Observational Study

Medicine

OPEN

Prospective observational study on the application of an integrative medicine program for the enhanced recovery of patients undergoing spinal surgery

Effects and survey-based analysis

Jung-Hyun Kim, PhD[a], In-Seok Son, PhD[b], Sung-Min Kim, PhD[b], Yong-Chan Kim, PhD[b], Byung-Kwan Seo, PhD[c,*]

Abstract

Enhanced recovery after surgery (ERAS) protocols have been widely adopted in various surgical disciplines to accelerate recovery and improve patient outcomes. However, the application of these programs in spinal surgery, particularly with an integrative medicine approach, remains limited. This study aimed to evaluate the effects of a customized integrative medicine-based program on postoperative recovery and to analyze patient-reported preferences for future protocol refinement. This study evaluated the enhanced recovery after spinal surgery (ERAS-K) program in single- and multi-segment spinal fusion surgeries, targeting improved activity as the primary endpoint. Secondary endpoints included pain, digestive dysfunction, and muscle weakness. Patients aged >40 years were divided into ERAS-K and non-ERAS-K groups. Statistical analyses, including ANCOVA and chi-square tests, adjusted for covariates, revealing significant outcomes (*P*-values adjusted via Benjamini–Hochberg). This study evaluated the ERAS-K program in single- and multi-segment spinal fusion surgeries, with improved activity as the primary endpoint. Secondary endpoints included pain, digestive dysfunction, and muscle weakness. Patients aged >40 years were divided into ERAS-K (N) and non-ERAS-K (M) groups. Postoperative recovery metrics showed no significant differences in numeric rating scale-axial ($P = .5588$) or numeric rating scale-leg ($P = .8576$) pain scores at baseline. Postoperatively, axial pain reduction showed a near-significant trend ($P = .0525$, ANCOVA; ERAS-K: 4.2 ± 1.1, non-ERAS-K: 4.8 ± 1.3). Short form-36 physical ($P = .1989$; ERAS-K: 42.5 ± 8.2, non-ERAS-K: 41.3 ± 7.9) and mental component scores ($P = .9572$) were similar. Mean days to improved activity were 4.81 ± 0.9 (ERAS-K) versus 4.96 ± 1.0 (non-ERAS-K; $P = .63551$). Non-ERAS-K patients preferred physical therapy ($P = .053$). Outcomes suggest ERAS-K's integrated rehabilitation may reduce the need for standalone physical therapy, though statistical significance was not achieved. Although the ERAS-K program did not demonstrate a statistically significant impact on conventional pain and quality-of-life metrics, this study highlights the critical importance of program standardization in future research. The findings also underscore strong patient-driven demand for the integration of traditional Korean medicine into conventional postoperative care pathways, suggesting that a holistic, patient-centered approach may improve satisfaction and outcomes beyond traditional metrics.

Abbreviations: ERAS = enhanced recovery after surgery, ERAS-K = enhanced recovery after spinal surgery, NRS = numeric rating scale, RCT = randomized controlled trial, SF-36 = short form-36, TKM = traditional Korean medicine.

Keywords: enhanced recovery after surgery, integrative medicine, pain management, patient satisfaction, prospective study, spinal surgery, traditional Korean medicine

JK and IS contributed to this article equally.

This research was supported by a grant from the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number: RS-2024-00441695).

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

The study was conducted in accordance with the guidelines of the Institutional Review Board (IRB) at Kyunghee University Hospital in Gangdong and was approved after the deliberation procedure (IRB No. KHNMCOH 2022-12-003 and KHNMC 2022-12-002).

Supplemental Digital Content is available for this article.

[a] *Department of Acupuncture and Moxibustion Medicine, Kyung Hee University Hospital at Gangdong, Seoul, Republic of Korea,* [b] *Department of Orthopaedic Surgery, Kyung Hee University Hospital at Gangdong, Kyung Hee University, Seoul, Republic of Korea,* [c] *Department of Acupuncture and Moxibustion Medicine, College of Korean Medicine, Kyung Hee University Hospital at Gangdong, Kyung Hee University, Seoul, Republic of Korea.*

** Correspondence: Byung-Kwan Seo, Department of Acupuncture and Moxibustion Medicine, College of Korean Medicine, Kyung Hee University Hospital at Gangdong, Kyung Hee University, Seoul, Republic of Korea (e-mail: seohbk@hanmail.net).*

How to cite this article: Kim J-H, Son I-S, Kim S-M, Kim Y-C, Seo B-K. Prospective observational study on the application of an integrative medicine program for the enhanced recovery of patients undergoing spinal surgery: Effects and survey-based analysis. Medicine 2026;105:2(e46943).

Received: 4 September 2025 / Received in final form: 10 November 2025 / Accepted: 12 November 2025

http://dx.doi.org/10.1097/MD.0000000000046943

1. Introduction

As global life expectancy increases, the incidence of degenerative spinal diseases and demand for spinal surgery have risen significantly.[1] Although spinal surgery can provide substantial relief from pain and disability, patients often experience prolonged recovery periods characterized by severe pain and immobility. This has amplified the need for effective postoperative strategies to accelerate recovery and improve patient outcomes.[2]

The concept of enhanced recovery after surgery (ERAS) was introduced in 1997 to optimize perioperative patient management.[3] Since then, ERAS programs have gained widespread support from numerous surgical societies and health institutions across various fields, including general surgery, thoracic surgery, gynecology, and urology.[4,5] The core objective of ERAS is to reduce surgical invasiveness and standardize patient care, thereby enhancing comfort, reducing complication rates, and ultimately shortening hospital stay.[6] These programs typically involve a multidisciplinary checklist that includes preadmission counseling, dietary education, physical therapy, minimally invasive surgical techniques, and opioid-sparing anesthesia.[7,8]

Despite its proven efficacy in many surgical disciplines, the application of ERAS in spinal surgery – particularly from an integrative medicine perspective – remains limited. In Korea, the implementation rate of ERAS for spinal surgery in both public and private hospitals is low. This represents a significant gap, given that conditions, such as spinal stenosis and degenerative kyphosis – highly prevalent in the aging population – place a substantial socioeconomic burden on patients and healthcare systems.[9,10] Common procedures, such as spinal fusion, are essential for treating these conditions but are often associated with prolonged recovery and high costs, particularly for long-segment fusions (3 or more segments) or single-segment fusions for stenosis.[11] The need to improve key recovery metrics – such as time to ambulation, functional recovery, length of stay, and readmission rates – is critical for both patient wellbeing and healthcare sustainability.

