et al., 2020).

To facilitate interpretation and evidence mapping, the final themes were integrated into a conceptual thematic framework illustrating the multidimensional relationships among physiological factors, neurocognitive recovery, organizational influences, and postoperative outcomes associated with early mobilization. This framework provided a comprehensive understanding of how multiple interacting factors influence the implementation and effectiveness of early mobilization after general anesthesia (**Table 2**).

The synthesis findings were subsequently presented narratively and supported by summary tables and thematic mapping to provide a structured overview of the available evidence and remaining research gaps.

Table 2. Thematic Coding Matrix of Included Studies

Overarching Theme	Descriptive Categories	Contributing Studies
Clinical effectiveness of early mobilization	ADL improvement, pain reduction, reduced LOS, decreased complications	Chen et al. (2025); Hung et al. (2025); Huang et al. (2023)
Physiological and pharmacological determinants influencing mobilization readiness	Hemodynamic stability, analgesic techniques, discharge readiness, recovery quality	Kang et al. (2025); Chhabra et al. (2023); Lodhi et al. (2023); Mao et al. (2022); Maroufi et al. (2025)
Neurocognitive determinants affecting postoperative recovery and mobilization participation	Cognitive recovery, delirium, attention, readiness for participation	Verma et al. (2025); Banerji et al. (2022); Maroufi et al. (2025)
Organizational and healthcare system factors influencing implementation	Staffing adequacy, education, multidisciplinary collaboration, institutional protocols	Huang et al. (2023); Zou et al. (2025); Olsén et al. (2026)

A thematic coding matrix was developed to document the relationship between primary study findings, descriptive categories, and final analytical themes. The matrix provides an explicit audit trail demonstrating how evidence from individual studies informed one or more analytical themes, thereby enhancing the transparency, credibility, and reproducibility of the synthesis.

Results
Selection of Sources of Evidence

The electronic database search identified a total of 312 records. After removal of duplicate records, 250 articles

remained for title and abstract screening. During the screening stage, 198 articles were excluded because they did not meet the predefined eligibility criteria. Consequently, 52 full-text articles were assessed for eligibility.

Following full-text review, 40 studies were excluded for the following reasons: not specifically addressing early mobilization after general anesthesia (n = 16), inappropriate study population (n = 9), non-primary research design (n = 7), insufficient outcome reporting (n = 5), and unavailable full-text articles (n = 3). Ultimately, 12 studies fulfilled all eligibility criteria and were included in the final synthesis.

Figure 1 illustrates the complete study selection process according to the PRISMA-ScR framework, including identification, screening, eligibility assessment, reasons for exclusion, and final study inclusion.

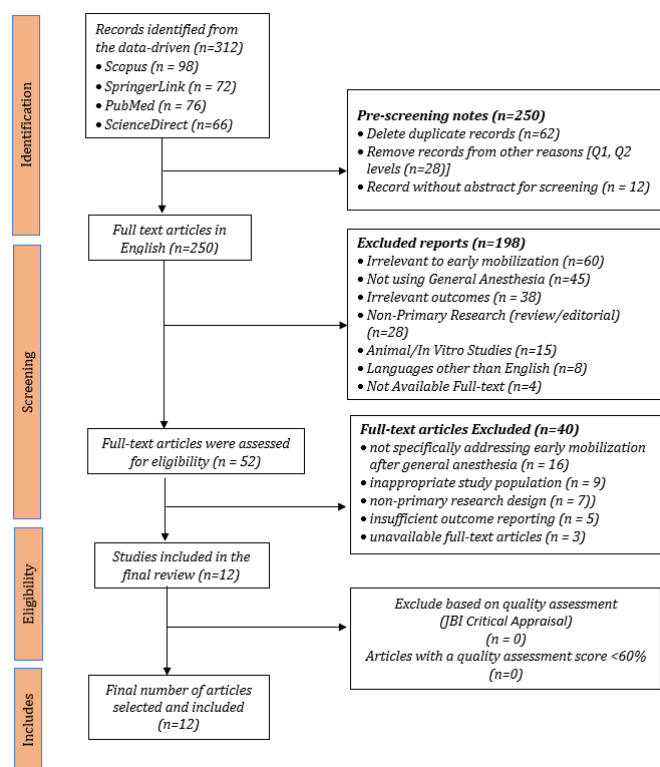


Figure 1. PRISMA-ScR flowchart illustrating the screening and selection process

Characteristics of Sources of Evidence

A total of 12 studies published between 2022 and 2026 met the inclusion criteria and were included in the final synthesis. **Table 3** presents the detailed characteristics of the included studies, including authors, publication year, country of origin, study design, population characteristics, intervention characteristics, outcomes assessed, and key findings.

Overall, the included studies represented a diverse range of methodological designs, comprising randomized controlled trials, prospective cohort studies, retrospective observational studies, cross-sectional studies, and qualitative investigations. The studies were conducted across various geographical regions, including Asia, Europe, and North America, reflecting increasing international interest in early mobilization after general anesthesia.

Although several included studies did not directly evaluate early mobilization interventions, these studies were retained because they examined factors closely related to mobilization readiness, postoperative recovery trajectories, and implementation feasibility following general anesthesia. Specifically, studies investigating cognitive recovery, discharge readiness, delirium, quality of recovery, and anesthesia-related recovery profiles contributed indirect evidence regarding patients' capacity to safely engage in early mobilization during the postoperative period.

