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a systematic review

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Published in:
European Spine Journal

DOI:
10.1007/s00586-024-08622-x

Publication date:
2025

Document version:
Final published version

Citation for pulished version (APA):
Lorenzen, M. D., Wickstrøm, L. A., Andersen, M. Ø., Carreon, L. Y., Clemensen, J., & Frandsen, T. F. (2025). Post-discharge care interventions to support patient recovery after elective degenerative spine surgery: a systematic review. *European Spine Journal*, *34*(3), 1042-1054. https://doi.org/10.1007/s00586-024-08622-x

European Spine Journal (2025) 34:1042–1054
https://doi.org/10.1007/s00586-024-08622-x

REVIEW ARTICLE

Post-discharge care interventions to support patient recovery after elective degenerative spine surgery: a systematic review

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Received: 16 August 2023 / Revised: 21 February 2024 / Accepted: 12 December 2024 / Published online: 19 December 2024

Abstract

Purpose To characterize the type, content, and results of care interventions that support spine surgery patients in their early post-discharge recovery.

Methods This systematic review was conducted according to PRISMA guidelines. The literature search was conducted in March 2022 (updated in May 2023) in MEDLINE (Ovid), EMBASE (Ovid), CINAHL (Ebsco), PsycINFO (Ovid), and Scopus. Given the heterogeneity of the interventions, outcome parameters, and controls, data for pooling for meta-analysis was not possible. We performed a thematic analysis to categorize the characteristics of the type, content, and results of care interventions.

Results A total of 14 articles met the eligibility criteria. The included studies were published between 2008 and 2022 and included 1,399 unique patients with mean reported ages of 42.3 to 62.3 years. The reported interventions were divided into two categories: "Early active rehabilitation" and "Telemonitoring". As for pain, function, quality of life, and activity the majority of the early active rehabilitation interventions showed no differences compared to usual care. In contrast, the telemonitoring interventions seemed mainly to be in favor of the interventions versus usual care in all of the aforementioned aspects.

Conclusion The included studies demonstrated diverse interventions across settings, populations, interventions, controls, follow-up times, and outcome measures. This variability suggests unclear patient needs and preferences for post-discharge care. Given the heterogeneity and overall study quality, further high-quality research is essential. Future studies should prioritize identifying these needs before intervention design.

Keywords Systematic review · Spine surgery · Post-discharge recovery · Post-discharge care

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Introduction

The human spine commonly undergoes degenerative changes as a natural process. In individuals experiencing symptoms of degenerative disorders, including back pain or neck pain with or without radiculopathy or myelopathy, the typical treatment approach is initially non-operative treatment options such as medication, rest, physiotherapy, and lifestyle modifications [1]. However, surgical interventions can become relevant when conservative measures fail and the individual patient experiences persistent symptoms [1, 2].

Lumbar spine surgeries are the most common within the field of spine surgery [3, 4]. According to a report from the Danish Registry for Spine Surgery (DaneSpine) [3], the majority, equivalent to approximately 80%, are lumbar spine surgeries. The most common lumbar diagnoses include spinal stenosis, disc herniation, spondylosis, and spondylolisthesis. Furthermore, cervical surgeries constitute approximately 14% of registrations, with prevalent diagnoses like disc herniation, spondylosis with radiculopathy, and spondylosis with myelopathy [3].

The need for hospitalization after surgery has decreased since the introduction of the Enhanced Recovery After Surgery (ERAS) protocol in the mid-1990s. The concept implies a multimodal perioperative care program that optimizes processes before, during, and after surgery to reduce postoperative complications, facilitate early mobility and recovery, and shorten the patient's length of stay [5–7]. ERAS, however, does not take into account a patient's continued recovery after they are discharged from the hospital. Most approaches for evaluating a patient's postoperative recovery are confined to in-hospital metrics, using measures that are of greatest interest to clinicians such as length of stay, opioid use, and pain [8–12].

Although a minority of patients are discharged to an acute care setting or rehabilitation facility, most patients are discharged to home, without any direct assistance from a healthcare provider on managing their pain, personal hygiene or return to daily activities. The increased push from hospital administrators, buoyed by the increased use of ERAS has led to a decrease in patient's hospital length of stay. This shortened length of stay may lead patients to feel that they are not ready to be on their own at home. In addition, healthcare providers do not have the tools needed to monitor a patient's recovery after surgery once they are discharged to home.

In a qualitative study [13] patients who had spinal fusion reported that there was a lack of support from the hospital department in managing pain during the period immediately following surgery. Another qualitative study [14] showed that patients were not provided with, but needed a detailed long-term recovery plan following spine surgery from the healthcare team. As these two studies are from the patients' perspective, it is unclear what tools and approaches are available to patients and healthcare providers to manage postoperative recovery at home after discharge. Thus, the aim of this systematic review is to characterize the type, content, and results of care interventions that support spine surgery patients in their early post-discharge recovery.

Methods

Review design

The protocol for this systematic review was registered on the database of prospectively registered systematic reviews in health and social care, PROSPERO (CRD42022262542), and is available in full on the PROSPERO website [15]. The study is reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines [16].

Data sources and search strategy

The literature search strategies were developed using controlled vocabulary and keywords and were done under the supervision of the last author [TFF]. A research librarian affiliated with the University Library of Southern Denmark was engaged to peer review the search strategies [17]. The search strategy was structured around three search blocks covering the spinal surgery patient population, the care interventions, and the concept of the post-discharge period. The Boolean operators AND/OR were used for building the search equations (Table 1).