Therefore, there is an urgent need for a comprehensive, integrative medical approach to postoperative spinal care. Such a program, which we term enhanced recovery after spinal surgery (ERAS-K), should encompass multimodal pain control and strategies to improve surgical outcomes while focusing on enhancing patients' overall quality of life. This study hypothesized that an integrative medicine-based ERAS-K program would significantly enhance postoperative recovery in spinal fusion patients by improving activity levels, reducing disability, and alleviating pain compared to standard care. To test this hypothesis, we evaluated the program's feasibility through comparative assessments of these outcomes between ERAS-K recipients and non-recipients, while analyzing self-reported questionnaires from participants during the intervention to derive insights for future refinements.

2. Materials and methods

2.1. Study design overview

This prospective observational study investigated the efficacy of the ERAS-K program in enhancing postoperative recovery among patients aged over 40 undergoing single- or multi-segment spinal fusion. Participants were allocated to ERAS-K or non-ERAS-K groups without additional recruitment, ensuring inclusivity across socioeconomic statuses while excluding reoperations and severe comorbidities. The study assessed integrative interventions, including Korean medicine and digital health tools, focusing on activity improvement and secondary outcomes like pain and quality of life, analyzed through validated scales and robust statistical methods.

2.2. Study participants

The study participants were adult patients aged >40 years who were admitted to or received outpatient treatment at the hospital's spine center for spinal surgery (either single-segment fusion or multi-segment fusion and correction). Participants were selected based on the typical patient volume for spinal surgery at the institution, with no separate recruitment process. The study group was divided into 2 groups: N patients who did not receive ERAS-K treatment and M patients who received ERAS-K treatment.

Patients were eligible regardless of their economic status, including those with National Health Insurance, Medical Aid, Second-Class Citizen status, and those who were homeless or transient. The exclusion criteria included patients who underwent reoperation and those with severe systemic diseases, such as infections, because these conditions are associated with a high risk of delayed recovery and complications. Informed consent was obtained from the prospective group after a detailed explanation of the study was provided.

Each participant was assigned a unique registration number in the format xyy-zzz, where "x" denotes the type of surgery (S for single-segment fusion; L for long-segment fusion), "yy" indicates the application of the ERAS-K program (01 for non-applied; 02 for applied), and "zzz" is a sequential serial number.

2.3. Surgical approaches

In both single- and multi-segment fusion and corrective surgeries, the primary endpoint for applying the ERAS-K program was improved activity.

For single-segment fusion, the secondary endpoints were surgical and nonsurgical site pain, digestive dysfunction, constipation, nausea, edema, urinary dysfunction, and general weakness.

For multi-segment fusion and corrective surgery, the secondary endpoints included surgical and nonsurgical site pain, digestive dysfunction, constipation, nausea, edema, urinary dysfunction, general weakness, lower limb muscle weakness, and muscle spasms.

2.3.1. Single-segment fusion surgery. This study included patients who underwent single-segment spinal fusion. The primary procedure was posterior lumbar interbody fusion with posterior instrumentation. Patients were diagnosed with spinal stenosis of the lumbar or lumbosacral region (ICD-10 codes M48.06 and M48.07) or spondylolisthesis of the lumbar or lumbosacral region (ICD-10 codes M43.16 and M43.17).

2.3.2. Multi-segment fusion and corrective surgery. This category included patients who underwent multi-segment fusion and corrective surgery. Long-segment surgery was defined as the involvement of 3 or more spinal segments. The surgical approach included a 2-stage procedure: posterior decompression with laminectomy and pedicle screw fixation, followed by lateral interbody fusion and posterior instrumentation. The diagnoses included spinal stenosis of the lumbosacral region (M48.16), degenerative lumbar scoliosis (M40.87), other and unspecified kyphosis (M40.25), posttraumatic kyphosis of the lumbar region (M40.15), and secondary kyphosis of the thoracolumbar region (M40.16).

2.3.3. Surgical procedure and postoperative recovery. Advanced imaging (CT, MRI) evaluated disease mechanisms and treatment progress, with preoperative safety confirmed via chest radiography, electrocardiography, and echocardiography. Spinal fusion surgeries, performed in prone or lateral positions, involved posterolateral, posteromedial, or anterior approaches, disc removal, cage insertion, bone grafting, and posterior fixation. Laminectomy and drainage tubes addressed decompression and hematoma risks. Post-drainage,

patients progressed through rehabilitation (sitting, standing, walking) with a thoracolumbar-sacral orthosis and walker. Hospital stays averaged 17 days for single-segment fusion and 24 days for multi-segment procedures. Antibiotics were discontinued when C-reactive protein fell below 2 mg/dL. Orthosis use spanned 3 months, with outpatient follow-ups and lumbar CT at 3 months to confirm fusion.

2.4. Traditional Korean medicine (TKM) interventions

The ERAS-K program employed targeted Korean medicine interventions to enhance mobility and digestive function in spinal fusion patients, tailored to symptoms like pain and digestive issues. Preoperatively, Yukgunja-tang was administered 4 times from day D-2 to D-1, followed by postoperative auricular and distal acupuncture. Symptom-specific treatments included Carecon capsules and pharmacopuncture for surgical pain, Jakyakkamcho-tang for nonsurgical pain, and Pyeongwi-san or Cheongjang capsules for digestive dysfunction. General and lower limb weakness were addressed with herbal medicines like Palmul-tang and acupuncture. Post-discharge, Palmul-tang was prescribed for 1 month, customized with additional herbal formulations based on patient needs.

2.5. Alternative medical interventions

A comprehensive integrative medicine protocol was implemented in addition to standard postoperative care. This included a customized dietary regimen, with patients receiving nutritional education and prescriptions for supplements, such as vitamin D, omega-3 fatty acids, and albumin, to support recovery. A structured exercise therapy program was also introduced. This program involved the development and use of an interactive integrated healthcare application tailored to patients undergoing spinal surgery. The application was designed to manage and educate patients during the 1- and 3-month outpatient follow-up periods after discharge. It enabled 2-way communication between patients and the medical team, allowing for tailored educational content on exercise and diet while enabling medical staff to monitor and provide feedback on patient adherence. The application also featured a library of 6 instructional exercise videos, including 2 preoperative breathing exercises for pulmonary function and 4 postoperative exercises (ankle pumping, quadriceps setting, leg raises, and leg raising while walking) aimed at enhancing mobility and rehabilitation. The protocol was further complemented by additional supportive therapies, including breathing exercises, mindfulness meditation, stretching, and music therapy, all of which were designed to improve holistic wellbeing and recovery.