Regarding study settings, most investigations were conducted in tertiary hospitals and specialized surgical centers, particularly within postoperative recovery units, surgical wards, intensive care units, and Enhanced Recovery After Surgery

(ERAS) programs. Several studies specifically focused on perioperative care pathways implemented in large academic medical centers, whereas only a limited number of studies originated from resource-limited healthcare settings. This distribution suggests that current evidence is predominantly derived from well-resourced institutions, potentially limiting transferability to low-resource environments.

Population characteristics varied across studies. Most studies involved adult patients undergoing major elective surgical procedures under general anesthesia, including abdominal, gastrointestinal, orthopedic, thoracic, and oncological surgeries. Sample sizes ranged considerably, from small qualitative samples exploring patient experiences to large observational cohorts involving several hundred participants. Despite variations in surgical populations, the majority of studies focused on adult postoperative patients during the immediate recovery period, emphasizing the importance of early mobilization in enhancing functional recovery and preventing postoperative complications.

The included studies comprised two distinct categories of evidence. First, three studies directly evaluated early mobilization interventions and their clinical outcomes following general anesthesia, including randomized and observational investigations assessing mobilization protocols, mobilization timing, and patient experiences related to mobilization implementation (Chen et al., 2025; Huang et al., 2023; Hung et al., 2025). These studies provided direct evidence regarding the effectiveness of early mobilization on postoperative outcomes.

Second, the remaining studies provided indirect or contextual evidence by examining factors influencing postoperative recovery, mobilization

readiness, and implementation feasibility, including discharge readiness prediction, anesthetic techniques, neurocognitive recovery, delirium, quality of recovery, and organizational practices (Banerji et al., 2022; Kang et al., 2025; Mao et al., 2022; Maroufi et al., 2025; Verma et al., 2025a; Zou et al., 2025). Although these studies did not directly evaluate mobilization interventions, they contributed important contextual insights regarding conditions necessary for safe and successful early mobilization implementation.

Outcome measures reported across the included studies were heterogeneous. Nevertheless, several outcome domains were consistently evaluated. The most frequently reported outcomes included Activities of Daily Living (ADL), postoperative pain, length of hospital stay (LOS), postoperative complications, Quality of Recovery, mobilization readiness, and discharge outcomes. In addition, several studies examined determinants influencing mobilization implementation, including physiological stability, neurocognitive recovery, pain management, staffing adequacy, multidisciplinary collaboration, and organizational support.

The heterogeneity observed across study settings, populations, interventions, and outcome measures further supports the appropriateness of adopting a scoping review methodology to comprehensively map existing evidence and identify areas requiring further investigation (Arksey & O'Malley, 2005; Peters et al., 2020).

Methodological Quality Assessment

The methodological quality of the included studies varied across study designs. Most studies demonstrated moderate to high methodological quality based on the JBI critical appraisal criteria. **Table 4** summarizes the results of the methodological quality assessment, including appraisal scores and corresponding quality classifications for each included study.

Evidence Synthesis

The thematic synthesis identified four major themes related to early mobilization after general anesthesia. These themes included: (1) clinical effectiveness of early mobilization, (2) physiological and pharmacological determinants influencing mobilization readiness, (3) neurocognitive determinants affecting postoperative recovery and mobilization participation, and (4) organizational and healthcare system factors influencing implementation.

Table 5 presents the thematic coding matrix illustrating how evidence from individual studies contributed to the development of descriptive categories and overarching analytical themes. In addition, **Table 6** summarizes the thematic categorization of evidence and provides

representative findings for each identified theme and subtheme. **Figure 2** illustrates the conceptual thematic framework demonstrating the multidimensional relationships among physiological, neurocognitive, and organizational factors influencing the implementation and effectiveness of early mobilization after general anesthesia.

Clinical Effectiveness of Early Mobilization

Evidence consistently demonstrated that early mobilization improved postoperative recovery outcomes, including activities of daily living, pain reduction, shorter hospital stay, and decreased postoperative complications. These findings were primarily derived from studies directly evaluating early mobilization interventions and are presented within Theme 1 and **Table 6**.

Determinants and Implementation Factors

Several physiological, neurocognitive, and organizational factors influenced mobilization readiness and implementation success. These determinants, barriers, and facilitators are synthesized across Themes 2, 3, and 4 and summarized in **Table 6** and **Figure 2**.

Table 3. Characteristics of Included Studies

No	Title & Author	Country	Study Design	Population/Sample	Types of interventions	Yield Domains	Key Findings
1	Prediction of Post-Anesthesia Care Unit (PACU) Readiness Using Machine Learning: A Comparative Study of Algorithms (Maroufi et al., 2025)	Iran	Cross-sectional Study	830 patients under general anesthesia	Machine learning predictions of PACU release readiness	Recovery readiness, time of release	Random Forest shows the highest accuracy in predicting PACU discharge readiness and recovery outcomes.
2	Superficial Cervical Plexus Nerve Block Effect with Ropivacaine... (Kang et al., 2025)	China	Randomized controlled trials (RCTs)	140 patients underwent thyroid cancer surgery	Cervical plexus block + general anesthesia	Pain, QoR-15, Quality of Recovery	Regional blocks improve the quality of postoperative recovery and reduce postoperative pain.

