European Journal of Surgical Oncology 51 (2025) 110447

Contents lists available at ScienceDirect

European Journal of Surgical Oncology

journal homepage: www.ejso.com

Review Article

Postoperative physiotherapy in enhanced recovery pathways: A general surgery evidence update, dominated by colorectal studies

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ARTICLE INFO

Keywords:
Enhanced recovery after surgery (ERAS)
Physiotherapy
Mobilisation
Rehabilitation
Surgery
Recovery

ABSTRACT

Introduction: Physiotherapy is a pivotal component of enhanced recovery protocols, particularly in initiating early mobilisation and supporting the return to functional independence. Despite this, there is a lack of guidance on optimal post-mobilisation physiotherapy strategies. This systematic review aims to synthesise and critically appraise the most recent evidence on postoperative physiotherapy interventions within enhanced recovery pathways for general surgical patients. This review seeks to advance scientific understanding and provide guidance for the optimisation of physiotherapy practice within enhanced recovery pathways.
Materials and methods: A systematic review of the literature between 2000 and 2024 was conducted to identify studies of physiotherapy interventions in general surgical populations following an enhanced recovery protocol.
Results: Ten studies met the inclusion criteria. Six studies were conducted in colorectal patients, one study (plus a secondary analysis) was conducted in radical cystectomy patients, one in head and neck patients undergoing oncologic resection, and one included a mixed patient sample (colon, rectum, stomach, pancreas and liver surgery). Interventions involving early physiotherapy were found to benefit postoperative walking distance, achievement of activities of daily living and length of stay in hospital. There was mixed evidence for influence on readiness for discharge, quality of recovery measures and health-related quality of life. No consistent effects were observed for inpatient satisfaction or functional outcome.
Conclusion: This review supports the feasibility and potential benefits of a structured physiotherapy interventions within enhanced recovery protocols. These results highlight the potential for structured mobilisation interventions to enhance recovery, particularly when supported by education and technology-based strategies.

1. Introduction

Enhanced recovery protocols are a multimodal treatment approach for patients undergoing major surgery, helping them to recover quicker and return home sooner after their operation [1]. The integration of minimally invasive surgical methods, regional anaesthetic techniques, multimodal analgesia strategies, early nutritional and mobilisation interventions has been instrumental in advancing patient care standards [2]. Although the enhanced recovery principles were originally applied to colorectal surgery, there are now published guidelines in 23 specialties, including cardiology, pancreatic and urology [3–5]. This shift in perioperative practice has been associated with measurable improvements in clinical outcomes and significant cost savings for healthcare providers [6].

Within enhanced recovery protocols, physiotherapy plays a pivotal role in initiating early mobilisation and aiding patients' return to functional capacity [7]. By encouraging the patient to mobilise soon after surgery, risk of postoperative complications and length of stay decreases [7,8], and progressive postoperative exercise can improve longer-term patient outcomes [9]. Despite this, studies of physiotherapy interventions in enhanced recovery protocols have primarily focused on prehabilitation and early mobilisation, with a lack of guidance on

Abbreviations: RCT, randomised controlled trial; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; CINAHL, The Cumulative Index to Nursing and Allied Health Literature; VR, virtual reality; PEDro, Physiotherapy Evidence Database.

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https://doi.org/10.1016/j.ejso.2025.110447
Received 8 July 2025; Received in revised form 5 September 2025; Accepted 15 September 2025
Available online 16 September 2025

optimal in hospital post-mobilisation physiotherapy strategies [10]. An earlier review found just one randomised control trial (RCT) and secondary analysis reporting findings of a postoperative physiotherapy intervention in general surgical procedures [10]. The evidence is better established in orthopaedic surgeries, such as hip and knee replacement, with some evidence to support progressive resistance training and higher intensity rehabilitation programmes [11].

The evolving focus of enhanced recovery pathways extend beyond early discharge to encompass the optimisation of functional recovery and return to physical activity following surgery [12]. Therefore, there is a need to identify and evaluate effective physiotherapy modalities during post the inpatient and post-discharge phases of postoperative care. This systematic review aims to synthesise and critically appraise the most recent evidence on postoperative physiotherapy interventions within enhanced recovery pathways for general surgical patients. By identifying effective protocols, this review seeks to advance scientific understanding and provide guidance for the optimisation of physiotherapy practice within enhanced recovery pathways.

2. Materials and Methods

This systematic review was conducted following the methodology of a previous review, published in 2017 [10], and reported in accordance to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [13]. In addition, this systematic review was mapped to the Assessing the Methodological Quality of Systematic Reviews 2 (AMSTAR-2) checklist (Supplementary file 1) [14]. The review aimed to summarise the available literature on postoperative physiotherapy interventions specifically within cohorts of general surgical patients treated within a recognised enhanced recovery pathway. Orthopaedic studies were not included due to the specific nature of procedures and already published literature in this area. While the previous review [10] focused only on randomised controlled trials (RCTs) this review was widened to include all research methodologies, to gain a broader understanding of the evidence in this area. No external funding was received for this project.

2.1. Information sources

In July 2024, a web-based literature search was completed using the following electronic databases: CINAHL (The Cumulative Index to Nursing and Allied Health Literature) Ultimate, Medline Complete, and PubMed. The search aimed to review all full-text articles available in the English language, since 2000. This date was chosen to encompass the results found from the previous search and to review any research that has been published since.

