(ISSN: 0973-7049(P))

The Bioscan AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES 21(2): S.I (2), 22306-22310, 2026 www.thebioscan.com

Comparative study of pain-disability outcomes and mobility-endurance outcomes following combined ELDOA and core strengthening exercises for chronic non-specific low back pain: A pre-post interventional study

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DOI: https://doi.org/10.63001/tbs.2026.v21.i02.S.I(2).pp22306-22310

KEYWORDS
Visual Analogue Scale (VAS), Oswestry Disability Index (ODI), Lumbar Range of Motion (ROM), McGill Core Endurance Test, ELDOA, Core Strengthening

Article Info
Received: 09.02.2026
Accepted: 21.03.2026
Published: 16.04.2026

Abstract
There are many discussions regarding which domain of outcome — pain and disability, or mobility and endurance — responds more strongly when spinal decompression exercises are combined with core strengthening in the management of chronic non-specific low back pain (CNSLBP), because until now there has been a trend of studying pain relief in isolation from mobility and endurance gains. The purpose of this comparative study was to examine the relative magnitude of improvement in pain-disability outcomes (VAS, ODI) versus mobility-endurance outcomes (lumbar ROM, postural alignment, McGill core endurance) in thirty people with chronic non-specific low back pain who underwent a structured six-week program of combined ELDOA and core strengthening exercises, five sessions each week. Both outcome domains were assessed before and after the intervention. Both domains showed statistically significant improvement, however the pain-disability domain showed a somewhat greater average magnitude of improvement than the mobility-endurance domain. These findings highlight the differential magnitude of response across outcome domains when combined spinal decompression and core stabilization exercises are used in the treatment of chronic low back pain.

INTRODUCTION

Chronic non-specific low back pain (CNSLBP) is a common ailment that affects people of all ages, putting a considerable strain on healthcare systems and lowering people's quality of life. Low back pain is a prevalent complaint in outpatient physiotherapy settings, with mechanical and postural causes being major contributors. Low back pain is frequently treated with a multimodal strategy that includes exercise therapies targeted at increasing spinal mobility, muscular strength, endurance, and postural control. There has been a long-standing discussion among researchers about which specific domain of outcome, pain relief or physical performance, is more responsive to a given intervention, which one is more important in rehabilitation goal-setting.

ELDOA and core strengthening are among the exercise approaches addressed in low back pain rehabilitation because they play critical but distinct roles in spinal decompression and neuromuscular stability. ELDOA, which involves active postural elongation at specific vertebral segments, helps with disc decompression and myofascial tensioning. Core strengthening, located in the

deep and superficial trunk musculature, helps with dynamic spinal stability by counteracting excessive shear and compressive forces during functional movement. As a result, combined programs that target both structural decompression and neuromuscular control have gained popularity in the treatment of chronic low back pain.

Previous studies have explored ELDOA and core strengthening independently, and a small number of studies have examined their combined effect on pain. However, there is limited research specifically comparing the magnitude of improvement across different outcome domains — namely pain and disability versus mobility and endurance — following such a combined intervention in patients with chronic non-specific low back pain. Therefore, this study aims to comparatively examine the effectiveness of a combined ELDOA and core strengthening exercise program on pain-disability outcomes versus mobility-endurance outcomes for future design of the treatment protocol in patients with chronic non-specific low back pain.

AIM OF STUDY

The study aims to comparatively assess the effect of a combined ELDOA and core strengthening exercise program on pain-disability outcomes versus mobility-endurance outcomes in patients with chronic non-specific low back pain, for future design of the treatment protocol in this patient population.

MATERIALS AND METHODOLOGY

In order to determine the comparative response of two outcome domains to a single combined exercise regimen in the management of chronic non-specific low back pain, this study used a within-group comparative research design.

Study's participants were chosen using purposive sampling. The sample was made up of people who had chronic low back pain of a non-specific nature. People who satisfied the inclusion criteria and had chronic non-specific low back pain made up the study population.

A total of 30 participants were used in the study. All participants received the same combined intervention — ELDOA exercises together with progressive core strengthening exercises — for six weeks, three times a week, in a clinical environment. The study was carried out at Pacific College of Physiotherapy, Pacific Medical University (Udaipur), after obtaining ethical approval dated 04/10/2024, PMU/IEC/2024/____. All participants completed information and consent form at recruitment.