On the 24th of March 2022, the following databases were searched: MEDLINE (Ovid), EMBASE (Ovid), CINAHL (Ebsco), PsycINFO (Ovid), and Scopus. Languages were limited to Danish, English, Norwegian, and Swedish. The searches were restricted to journal articles, conference proceedings, book chapters, and clinical study reports. The detailed search strategies are available as Supplementary Material [18]. The literature search was updated on the 10th of May 2023 [19].

Study selection

Following the advice in the Cochrane Handbook [20], the screening took place in the following steps.

First, we consolidated search results from the data sources using reference management software, EndNote [21], and duplicates were eliminated. After that, the references were exported to the online screening tool, Covidence [22]. Titles and abstracts were carefully examined by two independent reviewers [MDL and LAW] to weed out obviously irrelevant reports. Once potential eligible reports were identified, we retrieved their full texts.

The next step involved a thorough examination of the full-text reports to ensure compliance with eligibility criteria. Communication with a third reviewer [LYA] was initiated, if necessary, to clarify cases of conflicts. Final decisions were made regarding the inclusion of studies, and we moved on to the data collection phase.

Eligibility criteria

The participants of interest were patients who have undergone elective surgery for degenerative conditions in the lumbar spine for back pain or sciatica due to disc herniation, spinal stenosis, spondylolisthesis, degenerative disc disease, or recurrent disc herniation. Surgical interventions

Table 1 Search terms

Block 1 Spinal surgery patient population	"Laminectomy" OR "diskectomy, percutaneous" OR "decompression, surgical" OR "spinal fusion" OR "spinal diseases" OR (("neurosurgery" OR "neurosurgical procedures" OR "orthopedics" OR "orthopedic procedures" OR "spinal surgery") AND ("low back pain" OR "radiculopathy" OR "spinal diseases" OR "spine" OR "lumbar vertebrae"))
AND	
Block 2 Care interventions	"Telemedicine" OR "telephone" OR "cell phone" OR "smartphone" OR "tablets" OR "mobile applications" OR "telerehabilitation" OR "telenursing" OR "videoconferencing" OR "health communication" OR "medical informatics applications" OR "nursing informatics" OR "ehealth" OR "house calls" OR "real-time support" OR "aftercare" OR "continuous nursing" OR "follow-up care" OR "follow-up support" OR "remote monitoring" OR "active postdischarge surveillance" OR "simulation training" OR "instructional film and video" OR "pain management" OR "analgesia" OR "clinical teaching methods" OR "client education" OR "patient education" OR "continuity of patient care" OR "self care" OR "health promotion" OR "multidiscipline care" OR "self-management" OR "recovery of function" OR "convalescence" OR "mobile team" OR "text messaging" OR "preoperative education" OR "prehabilitation" OR "preoperative exercise" OR "emotional adjustment" OR "psychological adaption" OR "physiological adaption" OR "adaptive behaviour"
AND	
Block 3 Post-discharge period	"Short time stay" OR "short term stay" OR "short time hospitalization" OR "short term hospitalization" OR "return home" OR "hospital home" OR "discharge" OR "patient discharge" OR "postdischarge" OR "transition home" OR "length of stay"

included decompressions, discectomies, microdiscectomies, and fusions. These pathologies and surgeries were included as these are the most common pathologies and elective spine surgeries performed. Studies that included surgeries for complex spine deformities, infections, tumors, or trauma were excluded. We included studies examining the adult human population (18 years or older) discharged from the hospital to their private home after spine surgery. The publication types included were limited to: journal articles, conference proceedings, book chapters, and clinical study reports. Studies were found eligible if they addressed post-discharge care interventions, referring to any activity initiated by a member of the hospital health care team from the hospital ward where the patient was admitted during the surgery. This included, but was not limited to, structured telephone calls, telemedicine, home visits, remote monitoring, eHealth interventions, team-based care, discharge education, or involving rehabilitation.

Data extraction

Data extraction was done independently by two reviewers [MDL and LYC] and followed by comparison to ensure data accuracy. Any disagreement was resolved by consensus after a thorough discussion. A data collection form developed by adapting existing forms for intervention reviews for randomized controlled trials (RCTs) and non-RCTs was used [23, 24]. Data was extracted from the included studies using the following variables: (1) Author, year of publication, country of origin, and setting (2) Study design and participants (number and mean age), (3) Pathology and surgical technique, (4) Aim (5) Intervention and control (6) Follow-up (7) Outcome assessment tools and (8) Comparison of results–Interventions versus Controls.

Data analysis

The analyses of the data took place from September to November 2022. Given the heterogeneity of the interventions, outcome parameters, and controls, data for pooling for meta-analysis was not possible. We performed a thematic analysis to categorize the characteristics of the type, content, and results of care interventions.

Risk of bias assessment

We found it important to include all relevant literature regardless of methodological quality. Therefore, a risk of bias assessment of the included studies was performed after the data extraction. The number of outcome assessments was limited to as patient-reported at the last follow-up. The revised Cochrane risk of bias tool for randomized trials (RoB 2.0) [25] and the Risk of Bias In Non-randomized Studies–of Interventions (ROBINS-I) assessment tool [26] were used to assess the risk of bias and methodological quality. The judgments were made by the first review author [MDL] by answering the signaling questions in the assessment tools [27]. Judgments were supported by The Cochrane Handbook [28] and they were discussed with one of the co-authors [MOA]. Robvis [29] was used to create the risk of bias plots.