No	Title & Author	Country	Study Design	Population/Sample	Types of interventions	Yield Domains	Key Findings
3	Nurses' Actual Experience in Implementing Hypothermia Prevention Practices During PACU (Zou et al., 2025)	China	Qualitative Studies	PACU Nurse	Hypothermia prevention practices	Recovery support, nursing barriers	Human resources, training, and protocols significantly impact postoperative recovery practices.
4	Assessment of Cognitive Recovery in Patients After Desflurane versus Sevoflurane-Based General Anesthesia (Verma et al., 2025)	India	Randomized Double-Blind Trial	60 patients with laparoscopic cholecystectomy	Desflurane vs Sevoflurane	Cognitive recovery, PACU recovery	Cognitive function returned to baseline within 150 minutes in both groups.
5	Early Mobilization in Postoperative Glioma Patients: Real-World Impact on Recovery and Long-Term Prognosis (Chen et al., 2025)	China	Randomized controlled trials	Adult glioma patients after craniotomy	Initial mobilization protocol	ADL, pain, LOS, complications	Early mobilization improves ADL, reduces pain, shortens LOS, and lowers complication rates.
6	Exploring Elderly Patients' Experiences and Concerns About Early Mobilization After Lumbar Spine Surgery (Huang et al., 2023)	China	Qualitative Studies	24 elderly spinal surgery patients	Early mobilization (<4 hours)	Patient experience, barriers	Education, pain management, and multidisciplinary support influence the success of mobilization.
7	Comparative Study of Clinical Effects and Recovery Characteristics of Dexmedetomidine Infusion with Ketamine versus Fentanyl (Lodhi et al., 2023)	India	Comparative Clinical Trials	80 surgical patients	Dexmedetomidine + Ketamin vs Fentanil	Recovery characteristics, PACU stay	The combination of ketamine reduces PACU resistance and improves hemodynamic stability.
8	Comparison of Recovery Quality (QoR-15) After Intravenous Lignocaine and Fentanyl (Chhabra et al., 2023)	India	Randomized Controlled Trial (RCT)	64 septoplasty patients	IV Lignocaine vs Fentanyl	QoR-15, release readiness	Lignocaine improves the quality of recovery and accelerates exit readiness.
9	Determinants of Early Mobilization in Elderly Patients Undergoing Total Knee Replacement (Hung et al., 2025)	Taiwan	Cohort Retrospective	1,759 elderly TKR patients	Initial mobilization within 24 hours	LOS, falling, decisive	Early mobilization reduces LOS without increasing the risk of falling.
10	Time Frame for Early Mobilization After Abdominal and Cardiothoracic	Sweden	Mixed-Methods Study	503 professionals; 736 patients	Consensus development	Definition of early mobilization	Early mobilization is defined as mobilization

No	Title & Author	Country	Study Design	Population/Sample	Types of interventions	Yield Domains	Key Findings
11	Surgery (Fagevik Olsén et al., 2026) Quality of Recovery After General Anesthesia with Remimazolam in Patients Undergoing Urological Surgery (Mao et al., 2022)	China	Randomized controlled trials	Urological surgical patients	Remimazolam vs Propofol	QoR-15, hemodynamics	within 6 hours postoperatively. Remimazolam provides stable hemodynamics but a lower quality of early recovery.
12	Deconstruction of Delirium in the Post-Anesthesia Care Unit (Banerji et al., 2022)	New Zealand	Secondary Analytical Studies	200 patients aged >60 years	PACU delirium assessment	Neurocognitive recovery, delirium	Neurocognitive recovery occurs gradually, with attention deficits persisting during early recovery.

Critical Appraisal Within Sources of Evidence

Methodological quality appraisal was conducted for all included studies using the Joanna Briggs Institute (JBI) Critical Appraisal Tools appropriate to each study design. **Table 4** summarizes the methodological quality assessment results, including appraisal scores and quality classifications for each included study.

Overall, the majority of included studies demonstrated moderate to high methodological quality, indicating that the current body of evidence provides a reasonably robust basis for understanding the effectiveness and implementation of early mobilization after general anesthesia. Most randomized controlled trials exhibited clear intervention descriptions, appropriate outcome measurements, and adequate follow-up procedures. Similarly, observational studies generally demonstrated satisfactory methodological rigor in participant selection and outcome assessment.

Nevertheless, several methodological weaknesses were identified across the included studies. Common limitations included inadequate reporting of allocation concealment and blinding procedures in randomized controlled trials, limited

sample sizes, insufficient control of potential confounding variables in observational studies, and incomplete reporting of participant attrition. In addition, some studies lacked detailed descriptions of intervention protocols, thereby limiting reproducibility and comparison across studies. Considerable heterogeneity was also observed regarding definitions of early mobilization, timing of intervention initiation, and outcome measurement methods.

Qualitative studies generally demonstrated strong alignment between research methodology and study objectives; however, several studies provided limited reflexivity regarding researcher influence and insufficient description of strategies used to enhance trustworthiness. Furthermore, a limited number of studies explicitly reported long-term follow-up outcomes, restricting understanding of the sustained effects of early mobilization beyond the immediate postoperative period.

The identified methodological limitations have important implications for interpretation of the review findings. Specifically, risks of selection bias, performance bias, and reporting bias may have influenced estimates of intervention effectiveness in some studies.

Consequently, findings related to clinical effectiveness should be interpreted cautiously, particularly when evidence is derived from studies with moderate methodological quality or limited sample sizes. Despite these limitations, the overall consistency of findings across multiple study designs strengthens confidence in the beneficial effects of early mobilization after general anesthesia.