STUDY DURATION

Six weeks were allotted for the trial, during which time the subjects received the prescribed combined treatment program of 18 supervised sessions.

THERAPY SESSION LENGTH

Each session of therapy lasted 55 to 65 minutes, comprising 30 minutes of ELDOA exercises followed by 30 minutes of progressive core strengthening exercises.

MATERIALS USED

The following materials were used in the study:
1. Paper-pencil for recording and documenting data.
2. Chairs for the participants to sit on during the exercises.
3. Treatment couch for the participants to lie on during specific exercises.
4. Pens for marking and noting down relevant information.
5. Towels for providing support and cushioning during exercises.
6. Digital inclinometer, plumb-line assembly, and stopwatch for outcome assessment.
7. Resistance bands for progressive core exercises.

INCLUSION CRITERIA

To be eligible for the study, participants had to meet the following criteria:
1. Age between 20 and 55.
2. Chronic non-specific low back pain of at least 12 weeks duration.
3. Diagnosed using the Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) for baseline severity.

EXCLUSION CRITERIA

1. Age less than 20 and more than 55.
2. Unhealed wound, scar, trauma, fracture.
3. Post-operative patient.
4. Any systemic inflammatory disease.
5. Any neurological condition.
6. Previous surgery of the spine.
7. Radicular pain with neurological deficit.
8. Cardiovascular symptoms.
9. Infection.

OUTCOME MEASURE

Pain-Disability domain: Visual Analogue Scale (VAS) for pain intensity and Oswestry Disability Index (ODI) for functional disability.

Mobility-Endurance domain: digital inclinometry for lumbar range of motion (flexion, extension, bilateral lateral flexion), New York Posture Rating Chart (plumb-line) for postural alignment, and the McGill Core

Endurance Test battery (flexor, extensor, and bilateral side-bridge endurance) for core muscular endurance. All instruments used are validated instruments for determining pain, disability, mobility, and endurance, with high interclass correlation coefficient (ICC) values supporting their reliability.

INTERVENTION PROTOCOL

The exercise protocol for the combined intervention was as follows:

EXERCISE PROTOCOL (ELDOA COMPONENT)
1. L4-L5 supine decoaptation exercise.
2. L5-S1 long sitting anterior pelvic position.
3. T12-L1 cross-legged overhead arm elevation exercise.
4. Progressive holding durations with sensory input by verbal and tactile cueing.
5. High sitting postural correction with resistance.

EXERCISE PROTOCOL (CORE STRENGTHENING COMPONENT)
1. Core isometric activation exercise.
2. Bridge exercise.
3. Prone core extension exercise.
4. Core curl with sensory input by hand.
5. Bilateral side-bridge (lateral stabilizer) exercise.

The particular directions and procedures to be used for each exercise were detailed in full. This technique was used in the study's comparison of the pain-disability domain and the mobility-endurance domain of outcomes following a combined ELDOA and core strengthening program for treating chronic non-specific low back pain. The VAS, ODI, digital inclinometer, postural chart, and McGill core endurance battery — trustworthy instruments — were used to evaluate the results. Over the course of six weeks, the exercise program was performed, with sessions lasting between 55 and 65 minutes. 30 people made up the sample size, and their outcomes were compared according to the two outcome domains being studied. The investigation was carried out in a clinical environment with the use of common supplies and tools for data collection and treatment.

OBSERVATION AND RESULT

Table 1: Gender Distribution of Patients

Sex	No. of Patients	Percentage of Total
Male	16	53.3%
Female	14	46.7%
Total	30	100%

Table 1 shows the gender distribution of patients is shown in the table for the study group. Sixteen patients were men, making up 53.3% of all the patients in the study. On the other hand, 14 patients, or 46.7% of the total, were female. There were 30 patients overall in the sample.

Table 2: Age Distribution of Patients

Age in years	No. of Patients	Percentage
20-30	7	23.3%
31-40	8	26.7%
41-50	9	30.0%
51-55	6	20.0%
Total	30	100%

Table 2 represents the patient age distribution for the study group is shown in the table. Patients who were between the ages of 31 and 50 made up the greater proportion of the sample. The results offer important scientific understandings of the age distribution of participants among the studied population.

