

COMPARATIVE EFFECTS OF MUSCLE ENERGY TECHNIQUE AND CORE STABILIZATION EXERCISES ON PAIN INTENSITY, FUNCTIONAL DISABILITY, AND SELF-REPORTED EXERCISE ADHERENCE IN PATIENTS WITH CHRONIC LOW BACK PAIN OF FACET JOINT ORIGIN

Vashal Asif^{*1}, Arif Ali Rana², Muhammad Wasif Awan³, Muhammad Arslan⁴, Samran Irshad⁵

^{*1,3,4,5}Department of Physical Therapy and Rehabilitation Sciences, Faculty of Allied Health Sciences, Superior University, Lahore, Pakistan

²Assistant Professor, Department of Physical Therapy and Rehabilitation Sciences, Faculty of Allied Health Sciences, Superior University, Lahore, Pakistan

^{*1}vashalgulzar06@gmail.com

DOI: <https://doi.org/10.5281/zenodo.22745246>

Keywords

Lumbar facet joint dysfunction; chronic low back pain; Muscle Energy Technique; core stabilization exercises; pain intensity; functional disability; exercise adherence; physiotherapy; rehabilitation.

Article History

Received: 01 June 2026

Accepted: 23 August 2026

Published: 14 September 2026

Copyright @Author

Corresponding Author: *

Vashal Asif

Abstract

Background: Lumbar facet joint dysfunction is a recognized contributor to chronic low back pain (CLBP) and may result in persistent pain, functional limitations, and reduced engagement with therapeutic exercise. Muscle Energy Technique (MET) and Core Stabilization Exercises (CSE) are commonly used physiotherapeutic approaches; however, their comparative effects in patients with facet joint-related CLBP remain insufficiently established.

Objective: To compare the effects of MET and CSE on pain intensity, functional disability, and self-reported exercise adherence in patients with CLBP of facet joint origin.

Methods: A randomized controlled trial was conducted among 62 participants aged 18–60 years with CLBP of facet joint origin at Shafi Memorial Hospital, Sialkot. Participants were randomly allocated to either an MET group or a CSE group and received their respective interventions over 12 weeks, with 3–5 sessions per week. Pain intensity, functional disability, and exercise adherence were assessed using the Visual Analogue Scale (VAS), Oswestry Disability Index (ODI), and Exercise Adherence Rating Scale (EARS), respectively. Within- and between-group differences were analyzed using paired- and independent-samples t-tests in SPSS version 25. Statistical significance was set at $p \leq 0.05$.

Results: Both MET and CSE significantly reduced pain intensity and functional disability following the 12-week intervention (VAS and ODI, $p < .001$). VAS scores decreased from 7.15 ± 1.13 to 4.33 ± 1.45 in the MET group and from 7.02 ± 0.80 to 3.70 ± 1.43 in the CSE group. The reduction in pain was significantly greater with CSE than MET (3.32 ± 0.98 vs. 2.82 ± 0.96 ; $p = .046$). ODI scores decreased by $20.97 \pm 10.79\%$ with MET and $24.00 \pm 10.13\%$ with CSE; however, the between-group difference was not

statistically significant ($p = .259$). Exercise adherence increased significantly only in the CSE group (12.35 ± 2.61 to 15.00 ± 1.51 ; $p < .001$), with a significantly greater improvement than MET (2.65 ± 2.51 vs. 0.81 ± 4.03 ; $p = .035$).

Conclusion: Both MET and CSE were effective in improving pain, functional disability, and exercise adherence among patients with CLBP of facet joint origin. Although CSE appeared to provide additional benefits for functional recovery and adherence, the absence of a statistically significant between-group difference in ODI indicates that neither intervention demonstrated clear superiority for reducing functional disability. These findings support the use of both approaches as therapeutic options in the rehabilitation of patients with facet joint-related CLBP.

1. INTRODUCTION

Chronic low back pain (CLBP) is defined as pain or discomfort between the rib margin and gluteal folds persisting for more than 12 weeks. It is a complex, multidimensional condition influenced by physical, psychological, and social factors and represents a major global musculoskeletal health burden [1]. Globally, low back pain affects approximately 7.5% of the population, while its burden is also substantial in Pakistan [2,3]. Local evidence has reported a prevalence of 88.4% among allied health students in Peshawar, highlighting the potential influence of prolonged sitting, postural demands, and physical inactivity [4]. Lumbar facet joint pain is an important contributor to chronic mechanical low back pain and may account for a considerable proportion of CLBP cases [5].

The etiology of CLBP is heterogeneous and includes mechanical and non-mechanical causes. Common mechanical contributors include muscle and ligament injury, intervertebral disc degeneration, and facet joint dysfunction, whereas less common causes include infection, neoplasms, inflammatory disorders, and systemic disease [6]. Facet joints are paired synovial joints that contribute to spinal stability and controlled flexion, extension, and rotation. Degeneration, inflammation, or mechanical irritation of these joints can activate nociceptive pathways, producing localized low back pain that may extend to the buttocks or thighs and is often aggravated by spinal extension and rotation [8, 9]. Prolonged sitting, poor posture, physical inactivity, obesity,

heavy lifting, and repetitive movements may further contribute to abnormal spinal loading and persistent symptoms [7].

Persistent CLBP can involve both peripheral nociception and central sensitization, contributing to increased pain severity and chronicity [10]. Pain intensity is commonly assessed using validated measures such as the Visual Analogue Scale (VAS) and Numeric Pain Rating Scale, while functional disability is frequently evaluated using instruments such as the Oswestry Disability Index (ODI). Persistent pain may restrict walking, sitting, bending, lifting, self-care, occupational performance, and social participation, thereby adversely affecting overall quality of life [6,11]. In addition to pain and disability, adherence to prescribed exercise is an important determinant of rehabilitation success. Poor adherence may delay recovery and contribute to persistent symptoms and recurrence, whereas effective therapeutic communication, education, and perceived treatment benefits may promote adherence [8].