2.2. Eligibility criteria

Although the initial review only looked at RCTs [10], this review had a wider search and included all trials including feasibility, qualitative and retrospective analyses. Studies were included if they (1) used cohorts of general surgical patients, (2) specified that patients followed an enhanced recovery pathway (3) involved postoperative mobilisation or physiotherapy. Studies were excluded if (1) general surgical pathway patients were involved rather than enhanced recovery or 'fast-track'; (2) the trial focused on preoperative mobilisation rather than postoperative; (3) they were orthopaedic studies due to the specific nature of procedures and already published literature; (4) the article was not a trial; (5) the article was not available in the English language; or (6) there was no access to the full text.The eligibility criteria is outlined using the PICOS criteria (Population, Intervention, Comparison, Outcome Measures and Study) in Table 1 [15].

Table 1
Eligibility criteria defined using the PICOS framework [15].

PICOS item	Inclusion criteria	Exclusion criteria
Population	General surgical patients following an enhanced recovery pathway	Orthopaedic surgical patients General surgical patients on a standard pathway
Intervention	Postoperative mobilisation or physiotherapy	Preoperative mobilisation or physiotherapy
Comparison	No postoperative intervention Studies with no comparison group	N/A
Outcome measures	Adverse events Complications Feasibility measures Functional recovery Quality of life Length of stay Readiness for discharge Patient experience	N/A
Study	Randomised controlled trials Non-randomised trials Feasibility and pilot studies Qualitative studies Retrospective analyses	Review articles Case-studies Not available in the English language No access to full text

2.3. Search strategy

The procedure-specific terminology that was used in the initial study was repeated for this review, with each surgery using specific surgical search terms alongside enhanced recovery and physiotherapy search terms, listed in Table 2. The same surgeries were included as in the initial search: gynaecologic, gastrointestinal, gastrectomy, cystectomy, pancreatic, colon, colorectal, bariatric, head and neck, liver, and breast [4,5,16–23].

2.4. Selection process

Following identification of studies through database searches, duplicate records were removed. The titles and abstracts of the remaining studies were then independently screened for inclusion by two reviewers (CB and TW). Finally, a full-text screen was completed by two independent researchers (CB and TW), to confirm study eligibility for inclusion in the review.

2.5. Data collection process and data items

Data were extracted from the included studies by two independent researchers (CB and TW) on study design and sample size, patient group, intervention, comparison group, outcome measures adverse events and main findings. Given the limited research in this area, all outcome data were extracted to gain a holistic understanding of the impact of physiotherapy interventions, including feasibility measures, recovery data (postoperative walking distance, functional outcomes, health-related quality of life, activities of daily living), patient experience data (inpatient satisfaction, views and experiences of mobilisation) and factors surrounding discharge (readiness for discharge, length of stay, postoperative complications and mortality). Data were also collected on adverse events reported within the study, to identify any association between early postoperative physiotherapy interventions and adverse event risk.

2.6. Quality assessment

The PEDro scale (Physiotherapy Evidence Database Scale) was used to assess the methodological quality of the included randomised controlled trials studies [24]. The PEDro scale is suitable for randomised controlled studies in physiotherapy and rehabilitation [25,26] and

Table 2
Search strategy for database searching.

Surgery	Surgical Search Terms	Enhanced recovery Search Terms	Physiotherapy Search Terms
Gynaecologic	"Gynaecolog* surgery" OR "gynecolog* surgery" OR (AB "Gynecology")	"enhanc* recover*" OR "fast track" OR "fast-track" OR "ERAS" OR "rapid surgery" OR "rapid-surgery" OR "accelerated surgery" OR "accelerated-surgery" OR "rapid recovery" OR "rapid-recovery" OR "early mobilisation" OR "multimodal pain" OR outpatient* OR ambulatory	(AB "Physical Therapy Modalities") OR (AB "Physical Therapy Speciality") OR "physical therapy" OR physiotherapy OR (AB "Exercise Therapy") OR (AB "Rehabilitation") OR "strengthening training" OR "strengthening exercise*" OR "resistance training" OR "resistance exercise*" OR "manual therapy" OR stretch* OR exercise OR "musculoskeletal manipulations"
Gastrointestinal	(AB "Endoscopy, Gastrointestinal") OR "gastrointestinal surgery"		
Gastrectomy	(AB "Gastrectomy") OR Gastric cancer surgery OR gastrectomy		
Cystectomy	(AB "Cystectomy")		
Pancreatic	(AB "Pancreaticoduodenectomy")		
Colon	(AB "Colon") OR "colonic surgery"		
Colorectal	(AB "Colorectal Surgery") OR "rectal surgery" OR "pelvic surgery"		
Bariatric	(AB "Bariatric Surgery") OR bariatric OR "gastric bypass" OR (AB "Gastric Bypass")		
Liver	(AB "Hepatectomy") OR "liver surgery"		
Head or Neck	(AB "Pharyngectomy") OR (AB "Laryngectomy") OR (AB "Laryngoscopes") OR laryngopharyngectomy OR (AB "Laryngoplasty") OR (AB "Neck Dissection") OR (AB "Lymph Node Excision") OR (AB "Thyroidectomy") OR "oral cavity resection" OR (AB "Glossectomy") OR "head surgery" OR "neck surgery" OR "head and neck surgery"		
Breast	(AB "Breast Surgery") OR (AB "mastectomy") OR (AB "Lumpectomy") OR (AB "Quadrantectomy") OR (AB "axillary dissection" OR (AB "breast cancer") OR (AB "breast carcinoma") OR (AB "axillary node dissection")		

assesses factors surrounding the allocation of the physiotherapy intervention, baseline comparability of study groups, blinding of subjects and assessors, follow up time, intention-to-treat analyses and methods and presentation of inferential statistics [24]. Studies were awarded a Yes (1) (item reported) or No (0) (not reported), unless they were a feasibility study or qualitative investigation, in which case an N/A was awarded for irrelevant items on the checklist. Randomised controlled trials were graded out of ten (item 1 excluded as it relates to external validity), with scoring categories defined as: 0–3 = poor quality; 4–5 = fair quality; 6–8 = good quality; 9–10 = excellent quality [24].

