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EFFECTS OF KINETIC CONTROL TRAINING ON PAIN AND FUNCTIONAL DISABILITY AMONG PATIENTS WITH NON-SPECIFIC CHRONIC LOW BACK PAIN

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Abstract

Background: *Patients with non-specific chronic low back pain (NSCLBP) often experience persistent pain and functional limitations. Physiotherapy interventions like kinetic control training are increasingly used to improve pain, functional ability, and trunk muscle coordination.*

Objective: *To determine the effects of kinetic control training on pain and function with non-specific chronic low back pain.*

Methods: *A randomized controlled trial was conducted on 42 participants divided into two groups. Group A received kinetic control training with conventional therapy, and Group B received only conventional physiotherapy. Pain was measured using the Visual Analogue Scale (VAS), for function Oswestry Disability Index (ODI) was used. The duration of the study was 6 months after the approval of the synopsis. Data were analyzed using SPSS 27.0.*

Result: *Average age was 39.95 ± 8.77 years for Group A and 40.67 ± 7.91 years for Group B. Post-treatment Group A demonstrated significantly greater improvements in pain (VAS: 4.19 ± 1.47 vs. 5.33 ± 1.68, p = 0.024) and functional disability (ODI: 30.19 ± 11.90 vs. 39.61 ± 14.33, p = 0.026).*

Conclusion: *Kinetic control training was more effective than conventional therapy in reducing pain, improving functional disability with non-specific chronic low back pain compared with conventional rehabilitation approaches.*

INTRODUCTION:

Low back pain is a common musculoskeletal complaint that is often seen throughout the world. Its significant impacts the quality of life of a person. (1) The lower back region, particularly the lumbar region, plays a central role in supporting body weight and also in facilitating the movement of the body. (2) Lower back pain can be categorized as acute, subacute, and chronic based on the duration. (3) Chronic lower back pain is in concerning problem that normally occurs due to prolong course and resistance to conventional treatment. (4) The pain is usually located between the lower ribs and the gluteal folds and is often described as a dull, aching discomfort that may worsen with prolonged sitting, standing, or physical activity. (5) Studies have shown that almost 23% of the global population suffer from chronic lower back pain. (6) The signs and symptoms that are

normally seen in chronic low back patient is persistent stiffness, discomfort, and pain, which can be localized or radiating. (7) Chronic lower back patient specially due to hyperlumbar lordosis are seem to have excessive inverted curvature, which is commonly associated with chronic low back pain more than the other cases. (8) Some patients may experience radiating pain into the legs due to nerve root compression, commonly known as sciatica. Reduced spinal flexibility makes it harder to perform bending or twisting motions, further limiting activity. (9) Many risk factors are associated with chronic low back pain. (10) The lower back, or lumbar spine, comprises five vertebrae from L1 to L5. Each vertebra is separated by an intervertebral disc that acts as a cushion, preventing bone-on-bone friction. (11) Any disruption in the harmony of these structures directly affects spinal mechanics and overall posture. (12) The coordination of all these vertebrae contributes to spinal flexibility, shock absorption, and stability. (13) Beyond structural and postural characteristics, the ability to coordinate trunk and pelvic movements is an important component of functional spinal control. Individuals with chronic low back pain may demonstrate alterations in the timing, recruitment, and coordination of trunk muscles during postural and functional movements. (14) However, altered muscle activation should not necessarily be considered the sole cause of chronic low back pain. (15) Physiotherapy plays an important role in improving lower back pain patients. (16) Among these various treatment options, core stabilization exercises have proven to be quite effective in terms of improving spinal alignment and reducing the symptoms of chronic low back pain. (17) Physiotherapists also use modalities such as heat therapy, ultrasound, and electrical stimulation to complement exercise-based interventions. (18) Recent studies have shown potential benefits of kinetic chain exercises. (19) Studying the effects of kinetic control training on patients with non-specific chronic low back pain can provide valuable insights into effective non-invasive rehabilitation strategies for managing this common musculoskeletal condition. Understanding how kinetic control training influences pain levels and functional ability may help improve clinical outcomes and provide a better understanding of the neuromuscular and biomechanical factors involved in chronic low back pain. This research may contribute to the development of more targeted physiotherapy interventions, refine rehabilitation protocols, and ultimately enhance the quality of life for individuals suffering from non-specific chronic low back pain. Therefore, this study was conducted to determine the effects of kinetic control training on pain and function among patients with non-specific chronic low back pain.