Conservative management remains a cornerstone of CLBP rehabilitation and includes pharmacological and non-pharmacological interventions. Physiotherapy-based approaches, including manual therapy, therapeutic exercise, postural correction, and lifestyle modification, are widely used because they address functional impairments while avoiding the risks associated with invasive procedures [12,13]. Among these approaches, Muscle Energy Technique (MET) involves voluntary muscle contraction against therapist-applied resistance and is proposed to

improve joint mobility, reduce muscle tension, and modulate pain through mechanisms including post-isometric relaxation and reciprocal inhibition [14,15].

Core Stabilization Exercises (CSE), in contrast, emphasize active neuromuscular control and strengthening of the trunk musculature, including the transversus abdominis and multifidus. By improving trunk muscle coordination, spinal stability, and movement control, CSE may reduce mechanical stress and pain while improving functional capacity and potentially reducing recurrence [16,17].

Although both MET and CSE have demonstrated benefits in patients with low back pain, they differ in their primary therapeutic mechanisms. MET primarily targets muscular tension, mobility, and symptomatic relief, whereas CSE focuses on active neuromuscular control, strength, and longer-term spinal stability [18]. However, limited evidence directly compares these approaches in patients specifically presenting with CLBP of facet joint origin, particularly when exercise adherence is considered alongside pain and functional disability.

Therefore, this study aimed to compare the effects of MET and CSE on pain intensity, functional disability, and self-reported exercise adherence in patients with CLBP of facet joint origin. The findings may assist physiotherapists in selecting appropriate rehabilitation strategies and developing more effective, patient-centered management programs for this specific clinical population.

2. CRITICAL ANALYSIS OF LITERATURE

Liu et al. [11] demonstrated that lumbar muscle quality is closely associated with CLBP. In a cross-sectional comparison of 136 patients with CLBP and 119 healthy individuals, patients with CLBP showed greater fat infiltration and lower functional cross-sectional area of the multifidus and erector spinae muscles. Longer pain duration was also associated with greater muscular degeneration, while better multifidus characteristics were related to improved quality of life. Although these findings support the

importance of trunk muscle function in CLBP, the cross-sectional design limits causal interpretation and does not establish whether rehabilitation can reverse these changes.

Evidence generally supports core stabilization as an effective approach for improving clinical and functional outcomes. Sengul et al. [16] found that stabilization exercises produced greater improvements in activity-related pain, trunk endurance, and functional performance than conventional exercises in patients with chronic non-specific low back pain. Similarly, a randomized controlled trial reported superior improvements in proprioception, balance, trunk muscle thickness, disability, and fear of movement following core stabilization compared with general strengthening exercises [22]. However, both studies involved non-specific or subacute CLBP rather than patients with confirmed facet joint-related pain, limiting their direct applicability.

The effectiveness of Muscle Energy Technique (MET) appears more variable. Santos et al. [14], in a systematic review and meta-analysis of 19 randomized controlled trials involving 609 participants, found a statistically significant reduction in pain with MET in chronic low back pain, although the effect was clinically small and no significant benefit for disability was identified. This suggests that MET may provide pain relief without necessarily producing comparable functional gains. In another randomized trial, MET combined with conventional physiotherapy produced significantly greater improvements in lateral flexion range of motion, but no significant between-group difference in pain [20]. These findings indicate that the benefits of MET may be outcome-specific and are not consistently superior to conventional treatment.

Comparative evidence from other musculoskeletal populations also suggests benefits from both approaches. Arjunan et al. [18] reported significant improvements in pain, flexibility, and functional outcomes following both core stability training and MET in patients with knee osteoarthritis. However, the different pathology and short four-week intervention substantially limit the relevance of these findings to facet joint-

related CLBP. Likewise, a proposed trial comparing dynamic stabilization and MET highlights the need for direct comparative research but does not yet provide empirical evidence [19]. Exercise adherence is another important consideration in rehabilitation. Evidence from m-health-supported exercise programs indicates that structured self-management can improve pain, functional outcomes, quality of life, and physical activity in chronic pain populations [21]. Nevertheless, adherence is influenced by multiple factors, including pain, self-efficacy, social support, and perceived treatment effectiveness. Despite its clinical importance, adherence has received considerably less attention than pain and disability in comparative physiotherapy research.

Overall, current evidence supports both MET and core stabilization exercises for CLBP, but their relative effectiveness remains uncertain. Most existing studies involve non-specific CLBP, different musculoskeletal conditions, or short intervention periods, with limited evidence specifically addressing facet joint-related CLBP. Furthermore, few studies have directly compared MET and core stabilization while simultaneously examining pain, functional disability, and exercise adherence. This gap supports the need for the present randomized controlled trial to determine whether one approach provides greater clinical benefit in patients with CLBP of facet joint origin.

2.1 PROBLEM STATEMENT

Chronic low back pain (CLBP) is a prevalent musculoskeletal condition associated with persistent pain, functional disability, and reduced quality of life. Lumbar facet joint dysfunction is an important contributor to chronic mechanical low back pain and has been implicated in approximately 27-40% of CLBP cases [5]. Despite the widespread use of physiotherapy interventions such as Muscle Energy Technique (MET) and Core Stabilization Exercises (CSE), limited evidence is available regarding their comparative effectiveness in patients with CLBP of facet joint origin, particularly within the Pakistani population. Therefore, this study was undertaken to compare the effects of MET and CSE on pain

intensity, functional disability, and self-reported exercise adherence, with the aim of informing evidence-based rehabilitation strategies for this specific patient population.

2.2 AIM AND OBJECTIVES

Aim

To compare the effects of Muscle Energy Technique (MET) and Core Stabilization Exercises (CSE) on pain intensity, functional disability, and self-reported exercise adherence in patients with chronic low back pain of facet joint origin.

Objectives

- To determine the effect of MET on pain intensity in patients with chronic low back pain of facet joint origin.
- To determine the effect of CSE on pain intensity in patients with chronic low back pain of facet joint origin.
- To compare the effects of MET and CSE on functional disability in patients with chronic low back pain of facet joint origin.
- To compare self-reported exercise adherence between patients receiving MET and CSE.