2.7. Synthesis methods

Due to the limited research available and the homogeneity of patient populations and outcome measures used, conducting a meta-analysis was not appropriate. Instead, data were grouped into thematic categories (e.g., factors related to hospital discharge, functional outcomes, postoperative complications) and synthesised narratively.

3. Results

3.1. Study selection

The completed search identified 621 records from the databases, and during preliminary screening, 29 duplicates were removed, and 375 were deemed to not be relevant and were excluded. Only five reports were not retrieved, leaving 212 to be assessed for eligibility. A further 202 articles were removed (general enhanced recovery not specific to mobilisation or physiotherapy (108); mobilisation but not post-operatively (65); not enhanced recovery or fast-track patients (27); spinal surgery (1) and not a trial or review (1) (Supplementary material 2)). Ten articles were included in this review and are summarised in Table 3. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram demonstrates the search process in Fig. 1.

3.2. Study design and participants

The included studies varied in design, including six randomised controlled trials [27–32], two feasibility studies [33,34], one qualitative investigation [35] and one secondary analysis of an RCT [36]. Six studies were conducted in colorectal patients [28,30–32,34,35], one study (plus a secondary analysis) was conducted in radical cystectomy patients [27,36], one in head and neck patients undergoing oncologic resection [33], and one included a mixed patient sample (colon, rectum, stomach, pancreas and liver surgery) [29]. Full study details are included in Table 3.

3.3. Quality appraisal

Out of the six randomised controlled trials [27–32] and one secondary analysis [36], one was considered fair quality [29], four good quality [27,30,31,36], and one excellent quality [32]. Consistently high scoring items were item 2 (random allocation of participants to study group), item 3 (concealed allocation), item 4 (groups similar at baseline), item 9 (intention to treat analysis), item 10 (between-group statistical comparisons) and item 11 (point measures). Consistently low scoring items were item 5 (blinding of subjects), item 6 (blinding of therapists) and item 7 (blinding of assessors), although it is acknowledged that it is not always possible to blind the participant or therapist in rehabilitation interventions [37]. A summary of the quality appraisal scores for all studies, including the non-randomised research, can be found in Table 4.

3.4. Post-operative physiotherapy protocol

3.4.1. Cystectomy

One prospective RCT completed by Jensen et al. [27] and a secondary analysis of additional outcome measures [36] compared standard fast-track radical cystectomy ($n = 57$) to fast-track radical cystectomy with the additional of an exercise-based intervention ($n = 50$). The intervention group received fast-track surgery and an exercise-based intervention that involved standard pre- and post-operative exercises, and enhanced mobilisation. Enhanced mobilisation included scheduled out of bedtime increasing from 3 h on day one, to 8 h on the fourth postoperative day, and walking distance increased from 125 m on the day after surgery, to 1000 m on the fourth postoperative day. In addition, patients in the intervention group received an exercise-based rehabilitation programme, physical therapy twice per day for the first seven postoperative days and progressive muscle strength and endurance training [27].(See Table 3)

Table 3
Summary of included studies (*LOS: length of stay; PADL: personal activities of daily living; VAS: visual analogue scale, HR-QOL: health-related quality of life; TUG: timed up and go;* 6MWT*: 6-min walk test; VIPS: Visual Information Preference Scale; QoR: quality of recovery)*.

Study	Design and sample size	Funding source	Patient, population, or problem	Intervention, prognostic factor, or exposure	Comparison or intervention	Outcomes	Main findings
Jensen et al.	RCT $n = 107$	Shared funding from Aarhus University Hospital, university scholarships, and industrial collaborators and foundations.	Radical cystectomy patients	Standardised pre-operative and post-operative strength and endurance exercises and progressive postoperative mobilisation.	Standard, fast-track surgery	Mobilisation (hours out of bed), length of stay (LOS), walking distance (m), the ability to perform personal activities of daily living (PADL), time to restored bowel function, pain and nausea (VAS).	Post-operative mobilisation was significantly improved with walking distance. PADL improved by a day for the intervention group. LOS did not change between groups. No significant difference for severity of complications.
Jensen et al.	RCT $n = 107$	Shared funding from Aarhus University Hospital, university scholarships, and industrial collaborators and foundations.	Radical cystectomy patients A secondary analysis	Standardised pre-operative and post-operative strength and endurance exercises and progressive postoperative mobilisation.	Standard, fast-track surgery	Health-related quality of life (HRQoL), EORTC Quality of life questionnaire Core 30 (QLQ-C30) combined with the disease-specific EORTC BLS24 (baseline) and EORTC BLM30 (follow-up), inpatient satisfaction (PATSAT32)	The intervention group significantly improved HRQoL scores in dyspnoea ($p \leq 0.05$), constipation ($p < 0.02$) and abdominal flatulence ($p \leq 0.05$) compared to the standard group. The standard group had reduced symptoms in sleeping pattern and clinically relevant differences in fatigue, body function and role function.
Min et al.	RCT $n = 52$	National Research Foundation of Korea grant, National R&D Programme for Cancer Control and the Yonsei Signature Research Cluster Project.	Colorectal cancer patients	15 min of supervised exercise 2x per day for the duration of their stay in hospital.	Standard, fast-track surgery	Length of stay (LOS) and patient-perceived readiness for hospital discharge (Pt-RHDS)	Median LOS was significantly shorter for participants in the intervention group. The intervention group felt greater readiness for hospital discharge compared to usual care group.
Thörn et al.	RCT $n = 144$	Örebro University Hospital Research Foundation and Research Committee of Örebro County Council	Elective colorectal surgery patients	Mobilisation starting 30mins after arrival in the post-anaesthesia care unit.	Standard, fast-track surgery	In-hospital physical activity (step count) during first 3 days post op, 6min walk test (6MWT), TUG test, readiness for discharge (days from surgery until discharge criteria met), severity of postop complications.	No significant differences in daily step count, 6MWT, TUG, complications, or physical activity 1 month after surgery. Median time to readiness for discharge was 1 day longer for intervention group.
Jones et al.	RCT $n = 96$	No funding statement included.	Colorectal and gynaecological oncological surgery patients	Animated intervention describing the purpose of early mobilisation, importance of early oral nutrition, and the link between the two. Active control group received the same verbal script as intervention group but saw no animations.	Standard, fast track surgery	Step count, self-reported exercise, quality of recovery (QoR-15), perceptions of surgery and recovery, perceptions of enhanced recovery behaviours and Health Visual Information Preference Scale (Health VIPS).	Intervention group had a significantly higher step count compared to both other groups. Intervention group had significantly greater QoR-15 score compared with control group.
Thörn et al.	Feasibility $n = 42$	Research Committee of Örebro County Council and Örebro University Hospital Research Foundation.	Elective colorectal surgery patients	Structured mobilisation performed by a specialised physiotherapist.	N/A	Successful mobilisation (defined by patient sitting on edge of bed, standing or ambulating).	71 % reached highest level of mobilisation between 2nd and 4th hour of arrival in postoperative anaesthesia care unit. Before moving to ward, 43 % could stand by bed and 38 % could ambulate.