METHODOLOGY

The study was a randomized clinical trial (20)The participants were recruited from SUMS Diagnostic Ultrasound, Lahore, Pakistan. After approval of the synopsis, the duration was six months, from March to August 2026. The calculated sample size is 38 using the visual analogue scale as an outcome measure, by G power software based on the mean difference value. After adding10% drop out 38+4=42 total, with 21 participants in each group. (21) It was a non-probability convenience sampling technique. Inclusion Criteria were, Participant with age 25-55 years, both genders, participants with low back pain for more than 6 weeks, Patient with pain more than 5 on the visual analogue scale. (22) Participants who didn't undergo any physiotherapy treatment for low back pain. Patient who are not bed bound or has exaggerated symptoms according to ODI <81%. (23) Exclusion criteria were: Participant with any history of lumbar radiculopathy, Patient taking any pain killers medications, Patient with other spinal pathologies like prolapsed disc, spinal stenosis, spondylolisthesis, vertebral fractures, or spinal infections. (24)Patient with systemic conditions such as rheumatoid arthritis, ankylosing spondylitis, fibromyalgia, or malignancies; pregnant females; patient with other postural deformity like scoliosis; patient with neurological conditions like stroke, multiple sclerosis, etc.; patient with any present heart condition or any psychological condition. (25) Visual Analogue Scale and Oswestry Disability Index.

DATA COLLECTION PROCEDURE:

Participants who met the inclusion criteria were recruited using a Convenience sampling

technique. This involves selecting participants who were readily available to participate in the study. Randomization was conducted using a lottery method by which participants were randomly assigned to two groups. Group A and Group B. The allocation process involved using small slips of paper, with 42 participants, 21 in each group. These slips were drawn by the participants from a ballot box, with each participant selecting a slip to determine their group assignment. This open and transparent process ensured that participants were fully aware of how they were assigned to their respective groups and provided a clear and unbiased method of allocation. It was single blinded randomization control trail. The assessor was unaware of the treatment allocation. The intervention was given after taking informed consent from the participants. A total of 50 people were randomly divided into two groups, where group A was given kinetic control training and group B was given conventional treatment. The treatment was given for 30 minutes, 5 days per week, for 4 weeks. Data were analyzed using SPSS version 27.0.

Group A Kinetic Control exercise: Group A received kinetic control exercises along with conventional therapy. The intervention was provided under the supervision of a physiotherapist. Each treatment session was 45 minutes, in which 15 minutes consisted of kinetic control exercises and 20 minutes consisted of conventional therapy. The treatment was given 3 sessions per week for 6 weeks, making a total of 18 sessions. After conventional therapy, as mentioned in group B with less duration, participants performed kinetic control extension-movement control exercises. Each exercise was held for 20–30 seconds and repeated 3–5 times. The exercises were performed three times per week for six weeks. Patients were also instructed to perform the same exercises twice daily at home.

Group B Conventional Therapy: The patient was instructed to lie comfortably, and TENS was applied in conventional mode for 20 minutes with a frequency of 70 Hz and a pulse width of 100 microseconds. Two 40x40 mm electrodes were placed in a cross-arranged position on each side of the lumbosacral spine. Hot moist packs were applied to the lumbosacral and gluteal regions for 10 minutes, while the patient was positioned prone. Strengthening Exercises (5 minutes): Pelvic Tilt (2.5 minutes) - The patient was instructed to lie on their back with their knees bent and feet flat on the floor. They then performed a pelvic tilt, lifting the hips upward, holding for 10-15 seconds, and then slowly releasing. Pelvic rotation, Alternate Leg Extension (2.5 minutes): In the prone position, the patient was instructed to lift one leg, hold it for 10 seconds, lower it, and then raise the other leg. Quad strengthening and adductor and abductor strengthening were also done by using a pillow and pressing it. (26). Core stabilizing exercises (Gluteal Bridge, abdominal crunch, and cross-crawl exercise). For those patients who felt better in lumbar flexion, they followed a flexion-biased program, including single/ double knee-to-chest and posterior pelvic tilting; however, for patients who felt better with lumbar extension, they followed an extension-biased exercise, such as cobra stretch (on elbows or on hands)