Results

Study selection and characteristics

A total of 14,055 studies were identified through the initial search. After removing duplicates 8,169 publications were screened without the use of filtering based on title and abstract. There were 54 conflicts giving an interrater agreement of 98% (Cohen's κ = 0.64) after the first screening. The conflicts were resolved by consensus after discussion, and 55 articles were read in full text. This second screening process resulted in 16 conflicts giving an inter-rater agreement of 71% agreement (Cohen's κ = 0.40). The full-text review of articles led to discussions, and conflicts were solved. The screening and selection process is shown in the PRISMA flow diagram (Fig. 1). The updated, supplementary screening and selection process is shown in another PRISMA flow diagram (Appendix 1). No further studies were included.

Finally, 14 studies were identified that met the inclusion criteria (Table 2). Studies included were published between 2008 and 2022. There were twelve randomized controlled trials [30–41], one quasi-experimental trial [42], and one prospective lagged controlled trial [43]. Three articles [35, 39, 43] referred to detailed descriptions of the interventions in previous publications and were considered duplicate data sources, even though they are distinct articles [44–46]. Collectively, the 14 studies included 1,399 unique patients with the mean reported ages of 42.3 to 62.3 years. The pathologic diagnoses reported in the included studies were: Lumbar spinal stenosis [32, 33, 43], nerve root compression [35], degenerative lumbar disease [31, 37, 39] or degenerative conditions [41], lumbar disc herniation [30, 32, 34–36, 38, 40, 42], and spondylolisthesis [32, 39, 42]. The surgical techniques presented included discectomies [30, 34, 38, 40]