3. MATERIALS AND METHODS

3.1 Study Design and Setting

A two-arm, parallel-group randomized controlled trial was conducted to compare the effects of Muscle Energy Technique (MET) and Core Stabilization Exercises (CSE) on pain intensity, functional disability, and self-reported exercise adherence in patients with chronic low back pain (CLBP) of facet joint origin. Participants underwent baseline assessment before the intervention and post-intervention assessment after completion of the treatment period.

The study was conducted in the Physiotherapy Outpatient Department of Shafi Memorial Hospital, Sialkot Cantt, Pakistan, over a six-month period, including recruitment, intervention, assessment, and data analysis.

3.2 Sample Size and Participants

The sample size was calculated based on the clinically important difference in pain intensity measured using the Visual Analogue Scale (VAS), with a significance level of $\alpha = 0.05$ and statistical power of 80%. The required sample was 28 participants per group. Allowing for a 10% potential dropout rate, a total of 62 participants were recruited, with 31 allocated to each group.

$$n = \frac{2 \times (Z_{\alpha/2} + Z_{\beta})^2 \times \sigma^2}{\Delta^2}$$

Adults aged 18–60 years with clinically diagnosed CLBP of facet joint origin who attended the study setting were eligible. Participants were recruited consecutively and randomly allocated to either the MET or CSE group.

3.3 Eligibility Criteria

Participants were included if they were aged 18–60 years, had CLBP persisting for more than 12 weeks, had a clinical diagnosis of facet joint-origin low back pain, were medically fit to participate in the interventions, could understand and follow treatment instructions, and provided written informed consent.

Participants were excluded if they had previous spinal surgery, spinal fracture, severe scoliosis, neurological impairment affecting the lower limbs, severe cardiac or systemic disease contraindicating exercise, pregnancy, or any condition that could prevent safe participation or adherence to the intervention protocol.

3.4 Randomization and Blinding

Following baseline assessment, participants were allocated to the MET or CSE group using a computer-generated randomization sequence. Allocation was concealed using sequentially numbered, opaque, sealed envelopes that were opened only after enrolment and baseline assessment. MET was administered to Group A and CSE to Group B.

Due to the nature of the interventions, participants and treating physiotherapists could not be blinded. However, the outcome assessor

was blinded to group allocation, and the statistician remained blinded during data analysis to minimize assessment and analytical bias.

3.5 Variables and Outcome Measures

The independent variable was the assigned rehabilitation intervention (MET or CSE). The dependent variables were pain intensity, functional disability, and self-reported exercise adherence. Pain intensity was assessed using the Visual Analogue Scale (VAS), functional disability using the Oswestry Disability Index (ODI), and exercise adherence using the Exercise Adherence Rating Scale (EARS).

3.6 Intervention

Participants received their assigned intervention for 12 weeks at a frequency of 3–5 sessions per week. The MET group received Muscle Energy Technique, whereas the CSE group participated in a structured core stabilization exercise program. Both groups were assessed at baseline and immediately following the intervention period.

3.7 Outcome Measurement Tools

3.7.1 Visual Analogue Scale (VAS)

Visual Analogue Scale (VAS) for Pain: The Visual Analogue Scale (VAS) is a unidimensional, subjective measure commonly used in clinical practice and research to assess pain intensity in adults. It consists of a straight horizontal or vertical 10-cm (100-mm) line, anchored by 0 = no pain and 10 = worst imaginable pain. Participants self-administered the scale by placing a perpendicular mark corresponding to their perceived pain intensity. The score was determined by measuring the distance from the “no pain” anchor and ranged from 0–10, with 0 indicating no pain, 1–4 mild pain, 5–7 moderate pain, and 8–10 severe pain. The VAS demonstrates excellent test-retest reliability (ICC $\approx$ 0.97) and strong correlation with the Numeric Rating Scale ($r = 0.62$ – 0.91). It is sensitive to changes in both acute and chronic pain and can detect clinically meaningful treatment-related changes. The scale requires approximately 1 minute to administer [23,24].

3.7.2 Oswestry Disability Index (ODI)

Oswestry Disability Index (ODI): The Oswestry Disability Index (ODI) is a condition-specific, self-reported questionnaire used to assess functional disability and limitations in daily activities associated with low back pain and is widely regarded as a standard measure for spinal disorders. It comprises 10 sections covering pain, personal care, lifting, walking, sitting, standing, sleeping, social life, travelling, and employment/homemaking, with each section containing six statements scored from 0–5. The ODI is self-administered using a paper-and-pencil format and requires approximately 5 minutes to complete. The maximum raw score is 50, which is converted into a percentage; 0–20% indicates minimal disability, 21–40% moderate disability, 41–60% severe disability, 61–80% crippled, and 81–100% bed-bound/exaggerating symptoms, with higher percentages indicating greater disability.

Higher percentages = greater disability

$$\text{ODI (\%)} = (\text{Total score} / 50) \times 100$$

3.7.3 Exercise Adherence Rating Scale (EARS)

Exercise Adherence Rating Scale (EARS): The Exercise Adherence Rating Scale (EARS) is a self-reported questionnaire designed to assess

adherence to prescribed home-exercise programs, particularly among individuals with chronic conditions such as chronic low back pain. The adherence behavior component consists of six items derived from the original 16-item pool and is rated on a five-point Likert scale from 0–4 per item. The scale is self-administered using a paper-and-pencil format. The total score ranges from 0–24, with 0–8 indicating poor adherence, 9–16 moderate adherence, and 17–24 good adherence; higher scores indicate greater adherence. The EARS demonstrates good internal consistency (Cronbach's $\alpha = 0.81$) and excellent test-retest reliability (ICC = 0.97; 95% CI: 0.94–0.98). A Kaiser-Meyer-Olkin (KMO) value of 0.85 supports factorability and construct validity. Completion requires approximately 5 minutes [27,28].

3.8 Intervention Protocols

Both groups received conventional physiotherapy followed by their allocated intervention (MET or CSE) three times weekly for 12 weeks. Each session lasted approximately 30–45 minutes, with progressive treatment according to the intervention phase and individual tolerance. The detailed techniques, exercises, progression, repetitions, contraction intensity, and treatment duration are presented in Table 1.