DATA ANALYSIS PROCEDURE:

The data were analyzed using SPSS-27.0 (Statistical Package for Social Sciences) software. Continuous variables were represented through histograms, means, and standard deviations to illustrate their distribution and central tendencies. Categorical variables were evaluated using frequencies and percentages and were visually presented using bar and pie charts. Normality of the data was tested using the Shapiro-Wilk test, as the sample size was more than 50. Based on the p-values obtained, parametric tests were applied, as the data were not normally distributed as it was less than 0.05. For between-group analyses independent sample t test was applied, and for within-group analysis paired sample t test was applied, where a p-value less than 0.05 was considered significant.

RESULTS

Demographic characteristics showed comparable baseline characteristics between both intervention groups. The total sample consisted of 42 patients with non-specific chronic low back pain, with 21 participants allocated to Group A receiving Kinetic Control

Training and 21 participants allocated to Group B receiving Conventional Therapy. The mean age of participants was 39.95 ± 8.772 years in Group A and 40.67 ± 7.914 years in Group B, indicating similar age distribution between both groups. Gender distribution showed that Group A consisted of 15 males (71.4%) and 6 females (28.6%), whereas Group B consisted of 11 males (52.4%) and 10 females (47.6%). Height, weight, and BMI measurements demonstrated comparable baseline characteristics between groups. The mean height was 167.57 ± 10.284 cm in Group A and 170.38 ± 9.877 cm in Group B. The mean body weight was 76.20 ± 12.731 kg in Group A and 71.67 ± 14.681 kg in Group B. Similarly, the mean BMI was 27.30 ± 5.145 kg/m² in Group A and 25.03 ± 6.354 kg/m² in Group B.

BMI category distribution showed that participants were classified into different categories in both groups. In Group A, 9 participants (42.9%) were within the normal BMI category, 6 participants (28.6%) were overweight, and 6 participants (28.6%) were obese. In Group B, 3 participants (14.3%) were underweight, 8 participants (38.1%) were within the normal BMI category, 5 participants (23.8%) were overweight, and 5 participants (23.8%) were obese. Baseline and post-treatment comparisons were performed for pain intensity measured through the Visual Analogue Scale (VAS) and functional disability assessed through the Oswestry Disability Index (ODI).

The pre-treatment VAS score was 7.95 ± 1.35 in Group A and 7.95 ± 1.68 in Group B. Following intervention, the VAS score decreased to 4.19 ± 1.47 in Group A and 5.33 ± 1.68 in Group B. The post-treatment difference between groups was statistically significant ($p = 0.024$), indicating greater reduction in pain intensity in the Kinetic Control Training group. The pre-treatment Oswestry Disability Index score was 56.23 ± 13.09 in Group A and 55.28 ± 14.93 in Group B. After intervention, ODI scores reduced to 30.19 ± 11.90 in Group A and 39.61 ± 14.33 in Group B. A statistically significant difference was observed between groups after treatment ($p = 0.026$), demonstrating greater improvement in functional disability in the Kinetic Control Training group.