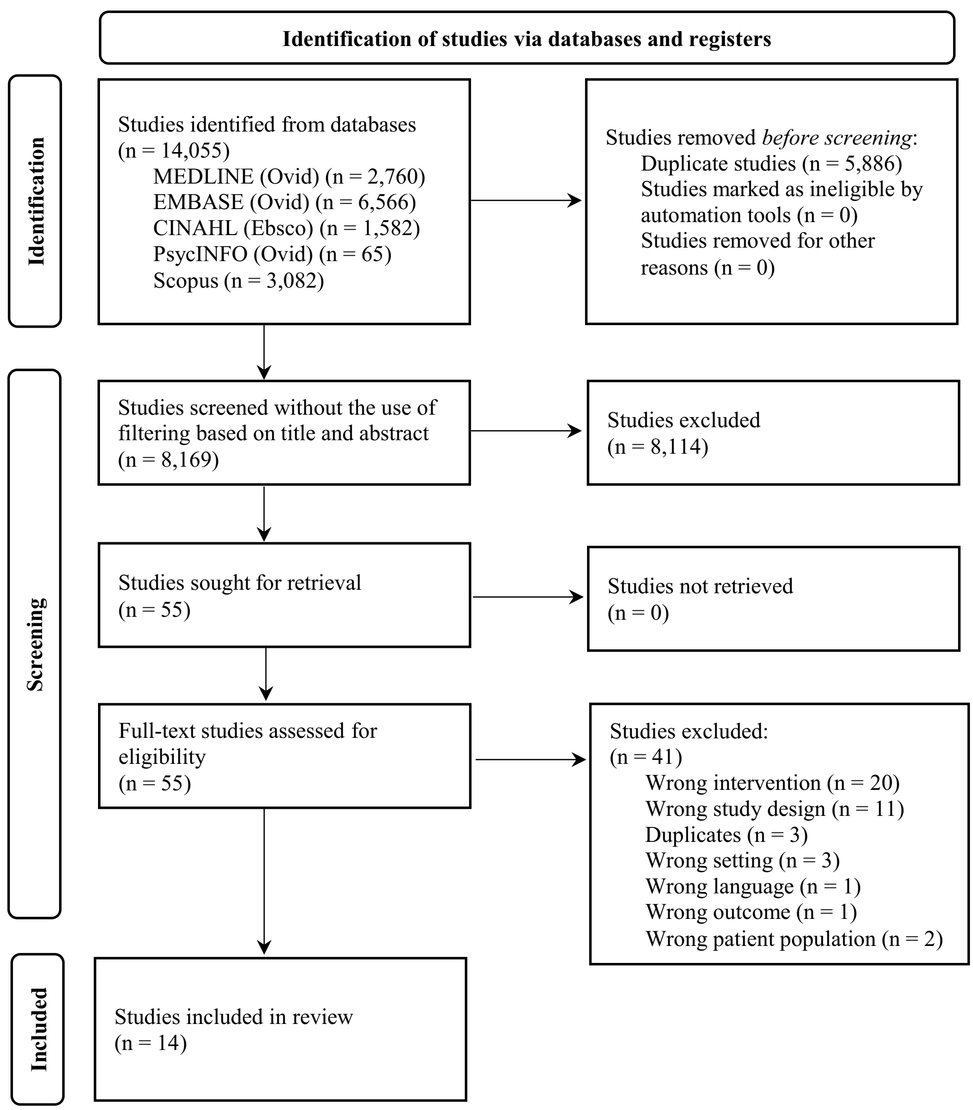

Fig. 1 PRISMA flow diagram of articles screening and selection process

Table 2 Study characteristics of articles included in the systematic review

Study ID 1st author Year of publication Country of origin Setting	Study design Participants number (intervention/control) Mean age Year (intervention/control)	Pathology Surgical technique	Aim	Intervention Control	Follow-up	Outcome assessment tools 1) Pain 2) Function 3) Quality of life 4) Activity	Comparison of results—Interventions versus Controls 1) Pain 2) Function 3) Quality of life 4) Activity
1. Aldemir [30] 2021 Tÿrkiye Neurosurgery clinic	Randomized controlled trial 33/34 42.3/44.9	Lumbar disc herniation Standard lumbar discectomy using a microsurgical technique	Determine the effect of pedometer-supported walking and telemonitoring	I: Telemonitoring Pedometer-supported walking exercise and telemonitoring C: No walking exercise	3 months	1) MPQ 2) ODI 3) SF36 4) Daily physical activity	1) Favors intervention 2) Favors intervention 3) Favors intervention 4) Favors intervention
2. Bizheva [31] 2016 Republic of Macedonia Department of neurosurgery	Randomized controlled trial 20/10 55.9/58.3	Degenerative lumbar diseases Low back surgery	Determine the influence of early goal-oriented physical therapy program with booklet	I: Early active rehabilitation Additional early goal-oriented physical therapy program with educational booklet C: Standard care physical therapy without booklet	1 month	1) NA 2) NA 3) NA 4) Bed transfers and Timed Up and Go	1) NA 2) NA 3) NA 4) Favors intervention
3. Chen [33] 2015 Taiwan NA	Randomized controlled trial 29/31 51.8/52.1	Lumbar stenosis Primary decompression with or without fusion	Examine outcomes of peri-operative rehabilitation intervention	I: Early active rehabilitation Patient education, breathing exercises, early postoperative mobilization, trunk and extremity exercises C: No active early mobilization strategies	6 months – 50% lost to follow-up	1) Back Pain VAS, Leg Pain VAS 2) RMDQ 3) SF12 4) 15 m Walking, 5XSit-to-stand	1) Favors intervention (back pain), Favor control (leg pain) 2) Favors control 3) No difference 4) Favors control (15 m Walking), No difference (5XSit-to-stand)
4. Guo [42] 2022 China Spine Surgery Department	Quasi-experimental design 36/36 57.6/62.3	Lumbar disc herniation and lumbar spondylolisthesis Lumbar fusion surgery with no prior history of spinal surgery	Explore effectiveness of WeChat	I: Telemonitoring WeChat-based individualized rehabilitation program C: Routine follow-up guidance	3 months	1) NRS 2) ODI 3) NA 4) Exercise self-efficiency	1) Favors intervention 2) No difference 3) NA 4) Favors intervention

Table 2 (continued)

Study ID 1st author Year of publication Country of origin Setting	Study design Participants number (intervention/control) Mean age Year (intervention/control)	Pathology Surgical technique	Aim	Intervention Control	Follow-up	Outcome assessment tools 1) Pain 2) Function 3) Quality of life 4) Activity	Comparison of results—Interventions versus Controls 1) Pain 2) Function 3) Quality of life 4) Activity
5. He [36] 2021 China Medical Center	Randomized controlled trial 47/48 46.0/45.9	Lumbar disc herniation Not specified	Effect on post-operative rehabilitation	I: Telemonitoring Continuous nursing using WeChat C: Routine continuous nursing	3 months	1) NA 2) ODI 3) SF36 4) NA	1) NA 2) Favors intervention 3) Favors intervention 4) NA
6. Hou [32] 2019 China 3 hospitals affiliated to the Sun Yat-sen University	Randomized controlled trial 60/61 51.1/49.4	Lumbar disc herniation, spinal stenosis, or lumbar spondylolisthesis Lumbar spinal surgery	To examine the efficacy of mobile phone based rehabilitation systems	I: Telemonitoring Mobile Phone based electronic health program C: Usual care	24 months	1) VAS 2) ODI 3) EQ-5D, SF36 4) NA	1) Favors intervention 2) Favors intervention 3) Favors intervention 4) NA
7. Kim [34] 2016 Korea Rehabilitation centre at a specialized hospital for spinal surgery	Randomized Clinical Trial (pilot study) 14/7 45.7/54.9	Disc herniation Lumbar open laser microdiscectomy	Evaluate the feasibility of early individualized manipulative rehabilitation	I: Early active rehabilitation Early manipulative rehabilitation C: Active control group Home exercise booklet with verbal instruction—home exercise program for 4 weeks	4 weeks	1) VAS back, VAS leg 2) RMDQ 3) SF36 4) NA	1) No difference (back pain), Favors intervention (leg pain) 2) Favors intervention 3) No difference 4) NA
8. McGregor [35] 2011 England Seven hospitals	Randomized controlled trial 86/70/91/91 54.0/53.0/53.0/55.0	Nerve root compression or lumbar disc herniation Not specified	Can functional outcome be improved by formal rehabilitation program	I: Early active rehabilitation (1) 6wk formal rehabilitation (2) booklet-only (3) 6wk formal rehabilitation + booklet C: Usual care	12 months	1) VAS 2) ODI 3) NA 4) NA	1) No difference 2) No difference 3) NA 4) NA
9. Nielsen [37] 2008 Denmark NA	Randomized controlled trial 28/32 48.0/52.0	Degenerative lumbar disease Lumbar fusion	Assess quality of life between integrated rehabilitation program and standard of care	I: Early active rehabilitation Integrated program including prehabilitation and early rehabilitation C: Standard care program	6 months	1) NA 2) NA 3) Index score (15D score) 4) NA	1) NA 2) NA 3) No difference 4) NA