(*continued on next page*)

Table 3 (*continued*)

Study	Design and sample size	Funding source	Patient, population, or problem	Intervention, prognostic factor, or exposure	Comparison or intervention	Outcomes	Main findings
Mathiasen et al.	Qualitative $n = 11$	University College Copenhagen and the Research Council at Herlev and Gentofte Hospital.	Colorectal surgery	Semi-structured interviews with patients in days 1–5 after surgery.	N/A	Patients' views, experiences and recommendations for early ambulation.	3 themes identified – bodily sensations influencing early mobilisation, motivation and demotivation in the environment, experiences when walking in the ward.
Schrempf et al.	RCT $n = 62$	University of Augsburg grant, without external funding.	Colorectal surgery	Daily bedside fitness exercises using immersive, activity-promoting, virtual reality fitness games in addition to standard care.	Standard, fast-track surgery	Feasibility outcomes, length of stay (LOS), differences in perioperative surgical outcomes, overall health, distress, patient satisfaction, changes in vital signs/mood/feelings before and after each session for VR group.	There was an improvement in overall mood and positive feelings within the VR group. LOS was 2 days shorter for VR group, but this difference did not reach statistical significance. Health status, distress and surgical outcomes did not differ between groups.
Wolk et al.	RCT $n = 132$	No external funding.	Patients undergoing major visceral surgery - (colon, rectum, stomach, pancreas, liver)	Continuous feedback of daily activity during the first 5 days postop.	Standard, fast-track surgery with no feedback of activity Laparoscopic and open arms	Average step count during first 5 days post op, percentage of patients who mastered predefined step count targets, length of stay (LOS), assessment of activity data, number of patients who received physio, 30-day mortality, 30-day overall morbidity.	Laparoscopic arm – the intervention significantly increased the mean daily and cumulative step counts. Activity time of intervention group was significantly longer, and percentage of patients achieving mobilisation targets were higher. No difference in LOS or postop morbidity. Open arm – the control group had significantly higher daily and cumulative step counts. Also, higher percentage of patients achieving mobilisation targets and cumulative activity time in control group. No significant difference in postop morbidity or LOS.
Daun et al.	Feasibility $n = 16$	Ohlson Research Institute and Alberta Innovates Health Solutions graduate studentship.	Head and neck cancer patients undergoing oncologic resection with free flap reconstruction	Assess feasibility of measuring PROs, physical function, and in-hospital mobilisation across the surgical timeline.	N/A	Feasibility of completing assessments and questionnaires pre-surgery, in-hospital, and post-surgery). Changes in these assessments across the timeline.	Measuring PROs and in-hospital mobilisation is feasible. In-hospital mobilisation was completed for 63 % of participants.

3.4.2. *Colorectal*

Six studies were conducted in colorectal patients [28,30–32,34,35]. Of these studies, four were RCTs comparing a standard, fast-track colorectal surgery pathway to fast-track colorectal surgery with the additional of an early mobilisation or physiotherapy intervention. For example, in the study by Min et al. [30] ($n = 56$), participants in the intervention group ($n = 26$) engaged in a 15-min supervised exercise intervention (stretching and low intensity resistance exercises) twice a day, starting on postoperative day one and progressing during their hospital stay. Phase 2 (days two and three) of the programme involved adding resistance exercises, stretching and core resistance exercises to the phase 1 exercise. Phase 3 (day four to hospital discharge) involved continuing phase 2 of the programme, with balance exercise added [30].

In the study by Thorn et al. [32] patients ($n = 144$) received a standard fast-track pathway where mobilisation was initiated after arrival at the ward ($n = 72$) or a structured mobilisation intervention in the post-anaesthesia care unit (PACU), described in an earlier feasibility study [34]. In the intervention group, mobilisation occurred approximately 30 min after arrival to the unit, and then at 30-min intervals, with 30 min rest between attempts during the first, second, third and fourth hour after arrival. At each stage, patients were advanced as far as they were able, while adhering to safety criteria. This continued until discharge from the PACU where mobilisation continued according to standard care, or for a maximum of 4 h [32,34].