Table 1: Demographic Characteristics of Participants

Variable	Category	Group A: Kinetic Control Exercise (n=21)	Group B: Conventional Therapy (n=21)
Age (years)	Mean ± SD	39.95 ± 8.77	40.67 ± 7.91
Height (cm)	Mean ± SD	167.57 ± 10.28	170.38 ± 9.88
Weight (kg)	Mean ± SD	76.20 ± 12.73	71.67 ± 14.68
BMI (kg/m²)	Mean ± SD	27.30 ± 5.15	25.03 ± 6.35
Gender	Male	15 (71.4%)	11 (52.4%)
	Female	6 (28.6%)	10 (47.6%)
BMI category	Underweight	0 (0.0%)	3 (14.3%)
	Normal	9 (42.9%)	8 (38.1%)
	Overweight	6 (28.6%)	5 (23.8%)
	Obese	6 (28.6%)	5 (23.8%)

Table 2: Independent-Samples Comparison of Visual Analogue Scale Scores

Time point	Group A Mean ± SD	Group B Mean ± SD	t value	Mean difference	p-value	Cohen's d
Pre-treatment	7.95 ± 1.36	7.95 ± 1.69	0.000	0.000	1.000	0.000
Post-treatment	4.19 ± 1.47	5.33 ± 1.68	-2.343	-1.143	0.024	-0.723

Table 3: Independent-Samples Comparison of Oswestry Disability Index Scores

Time point	Group A Mean ± SD	Group B Mean ± SD	t value	Mean difference	p-value	Cohen's d
Pre-treatment	56.24 ± 13.10	55.29 ± 14.93	0.220	0.952	0.827	0.068
Post-treatment	30.19 ± 11.91	39.62 ± 14.33	-2.319	-9.429	0.026	-0.716

Table 4: Paired-Samples Comparison Within Group A (Kinetic Control Exercise)

Variable	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	t value	p-value	Cohen's d
VAS	7.95 ± 1.36	4.19 ± 1.47	19.390	<0.001	4.231
ODI	56.24 ± 13.10	30.19 ± 11.91	11.332	<0.001	2.473

Table 5: Paired-Samples Comparison Within Group B (Conventional Therapy)

Variable	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	t value	p-value	Cohen's d
VAS	7.95 ± 1.69	5.33 ± 1.68	13.881	<0.001	3.029
ODI	55.29 ± 14.93	39.62 ± 14.33	12.745	<0.001	2.781

DISCUSSION:

This randomized controlled trial aimed to assess pain and functional disability in non-specific chronic low back pain (NSCLBP) after Kinetic Control Training (KCT). The main finding of the present study was that patients who received KCT showed greater improvement in pain and functional disability than those who received conventional physiotherapy. Since the groups were similar before treatment, the differences seen after treatment provide support for an additional benefit of including KCT in the physiotherapy treatment. However, these findings require careful interpretation because a statistically significant difference does not always mean the change is large enough to matter to the patient.

The improvement in pain in both groups is consistent with the general role of exercise in the management of chronic low back pain. The greater improvement seen in the KCT group may be related to the way KCT uses controlled and purposeful movements during exercise. For a patient with chronic low back pain, treatment is not only concerned with reducing pain but also with helping the patient move and perform daily activities with less difficulty. The greater improvement in ODI in the KCT group is therefore important because it suggests that the improvement was not limited to pain scores but was also reflected in the patients' reported ability to perform daily activities. This distinction is important because a treatment can produce a statistically significant difference without producing a noticeable change in everyday life.

The findings have practical implications for physiotherapists managing patients with NSCLBP. KCT may be included as part of a rehabilitation programme when the treatment goal is to improve pain, function, and controlled movement during exercise. The present results suggest that this approach may offer additional benefits compared with conventional physiotherapy alone. However, treatment should still be individualized because patients with chronic low back pain may have different movement problems, functional limitations, and responses to exercise.