Importantly, consistent with the principles of scoping reviews, methodological quality appraisal findings were not used as criteria for excluding studies. Instead, appraisal results informed interpretation of the evidence, facilitated identification of methodological gaps, and highlighted priorities for future high-quality (Arksey & O'Malley, 2005; Peters et al., 2020).

Table 4. Critical Appraisal Results

No	Author (Year)	Study Design	Score	Percentage (%)	Categories Quality
1	Maroufi et al. (2025)	Cross-sectional Study	7/8	87.5	High
2	Kang et al. (2025)	RCT	9/13	69.2	Medium
3	Zou et al. (2025)	Qualitative	8/10	80.0	High
4	Verma et al. (2025)	RCT	11/13	84.6	High
5	Chen et al. (2025)	RCT	10/13	76.9	Medium
6	Huang et al. (2023)	Qualitative	8/10	80.0	High
7	Lodhi et al. (2023)	Clinical Trials	8/13	61.5	Medium
8	Chhabra dkk. (2023)	RCT	12/13	92.3	High
9	Hung et al. (2025)	Cohort	10/11	90.9	High
10	Olsén et al. (2026)	Mixed Method	8/8	100	High
11	Mao & Guo (2022)	RCT	9/13	69.2	Medium
12	Banerji et al. (2022)	Cohort/Secondary Analysis	9/11	81.8	High

Results of Individual Sources of Evidence

Table 6. Thematic Categorization of Evidence

Theme	Subtheme	Representative Findings
Clinical Effectiveness	Functional recovery	Improved ADL and physical independence
	Postoperative complications	Reduced respiratory and thromboembolic complications
	Length of stay	Shorter hospitalization duration
Physiological and Pharmacological Determinants	Physiological stability	Hemodynamic stability and pain control
	Pharmacological factors	Effects of anesthesia and analgesia
Neurocognitive Determinants	Cognitive recovery	Delirium and cognitive status
	Patient engagement	Motivation and psychological readiness
Organizational Factors	Multidisciplinary collaboration	Team-based perioperative care
	Organizational support	Protocols, staffing, and resources

The synthesis of evidence was organized according to the review objectives and research questions, focusing on the effectiveness, determinants, implementation factors, and limitations of early mobilization after general anesthesia. The thematic analysis generated four overarching themes and several related

subthemes. **Table 6** presents the thematic categorization of findings derived from the included studies, while **Figure 2** illustrates the conceptual relationships among the identified themes.

Theme 1: Clinical Effectiveness of Early Mobilization

The first theme addressed the clinical effectiveness and benefits of early mobilization following general anesthesia, corresponding to the first review question. Evidence consistently demonstrated that early mobilization was associated with improved postoperative recovery outcomes.

Subtheme 1.1: Improvement in Functional Recovery

Several studies reported significant improvements in Activities of Daily Living (ADL), physical functioning, and patient independence following implementation of early mobilization protocols (Chen et al., 2025; Hung et al., 2025).

Subtheme 1.2: Reduction in Postoperative Complications

Multiple studies demonstrated that early mobilization reduced postoperative complications, particularly respiratory complications, thromboembolic events, and functional decline (Banerji et al., 2022; Verma et al., 2025).

Subtheme 1.3: Shortened Length of Hospital Stay

A substantial proportion of studies reported reductions in length of hospital stay and earlier discharge among patients receiving structured early mobilization interventions (Chen et al., 2025; Mao & Guo, 2022).

Theme 2: Physiological and Pharmacological Determinants

The second theme addressed physiological and pharmacological factors influencing mobilization readiness and implementation success, corresponding to the second review question.

Subtheme 2.1: Hemodynamic and Physiological Stability

Hemodynamic stability, pain control, muscle strength, overall physiological recovery, and postoperative discharge readiness emerged as important prerequisites for safe mobilization. Studies examining recovery readiness in the Post-Anesthesia Care Unit (PACU) further suggested that objective prediction of recovery status may support timely and safe initiation of postoperative mobilization (Huang et al., 2023; Mao et al., 2022; Maroufi et al., 2025).

Subtheme 2.2: Anesthetic and Pharmacological Considerations

The type of anesthesia, residual sedative effects, analgesic regimens, and postoperative pain management significantly influenced patients' ability to participate in early mobilization activities (Banerji et al., 2022).

Theme 3: Neurocognitive Determinants

The third theme explored neurocognitive factors influencing early mobilization participation.

Subtheme 3.1: Cognitive Recovery and Delirium

Several studies identified postoperative cognitive recovery and delirium prevention as important determinants of successful mobilization. Patients experiencing delayed cognitive recovery were less likely to engage safely in mobilization activities (Banerji et al., 2022; Olsén et al., 2026).

Subtheme 3.2: Patient Engagement and Motivation

Patient motivation, understanding of mobilization benefits, and psychological readiness were also reported as factors facilitating postoperative mobilization (Hung et al., 2025).

Theme 4: Organizational and Healthcare System Factors

The fourth theme addressed organizational determinants influencing implementation within perioperative care settings.

Subtheme 4.1: Multidisciplinary Collaboration

Evidence indicated that effective collaboration among nurses, surgeons, anesthesiologists, and rehabilitation professionals facilitated successful implementation of early mobilization programs (Zou et al., 2025).