In the study by Jones et al. [28], where patients underwent either colorectal ($n = 74$) or gynaecological oncology surgery ($n = 26$), there were three study groups: a standard care group ($n = 31$), a visualisation group ($n = 33$) or an active control group ($n = 32$). All participants received standard care as part of an enhanced recovery protocol, with a focus on early oral nutrition and early mobilisation. The visualisation

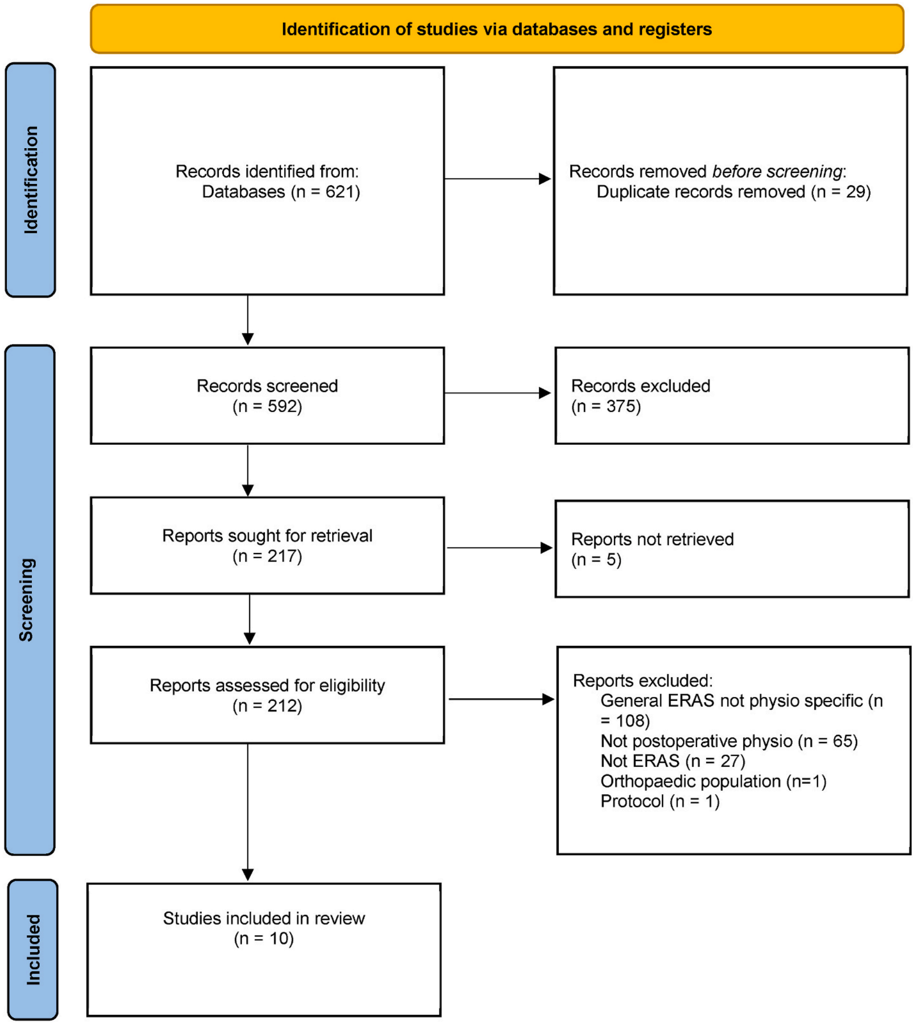

Fig. 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram of study selection.

Table 4
Results of quality appraisal (PEDro) [24].

Item	Description	Jensen et al. (2015)	Jensen et al. (2014)	Min et al. (2023)	Thorn et al. (2024)	Jones et al. (2019)	Thorn et al. (2022)	Mathiasen et al. (2021)	Schrempf et al. (2023)	Wolk et al. (2019)	Daun et al. (2022)
1	Eligibility criteria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	Randomised allocation	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	N/A (0)	Yes (1)	Yes (1)	N/A (0)
3	Concealed allocation	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	N/A (0)	N/A (0)	Yes (1)	Yes (1)	N/A (0)
4	Comparable at baseline	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	N/A (0)	N/A (0)	Yes (1)	No (0)	N/A (0)
5	Blinded subjects	No (0)	No (0)	No (0)	No (0)	No (0)	N/A (0)	N/A (0)	No (0)	No (0)	N/A (0)
6	Blinded therapists	No (0)	No (0)	No (0)	Yes (1)	Yes (1)	N/A (0)	N/A (0)	No (0)	No (0)	N/A (0)
7	Blinded assessors	No (0)	No (0)	No (0)	Yes (1)	Yes (1)	N/A (0)	N/A (0)	Yes (1)	No (0)	N/A (0)
8	Adequate follow-up	No (0)	No (0)	No (0)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	Yes (1)
9	Intention-to-treat analysis	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	N/A (0)	Yes (1)	Yes (1)	N/A (0)
10	Between group comparisons	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	N/A (0)	N/A (0)	Yes (1)	Yes (1)	N/A (0)
11	Point estimates and variability	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	N/A (0)	Yes (1)	Yes (1)	N/A (0)
	Total	**6**	**6**	**6**	**9**	**9**	**2**	**1**	**8**	**5**	**1**

group received educational materials and animations on improved patient outcomes with enhanced recovery protocols, as well as detail on why early mobilisation was important to optimise recovery. In addition, they received an elaborated reasoning task to help contextualise how they could incorporate early mobilisation into their recovery. The active control group received the same verbal information, but no animations, and the control group received standard postoperative enhanced recovery care [28].