These findings are similar to those of Alhumayani et al. (2026), who studied open

kinetic chain, closed kinetic chain, and combined kinetic chain exercises with lumbar stabilization exercises in adults with non-specific low back pain. Their study reported improvement in pain intensity. The similar improvement in pain may suggest that exercise approaches involving controlled movement can be useful in the management of low back pain. However, the two studies used different treatment programmes. Alhumayani et al. used different types of kinetic chain exercises combined with lumbar stabilization, whereas the present study used KCT. Therefore, the results can be compared in terms of improvement in pain, but they should not be used to say that one treatment was better than the other. (27)

Similar findings were also reported by Mohammed Ahmed et al. (2025), who studied Kinetic Control retraining combined with physical therapy in patients with chronic low back pain with radiculopathy. They found a reduction in pain following treatment. The present study also found lower pain scores after KCT. However, the participants were different because Mohammed Ahmed et al. included patients with radiculopathy, while the present study included patients with NSCLBP. Their study also assessed neuropathic pain, which was not assessed in the present study. Therefore, the findings are similar in relation to pain improvement, but the results should be interpreted according to the different patient populations and outcome measures. (28)

A similar pattern was found for functional disability. Group A had a lower post-treatment ODI score than Group B (30.19 ± 11.91 vs. 39.62 ± 14.33). The mean between-group difference was 9.43 points and was statistically significant ($p = 0.026$), with a large effect size (Cohen's $d = 0.716$). This indicates a fairly large difference in disability between the groups after treatment. The reduction in ODI is important from a physiotherapy perspective because ODI reflects difficulty with activities such as walking, lifting, sitting, standing, and daily activities. Therefore, the lower ODI score in the KCT group suggests better self-reported function after treatment. However, as with VAS, statistical significance does not by itself confirm that the change was clinically important.

The improvement in disability is consistent with Mohammed Ahmed et al. (2025), who also reported improvement in disability after Kinetic Control retraining. Although the direction of the findings is similar, their participants had chronic low back pain with radiculopathy, whereas the present study included NSCLBP. This difference is important because patients with radiculopathy may have different symptoms and functional problems from patients with non-specific low back pain. Therefore, the similar improvement in disability supports the present finding but does not mean that the results of the two studies are directly the same. (28)

The proposed results of Yalfani Ali et al. (2024) also support the current findings, which examined open and closed kinetic chain exercises in individuals suffering from chronic non-specific low back pain. They investigated the muscle activity, lumbopelvic control, pain intensity, balance, and psychological factors. Although their intervention was based on kinetic chain exercises rather than Kinetic Control Training, the underlying concept of improving coordinated muscle activation is similar to the current study. The present study demonstrated that the ratios of lumbar multifidus, gluteus maximus, rectus abdominis and external oblique muscle contractions were statistically significant, highlighting the significance of muscle function restoration using a kinetic approach. These improvements appear to be physiologic because chronic LBP often leads to inhibition of deep spinal stabilizers, especially the multifidus, which leads to decreased spinal control. Motor control exercises restore the proper recruitment patterns and enhance stability. However, on the contrary, current study showed significant completed clinical outcomes, whereas Yalfani et al. mainly presented a treatment protocol without reported final effectiveness results. (29)

The advantage of Kinetic Control Training from the current study is the pathophysiology of chronic low back pain. Chronic pain can result in shifting neuromuscular control, delayed activation of stabilizing muscles and decreased proprioceptive feedback. The lumbar multifidus and abdominal muscles lose their ability to provide segmental stability of the spine, which

leads to compensation of superficial muscles and a rise in mechanical stress. Kinetic Control Training has been shown to increase motor learning, restore muscle timing, and reduces abnormal loading patterns, while also improving spinal stability, thus helping to decrease pain and improve function. (30)

Based on the results of previous studies and the present randomized controlled trial, Kinetic Control Training appears to be an effective rehabilitation method for non-specific chronic low back pain patients. The intervention enhances the severity of pain, functional disability and activation of trunk muscles by correcting impaired motor control mechanisms. All the evidence and findings from this study indicate that Kinetic Control Training is a useful complement to standard physiotherapy in the treatment of chronic low back pain patients to enhance clinical and neuromuscular results.

CONCLUSIONS

Based on these findings, both Kinetic Control Training and Conventional Therapy were effective in reducing pain, improving functional disability among patients with non-specific chronic low back pain. However, Kinetic Control Training produced significantly greater improvements in pain reduction, functional disability compared with Conventional Therapy. Therefore, Kinetic Control Training might be considered a more effective rehabilitation intervention functional outcomes in patients with non-specific chronic low back pain.

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