Subtheme 4.2: Institutional Protocols and Resource Availability

Availability of standardized protocols, adequate staffing, staff training, and organizational support were consistently identified as essential implementation facilitators (Huang et al., 2023; Zou et al., 2025).

Overall, the findings demonstrate that early mobilization after general anesthesia is a multidimensional intervention influenced by interactions among clinical, physiological, neurocognitive, and organizational factors. These findings directly address the review objectives by providing a comprehensive synthesis of the effectiveness, determinants, implementation factors, and limitations associated with early mobilization in perioperative settings.

Synthesis of Results

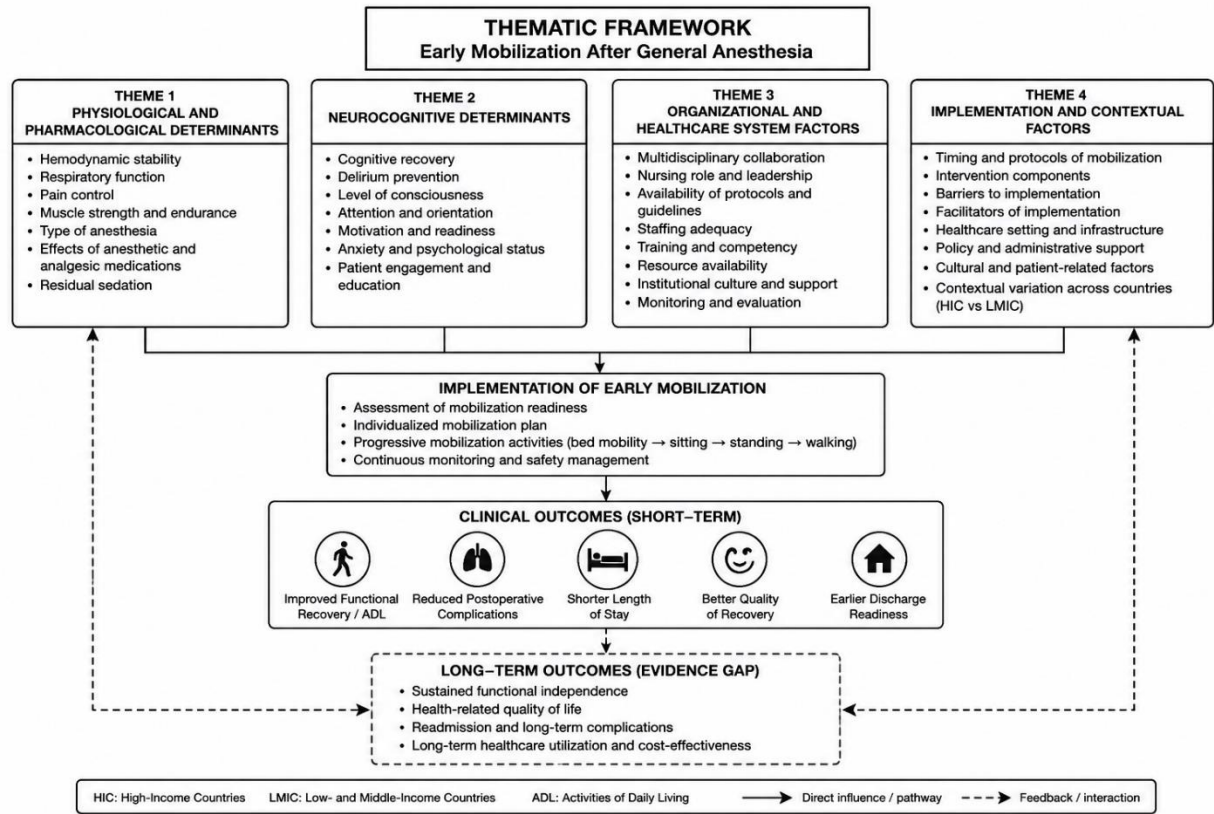


Figure 2. Conceptual Framework

Figure 2. Conceptual Framework of Multidimensional Determinants of Early Mobilization After General Anesthesia. The

framework was developed through thematic synthesis of the included studies and illustrates the multidimensional

relationships among physiological, neurocognitive, organizational, and contextual factors influencing the implementation and effectiveness of early mobilization after general anesthesia. Solid arrows represent relationships directly supported by empirical evidence identified in the included studies, whereas dashed arrows indicate higher-order conceptual relationships generated through thematic synthesis.

The synthesis of evidence generated four overarching themes and eight related subthemes addressing the review objectives. **Figure 2** illustrates the conceptual thematic framework describing the multidimensional relationships among determinants, implementation factors, and postoperative outcomes associated with early mobilization after general anesthesia.

The first theme, clinical effectiveness of early mobilization, encompassed improvements in functional recovery, reduction in postoperative complications, and shortened hospital stay. Across studies, early mobilization consistently demonstrated positive effects on Activities of Daily Living (ADL), pain reduction, discharge readiness, and overall Quality of Recovery (Chen et al., 2025; Hung et al., 2025).

The second theme, physiological and pharmacological determinants, highlighted the importance of hemodynamic stability, pain control, muscle strength, anesthetic techniques, and postoperative pharmacological management in determining mobilization readiness (Banerji et al., 2022; Mao & Guo, 2022). The third theme, neurocognitive determinants, emphasized cognitive recovery, delirium prevention, and patient engagement as essential factors influencing safe participation in mobilization activities (Olsén et al., 2026).