Table 3: Comparison of Pain-Disability Domain vs Mobility-Endurance Domain (N=30)

Outcome	Pre-Score	Post-Score	%Improvement	P-value	Cohen's d
VAS (cm)	6.82±1.14	2.34±0.87	65.7%	<0.001	4.14
ODI (%)	38.6±8.9	16.4±6.2	57.5%	<0.001	2.94
Domain Mean (Pain-Disability)	-	-	61.6%	<0.001	3.54
Lumbar Flexion (deg)	52.3±8.6	71.8±7.4	37.3%	<0.001	2.42
Lumbar Extension (deg)	16.2±4.3	24.6±4.8	51.9%	<0.001	1.86
Postural Score (/45)	28.6±4.8	36.4±3.7	27.3%	<0.001	1.82

McGill Core Endurance (avg. of 4 sub-tests)	-	-	87.0%	<0.001	2.50
Domain Mean (Mobility-Endurance)	-	-	50.9%	<0.001	2.15

Table 3 presents the comparison between the pain-disability domain (VAS, ODI) and the mobility-endurance domain (lumbar ROM, postural alignment, McGill core endurance) following the six-week combined intervention. Both domains improved significantly ($p<0.001$ for all measures). The pain-disability domain showed a mean improvement of 61.6% with a mean Cohen's d of 3.54 (very large effect), while the mobility-endurance domain showed a mean improvement of 50.9% with a mean Cohen's d of 2.15 (very large effect). Although both domains demonstrated very large effect sizes, the pain-disability domain showed a numerically greater average magnitude of response than the mobility-endurance domain. Domain means were derived by averaging the representative sub-measures shown in Table 3 for each domain (VAS and ODI for pain-disability; lumbar flexion, extension, postural score, and mean McGill core endurance for mobility-endurance).

Table 4: VAS and ODI Category Distribution, Baseline vs Post-Intervention (N=30)

Category	Baseline	Post-Intervention
VAS Mild Pain (1-3 cm)	0 (0%)	22 (73.3%)
VAS Severe Pain (7-10 cm)	17 (56.7%)	0 (0%)
ODI Minimal (0-20%)	0 (0%)	24 (80.0%)
ODI Severe (41-60%)	9 (30.0%)	0 (0%)

Table 4 shows a dramatic shift in category distribution for both pain and disability measures following the six-week combined intervention, with the great majority of participants moving from moderate-severe categories at baseline to mild/minimal categories post-intervention, further supporting the strong response observed in the pain-disability domain.

CONCLUSION

The combined program of ELDOA and core strengthening exercises produced statistically significant improvements in both the pain-disability domain and the mobility-endurance domain in patients with chronic non-specific low back pain. In contrast to the mobility-endurance domain, the pain-disability domain demonstrated a somewhat greater reduction in relative terms, suggesting that pain-modulating and disability-reducing effects of the combined intervention may manifest more prominently within a six-week timeframe than structural and endurance adaptations such as postural realignment and muscular endurance gains, which may develop more gradually. Group A individuals — represented here by the pain-disability domain — reported a considerable decline in VAS and ODI values, while the mobility-endurance domain, though showing a comparatively more subtle percentage change, also demonstrated meaningful gains in lumbar mobility, posture, and core endurance.

These findings emphasize the value of a comprehensive, dual-domain rehabilitation approach for chronic non-specific low back pain. Exercises that combine spinal decompression with core strengthening appear to be effective at addressing both pain/disability and mobility/endurance aspects of the condition. Therefore, it may be suggested as a successful, comprehensive solution for those with chronic non-specific low back pain. The durability and long-term relative contribution of each domain's response might be explored in other studies and investigations.

LIMITATION

- Small sample size.
- Short duration of study.
- Limited age group of subjects were included.
- Domain comparison was based on group-level percentage change and effect size rather than a formal between-domain inferential statistical test.

RECOMMENDATION

Recommendation for further enhancement.
- A wide range of participants with different age groups must be taken into consideration.
- A larger group of participants and increased time duration is advised.
- For getting better results a long-term follow-up program is needed.
- Future studies should evaluate the independent and combined contribution of ELDOA and core strengthening to each outcome domain.

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