Table 2 (continued)

Study ID 1st author Year of publication Country of origin Setting	Study design Participants number (intervention/control) Mean age Year (intervention/control)	Pathology Surgical technique	Aim	Intervention Control	Follow-up	Outcome assessment tools 1) Pain 2) Function 3) Quality of life 4) Activity	Comparison of results—Interventions versus Controls 1) Pain 2) Function 3) Quality of life 4) Activity
10. Oosterhuis [38] 2017 The Netherlands NA	Randomized controlled trial 82/71 47.0/47.0	Lumbar disc herniation Discectomy	Is referral for early rehabilitation after lumbar disc surgery effective	I: Early active rehabilitation Early rehabilitation C: No referral	6 months	1) NRS 2) ODI 3) SF12 4) NA	1) No difference 2) No difference 3) No difference 4) NA
11. Rolving [39] 2015 Denmark The Orthopedic department of a university hospital and a general hospital	Randomized controlled trial 59/31 51.4/47.7	Degenerative disease or spondylolisthesis Lumbar spinal fusion of ≤ 3 levels	Effect of Cognitive Behavioral Intervention	I: Early active rehabilitation Standard course of treatment and preoperative cognitive-behavioral intervention C: Usual care	12 months	1) NRS 2) ODI 3) NA 4) NA	1) No difference 2) No difference 3) NA 4) NA
12. Saha [40] 2021 Tÿrkiye Neurosurgery clinic	Randomized controlled trial 30/30 48.9/49.0	Lumbar disc herniation Lumbar discectomy surgery	Determine the effect of computer based discharge training on self-agency and independence	I: Telemonitoring Computer-Based Training on Self-care and Daily Living Activities C: Usual care	6 weeks	1) NA 2) Modified Barthel Index 3) NA 4) Exercise of Self Care	1) NA 2) No difference 3) NA 4) Favors intervention
13. Skolasky [43] 2018 USA Academic spine center at a community-based hospital	Prospective lagged controlled trial 63/59 60.0/58.0	Lumbar spinal stenosis Lumbar decompression	Compare the effectiveness of health behavior change counseling to improve health outcomes	I: Telemonitoring Telephone-based health behavior change counseling C: Usual care	36 months	1) Brief Pain Inventory 2) ODI 3) SF12 4) NA	1) Favors intervention 2) Favors intervention 3) Favors intervention 4) NA
14. Uhrbrand [41] 2021 Denmark Department of neurosurgery	Randomized controlled trial 55/55 58.0/55.3	Degenerative conditions Cervical or lumbar spine surgery	Effect of a personalized opioid tapering plan	I: Telemonitoring Personalized opioid tapering plan C: Standard care	3 months	1) NRS 2) NA 3) NA 4) NA	1) No difference 2) NA 3) NA 4) NA

EQ-5D EuroQol-5 dimension, *MPQ* McGill Pain Questionnaire, *NA* not available, *NRS* numeric rating scale, *ODI* Oswestry Disability Index, *RMDQ* Roland-Morris Disability Questionnaire, *SF 12* Short Form 12, *SF36* Short Form 36, *VAS* Visual Analogic Scale including microdiscectomies [30, 34], decompressions [33, 43], and lumbar spinal fusions [33, 37, 39, 42]. The surgical techniques being used in some studies were not specified [31, 32, 35, 36, 41].

Due to the heterogeneity of the included studies concerning the setting, population, intervention, controls, and outcome measures we did not perform quantitative analyses.

Risk of bias of included studies

The risk of bias of the 12 included RCTs are summarized in Fig. 2. Eight of the studies were overall rated as at some concerns [31–36, 39, 40], while the remaining four studies were overall rated as at high risk [30, 37, 38, 41]. Ten of the RCTs were rated as at low risk concerning bias arising from the randomization process [30, 32–36, 38–41]. Two of the RCTs had some concerns according to this domain [31, 37]. Concerning the domain of bias due to deviations from the intended intervention, two studies met the criteria for low risk of bias [33, 35], seven studies had some concerns [30–32, 34, 36, 39, 40], and three studies were assessed as at high risk of bias [37, 38, 41]. All of the RCTs, except for one [30], had a low risk of bias due to missing outcome data. Conversely, except for one study [31], all of the RCTs had some concerns due to the measurement of outcome. Finally, three RCTs were rated as at low risk of bias [35, 38, 41], while the other nine studies had some concerns [30–34, 36, 37, 39, 40], due to bias in the selection of the reported result.

Of the two non-randomized studies (Fig. 3), the study of Skolasky et al. [43] was overall rated as moderate risk. The study of Guo et al. [42] was overall rated as at serious risk. This study had serious risk of bias due to confounding and moderate risk of bias due to missing data, measurement of outcomes, and in the selection of the reported result. Both of the studies were rated as at low risk according to the selection of participants, classification of interventions, and deviations from intended interventions.

Timing of the interventions

Care interventions that supported spine surgery patients in their early post-discharge recovery were conducted during the prehospital [30, 33, 37, 39, 43], postsurgical in-hospital [31, 33, 37, 38, 40]–[42], and post-discharge [30, 31, 33, 35–43] phases. In the study of Aldemir et al. [30] patients were introduced to the post-discharge care intervention before their surgery, although the actual intervention took place after discharge.