Table 1. Intervention Protocol for MET and Core Stabilization Exercise Groups

Intervention component	MET Group	CSE Group
Common treatment	Moist heat therapy + TENS, followed by passive lumbar ROM and stretching	Moist heat therapy + TENS, followed by passive lumbar ROM and stretching
Common treatment duration	10–15 min at the beginning of each session	10–15 min at the beginning of each session
Frequency and duration	3 sessions/week for 12 weeks	3 sessions/week for 12 weeks
Session duration	30–45 min	30–45 min
Primary targets	Lumbar erector spinae, quadratus lumborum, iliopsoas, hamstrings and piriformis	Transversus abdominis, multifidus, pelvic floor muscles and diaphragm
Main techniques/exercises	Post-isometric relaxation of lumbar erector spinae; MET for quadratus lumborum in lateral flexion; iliopsoas release; contract-relax hamstring stretching; piriformis release	Abdominal bracing, pelvic tilts, diaphragmatic breathing, dead bug, bridging, bird-dog and advanced stabilization exercises

Weeks 1-2	20-30% MVC; 5-7 contractions; 5-7 s holds	Abdominal bracing, pelvic tilts and diaphragmatic breathing; 8-10 repetitions; 5-10 s holds
Weeks 3-6	30-50% MVC; 5-7 contractions; 7-10 s holds	Dead bug and bridging; 10-12 repetitions; 10-15 s contraction holds
Weeks 7-9	50-60% MVC; 7-10 contractions; correct technique maintained	Bird-dog and advanced dead bug; 12-15 repetitions; emphasis on stability, movement control and breathing
Weeks 10-12	MET integrated with functional movements	Functional stabilization; approximately 15 repetitions according to tolerance, maintaining spinal alignment and core activation
Treatment objectives	Reduce pain and muscle tightness; improve flexibility, lumbar mobility, spinal alignment and functional performance	Improve deep-core activation and endurance, lumbopelvic stability, postural control, pain and functional capacity
Supervision/progression	Progressed according to treatment phase and correct technique	Supervised by a physiotherapist and individually modified according to clinical condition and tolerance

3.9 Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) before data collection, and permission was obtained from Shafi Memorial Hospital, Sialkot Cantt. Written informed consent was obtained from all participants after explaining the study purpose, procedures, potential risks, benefits, and participant rights. Participation was voluntary, with the right to withdraw at any stage without penalty or effect on treatment. Participant privacy, anonymity, and confidentiality were maintained throughout the study, and all procedures followed the principles of the Declaration of Helsinki.

3.10 Data Collection Procedure

Eligible patients with chronic low back pain of facet joint origin, aged 18-60 years, were recruited from the Physiotherapy Outpatient Department of Shafi Memorial Hospital, Sialkot Cantt, according to the predefined selection criteria. After written consent, demographic and clinical data, including age, gender, BMI, and symptom duration, were

recorded. Baseline pain, disability, and exercise adherence were assessed using the VAS, ODI, and EARS, respectively. Participants were then randomly allocated to the MET or CSE group and received their respective 12-week interventions, three sessions per week for 30-45 minutes. Outcomes were reassessed using the same tools after intervention. Attendance, missed sessions, withdrawals, and reasons for dropout were documented, while all collected data were securely maintained and missing data were considered during analysis.

3.11 Data Analysis

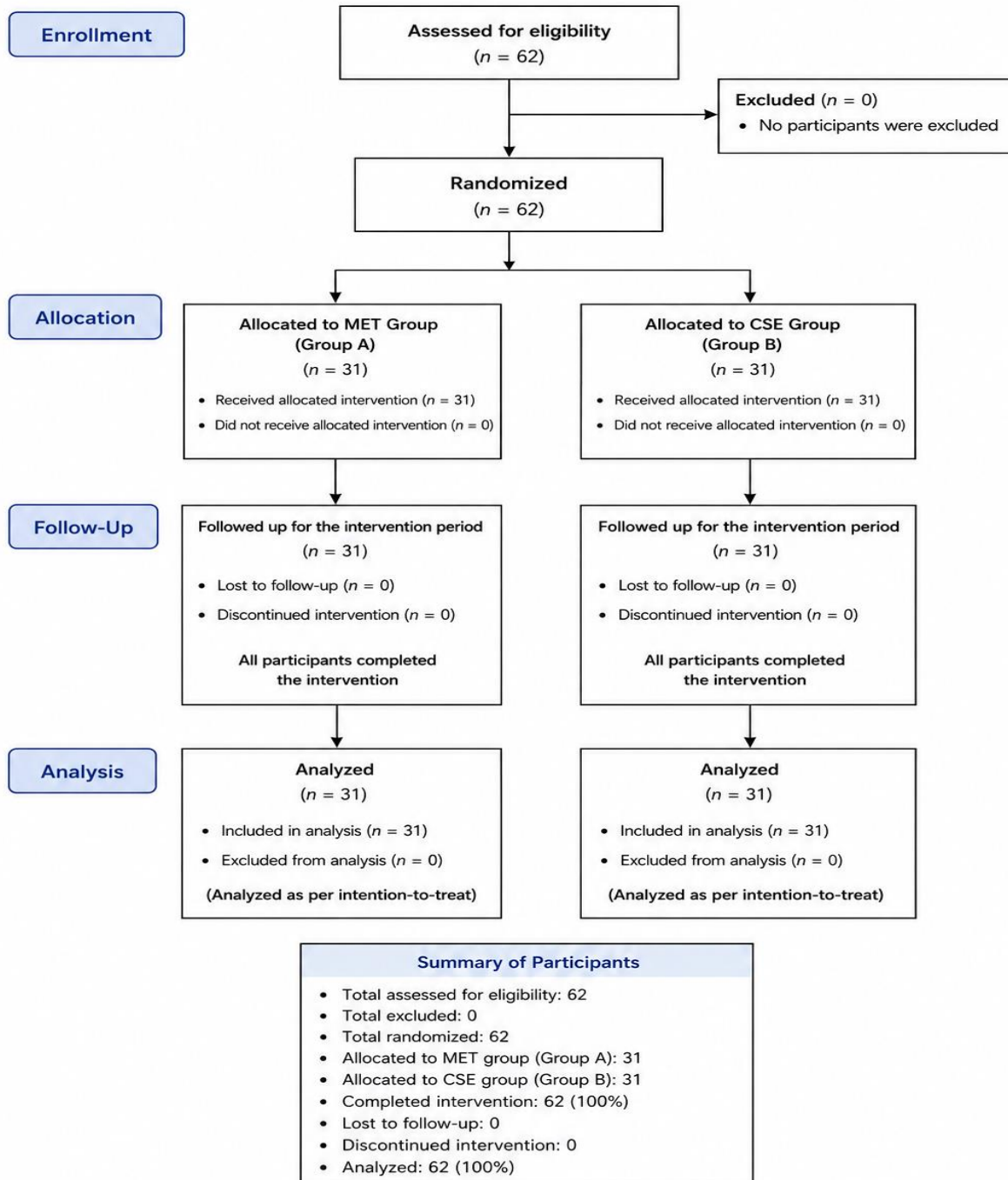
Data were analyzed using SPSS version 26.0. Descriptive statistics included mean $\pm$ SD for continuous variables and frequencies and percentages for categorical variables. Normality was assessed using the Shapiro-Wilk test. For normally distributed data, paired-samples t-tests were used for within-group comparisons and independent-samples t-tests for between-group comparisons. For non-normally distributed data,