The fourth theme, organizational and healthcare system factors, demonstrated

that successful implementation of early mobilization depends on multidisciplinary collaboration, standardized protocols, staffing adequacy, organizational support, and resource availability (Huang et al., 2023; Zou et al., 2025).

Figure 2 illustrates that these physiological, neurocognitive, and organizational domains interact dynamically to influence both implementation success and postoperative recovery outcomes. The conceptual framework further demonstrates that early mobilization should be considered a multidimensional intervention rather than an isolated postoperative activity.

Several important literature gaps were identified. The major evidence gaps and future research priorities emerging from this review. Notably, substantial heterogeneity was observed regarding operational definitions of early mobilization, timing of intervention initiation, intervention components, and outcome measurement approaches. Furthermore, most studies primarily focused on short-term postoperative outcomes, whereas evidence concerning long-term functional recovery, health-related quality of life, sustained independence, and long-term healthcare utilization remains limited.

Contextual variations across countries were also evident. Studies conducted in high-income countries predominantly reported structured implementation within Enhanced Recovery After Surgery (ERAS) pathways supported by multidisciplinary teams and institutional protocols. Conversely, evidence from low- and middle-income countries (LMICs) and resource-limited settings remained scarce, with studies frequently reporting barriers related to limited staffing, inadequate resources, and lack of standardized mobilization protocols. These contextual differences suggest that implementation

strategies should be adapted according to local healthcare infrastructure, workforce capacity, and available resources.

Overall, the synthesis highlights the need for future multicenter studies employing standardized definitions, harmonized outcome measures, and long-term follow-up across diverse healthcare settings to strengthen the evidence base for perioperative early mobilization.

Discussion

Comparison with Existing Literature

Interpretation of intervention effectiveness was restricted to studies that directly implemented early mobilization interventions. Direct evidence demonstrated that early mobilization was associated with improved Activities of Daily Living, reduced postoperative pain, shorter hospital length of stay, and lower postoperative complication rates (Chen et al., 2025; Hung et al., 2025). In contrast, studies evaluating anesthesia techniques, recovery characteristics, cognitive recovery, or organizational practices were interpreted as contextual evidence influencing mobilization readiness rather than evidence of intervention effectiveness (Banerji et al., 2022; Mao & Guo, 2022; Maroufi et al., 2025; Verma et al., 2025; Zou et al., 2025).

This scoping review synthesized current evidence regarding the effectiveness, determinants, implementation factors, and limitations of early mobilization following general anesthesia. Overall, the findings consistently demonstrated that early mobilization contributes to improved postoperative recovery through enhanced functional independence, reduced postoperative complications, shortened length of hospital stay, and improved Quality of Recovery. These findings are consistent with previous Enhanced Recovery After Surgery (ERAS) literature

emphasizing early mobilization as a cornerstone intervention for accelerating postoperative recovery and reducing healthcare utilization (Kehlet, 2018; Ljungqvist et al., 2017).

Interpretation of the synthesized evidence was informed by the methodological quality appraisal results. Findings derived from studies classified as high methodological quality were considered to provide stronger and more reliable evidence, whereas findings originating from studies categorized as moderate quality were interpreted with greater caution. Consequently, greater interpretive weight was assigned to high-quality studies when discussing intervention effectiveness and implementation determinants.

Evidence supporting the effectiveness of early mobilization was primarily derived from studies of moderate-to-high methodological quality, particularly the cohort study by Hung et al. (2025) and the qualitative study by Huang et al. (2023). However, conclusions regarding improvements in postoperative recovery, pain reduction, and quality of recovery were also informed by several moderate-quality studies (Chen et al., 2025; Kang et al., 2025; Mao et al., 2022). Therefore, although the overall evidence suggests beneficial effects, these findings should be interpreted cautiously because methodological limitations and heterogeneity across studies may have influenced the reported outcomes.

Therefore, conclusions regarding physiological and pharmacological determinants should be considered tentative because much of this evidence was derived from moderate-quality studies and indirect contextual evidence rather than direct intervention studies. Although factors such as hemodynamic stability, analgesic management, and postoperative recovery characteristics appear important

for mobilization readiness, the available evidence remains largely observational and context-dependent. Consequently, these findings should be interpreted as supportive contextual evidence rather than definitive causal explanations of successful early mobilization implementation.

The beneficial effects of early mobilization may be explained through several physiological mechanisms. Early mobilization promotes pulmonary expansion, improves ventilation-perfusion matching, enhances circulation, preserves skeletal muscle mass, stimulates gastrointestinal motility, and reduces inflammatory responses associated with prolonged bed rest (Scott & Wainwright, 2023). Mobilization also facilitates restoration of autonomic function and metabolic homeostasis, thereby accelerating multidimensional postoperative recovery. From a neurocognitive perspective, early mobilization may reduce delirium risk, improve cognitive recovery, and promote patient engagement in recovery processes (Banerji et al., 2022).

In addition to studies directly evaluating early mobilization interventions, indirect evidence concerning postoperative recovery readiness also contributed to understanding implementation feasibility. For example, prediction models assessing readiness for discharge from the Post-Anesthesia Care Unit (PACU) demonstrated the importance of physiological recovery status in determining patients' capacity to safely engage in postoperative mobilization activities (Maroufi et al., 2025). These findings further support the conceptualization of early mobilization as a multidimensional process dependent upon adequate physiological recovery and clinical readiness.