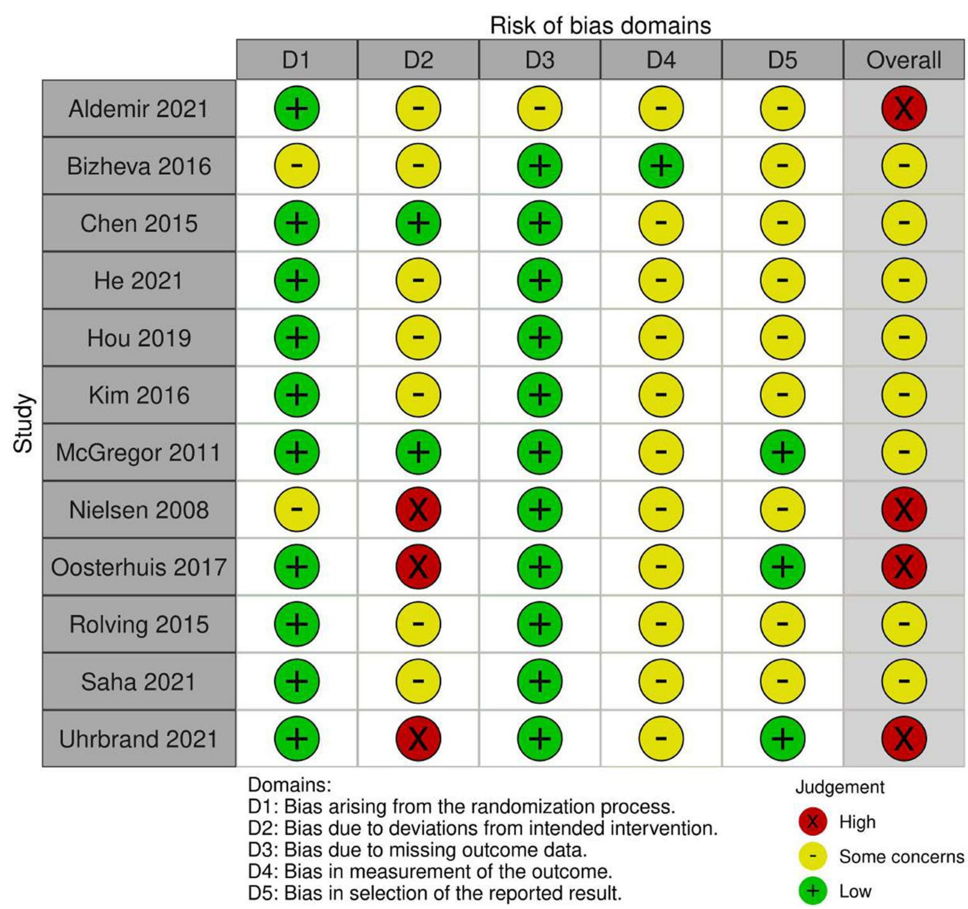

Fig. 2 Summary of risk of bias of the included RCT's

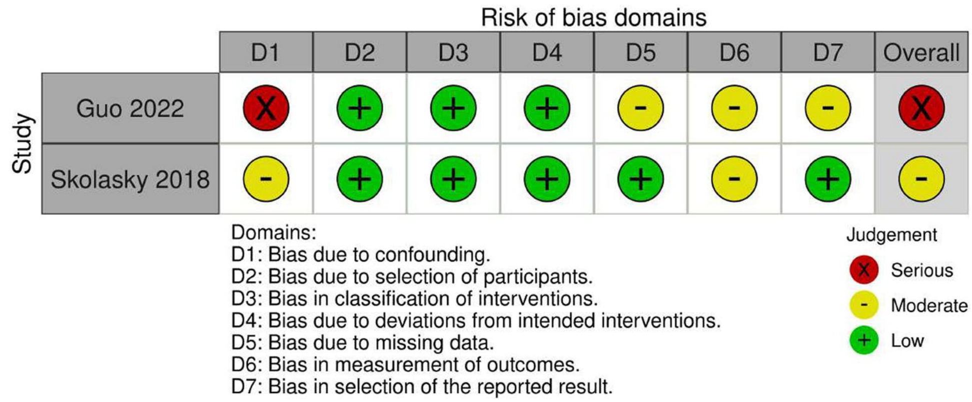

Fig. 3 Summary of risk of bias of the included non-RCT's

Type of interventions

The type of interventions can be stratified into two categories: "Early Active Rehabilitation" [31, 33–35, 37–39] and "Telemonitoring" [30, 32, 36, 40–43].

Outcomes reported

Studies reported varying outcomes, including pain, function, quality of life, and activity. Only the studies by Aldemir et al. [30] and Chen et al. [33] included all four selected outcome measures. The other studies reported only one [31, 37, 41], two [35, 36, 39, 40], or three [32, 34, 38, 42, 43] of these outcomes.