2.6. Prospective observational method

This study employed a prospective observational design to track patients who underwent spinal surgery (single- or multi-segment). The research team followed these patients without adding any new interventions to existing surgical, inpatient, rehabilitation, or follow-up processes. However, if a patient expressed a desire for or reported specific symptoms, Korean medicine interventions were provided, as outlined in the ERAS-K clinical pathway. The therapeutic protocol is presented in Figure 1.

Primary and secondary endpoints were measured to evaluate the effects of the ERAS-K program. The primary endpoint was improvement in activity. Secondary endpoints, assessed using self-reported questionnaires and chart reviews, included improvements in surgical site pain, nonsurgical site pain, digestive dysfunction, constipation, nausea, edema, urinary dysfunction, general weakness, lower limb weakness, muscle spasms, and overall recovery after discharge. The study also evaluated the effects of the ERAS-K program on key recovery metrics, such as time to ambulation, time to functional recovery, length of hospital stay, readmission rates, and medical cost reduction.

2.7. Outcome measures

Pain severity was evaluated using the numeric rating scale (NRS), a unidimensional measure of pain intensity. This scale, ranging from 0 (no pain) to 10 (worst possible pain), was used to quantify axial pain (NRS axial pain) and radicular pain in the leg (NRS leg pain). Assessments were conducted preoperatively and at multiple predefined postoperative intervals to track changes in pain levels over time.[12]

Health-related quality of life was comprehensively assessed using the short form-36 (SF-36) health survey. This standardized questionnaire consists of 36 items that measure 8 health domains, summarized into 2 main components: the physical component summary and mental component summary. High SF-36 scores indicate better self-reported health and function. These scores were recorded at baseline, preoperatively, and at specific follow-up appointments to monitor the impact of the ERAS-K program on patient wellbeing.[13]

2.8. Execution of the survey

A survey was conducted among patients scheduled for spinal surgery who underwent the ERAS-K program. The research investigator introduced the study and administered the survey. Participation was voluntary, and participants who provided written informed consent were asked to complete the questionnaire during the recovery period. The results from these self-reported surveys were analyzed to obtain qualitative insights for improving the quality of the program in the future.

2.9. Statistical analysis

Descriptive statistics were used for all intraoperative and postoperative parameters. Quantitative variables were reported as medians and standard deviations, whereas categorical variables were presented as absolute and relative frequencies. Between-group comparisons for continuous variables used the Student *t* test or Wilcoxon rank-sum test depending on distributional assumptions. For categorical variables, the chi-square test or Fisher's exact test was applied, as appropriate. To compare differences between groups while adjusting for the effects of covariates and to control for confounding variables in a non-randomized trial, ANCOVA analysis was applied. For multiple-response questions, each option was analyzed as a separate binary variable (selected vs not selected). Group differences were evaluated item by item using the chi-square test, with Fisher's exact test applied when expected cell counts were small. To account for multiplicity across items within the same question, *P*-values were adjusted using the Benjamini–Hochberg method. Adjusted *P*-value from the Benjamini–Hochberg procedure are presented in the Supplementary Tables (Tables S1 and S2, Supplemental Digital Content, https://links.lww.com/MD/R96). All statistical analyses were performed using R software (R Core Team, 2014. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria; http://www.R-project.org/).

3. Results

3.1. Postoperative recovery metrics of ERAS-K and non-ERAS-K groups

In the analysis of postoperative recovery metrics, no statistically significant differences were observed between the ERAS-K and

non-ERAS-K groups in NRS or SF-36 scores. At baseline, axial pain (NRS-axial, $P = .5588$) and leg pain (NRS-leg, $P = .8576$) were comparable between the 2 cohorts. Postoperatively, the change in axial pain scores demonstrated a near-significant trend ($P = .0627$, t test; $P = .0525$, ANCOVA), but a definitive statistically significant difference was not established. No significant differences in leg pain scores were noted at any of the measured time points ($P > .05$). Similarly, for the SF-36 health survey, baseline physical component scores ($P = .1989$) and mental component scores ($P = .9572$) were statistically similar between the 2 groups, and this nonsignificant trend persisted throughout the postoperative follow-up period ($P > .05$; Table 1). The