the Wilcoxon signed-rank test and Mann-Whitney U test were applied for within- and

between-group comparisons, respectively. Statistical significance was set at $p \leq 0.05$.

CONSORT Flow Diagram

Effectiveness of Muscle Energy Technique versus Core Stabilization Exercises on Pain Intensity, Functional Disability, and Self-Reported Adherence in Patients with Chronic Low Back Pain due to Facet Joint Origin



4. RESULTS

Table 2. Baseline Characteristics of Participants

Characteristic	MET Group (n=31)	CSE Group (n=31)
Gender, n (%)		
Male	16 (51.6)	16 (51.6)
Female	15 (48.4)	15 (48.4)
Age, years, mean $\pm$ SD	41.71 $\pm$ 9.81	39.39 $\pm$ 10.24
BMI, kg/m ² , mean $\pm$ SD	27.08 $\pm$ 3.01	26.16 $\pm$ 4.09
Duration of symptoms, months, mean $\pm$ SD	15.13 $\pm$ 7.83	15.94 $\pm$ 5.98

Note. MET = Muscle Energy Technique; CSE = Core Stabilization Exercises; BMI = body mass index; M = mean; SD = standard deviation.

As shown in Table 2, the study included 62 participants, with 31 participants in each group. Both groups had an identical gender distribution, comprising 16 (51.6%) males and 15 (48.4%) females. The mean age was 41.71 $\pm$ 9.81 years in the MET group and 39.39 $\pm$ 10.24 years in the

CSE group. Mean BMI was 27.08 $\pm$ 3.01 kg/m² and 26.16 $\pm$ 4.09 kg/m², respectively, while the mean duration of symptoms was 15.13 $\pm$ 7.83 and 15.94 $\pm$ 5.98 months. Overall, the groups showed broadly comparable baseline demographic and clinical characteristics.

Table 3. Pre- and Post-Intervention Outcome Scores

Outcome	MET Group (n=31) Pre, Mean $\pm$ SD	MET Group Post, Mean $\pm$ SD	CSE Group (n=31) Pre, Mean $\pm$ SD	CSE Group Post, Mean $\pm$ SD
VAS score	7.15 $\pm$ 1.13	4.33 $\pm$ 1.45	7.02 $\pm$ 0.80	3.70 $\pm$ 1.43
ODI (%)	58.32 $\pm$ 22.60	37.35 $\pm$ 14.42	53.94 $\pm$ 20.96	29.94 $\pm$ 13.66
EARS score	11.94 $\pm$ 2.90	12.74 $\pm$ 2.41	12.35 $\pm$ 2.61	15.00 $\pm$ 1.51

Note. MET = Muscle Energy Technique; CSE = Core Stabilization Exercises; VAS = Visual Analogue Scale; ODI = Oswestry Disability Index; EARS = Exercise Adherence Rating Scale; M = mean; SD = standard deviation. Each group comprised 31 participants.

Table 3 shows that both groups improved following treatment, with reductions in VAS and ODI scores and an increase in EARS scores. The

CSE group demonstrated greater descriptive improvement across all three outcomes compared with the MET group.

Table 4. Shapiro-Wilk Test of Normality

Variable	Group	W	p	Interpretation
VAS Pre	MET	.980	.817	Normal
VAS Post	MET	.980	.824	Normal
ODI Pre (%)	MET	.943	.097	Normal
ODI Post (%)	MET	.869	.001	Non-normal
EARS Pre	MET	.965	.397	Normal
EARS Post	MET	.951	.163	Normal

Change VAS	MET	.935	.059	Normal
Change ODI	MET	.941	.085	Normal
Change EARS	MET	.968	.470	Normal
VAS Pre	CSE	.955	.220	Normal
VAS Post	CSE	.972	.576	Normal
ODI Pre (%)	CSE	.929	.042	Mild non-normality
ODI Post (%)	CSE	.963	.360	Normal
EARS Pre	CSE	.971	.533	Normal
EARS Post	CSE	.947	.125	Normal
Change VAS	CSE	.967	.442	Normal
Change ODI	CSE	.961	.318	Normal
Change EARS	CSE	.944	.104	Normal

Note. VAS = Visual Analogue Scale; ODI = Oswestry Disability Index; EARS = Exercise Adherence Rating Scale; MET = Muscle Energy Technique; CSE = Core Stabilization Exercises. W = Shapiro-Wilk statistic. A p -value $> .05$ indicates no significant departure from normality.

Table 4 indicates that most variables were normally distributed ($p > .05$). Non-normality was observed for post-intervention ODI in the MET group ($p = .001$) and mild non-normality for

baseline ODI in the CSE group ($p = .042$). All change scores were normally distributed in both groups.