The included studies utilized various outcome assessment tools to measure the outcomes (Table 2). For pain assessment, tools like the McGill Pain Questionnaire (MPQ) [30], Visual Analog Scale (VAS) [32–35], Numeric Rating Scale (NRS) [37–39, 41], and Brief Pain Inventory [43] were employed. Function was measured using the Oswestry Disability Index (ODI) [30, 32, 35–39, 43], Roland Morris Disability Questionnaire (RMDQ) [33, 34], and Modified Barthel Index [40]. Quality of life was assessed using Short Form 36 (SF36) [30, 32, 34, 36], Short Form 12 (SF12) [33, 38, 43], EuroQol-5 dimension (EQ-5D [32], and Index score (15D score) [37]. Activity measurement included tools such as Daily Physical Activity [30], Bed Transfer and Timed Up and Go [31], 15 m walking and 5 × Sit-to-Stand [33], Exercise Self-Efficacy [37], and Exercise of Self-Care [40].

Outcomes of early active rehabilitation

Interventions in the "early active rehabilitation" category included early goal-oriented physical therapy [31], postoperative exercise therapy [38], early postoperative mobilization [33], patient education [33], educational booklets [31, 35, 38], prehabilitation programs [37] including cognitive-behavioral intervention [39], and manipulative rehabilitation intervention [34] performed prior to surgery. The follow-up time varied from 4 weeks to 12 months (Table 2). The studies categorized in the "early active rehabilitation" group were published from 2008 to 2017.

Table 2 in the last column, shows which outcomes are in favor of the respective intervention groups versus control groups for each of the included studies. The table shows, that the majority of the studies included in the "early active rehabilitation" category [35, 37–39] showed no differences between the intervention groups and the controls in pain, function, quality of life, or activity.

However, three studies showed statistically significant differences in outcomes. The studies by bizheva [31] and kim [34] favored early rehabilitation while the study by chen [33] favored standard of care. This is elaborated thoroughly in the following.

Bizheva et al. [31] examined the influence of a physical therapy program that combined active exercises with an educational booklet about activities of daily living (adls) versus oral information on functional mobility in patients one month after low back surgery. They found no significant differences between the two groups, except for bed transfers and timed up and go (tug), where the intervention group had statistically significantly better results than the control group. Bizheva et al. [31] suggested that patients who received a combination of a written educational booklet and physical therapy experienced heightened confidence and self-esteem in their movements early in their hospitalization. This improved their mindset and facilitated better adherence to adls, including proper bed transfers and movement restrictions, ultimately leading to accelerated recovery. Kim et al. [34] performed a pilot study on the feasibility of using early individualized manipulative rehabilitation compared to home exercise booklets to improve early postoperative functional disability following lumbar discectomy one month after surgery. No differences in sf-36 and vas back pain were seen between the two groups but favored early active rehabilitation in vas leg and roland morris questionnaire. Chen et al. [33] examined the outcomes of a perioperative rehabilitation intervention for patients who underwent lumbar decompression surgery in taiwan six months after surgery. No differences were seen regarding sf-12 or sit-to-stand between early active rehabilitation and no early active rehabilitation. Greater improvements in vas back pain were seen in the early active rehabilitation group, but greater improvements were seen for vas leg pain, roland-morris disability questionnaire, and walking distance in the no early activation group.

Outcomes of telemonitoring

The interventions in the "Telemonitoring" category include phone calls [41, 43], photos of registered activity sent via smartphone [30], the use of the Chinese mobile application WeChat [36, 42], a mobile phone-based health program [32], and a computer-based training video [40]. The follow-up time varied from 6 weeks to 36 months (Table 2). All the studies had cohort sizes of 30 or more. The studies categorized in the "Telemonitoring" group were published recently, from 2018 to 2022.

Except for the study of Uhrbrand et al. [41], all of the interventions in this category had outcomes concerning pain, function, quality of life, or activity, that were in favor of the interventions versus standard of care (Table 2). Uhrbrand and colleagues examined the personalized opioid tapering plan including telephone follow-up. However, this intervention did not show any difference in pain measured on a Numeric Rating Scale at 3 months after surgery.

Studies on the pedometer-supported walking exercise and telemonitoring intervention [30], the telephone-based health behavior change counseling [43], and the mobile phone-based electronic health program [32] all showed results in favor of the intervention group compared to usual care in the three outcome measures of pain, function, and quality of life. The study of Guo et al. [42] who examined a WeChat-based individualized rehabilitation program versus routine follow-up care reported outcomes in favor of the intervention group concerning pain and activity at 3 months after surgery, but their study showed no differences according to functional status measured by the Oswestry Disability Index (ODI). Saha et al. [40] performed an RCT on computer-based training on self-care and daily living activities versus usual care. They found no differences at 6 weeks after surgery in function measured by the Modified Barthel Index. In terms of activity, measured on exercise of self-care, the results were in favor of the intervention group. A Chinese RCT [36] examined the effect of continuous nursing using WeChat on post-operative rehabilitation. This study reported outcomes 3 months after surgery in favor of the intervention group in function measured in ODI and quality of life via the 36-Item Short Form Survey (SF36).

Discussion

In this systematic review, we aimed to characterize the type, content, and results of care interventions that support lumbar spine surgery patients in their early post-discharge recovery. The interventions in the included studies varied in type and content and included: Early goal-oriented physical therapy, postoperative exercise therapy, early postoperative mobilization, patient education, educational booklets, prehabilitation programs including cognitive-behavioral intervention, manipulative rehabilitation intervention performed prior to surgery, phone calls, photos of registered activity sent via smartphone, the use of the Chinese mobile application WeChat, a mobile phone-based health program, and a computer-based training video.