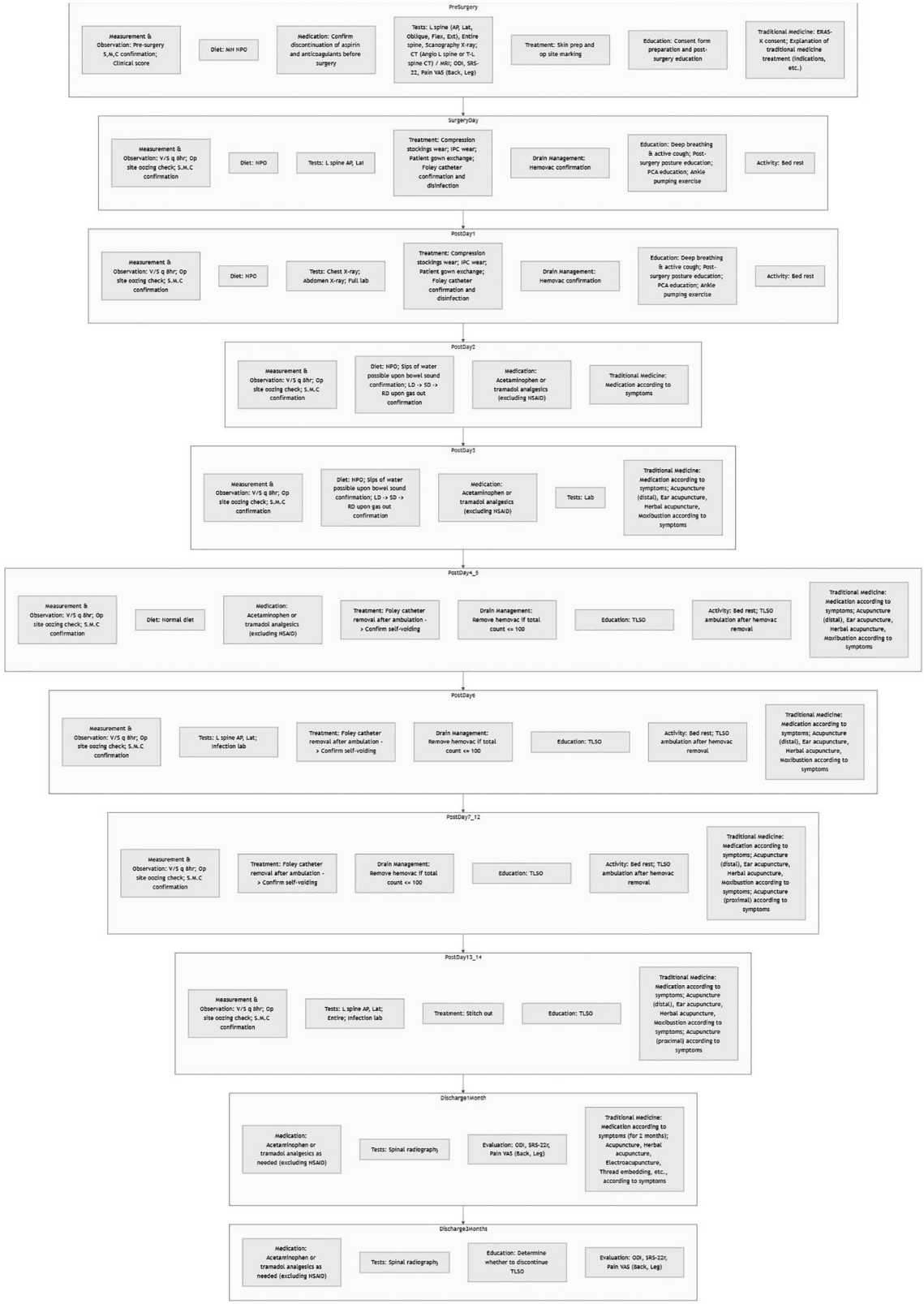

Figure 1. Time-task matrix of the enhanced recovery after spinal surgery program.

mean number of days until a return to improved activity was 4.81 days for ERAS-K recipients and 4.96 days for nonrecipients. The marginal difference of 0.15 days between the cohorts was not statistically significant, as demonstrated by both the *t* test ($P = .67731$) and Wilcoxon rank-sum test ($P = .63551$), which exceeded the conventional significance threshold of 0.05 (Table 2).

3.2. Survey results

Analysis of baseline demographic and clinical characteristics revealed that the ERAS-K and non-ERAS-K cohorts were statistically homogeneous. Both groups exhibited a similar sex distribution, with a female predominance (70% and 80%, respectively), and no significant age differences were noted. Occupational distribution also showed no substantial variance between cohorts. Furthermore, prior surgical history, including previous spinal surgery – a key potential confounding variable – was comparable between the groups. The demographic characteristics are shown in Table 3.

Significant findings emerged upon examining patient preferences for postoperative recovery programs among conventional medicine. While both ERAS recipients and non-recipients prioritized pain control, a noteworthy difference was observed in their preference for physical therapy.

An analysis of patient preferences for traditional Korean medicine (TKM) treatments revealed a significant desire for these interventions among the ERAS recipients. A majority of ERAS patients (92.6%) expressed a preference for acupuncture, moxibustion, and cupping therapy after surgery, a preference that was significantly higher than that of the non-recipients (62.2%, unadjusted $P = .005$, adjusted $P = .030$).

Similarly, a higher preference for preoperative administration of herbal medicine was observed among ERAS recipients (66.7%) compared to non-recipients (37.8%, unadjusted $P = .028$, adjusted $P = .050$). These results underscore a strong patient-driven demand for the integration of TKM into conventional postoperative care pathways, suggesting that such a combined approach could improve patient satisfaction and potentially lead to better recovery outcomes. Preferred programs are illustrated in Figures 2 and 3. Corresponding adjusted *P*-values are provided in Tables S1 and S2, Supplemental Digital Content, https://links.lww.com/MD/R96.

Regarding overall satisfaction, the vast majority of ERAS-K recipients were satisfied with the program, with 94.7% of

Table 1

Evaluation of postoperative recovery in enhanced recovery after spinal surgery (ERAS-K) and non-ERAS-K cohorts.

Metric	Time point	ERAS-K recipients (n = 27)	ERAS-K nonrecipients (n = 45)	*P*-value
NRS axial	Pre	5.94 ± 1.90	5.72 ± 2.13	.5588
	After	5.00 ± 1.82	4.82 ± 1.79	.5309
	1 mo	4.67 ± 1.98	3.93 ± 1.83	.1105
	3 mo	4.32 ± 1.88	3.22 ± 1.73	.205
NRS leg	Pre	5.32 ± 2.55	5.13 ± 2.60	.6874
	After	4.16 ± 2.46	3.67 ± 2.20	.3807
	1 mo	3.92 ± 2.47	3.16 ± 2.11	.1983
	3 mo	3.47 ± 2.29	2.58 ± 1.99	.1256
SF-36 physical	Pre	50.78 ± 11.12	49.07 ± 8.98	.4851
	After	55.45 ± 10.22	57.06 ± 7.97	.4831
	1 mo	57.19 ± 10.42	59.39 ± 7.91	.3644
	3 mo	59.62 ± 11.23	61.94 ± 8.26	.4439

ERAS-K = enhanced recovery after spinal surgery, NRS = numeric rating scale, SF-36 = short form-36.

Table 2

Mean days for enhanced recovery after spinal surgery (ERAS-K) and non-ERAS-K groups to regain functional mobility.

	n	Mean	SD	Min	Median	Max
ERAS recipients	27	4.814815	1.442141	1	5	8
ERAS nonrecipients	45	4.955556	1.34765	3	5	9

ERAS-K = enhanced recovery after spinal surgery, SD = standard deviation.

Table 3

Demographical traits of subjects.