The current findings may be interpreted within a multidimensional conceptual framework integrating

physiological recovery, neurocognitive recovery, and organizational readiness. Consistent with the Population-Concept-Context (PCC) framework and perioperative recovery theories, postoperative recovery should not be viewed solely as a physiological phenomenon but rather as a dynamic interaction among biological, psychological, and healthcare system factors. This interpretation aligns with person-centered perioperative care principles, which emphasize individualized assessment, multidisciplinary collaboration, and shared decision-making throughout the recovery process (Kehlet, 2018).

Despite generally favorable findings, considerable inconsistencies were observed across the included studies. Definitions of early mobilization varied substantially, ranging from sitting at the bedside within a few hours after surgery to structured ambulation during the first postoperative day. Similarly, intervention intensity, mobilization protocols, and outcome measurement approaches differed considerably. While several studies reported substantial reductions in postoperative complications and length of stay (Chen et al., 2025; Hung et al., 2025), other studies demonstrated more modest effects, particularly among patients with significant physiological instability or delayed cognitive recovery (Mao et al., 2022; Olsén et al., 2026). These inconsistencies likely reflect differences in patient characteristics, surgical complexity, perioperative care pathways, and healthcare system contexts.

Contextual variation across countries also emerged as an important finding. Most available evidence originated from high-income countries, where implementation of early mobilization is commonly integrated into established ERAS pathways supported by multidisciplinary teams, standardized protocols, and adequate healthcare

resources (Ljungqvist et al., 2017). In contrast, evidence from low- and middle-income countries (LMICs), including ASEAN countries, remains limited. Resource constraints, workforce shortages, insufficient staff training, and limited institutional support may hinder implementation in resource-limited settings (Biccard & Madiba, 2018). Consequently, direct transfer of implementation strategies developed in high-income settings may not always be feasible.

For LMICs and developing healthcare systems, adaptation strategies are required to ensure sustainable implementation. Potential approaches include development of simplified mobilization protocols, task-sharing among healthcare professionals, integration of family caregivers into mobilization activities, context-specific staff education, and prioritization of low-cost, high-impact interventions. Such strategies may facilitate implementation even in settings with limited technological and human resources while maintaining patient safety and care quality.

Although methodological quality was generally moderate to high, several limitations identified during critical appraisal should be considered when interpreting findings. Heterogeneity in intervention protocols, inconsistent definitions of early mobilization, limited sample sizes, and insufficient long-term follow-up reduce comparability across studies and limit the generalizability of conclusions. Furthermore, the predominance of studies conducted in well-resourced healthcare systems may restrict applicability to diverse global contexts.

It is important to acknowledge that not all included studies directly evaluated early mobilization interventions. Several studies focused on factors associated with postoperative recovery, such as cognitive recovery, discharge readiness, delirium, and

anesthesia-related recovery profiles. Therefore, these studies should be interpreted as providing indirect contextual evidence supporting understanding of determinants and implementation factors rather than direct evidence of intervention effectiveness.

Influence of Clinical Heterogeneity on Interpretation of Findings

An important consideration when interpreting the findings of this review is the substantial clinical heterogeneity across the included studies. Considerable variation existed regarding surgical specialties, mobilization protocols, timing of intervention initiation, outcome measures, and healthcare settings. Such heterogeneity limits direct comparison across studies and influences the generalizability of the synthesized evidence.

Nevertheless, several findings appeared relatively consistent across diverse surgical populations. Studies involving neurosurgical, orthopedic, and general surgical patients consistently reported that early mobilization was associated with improved functional recovery, reduced postoperative complications, and shorter hospital length of (Chen et al., 2025; Hung et al., 2025). In addition, organizational support, multidisciplinary collaboration, and adequate patient education emerged as common facilitators of successful mobilization implementation across different healthcare contexts (Huang et al., 2023; Zou et al., 2025).

Conversely, certain findings appear to be procedure-specific and therefore should not be generalized indiscriminately. For example, evidence regarding postoperative cognitive recovery was derived primarily from patients undergoing laparoscopic cholecystectomy and older surgical populations (Banerji et al., 2022; Verma et al., 2025), whereas evidence concerning

pain trajectories and functional recovery largely originated from neurosurgical, orthopedic, and thyroid surgery populations (Chen et al., 2025; Kang et al., 2025). These procedure-specific characteristics may influence patients' capacity and readiness to participate in early mobilization.

Furthermore, substantial variability was observed in the operational definition of early mobilization itself. Some studies defined early mobilization as mobilization initiated within four hours after surgery, whereas others considered mobilization within 24 hours postoperatively or did not specify a precise timeframe (Huang et al., 2023; Hung et al., 2025; Olsén et al., 2026). Similarly, outcome assessment varied considerably across studies, ranging from Activities of Daily Living and postoperative complications to quality of recovery, cognitive recovery, and discharge readiness. Consequently, although the overall evidence suggests potential benefits of early mobilization, the magnitude of effect and optimal implementation strategies cannot yet be generalized across all surgical populations and healthcare settings.

Therefore, caution is warranted when extrapolating findings beyond the specific clinical contexts represented in the included studies. Future high-quality studies employing standardized definitions, harmonized outcome measures, and diverse surgical populations are needed to establish more generalizable evidence regarding early mobilization after general anesthesia.