The included studies had also considerable variation in the outcome measures reported, both in terms of the type and quantity, which hindered any systematic synthesis. Even when the type of outcome measures were the same, the range in mean change scores was also wide. The follow-up period varied widely as well, from one to 36 months.

The types of interventions were stratified into the categories "Early Active Rehabilitation" and "Telemonitoring". Studies on "Early Active Rehabilitation" did not reach any significant conclusions in favor of or against early active rehabilitation after spine surgery in terms of pain, function, quality of life, and activity. The lack of differences between the intervention and usual care in these studies may be explained by the fact that the interventions in this category were 'standard of care' rehabilitation interventions or patient education implemented earlier than usual and more proactively. It is also unclear how actively patients were able to remain in contact with their rehabilitation providers in the immediate post-operative period, to ask for support if needed.

Correspondingly, Paulsen et al. [47] investigated the effect of supervised postoperative rehabilitation on return to work and working ability after lumbar discectomy. They found that outcomes of formal rehabilitation in the post-operative period were similar to no formal rehabilitation.

This systematic review indicates that telemonitoring could be a promising method for remotely supporting patients in their post-discharge recovery at home, with all six studies favoring the intervention in terms of pain, function, quality of life, and activity. This suggests, that digital health interventions potentially can help patients manage their condition in the immediate postoperative period. In line with this, Dawes et al. [48] found in a meta-analysis of 45 studies, that remote home monitoring using mobile health technology was associated with fewer emergency department visits, hospital readmissions, and accelerated improvements in quality of life after surgery. Dawes and colleagues reflect that the use of mobile health technology is a potentially more efficient method for delivering post-operative care interventions [48].

In contrast to “Early Active Rehabilitation”, “Telemonitoring” is a novel idea allowing both the patient and the healthcare provider to be more engaged in managing issues in the immediate postoperative period. However, digital health literacy issues must be taken into consideration [49].

The utilization of modern communication technologies such as smartphone applications and computer-based training videos reflects a shift towards more accessible and interactive approaches to postoperative care delivery. These interventions not only facilitate remote monitoring but also empower patients to actively engage in their recovery journey beyond the confines of traditional healthcare settings.

Jaensson et al. [50] suggest that digital follow-up tools can aid in patients’ recovery and sense of security. Additionally, the accessibility of nurses and personalized e-health programs can enhance patients’ postoperative recovery. However, they also found, that there is no consensus on the timing and method of follow-up after day surgery [50]. These are essential aspects to consider in future research within this field.

Strengths and limitations

To our knowledge, this is the first study to outline the landscape of care interventions that support patients in their early post-discharge recovery after spine surgery.

Despite the variation in outcome measures and follow-up periods, the study sheds light on the challenges and nuances in this field. However, the lack of significant conclusions in studies on "Early Active Rehabilitation" underscores the need for more innovative interventions.

Insufficient sample size calculations and a limited number of participants in several studies within the "Early Active Rehabilitation" domain [31, 33, 34, 37] raise concerns about statistical validity. These limitations underscore the need for more comprehensive, well-designed research in "Early Active Rehabilitation". Conducting studies with larger samples, rigorous methodologies, and thorough statistical analysis is crucial for obtaining reliable and conclusive evidence on intervention effectiveness in this field [51]. However, it is important to consider, that among the remaining studies in this group [35, 38, 39], conducted with proper sample size calculations, none demonstrated differences between intervention and control groups.

On the contrary, the study indicates a promising aspect in the "Telemonitoring" group, where systematic power calculations were employed, except for the study by He et al. [36], ensuring statistical robustness. This strengthens the reliability and overall validity of the findings, supporting the notion that telemonitoring could be an effective method for remote post-discharge support. The novelty of "Telemonitoring" compared to "Early Active Rehabilitation" suggests potential engagement benefits for both patients and healthcare providers in managing postoperative issues.

According to our search strategy, we had to use many different synonyms to identify the search terms of ‘post-discharge care interventions’ as there is no clear terminology for this. However, despite the thorough and systematic search strategy used, there is always a risk that relevant studies may not have been captured by our searches.

Another limitation of this study was the inability to synthesize the results of the included studies due to heterogeneity concerning variations in the settings, sample populations, interventions, controls, follow-up time points, and outcome measures, which underscores the need for cautious interpretation of this study’s findings. Further research is needed to address these variabilities and potentially yield more consistent results, focusing on standardizing methods, reducing variation in intervention protocols, and including larger samples, based on power calculations, to enhance the generalizability of findings.

Conclusion

We found that the identified care interventions of the included studies can be grouped into two general categories, “Early Active Rehabilitation” and “Telemonitoring”. No substantial differences were seen between “Early Active Rehabilitation” and usual care. However, studies in the “Telemonitoring” group favored the use of remote monitoring compared to usual care. The included studies varied to a great extent for a variety of reasons, including the settings, sample population, interventions, controls, follow-up time points, and outcome measures. The variety of the existing care interventions may indicate that patients’ needs and preferences for post-discharge care have not been fully clarified, with heterogeneity and overall lack of quality of the included studies, additional high-quality research in this area is needed. Future studies should identify these needs before designing and developing an intervention.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00586-024-08622-x.

Acknowledgements We thank the University of Southern Denmark Librarian, Herdis Foverskov, who helped qualify the search strategy for this review.

Funding Financial support was received from the Faculty of Health Science – University of Southern Denmark and the Spine Centre of Southern Denmark, Lillebaelt Hospital.

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