Variables	Overall (n = 72)	Applied (n = 27)	Not applied (n = 45)	*P*-value
Sex				.398
Male	17 (24%)	8 (30%)	9 (20%)	
Female	55 (76%)	19 (70%)	36 (80%)	
Age	5.39 ± 0.81	5.44 ± 0.89	5.36 ± 0.77	.364
Occupation				.688
Unemployed	40 (56%)	18 (67%)	22 (49%)	
Office worker	11 (15%)	4 (15%)	7 (16%)	
Manual labourer	13 (18%)	3 (11%)	10 (22%)	
Service worker	2 (2.8%)	0 (0%)	2 (4.4%)	
Other	6 (8.3%)	2 (7.4%)	4 (8.9%)	
Previously experienced surgery	55 (76%)	23 (85%)	32 (71%)	.253
Previous experienced spinal surgery	20 (28%)	11 (41%)	9 (20%)	.101

satisfied patients reporting that they were simply "satisfied." A small but notable proportion (29.6%) of the recipient group expressed neutral opinions (Table 4).

The key factors for evaluating treatment effectiveness were consistently ranked across both ERAS-K recipients and nonrecipients. Recovery of daily activity function was the most highly valued factor, selected by 45.8% of the overall patient cohort, followed by enhanced quality of life (29.2%) and pain relief (25.0%; Fig. 4).

In the survey on patient willingness and preferences, a notable divergence was observed between the ERAS-K and non-ERAS-K cohorts. Among the 45 patients who did not receive the ERAS-K protocol, a majority (55.6%) expressed a neutral stance regarding future participation, while a combined 40.0%

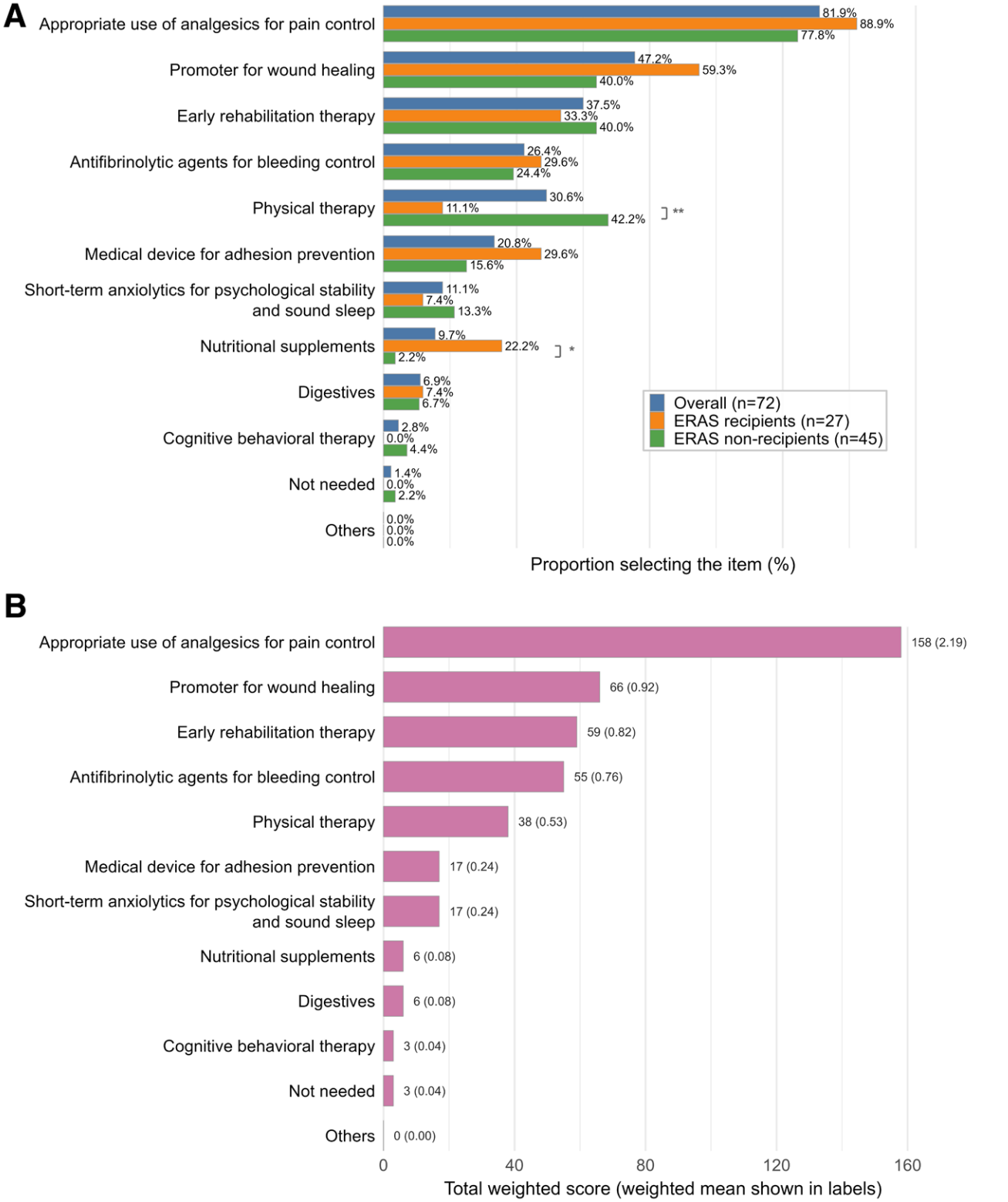

Figure 2. Desired medical interventions to support quick recovery from surgery.

(4.4% "absolutely willing" and 35.6% "willing") expressed openness to the program.

Analysis of future program preferences revealed a strong and consistent patient-driven demand for an integrated care model. Most patients in both groups favored a combined approach that incorporated conventional medicine with TKM. Specifically, 66.7% of non-ERAS-K participants and 66.7% of ERAS-K recipients preferred the hybrid model (40.7% for conventional + TKM and 26.0% for conventional + TKM + alternative medicine). This consensus reflects a patient-centered desire for a holistic approach to recovery that addresses dimensions of health beyond conventional medicine (Table 5).