In the study by Schrempf et al. [31], 62 patients undergoing curative surgery for colorectal cancer were randomly assigned to an intervention ($n = 31$) or control group ($n = 31$). The intervention group received a virtual reality (VR) based, activity promoting fitness session on weekdays, in addition to their standard physiotherapy. Game tasks involved rowing or cycling in a virtual environment, with the aim of creating active movement of the upper body, whereas the control group did not receive any additional sessions, besides standard physiotherapy [31]. Finally, in a qualitative analysis of patient experience, Mathiasen et al. [35] used semi-structured interviews with 11 patients, one to five days following surgery, to understand views and experiences of early mobilisation after colorectal surgery.

3.4.3. *Head and neck surgery*

In a feasibility study by Daun et al. [33], 16 head and neck cancer patients undergoing oncologic resection with free flap reconstruction completed in-hospital mobilisation while wearing an activity tracker (Garmin Vivofit 4) to record step count. Based on clinical judgement and surgical recovery, participants were encouraged to increase their mobilisation throughout their hospital stay.

3.4.4. *Mixed cohort*

In the study including a mixed patient sample receiving either open or laparoscopic surgery (colon, rectum, stomach, pancreas, and liver surgery) [29], 132 patients were randomised to receive feedback on their step counts using a wearable activity tracker or not. The wristbands were worn continuously after the operation to recover and monitor steps until the start of postoperative day six.

3.5. *Outcome measures*

3.5.1. *Adverse events*

Out of the ten studies, eight studies included a statement regarding adverse events [27,29–34,36], and two did not [28,35]. Of the studies that included a statement of adverse events, there were no significant differences between the intervention and control group in terms of short term, in-hospital adverse events or longer term adverse events in four studies [27,30,32,36] and no serious adverse events related to the intervention were reported in three studies [31,33,34]. In the radical cystectomy patients, four patients died within seven days from surgery (control $n = 3$, intervention $n = 1$), three due to intestinal perforations and abdominal abscess followed by heart failure, and one patient experienced gastrointestinal bleeding and heart failure. A further three patients died within 120 postoperative days (control group $n = 2$, intervention group $n = 1$), due to infections (pneumonia and urosepticaemia), and one experienced severe delirium and multiorgan failure [27,36]. There were no serious adverse events reported in the study by Thorn et al., 2024, although the authors report several complications related to infection, pain, nausea/vomiting and urinary retention across both study groups ($p = 0.48$) [32]. In the study by Min et al., 2023, one case of atelectasis and polyuria was reported in the exercise group and one case of urinary retention in the control group. The incidence of complications was not significantly different between the groups ($p = 0.55$) [30].

3.5.2. *Postoperative complications or mortality*

In the study evaluating step count after surgery [29], those who walked less than the median cumulative step count were significantly older, had a significantly higher length of stay and a higher complication rate for both open and laparoscopic surgeries. In the study by Thorn et al. [32], complications did not different significantly between patients receiving mobilisation starting 30 min after arrival at the PACU (complications in 34 patients) versus the control group ($n = 21$) ($p = 0.56$). Likewise, there were no difference ($p = 0.65$) in treatment groups in severity of complications in a study of radical cystectomy, when comparing fast-track pathways to fast-track pathway plus the additional exercise intervention [27], or in the study evaluating VR-based fitness game following colorectal surgery ($p = 1.0$) [31].

3.5.3. *Feasibility measures*

In the feasibility study by Thorn et al. [34] supervised mobilisation after elective colorectal surgery was considered feasible and safe to initiate in the immediate postoperative care after surgery. In all, 71 % ($n = 30$) of patients reached their highest level of mobilisation between the second and third hour of arrival in the PACU. Before discharge, 43 % ($n = 18$) could stand at the end of the bed and 35 % ($n = 16$) could ambulate. Symptoms that delayed advancement of mobilisation were pain, somnolence, hypotension, nausea, and patient refusal [34]. In the only study in head and neck cancer surgical patients [33], it was found to be feasible to measure patient reported outcome measures and in hospital mobilisation using wearable technology, however, assessment of function prior to surgery was not feasible due to the requirement of needing to attend an additional in-person assessment.

3.5.4. *Postoperative walking distance*

In the study evaluating the impact of visualisation activities to emphasise the importance of early mobilisation [28], a main effect of the group demonstrated that participants who were educated on the benefits of early mobilisation had a significantly higher average daily step count in the week following discharge compared to the control participants (adjusted mean: 2295 steps (95 % CI: 1.746–2745) versus 1347 steps (95 % CI: 827–1871), $p = 0.05$). On average, hours out of bed were 37 h over 7 days (95 % CI 32 to 44) for the intervention group, and 31 h (95 % CI 27 to 35) for the control participants, although these results were non-significant ($p = 0.10$) Despite this, there were no group differences in change in self-reported exercise from baseline to follow up. In an analysis of fast-track radical cystectomy patients receiving an additional exercise intervention, mobilisation (defined as distance walked during the first seven days postoperatively) was significantly higher (4806 m (95 % CI: 4075–5536 m) walked vs 2906 m (95 % CI: 2408–3404 m) when compared to the control group ($p < 0.001$)) [36]. Likewise, in the study including a mixed patient sample receiving either open or laparoscopic surgery [29], step count after laparoscopic operations during PODs 1–5 to be significantly increased when receiving feedback from a wearable tracker, compared to the control group who received no feedback (9867 versus 6107 steps, $p = 0.037$), however this could not be confirmed in the open surgery arm. In contrast, there were no differences in daily step count (POD 1–3) or time out of bed between patients receiving mobilisation starting 30 min after arrival at the PACU or standard care in the study by Thorn et al. [32] ($p > 0.05$).