New Knowledge and Conclusions

This review provides several important theoretical and practical contributions. First, the synthesis extends existing knowledge by conceptualizing early mobilization as a multidimensional intervention influenced by interactions

among physiological determinants, neurocognitive recovery, organizational readiness, and contextual healthcare factors. Rather than functioning as an isolated nursing intervention, early mobilization appears to represent a complex perioperative care strategy requiring coordinated multidisciplinary implementation.

Second, the review generated a thematic framework that integrates clinical effectiveness, physiological determinants, neurocognitive determinants, and organizational factors into a comprehensive conceptual model. This framework contributes to the theoretical advancement of perioperative nursing by highlighting mechanisms and contextual influences that shape mobilization outcomes across diverse healthcare settings.

Third, the findings have important implications for healthcare policy and perioperative practice. Policymakers and healthcare organizations should consider incorporating standardized early mobilization protocols into institutional and national perioperative care guidelines. Strengthening workforce capacity, multidisciplinary collaboration, and implementation support mechanisms may improve postoperative outcomes and healthcare efficiency.

Several important research priorities were identified. Future studies should establish standardized operational definitions of early mobilization, harmonize outcome measurement approaches, and evaluate implementation strategies across different healthcare contexts. Particular attention should be directed toward LMIC and ASEAN settings, where evidence remains scarce. In addition, future research should prioritize long-term outcomes, including functional independence, health-related quality of life, healthcare utilization, and cost-effectiveness, because current

evidence remains predominantly focused on short-term postoperative recovery.

Overall, this scoping review demonstrates that early mobilization after general anesthesia is an effective multidimensional intervention that can improve postoperative recovery. However, successful implementation depends on dynamic interactions among patient-related, organizational, and contextual factors. Continued development of context-sensitive implementation strategies and high-quality longitudinal research is necessary to strengthen evidence-based perioperative care globally.

Implications and limitations

This scoping review conceptualizes early mobilization after general anesthesia as a multidimensional perioperative recovery strategy influenced by physiological, neurocognitive, organizational, and contextual factors, supporting its integration into standardized perioperative care and Enhanced Recovery After Surgery (ERAS) pathways. However, the findings should be interpreted cautiously because the evidence was limited by the small number of studies, substantial methodological and clinical heterogeneity, predominance of studies from well-resourced settings, exclusion of non-English publications, and reliance on indirect or moderate-quality evidence for several determinants. Furthermore, evidence on long-term recovery outcomes remains limited, and the proposed conceptual framework has not yet been empirically validated, highlighting the need for rigorous studies across diverse healthcare settings.

Relevance to Practice

The findings of this review underscore the importance of implementing early mobilization through standardized and context-sensitive perioperative care pathways. Healthcare institutions should

develop and regularly update evidence-based early mobilization protocols integrated within perioperative and Enhanced Recovery After Surgery (ERAS) programs to ensure consistency and patient safety across clinical settings (Kehlet, 2020; Ljungqvist et al., 2017). Effective implementation also requires strong multidisciplinary collaboration among nurses, anesthesiologists, surgeons, physiotherapists, and other healthcare professionals to facilitate coordinated postoperative recovery processes. Comprehensive patient readiness assessments, including physiological stability, neurocognitive status, and pain management, should be routinely performed prior to mobilization to support individualized care planning and minimize adverse events (Banerji et al., 2022; Mao et al., 2022). In addition, healthcare organizations should prioritize workforce training and competency development to strengthen clinicians' knowledge and confidence in delivering early mobilization interventions. Institutional guideline development, continuous quality improvement initiatives, and implementation monitoring are equally essential to promote sustainable practice adoption (Huang et al., 2023; Zou et al., 2025). For resource-limited healthcare settings, adaptation strategies such as simplified mobilization protocols, task-sharing approaches, context-specific staff education, and involvement of family caregivers may enhance feasibility while maintaining quality and safety of postoperative care (Kifle et al., 2025).

Conclusion

This scoping review found that studies directly evaluating early mobilization interventions generally reported favorable postoperative outcomes, including improvements in Activities of Daily Living (ADL), reductions in pain, shorter Length of

Stay (LOS), and decreased postoperative complications (Chen et al., 2025; Hung et al., 2025). However, evidence regarding intervention effectiveness remains limited because only a small number of included studies directly implemented early mobilization protocols. Additional studies provided contextual evidence demonstrating that physiological, neurocognitive, pharmacological, and organizational factors substantially influence patients' readiness and the successful implementation of early mobilization after general anesthesia (Banerji et al., 2022; Mao et al., 2022; Maroufi et al., 2025; Zou et al., 2025). Therefore, conclusions regarding effectiveness should be interpreted cautiously, and future research should prioritize rigorously designed studies directly evaluating standardized early mobilization interventions across diverse surgical populations and healthcare settings.

Nevertheless, the strength of evidence varied across themes. Conclusions regarding the clinical effectiveness of early mobilization are supported predominantly by direct intervention studies with moderate-to-high methodological quality, whereas conclusions concerning physiological, pharmacological, and neurocognitive determinants rely largely on indirect or moderate-quality evidence and should therefore be interpreted more cautiously. Future research should prioritize rigorously designed, high-quality intervention studies employing standardized mobilization protocols and outcome measures.

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CrediT Authorship Contributions Statement

Candra Dermawan: Conceptualization, Methodology, Supervision, Writing – Original Draft

Rondhianto: *Conceptualization, Validation, Supervision, Review*

Dodi Wijaya: *Validation, Supervision, Writing – Review & Editing*

Conflicts of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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