A focused analysis of the reasons for nonparticipation in the ERAS-K program, as presented in the table, revealed several key insights. The most common reason cited was "doubt about effectiveness," accounting for 37.8% of responses. This concern was particularly pronounced among the "not willing" subgroup, where it represented 40.7% of responses, highlighting

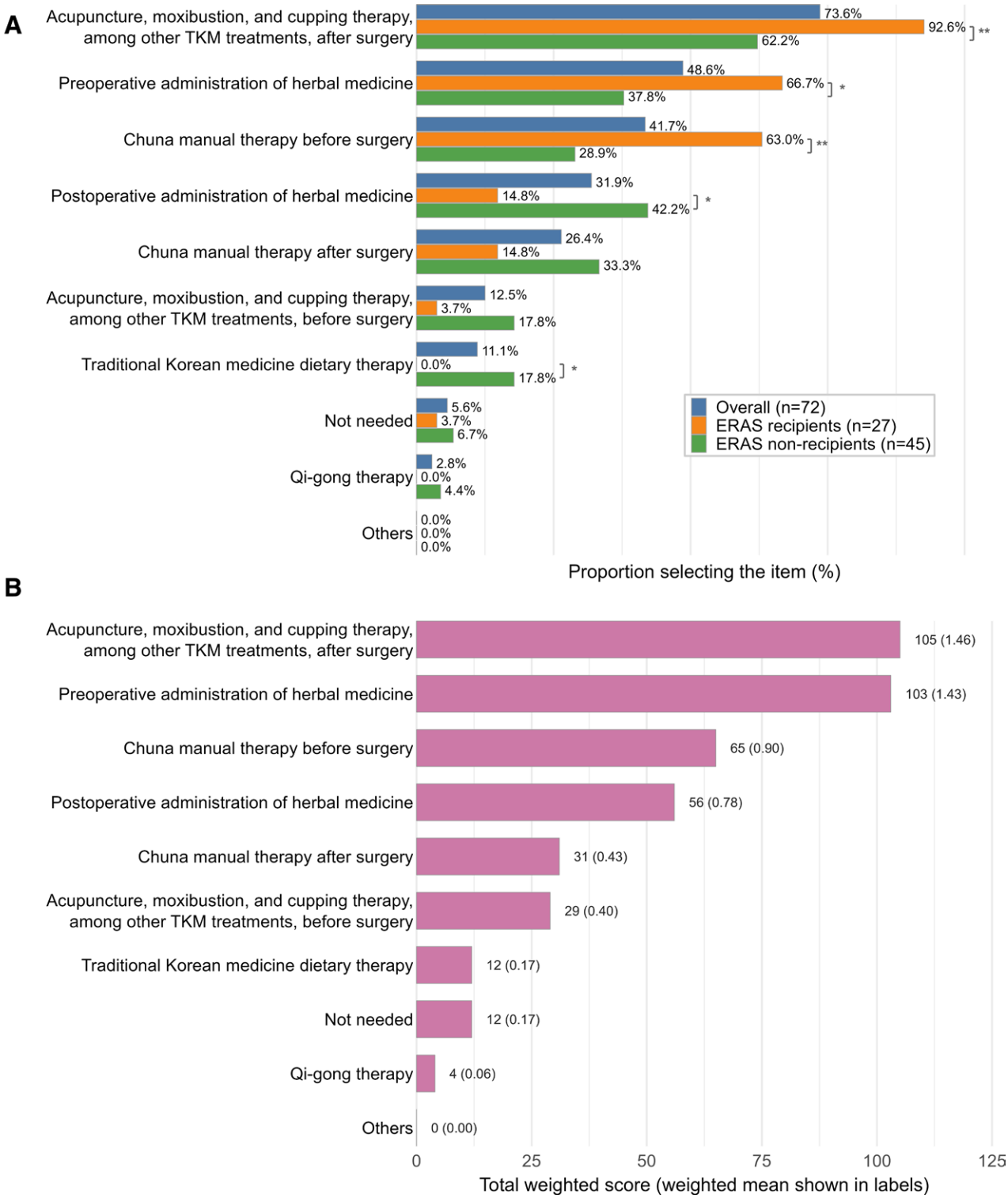

Figure 3. Preferred traditional Korean medicine (TKM) therapies for accelerating postsurgical recovery. TKM = traditional Korean medicine.

a significant barrier to adoption rooted in a lack of clinical conviction. A substantial proportion of patients (31.1%) also indicated a lack of awareness, stating, "I have no idea about the program." These findings underscore the need for improved outreach and education to increase awareness and build confidence. The third most common reason was "difficulty with long-term treatment," cited by 28.9% of patients overall and by a high percentage (37.0%) within the "not willing" subgroup, suggesting that the perceived burden of sustained compliance is a significant deterrent (Table 6).

4. Discussion

The present study provides valuable insights into the implementation and patient perception of a customized ERAS-K protocol, despite the key finding of no statistically significant differences in conventional postoperative recovery metrics, such as the NRS and SF-36 scores. While this outcome may appear contrary to some established literature on ERAS efficacy in spinal surgery, it necessitates deeper consideration of the unique study design and patient-centered findings.[14,15] The observed baseline homogeneity between the ERAS-K and non-ERAS-K cohorts suggests that patient characteristics were not confounding factors, allowing us to focus interpretation on the intervention itself and on patients' subjective experiences.

The absence of a robust effect on pain and quality-of-life metrics may be attributed to several methodological limitations inherent in the research design. As a quasi-experimental study, it lacked the methodological rigor of a randomized controlled trial (RCT). Although efforts were made to ensure baseline comparability, the nonrandomized design may still have introduced subtle biases that are difficult to quantify. Heterogeneity in data quality and collection methods could also have diluted the observed effects. A more rigorous, well-powered RCT will be essential for future studies to definitively assess the clinical efficacy of the protocol and to minimize confounding variables.[16] Another important limitation was the absence of a fully standardized ERAS-K protocol. Although all patients in the intervention group received the same types of care, the timing, duration, and execution of specific interventions likely varied across practitioners and clinical environments. Such variability – ranging from massage technique to the precise timing of analgesic administration – may have introduced inconsistencies that confounded the quality of the intervention and potentially masked its true effect.

Beyond these methodological considerations, our findings on patient preferences offer a profound insight into the future direction of ERAS protocols. The higher preference for physical therapy expressed by non-ERAS recipients (unadjusted $P = .008$, adjusted $P = .053$) highlights a clear, unmet need in standard postoperative care. This finding corroborates the value

Table 4

ERAS recipients' general satisfaction with the program.