3.5.5. *Functional outcome measures*

No differences were found in postoperative 6MWT (6-min walk test) (POD 3: intervention group: 285 ± 110 m; control: 301 ± 109 m, POD 30: intervention: 463 ± 115 m; control: 475 ± 115 m ($p > 0.05$)) or timed up and go (TUG) score (POD 30: intervention: 10.5 ± 5.6 s; control: 8.8 ± 4.4 s ($p = 0.17$)) between patients receiving mobilisation starting 30 min after arrival at the PACU, or standard care [32]).

3.5.6. *Health related quality of life*

In the secondary analysis of the radical cystectomy patients receiving an additional exercise intervention (endurance, strengthening exercise and progressive mobilisation) versus standard care), the intervention group had significantly improved health-related quality of life in dyspnoea ($p \leq 0.05$), constipation ($p < 0.02$) and abdominal flatulence ($p \leq 0.05$) compared to the standard group. In contrast, the control group reported significantly reduced symptoms in sleeping pattern ($p \leq 0.04$) and clinically relevant differences in role function, body function and fatigue [36].

3.5.7. Inpatient satisfaction

The study assessing the impact of a VR based, activity promoting fitness session on weekdays, in addition to their standard physiotherapy [31] found no differences in overall patient satisfaction between the VR and control group ($p = 0.49$) and in all other items of the patient satisfaction questionnaire at discharge. Likewise, inpatient satisfaction did not differ between treatment groups in the study by Jensen et al. [36] comparing an additional exercise intervention to standard care.

3.5.8. Length of stay

In the study comparing postoperative exercise to standard care for colorectal surgery [30], the control group had a significantly longer median length of stay (6.5 (IQR: 6–7) days versus 6 (IQR: 5–7) days), $p = 0.021$). Similarly, the intervention group in the study by Schrempf et al. (2023) had a lower median length of stay (7 days (IQR: 6–12)) than the control group (9 days (IQR: 7–13)), although this was non-significant ($p = 0.076$). In a study evaluating the impact of feedback on step count via an activity tracker, patients who achieved more than the median cumulative step count had a significantly shorter length of stay and lower morbidity, and step count was also correlated with length of hospital stay ($r = -0.341$, $p < 0.001$) [29]. In contrast, there was no significant difference in median length of stay for radical cystectomy patients receiving fast-track care or fast-track care with the addition of endurance and strengthening exercise, and progressive postoperative mobilisation (both groups = 8 days, $p = 0.68$) [27].

3.5.9. Activities of daily living

In the analysis of radical cystectomy patients receiving an additional exercise intervention, the ability to independently perform personal activities of daily living was evaluated using the validated Katz score, consisting of six self-care skills [27]. The study found that median achievement of PADL was reduced by one day (3 vs 4 days) when compared to the control group ($p \leq 0.05$) [27].

3.5.10. Readiness for discharge and quality of recovery

In the study comparing postoperative exercise to standard fast-track care for colorectal surgery, participants in the exercise group felt greater readiness for discharge (Pt-RHDS scores) from the hospital compared to the usual care group (adjusted group difference: 14.4 95 % CI, 6.2 to 22.6, $p < 0.01$) [30]. Interestingly however, median readiness for discharge was one day longer for the intervention group (4 days (IQR: 3–6)) compared to the control group (3 days (IQR: 2–6)), although this was non-significant ($p = 0.10$) [32]. Similarly, in the study evaluating the impact of visualisation activities to emphasise the importance of early mobilisation [28], there were no differences between groups in perception of surgery and recovery ($p > 0.05$), however the intervention group demonstrated a higher quality of recovery score post-surgery ($p = 0.043$).

3.5.11. Views and experiences of mobilisation and surgery

The study evaluating patient views and experiences of early mobilisation found three themes to consider: 1. Body sensations influencing early mobilisation; 2. Motivation and determination in the environment and 3. Experiences when walking in the ward [35]. Theme 1 encompassed physical symptoms that had affected the patients' ability to take part in early mobilisation, such as dizziness, bowel movement and pain. The second theme encompassed views that several factors that either motivated or discouraged the patients from early mobilisation, such as nurses' awareness and attention, their relationship with fellow patients, their own strategies based on prior experiences and knowledge-motivated mobilisation. Finally, the third theme addressed individual experiences while walking in the ward, such as access to walking aids and suitable locations to exercise [35].

4. Discussion

This systematic review identified ten studies examining the impact of postoperative mobilisation and physiotherapy within enhanced recovery protocols across a range of surgical specialties. Most of the evidence focused on colorectal and cystectomy procedures [27,28,30–32,34–36], with additional representation from head and neck [33], and mixed surgical cohorts [29]. Interventions ranged from structured physiotherapy and early mobilisation protocols to more innovative approaches such as virtual reality-based fitness games and wearable activity trackers.

Across the studies reviewed, early mobilisation or structured exercise interventions were generally associated with improvements to short-term outcomes, such as postoperative walking distance [27–29], achievement of activities of daily living [27] and length of stay in hospital [29–31]. Patients in the intervention group felt greater readiness for discharge in one study [30] although median length of stay was longer in the intervention group, suggesting that patient perceptions do not always align with operational outcomes. There was mixed evidence for influence on readiness for discharge [28,30], quality of recovery measures [28] and health-related quality of life [36]. No significant differences were found to inpatient satisfaction [31,36] or functional outcome measures [32]. In the studies reporting complications or adverse events, there were no significant differences in incidence of short or long-term complications between groups [27,30,32,36], and no adverse events were reported in three studies [31,33,34]. Importantly, the feasibility studies [33,34] and analysis of patient views and experience of early mobilisation [35] offer valuable insights into patient experiences and practical considerations for implementation which may be useful for clinicians looking to implement similar protocols.