Table 5. Within-Group Comparisons of Pain, Disability, and Exercise Adherence

Outcome	MET Pre, $M \pm SD$	MET Post, $M \pm SD$	t	p	CSE Pre, $M \pm SD$	CSE Post, $M \pm SD$	t	p
VAS	7.15 $\pm$ 1.13	4.33 $\pm$ 1.45	16.35	$< .001$	7.02 $\pm$ 0.80	3.70 $\pm$ 1.43	18.83	$< .001$
ODI (%)	58.32 $\pm$ 22.60	37.35 $\pm$ 14.42	10.82	$< .001$	53.94 $\pm$ 20.96	29.94 $\pm$ 13.66	13.19	$< .001$
EARS	11.94 $\pm$ 2.90	12.74 $\pm$ 2.41	-1.12	.274	12.35 $\pm$ 2.61	15.00 $\pm$ 1.51	-5.87	$< .001$

Note. MET = Muscle Energy Technique; CSE = Core Stabilization Exercises; VAS = Visual Analogue Scale; ODI = Oswestry Disability Index; EARS = Exercise Adherence Rating Scale. M = mean; SD = standard deviation. Paired-samples t tests were used for within-group comparisons.

In Table 5, both groups demonstrated significant reductions in VAS and ODI scores following intervention ($p < .001$). EARS scores increased

significantly in the CSE group ($p < .001$), whereas the increase in the MET group was not significant ($p = .274$).

Table 6. Between-Group Comparisons of Changes in Pain, Disability, and Exercise Adherence

Outcome	MET Change, $M \pm SD$	CSE Change, $M \pm SD$	t	p
VAS	2.82 ± 0.96	3.32 ± 0.98	-2.04	.046
ODI (%)	20.97 ± 10.79	24.00 ± 10.13	-1.14	.259
EARS	0.81 ± 4.03	2.65 ± 2.51	-2.16	.035

Note. MET = Muscle Energy Technique; CSE = Core Stabilization Exercises; VAS = Visual Analog Scale; ODI = Oswestry Disability Index; EARS = Exercise Adherence Rating Scale. M = mean; SD = standard deviation. Positive change values represent improvement. Independent-samples t tests were used for between-group comparisons.

In Table 6, CSE group demonstrated significantly greater improvement in VAS scores ($p = .046$) and EARS scores ($p = .035$) than the MET group. Although ODI improvement was greater in the CSE group, the between-group difference was not statistically significant ($p = .259$).

6. DISCUSSION

The present randomized controlled trial compared Muscle Energy Technique (MET) and Core Stabilization Exercises (CSE) for pain intensity, functional disability, and exercise adherence in patients with chronic low back pain (CLBP) of facet-joint origin. Sixty-two participants were randomized equally into MET and CSE groups and received treatment three times weekly for 12 weeks. Pain, disability, and adherence were assessed using the Visual Analogue Scale (VAS), Oswestry Disability Index (ODI), and Exercise Adherence Rating Scale (EARS), respectively. Both interventions produced significant within-group improvements in pain and disability; however, CSE produced a significantly greater reduction in pain and a significantly greater improvement in exercise adherence, whereas the between-group difference in disability was not statistically significant.

The MET group demonstrated a significant reduction in pain, with VAS scores decreasing from 7.15 ± 1.13 at baseline to 4.33 ± 1.45 after 12 weeks, representing a mean reduction of 2.82 ± 0.96 ($p < .001$). This finding is consistent with Bindra et al. [29], who reported significant pain reduction following MET in patients with chronic low back pain. The beneficial effect of MET may be related to post-isometric relaxation, reduced muscle tightness, improved soft-tissue extensibility, and restoration of lumbar

biomechanics, thereby reducing mechanical stress and pain.

Pain reduction was significantly greater in the CSE group than in the MET group. The mean VAS reduction was 3.32 ± 0.98 with CSE compared with 2.82 ± 0.96 with MET ($p = .046$). These findings are consistent with previous evidence indicating that stabilization exercises can reduce pain by improving activation and coordination of the deep trunk musculature, spinal stability, and movement control [30]. The superior pain reduction observed with CSE may therefore reflect its emphasis on sustained neuromuscular control and progressive activation of the trunk stabilizers rather than primarily addressing muscle tightness. Both interventions also produced significant improvements in functional disability. ODI scores decreased from $58.32 \pm 22.60\%$ to $37.35 \pm 14.42\%$ in the MET group and from $53.94 \pm 20.96\%$ to $29.94 \pm 13.66\%$ in the CSE group (both $p < .001$). These findings indicate meaningful improvements in daily functional capacity following both treatment approaches. The MET findings are supported by Bindra et al. [29], who reported significant reductions in ODI following MET, potentially through improved lumbar mobility and correction of muscular dysfunction.

Similarly, the significant improvement following CSE is consistent with Sengul et al. [31], who found that stabilization exercises improved disability and functional performance in patients with chronic non-specific low back pain. Activation and strengthening of the transversus abdominis, multifidus, and other trunk stabilizers may enhance spinal control and reduce mechanical loading during functional activities. Although the reduction in ODI was numerically

greater in the CSE group ($24.00 \pm 10.13\%$) than in the MET group ($20.97 \pm 10.79\%$), the between-group difference was not statistically significant ($p = .259$). Thus, both interventions appear similarly effective for improving functional disability, despite the greater numerical improvement observed with CSE.

Exercise adherence showed a different pattern. EARS scores increased from 11.94 ± 2.90 to 12.74 ± 2.41 in the MET group, but this change was not statistically significant ($p = .274$). In contrast, the CSE group demonstrated a significant increase from 12.35 ± 2.61 to 15.00 ± 1.51 ($p < .001$). Furthermore, the between-group difference in change scores was statistically significant, with a greater improvement in the CSE group (2.65 ± 2.51) than in the MET group (0.81 ± 4.03 ; $p = .035$). This finding is broadly consistent with Karacay et al. [32], who reported favorable effects of stabilization-based exercise programs on functional recovery and exercise-related outcomes in patients with CLBP.