Categories	Total (n = 27)	Satisfied (n = 19)	Not satisfied (n = 8)
Absolutely satisfied	1 (3.7)	1 (5.3)	0 (0.0)
Satisfied	18 (66.7)	18 (94.7)	0 (0.0)
Neutral	8 (29.6)	0 (0.0)	8 (100.0)
Not satisfied	0 (0.0)	0 (0.0)	0 (0.0)
Absolutely not satisfied	0 (0.0)	0 (0.0)	0 (0.0)

ERAS = enhanced recovery after spinal surgery.

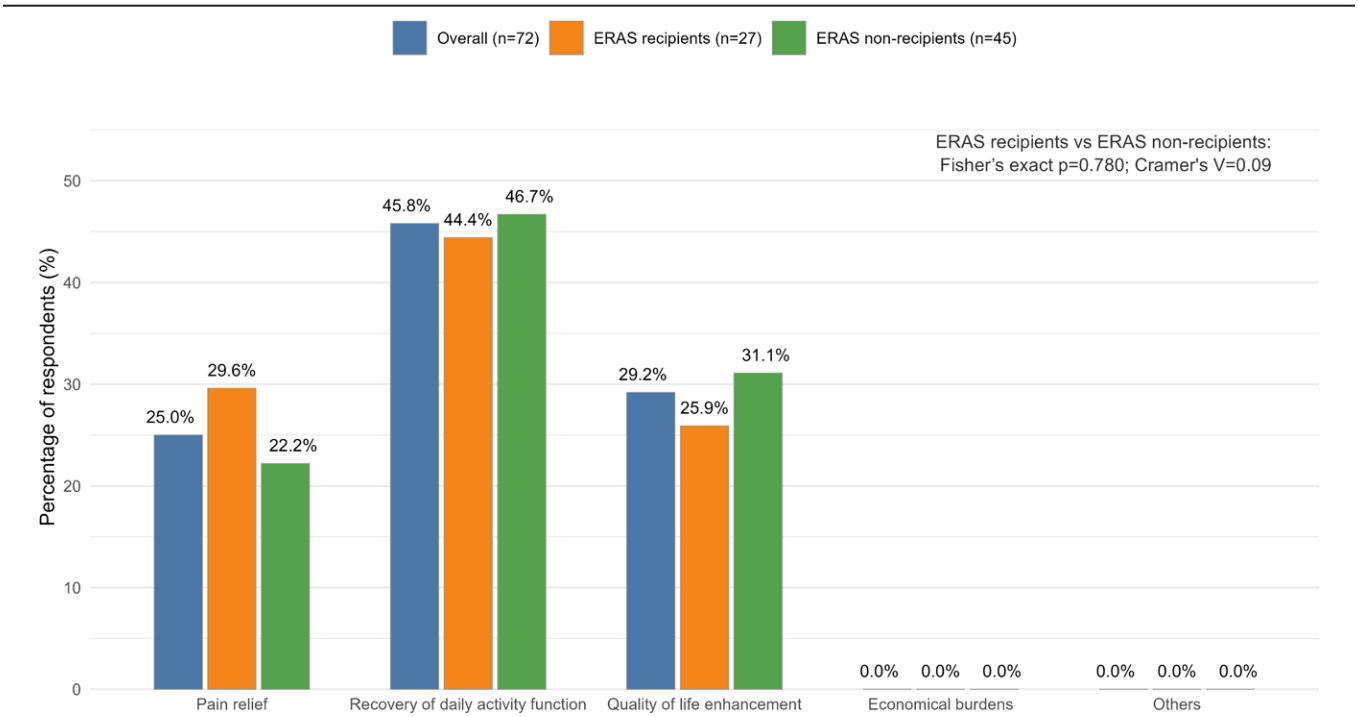

Figure 4. Crucial considerations for assessing how well a treatment works.

Table 5

Willingness to accept ERAS programs.

Willingness to accept ERAS programs among ERAS non-recipients			
	Total (n = 45)	**Willing (n = 18)**	**Not willing (n = 27)**
Absolutely	2 (4.4%)	2 (11.1%)	0 (0.0%)
Yes	16 (35.6%)	16 (88.9%)	0 (0.0%)
Neutral	25 (55.6%)	0 (0.0%)	25 (92.6%)
No	1 (2.2%)	0 (0.0%)	1 (3.7%)
Absolutely not	1 (2.2%)	0 (0.0%)	1 (3.7%)
Willingness of the ERAS group to reuse the same program in the future			
	Total (n = 27)	**Satisfied (n = 19)**	**Not satisfied (n = 8)**
Absolutely	3 (11.1)	3 (15.8)	0 (0.0)
Yes	17 (63.0)	16 (84.2)	1 (12.5)
Neutral	7 (25.9)	0 (0.0)	7 (87.5)
No	0 (0.0)	0 (0.0)	0 (0.0)
Absolutely not	0 (0.0)	0 (0.0)	0 (0.0)
Future program preferences among ERAS recipients			
	Total (n = 27)	**Satisfied (n = 19)**	**Not satisfied (n = 8)**
Only conventional medical treatments	0 (0.0)	0 (0.0)	0 (0.0)
Conventional and traditional Korean medicine	11 (40.7)	9 (47.4)	2 (25.0)
Conventional, traditional Korean medicine and alternative medicine	16 (59.3)	10 (52.6)	6 (75.0)
Not needed	0 (0.0)	0 (0.0)	0 (0.0)
Future program preferences among ERAS non recipients			
	Total (n = 45)	**Willing (n = 18)**	**Not willing (n = 27)**
Only conventional medical treatments	1 (2.2)	1 (5.6)	0 (0.0)
Conventional and traditional Korean medicine	30 (66.7)	10 (55.6)	20 (74.1)
Conventional, traditional Korean medicine and alternative medicine	12 (26.7)	7 (38.9)	5 (18.5)
Not needed	2 (4.4)	0 (0.0)	2 (7.4)

ERAS = enhanced recovery after spinal surgery.

Table 6

Reasons for ERAS program nonparticipation.

Question and category	**Total (n = 45)**	**Willing (n = 18)**	**Not willing (n = 27)**	***P*-value**
Reasons for not receiving the ERAS program after surgery				
I have no idea with programs	14 (31.1)	8 (44.4)	6 (22.2)	.147
Doubt about effectiveness	17 (37.8)	6 (33.3)	11 (40.7)	
Difficulty with long-term treatment	13 (28.9)	3 (16.7)	10 (37.0)	
Economical burden	1 (2.2)	1 (5.6)	0 (0.0)	
Others	0 (0.0)	0 (0.0)	0 (0.0)	

ERAS = enhanced recovery after spinal surgery.

of the ERAS protocol's integrated early mobilization component, which appears to have successfully addressed this need in the ERAS-K recipient group.