These findings suggest, despite the heterogeneity in study design, surgical populations, and outcome measures, a general trend was observed whereby early, structured mobilisation, particularly when delivered as part of a physiotherapy-led programme, appeared to support postoperative recovery. Strategies that included patient education or behavioural reinforcement, such as visualisation tools and real-time feedback from activity trackers, were associated with increased levels of physical activity without necessarily requiring intensive resources [28,29,31]. However, the evidence regarding longer-term outcomes such as patient satisfaction and functional recovery was less conclusive, suggesting that while mobilisation interventions may yield early postoperative benefits, the link to downstream clinical improvements cannot currently be established.

One of the strengths of this review lies in its comprehensive inclusion of a wide range of trial designs, allowing for a more holistic view of both effectiveness and feasibility of postoperative mobilisation interventions. The inclusion of qualitative and feasibility studies provided additional insights into patient experiences and implementation considerations, which are often overlooked in traditional reviews focusing solely on RCTs. However, this broader inclusion also introduced methodological heterogeneity, making synthesis of findings more complex and precluding formal meta-analysis. Differences in intervention protocols, outcome timing, and measurement tools further limited direct comparison across studies.

Compared to the previous review by Burgess et al. [10], which identified only a single relevant RCT, this updated analysis demonstrates an increase in research interest and trial activity in the field. These findings are consistent with the broader literature supporting early mobilisation as a cornerstone of recovery within enhanced recovery pathways [7]. However, by incorporating newer study designs and implementation-focused outcomes, this review adds further detail to the understanding of how, when, and for whom postoperative mobilisation may be most beneficial, and in what form. These findings may be useful to clinicians considering implementing early physiotherapy interventions to improve rehabilitation as part of an enhanced recovery pathway.

The review successfully addressed its original research question, revealing that new and diverse trials have indeed been published since the last review, and that these provide further insights into the role of mobilisation and physiotherapy in enhanced recovery care. The notion that postoperative mobilisation enhances recovery was generally supported, particularly with respect to activity levels and patient-reported readiness for discharge. Nevertheless, the impact on clinical outcomes such as complications, length of stay, and quality of life remained mixed, suggesting that while mobilisation is important, it may need to be paired with other components of enhanced recovery pathways to achieve more robust effects.

In addition to the educational and technology-based strategies discussed, several real-world challenges may limit the feasibility and consistency of postoperative physiotherapy within enhanced recovery protocols [8]. Staffing constraints, particularly the limited availability of physiotherapists during evenings or weekends, can delay mobilisation and reduce the dose or progression of therapy. Similarly, access to appropriate equipment (e.g., mobility aids) is not always guaranteed, especially in resource-limited settings [8]. Patient-related factors, such as low motivation, postoperative nausea, fatigue, orthostatic intolerance, anxiety, or pain, may further hinder engagement in rehabilitation [8]. Psychosocial elements, such as cognitive status, language barriers, or lack of social support, can also affect compliance with mobilisation plans and contribute to variation in discharge readiness [8]. These barriers are often under-reported in trials but are critical to consider when interpreting results and planning implementation in routine care.

Several limitations must be acknowledged. First, the review was limited to studies published in English and with full-text availability, potentially introducing selection bias. The methodological quality of the included studies varied, with several lacking blinding, allocation concealment, or intention-to-treat analysis, as reflected in the PEDro scores. In addition, although only studies specifying that patients followed an enhanced recovery pathway were included, the exact enhanced principles adopted were not always clearly defined. While some studies cited the ERAS® Society guidelines or principles [28,35], and others presented their institutional enhanced recovery pathways [27,29,30,32,34,36], some studies provided limited detail [31,33], making it difficult to determine which principles were applied. As a result, heterogeneity between surgical pathways cannot be ruled out. Outcome measures were inconsistently reported and often lacked standardisation. Additionally, the small number of studies in specific surgical subgroups reduced the ability to draw strong conclusions for those populations. Although this review aimed to capture evidence across general surgical cohorts, the included studies were predominantly conducted in colorectal populations. This reflects both the origins of enhanced recovery protocols in colorectal surgery and the current research focus in this domain. Future studies are needed to explore physiotherapy interventions in other general surgical specialties such as hepatobiliary, upper GI, and bariatric surgery. Finally, the possibility of publication bias cannot be excluded, particularly given the small number of studies per category.

5. Conclusion

In summary, this review confirms that postoperative mobilisation and physiotherapy are feasible and generally beneficial components of enhanced recovery pathways, especially in colorectal and urological surgeries. Improvements in patient mobility, discharge readiness, and recovery quality were commonly reported, though findings regarding clinical outcomes were less consistent. These results highlight the potential for structured mobilisation interventions to enhance recovery, particularly when supported by education and technology-based strategies.

The significance of these findings lies in their practical implications for enhanced recovery implementation. Interventions such as wearable feedback devices and educational tools could be integrated into care protocols with minimal burden on staffing or resources. However, the limitations of the current evidence base, particularly the heterogeneity of interventions and modest methodological rigour, indicate the need for further high-quality, standardised research. Future studies should aim to identify the most effective elements of mobilisation protocols, evaluate cost-effectiveness, and explore tailored approaches based on patient characteristics. Establishing consensus on outcome measures would also enhance comparability and support meta-analytic synthesis. Such efforts will be essential for advancing the evidence base and optimising postoperative recovery across surgical populations.

Credit author statement

Louise Burgess: Methodology, Validation, Formal analysis, Writing – Original Draft, Writing – Review and Editing. **Chloe Bascombe**: Methodology, Validation, Formal analysis, Writing – Review and Editing. **Thomas Wainwright**: Conceptualisation, Methodology, Validation, Writing – Review and Editing, Supervision.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of interest statement

The authors declare no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejso.2025.110447.

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