The greater adherence observed with CSE may be explained by its active and progressive nature, which enables patients to participate directly in their rehabilitation and develop skills that can be incorporated into daily activities. This interpretation is also supported by Smeets et al. [33], who highlighted the importance of active exercise and behavioral approaches in promoting engagement and self-management among individuals with chronic low back pain. Nevertheless, adherence is multifactorial and may also be influenced by perceived treatment effectiveness, motivation, symptom improvement, therapist-patient communication, and the practicality of the prescribed program [34].

The present study has several strengths. The randomized controlled design allowed a direct comparison of two commonly used physiotherapeutic approaches while reducing the potential for allocation bias. The use of validated outcome measures enabled assessment of three clinically relevant domains: pain, functional disability, and exercise adherence. In addition, the 12-week intervention provided sufficient duration to evaluate sustained changes in clinical outcomes.

Importantly, inclusion of adherence as an outcome extends beyond symptom reduction and provides information regarding patient engagement with rehabilitation. However, the findings should be interpreted in relation to the study population and treatment setting, and further studies involving larger samples, longer follow-up periods, and objective measures of adherence may strengthen the evidence [35].

Overall, both MET and CSE were effective in reducing pain and functional disability in patients with chronic facet-joint-related CLBP. CSE demonstrated a statistically greater effect on pain reduction and exercise adherence, whereas both interventions produced comparable improvements in disability. These findings suggest that CSE may offer an additional advantage when rehabilitation aims to combine symptom management with active patient participation and sustained exercise engagement.

7 CONCLUSION

The present study concludes that both Muscle Energy Technique (MET) and Core Stabilization Exercises (CSE) are effective in reducing pain and functional disability among patients with chronic low back pain of facet-joint origin. However, CSE demonstrated significantly greater improvements in pain reduction and exercise adherence, while both interventions produced comparable improvements in functional disability. CSE may therefore be a particularly useful rehabilitation approach for promoting active recovery and patient engagement.

8. LIMITATIONS OF THE STUDY

The study had a relatively small sample size and was conducted at a single center, which may limit the generalizability of the findings. The 12-week intervention did not assess long-term sustainability. As the study focused specifically on facet-joint-related CLBP, the findings may not apply to other forms of low back pain. Exercise adherence was assessed through self-report and may therefore be subject to recall or response bias. Psychological, occupational, lifestyle, and physical-

activity factors were also not comprehensively evaluated.

9. RECOMMENDATIONS FOR FUTURE RESEARCH

Future studies should use larger, multicenter samples and include longer follow-up periods to establish the durability of treatment effects. Further research should compare combined MET and CSE protocols with individual interventions and investigate their effectiveness across different CLBP subgroups. Objective measures of exercise adherence, alongside validated self-report scales, are also recommended. Future trials should additionally consider psychological, occupational, lifestyle, and physical-activity factors that may influence rehabilitation outcomes.

REFERENCES

1. Øverås CK, Johansson MS, de Campos TF, Ferreira ML, Natvig B, Mork PJ, Hartvigsen J. Distribution and prevalence of musculoskeletal pain co-occurring with persistent low back pain: a systematic review. *BMC Musculoskelet Disord*. 2021;22(1):91.
2. Yang N, Di J, Wang W, Feng H. Global burden of low back pain from 1990 to 2021: a comprehensive analysis of risk factors and trends using the Global Burden of Disease Study 2021. *BMC Public Health*. 2025;25(1):1886.
3. Tayyab M, Faisal S, Ahmad Z, Ahmad M, Tanveer M, Shah S, et al. Burden and trends of low back pain in Pakistan: a Global Burden of Disease Study, 1990–2021. *Cureus*. 2025;17(9):e93105. Available from: <https://pubmed.ncbi.nlm.nih.gov/41141049/>
4. Jan SI, Khan R, Mustafa M, Ullah A, Jaffary K, Tariq A, et al. Prevalence of low back pain and its association with quality of sleep among students of allied health science of Iqra National University Peshawar. *Res Med Sci Rev*. 2025;3(1):1570–1575. Available from: <https://thermsr.com/index.php/Journal/article/view/575>
5. Van Oosterwyck W, Vander Cruyssen P, Castille F, Van de Kelft E, Decaigny V. Lumbar facet joint disease: what, why, and when? *Life (Basel)*. 2024;14(11):148.
6. Nicol V, Verdaguer C, Daste C, Bissierex H, Lapeyre É, Lefèvre-Colau MM, et al. Chronic low back pain: a narrative review of recent international guidelines for diagnosis and conservative treatment. *J Clin Med*. 2023 Feb 20;12(4):1685.
7. Linton SJ, Flink IK, Vlaeyen JW. Understanding the etiology of chronic pain from a psychological perspective. *Phys Ther*. 2018 May;98(5):315–24.
8. Du R, Xu G, Bai X, Li Z. Facet joint syndrome: pathophysiology, diagnosis, and treatment. *J Pain Res*. 2022 Jan 1;15:3689–710.
9. Ambrosio L, Vadala G, Russo F, Pascarella G, De Salvatore S, Papalia GF, et al. Interventional minimally invasive treatments for chronic low back pain caused by lumbar facet joint syndrome: a systematic review. *Glob Spine J*. 2023 May;13(4):1163–79.
10. Suzuki H, Aono S, Inoue S, Imajo Y, Nishida N, Funaba M, et al. Clinically significant changes in pain along the Pain Intensity Numerical Rating Scale in patients with chronic low back pain. *PLoS One*. 2020 Mar 3;15(3):e0229228.
11. Liu S, Reitmaier S, Mödl L, Yang D, Zhang T, Becker L, et al. Quality of lumbar paraspinal muscles in patients with chronic low back pain and its relationship to pain duration, pain intensity, and quality of life. *Eur Radiol*. 2025 Jun;35(6):3652–60.