Furthermore, our study revealed a compelling patient-driven demand for the integration of TKM into conventional perioperative care. The strong preference for therapies such as acupuncture, moxibustion, and herbal medicine among ERAS-K recipients (unadjusted $P = .005$ and unadjusted $P = .028$, respectively) suggests that while the ERAS protocol effectively manages the conventional medical aspects of recovery, it may not fully address the patient's desire for a more holistic and complementary approach. This finding is consistent with a growing body of evidence supporting the use of adjunctive TKM therapies to improve patient satisfaction and outcomes in the surgical context.[17] The heightened interest among ERAS-K recipients may reflect their increased engagement in and education about recovery, which in turn encouraged them to actively seek additional therapies that support and enhance healing processes.

5. Conclusions

Although our findings did not demonstrate statistically significant improvements in pain or quality of life, they underscore the critical importance of standardizing ERAS protocols and incorporating patient-centered preferences into perioperative care. Future research should prioritize rigorous RCT designs with fully standardized protocols to establish stronger evidence of clinical efficacy. Moreover, the strong patient demand for combined conventional and TKM therapies provides a compelling rationale for developing and evaluating an integrated ERAS-TKM protocol. Such a combined approach has the potential to significantly improve clinical outcomes and enhance patient satisfaction by addressing the unmet needs identified in this study.

Acknowledgments

In the course of crafting the manuscript, the use of multiple artificial intelligence (AI) resources played a crucial role in confirming the accuracy and clarity of the English language utilized. Grammarly (https://www.grammarly.com/), an advanced tool powered by AI, was brought into play for thorough inspections of grammar, spelling, and punctuation. The Hemingway Editor (http://www.hemingwayapp.com/) was applied to increase the understandability of the text and to lessen the intricacy of sentences. LanguageTool (https://languagetool.org/), adept at performing grammar and spelling checks that are context-specific across a diversity of English dialects, was implemented as well. Ginger (https://www.gingersoftware.com/), another tool with AI, was employed for the restructuring of sentences and the enhancement of language flow. These tools were used in a repetitive manner throughout the writing process to uphold a high caliber of academic English.

Author contributions

Data curation: Yong-Chan Kim.
Formal analysis: Yong-Chan Kim.
Funding acquisition: Byung-Kwan Seo.
Investigation: Sung-Min Kim.
Methodology: Sung-Min Kim.
Project administration: Byung-Kwan Seo.
Resources: In-Seok Son.
Software: In-Seok Son, Yong-Chan Kim.
Supervision: Byung-Kwan Seo.
Validation: Jung-Hyun Kim.
Visualization: Jung-Hyun Kim.
Writing – original draft: Jung-Hyun Kim.
Writing – review & editing: Jung-Hyun Kim, In-Seok Son, Sung-Min Kim, Byung-Kwan Seo.

References

[1] Chen S, Chen M, Wu X, et al. Global, regional and national burden of low back pain 1990–2019: a systematic analysis of the Global Burden of Disease study 2019. J Orthop Translat. 2022;32:49–58.
[2] Contartese D, Salamanna F, Brogini S, et al. Fast-track protocols for patients undergoing spine surgery: a systematic review. BMC Musculoskelet Disord. 2023;24:57.
[3] Ljungqvist O, Scott M, Fearon KC. Enhanced recovery after surgery: a review. JAMA Surgery. 2017;152:292–8.
[4] Parks L, Routt M, De Villiers A. Enhanced recovery after surgery J Adv Pract Oncol. 2018;9:511–9.
[5] Steenhagen E. Enhanced recovery after surgery: it's time to change practice! Nutr Clin Pract. 2016;31:18–29.
[6] Ljungqvist O, de Boer HD, Balfour A, et al. Opportunities and challenges for the next phase of enhanced recovery after surgery: a review. JAMA surgery. 2021;156:775–84.
[7] Lau CS, Chamberlain RS. Enhanced recovery after surgery programs improve patient outcomes and recovery: a meta-analysis. World J Surg. 2017;41:899–913.
[8] Smith TW Jr, Wang X, Singer MA, Godellas CV, Vaince FT. Enhanced recovery after surgery: a clinical review of implementation across multiple surgical subspecialties. Am J Surg. 2020;219:530–4.
[9] Park H-J, Choi J-Y, Lee WM, Park S-M. Prevalence of chronic low back pain and its associated factors in the general population of South Korea: a cross-sectional study using the national health and nutrition examination surveys. J Orthop Surg Res. 2023;18:29.
[10] Fatoye F, Gebrye T, Ryan CG, Useh U, Mbada C. Global and regional estimates of clinical and economic burden of low back pain in high-income countries: a systematic review and meta-analysis. Front Public Health. 2023;11:1098100.
[11] Ravindra VM, Senglaub SS, Rattani A, et al. Degenerative lumbar spine disease: estimating global incidence and worldwide volume. Global Spine J. 2018;8:784–94.
[12] Hartrick CT, Kovan JP, Shapiro S. The numeric rating scale for clinical pain measurement: a ratio measure? Pain Pract. 2003;3:310–6.
[13] Ware JE Jr. SF-36 health survey update. Spine. 2000;25:3130–9.
[14] Bansal T, Sharan AD, Garg B. Enhanced recovery after surgery (ERAS) protocol in spine surgery. J Clin Orthop Trauma. 2022;31:101944.
[15] d'Astorg H, Fiere V, Dupasquier M, Vieira TD, Szadkowski M. Enhanced recovery after surgery (ERAS) protocol reduces LOS without additional adverse events in spine surgery. Orthop Traumatol Surg Res. 2020;106:1167–73.
[16] Pędziwiatr M, Mavrikis J, Witowski J, et al. Current status of enhanced recovery after surgery (ERAS) protocol in gastrointestinal surgery. Med Oncol. 2018;35:95.
[17] Cho YH, Kim CK, Heo KH, et al. Acupuncture for acute postoperative pain after back surgery: a systematic review and meta-analysis of randomized controlled trials. Pain Pract. 2015;15:279–91.