12. Lee SW, Nguyen D, Mack D, Aguila E, Thomas M, Doddy K. Conservative management of low back pain. *HCA Healthc J Med*. 2021 Oct 29;2(5):319.
13. Custers P, Van de Kelft E, Eeckhout B, Sabbe W, Hofman A, Debuysscher A, et al. Clinical examination, diagnosis, and conservative treatment of chronic low back pain: a narrative review. *Life (Basel)*. 2024 Aug 29;14(9):1090.
14. Santos GK, de Oliveira RG, de Oliveira LC, de Oliveira CF, Andraus RA, Ngomo S, et al. Effectiveness of muscle energy technique in patients with nonspecific low back pain: a systematic review with meta-analysis. *Eur J Phys Rehabil Med*. 2022 Sep 28;58(6):827.
15. Osama M, Rehman SS. Effects of static stretching as compared to autogenic inhibition and reciprocal inhibition muscle energy techniques in the management of mechanical neck pain: a randomized controlled trial. *J Pak Med Assoc*. 2020;2020.
16. Salik Sengul Y, Yilmaz A, Kirmizi M, Kahraman T, Kalemci O. Effects of stabilization exercises on disability, pain, and core stability in patients with non-specific low back pain: a randomized controlled trial. *Work*. 2021 Sep 28;70(1):99–107.
17. Smrcina Z, Woelfel S, Burcal C. A systematic review of the effectiveness of core stability exercises in patients with non-specific low back pain. *Int J Sports Phys Ther*. 2022 Aug 1;17(5):766.
18. Arjunan T, Arulpragassame S, Biju R. Comparative study to assess the effectiveness of core stability training (CST) versus muscle energy technique (MET) in osteoarthritis knee. *Korean J Physiol Pharmacol*. 2023;27(4):208–16.
19. Ahmed UA, Nadasan T, Van Oosterwijk J, Maharaj SS. Effect of dynamic stabilisation exercise therapy enhanced with muscles energy technique on some selected patients outcomes and trunk muscles function in patients with chronic non-specific low back pain: a study protocol. *Eur J Physiother*. 2021 Nov 2;23(6):344–54.
20. Mazidavi A, Karimi N, Khorasani B, Baraghoosh P, Biglarian A. Effects of muscle energy technique on pain and range of motion in chronic low back pain subjects with lateral flexion restriction. *Phys Treat Spec Phys Ther J*. 2023 Oct 10;13(4):245–52.
21. Moreno Liger M. Effectiveness of a physical exercise-based intervention delivered by an m-health system on biopsychosocial variables in patients with chronic pain from different origin (Doctoral dissertation).
22. Hlaing SS, Puntumetakul R, Khine EE, Boucaut R. Effects of core stabilization exercise and strengthening exercise on proprioception, balance, muscle thickness and pain related outcomes in patients with subacute nonspecific low back pain: a randomized controlled trial. *BMC Musculoskelet Disord*. 2021 Nov 30;22(1):998.
23. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: visual analog scale for pain (VAS pain), numeric rating scale for pain (NRS pain), McGill pain questionnaire (MPQ), short-form McGill pain questionnaire (SF-MPQ), chronic pain grade scale (CPGS), short form-36 bodily pain scale (SF-36 BPS), and measure of intermittent and constant osteoarthritis pain (ICOAP). *Arthritis Care Res (Hoboken)*. 2011;63(S11):S240–52.
24. Bijur PE, Silver W, Gallagher EJ. Reliability of the visual analog scale for measurement of acute pain. *Acad Emerg Med*. 2001;8(12):1153–7.

25. Fairbank JC, Pynsent PB. The Oswestry disability index. *Spine*. 2000;25(22):2940-53.
26. Fairbank JC. Oswestry disability index. *J Neurosurg Spine*. 2014;20(2):239-42.
27. Bollen JC, Dean SG, Siegert RJ, Howe TE, Goodwin VA. A systematic review of measures of self-reported adherence to unsupervised home-based rehabilitation exercise programmes, and their psychometric properties. *BMJ Open*. 2014;4(6):e005044.
28. Newman-Beinart NA, Norton S, Dowling D, Gavriloff D, Vari C, Weinman JA, Godfrey EL. The development and initial psychometric evaluation of a measure assessing adherence to prescribed exercise: the Exercise Adherence Rating Scale (EARS). *Physiotherapy*. 2017;103(2):180-8
29. Comparative study between muscle energy technique (MET) versus kinesiotopeing (KT) in managing work-related low back pain (WRLBP) among health professionals: a double-blinded study. *Turk J Physiother Rehabil*. 2021;32(3).
30. Akhtar MW, Karimi H, Gilani SA. Effectiveness of core stabilization exercises and routine exercise therapy in management of pain in chronic non-specific low back pain: a randomized controlled clinical trial. *Pak J Med Sci*. 2017;33(4):1002-7.
31. Salik Sengul Y, Yilmaz A, Kirmizi M, Kahraman T, Kalemci O. Effects of stabilization exercises on disability, pain, and core stability in patients with non-specific low back pain: a randomized controlled trial. *Work*. 2021;70(1):99-107.
32. Karacay BC, Sahbaz T, Gurtekin B, Yildiz S, Ozcan E. Effectiveness of whole-body vibration exercise and core stabilization exercise in chronic non-specific low back pain: a randomized controlled study. *Turk J Phys Med Rehabil*. 2022;68(2):184-92.
33. Smeets RJEM, van den Hoogen HJM, Knottnerus JA, et al. Effects of behavioural exercise therapy on the effectiveness of multidisciplinary rehabilitation for chronic non-specific low back pain: a randomized controlled trial. *BMC Musculoskelet Disord*. 2021;22:500. doi:10.1186/s12891-021-04353-y.
34. Tariq S, Kiran Q, Shahid N, Qayyum S, Rana HZ, Arif K, Mohsin A. EFFECTIVENESS OF STABILITY BALL TRAINING, DEAD BUG EXERCISES, AND THEIR COMBINATION ON REDUCING SPECIFIC LOW BACK PAIN.
35. Asad A, Irshad A, Hassan T, Kiran Q, Kouser S, Hassan F. Comparative analysis of Kinesio taping and dryneedling: effects on pain and disability in patients with mechanical low back pain. *Anaesthesia, Pain & Intensive Care*. 2024 Oct 1;28(5):933.