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# Effect of Cognitive Behavioral Therapy on Functional Outcome in Patients with Lumbosacral Radiculopathy

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## ABSTRACT

**Background:** Pain, tingling, numbness, or weakness that radiates down the lower back and into the lower extremities is known as lumbosacral radiculopathy. It is the most persistent type of musculoskeletal pain, marked by ongoing changes in the central nervous system. Eighty percent of people will experience it at any time throughout their lives. **Objective:** To examine the effectiveness of cognitive behavioral therapy (CBT) on functional outcomes in patients with lumbosacral radiculopathy. **Subjects and Methods:** Fifty-two patients with lumbosacral radiculopathy, with ages between 30 and 45 years, were selected from the Mataria Teaching Hospital clinic, and were randomly split into two groups with the same numbers; study group (GA) underwent cognitive behavioral therapy (CBT), and control group (GB) underwent selected physiotherapy training. Treatment was done two sessions/week for two months. All variables were evaluated before and after the intervention. Visual analogue scale (VAS), Oswestry disability index (ODI), and the fear-avoidance beliefs questionnaire (FABQ) were utilized to evaluate pain level, functional disability, and the effect of fear-avoidance beliefs linked to work and physical activity, respectively. An electro-goniometer was used for measuring active hip joint flexion. Stabilizer pressure biofeedback was applied to evaluate lumbar stability. **Results:** A significant drop in the VAS and ODI was observed in both groups after treatment in comparison to baseline ($p < 0.05$), with a more favorable effect observed in the GA. A significant increase in both lumbar stability and hip flexion angle was observed in the two groups after treatment in comparison to baseline ($p < 0.05$), with a more favorable effect observed in GA. **Conclusions:** CBT is a beneficial approach for alleviating pain and functional impairment in patients with lumbar radiculopathy.

**Keywords:** *Cognitive behavioral therapy, Functional outcome, Lumbosacral radiculopathy, Low back pain.*

## 1. INTRODUCTION

Lumbosacral radiculopathy describes pain, tingling, numbness, or weakness that radiates down the lower back and into the lower limbs [1]. It is identified that most chronic musculoskeletal pain is characterized by constant alterations in the central nervous system (CNS) [2]. It affects 80% of individuals at some point [3]. Low back pain (LBP) is accompanied by lumbosacral radiculopathy. Lumbosacral radiculopathy usually occurs due to impingement of the nerve or nerve root caused by disc herniation or foraminal compressions. Most of the population has encountered LBP and radiculopathy in their lifetime [4]. Lumbosacral radiculopathy is a common ailment in people from different demographic groups. Both sexes are affected, with a prevalence of 3 to 5% of the population [2].

Lumbosacral painful diseases have been extensively studied. The majority of persistent skeletal and muscle pain is typified by ongoing changes in CNS functions. Neurons respond more strongly to input from both unimodal and polymodal receptors. The pathophysiological status that results from these events is known as central sensitization [5].

The management of LBP can be divided into several approaches, including behavioral therapy, medicine, and exercise. The behavioral therapy approach influences social aspects and psychological issues in addition to pain and the resulting impairment. Chronic LBP is not just a physical condition; it is also influenced by the patient's beliefs, actions, and psychological stress [5]. Rest and electrotherapy treatment is frequently preferable for acute symptom management, but exercise and manual therapy are mostly preferred for the treatment of chronic LBP and lumbosacral radiculopathy [6].

Cognitive-behavioral therapy (CBT) is a proven effective therapy which is frequently described for people who have persistent pain. Improving self-efficacy for pain treatment and reducing the negative perspectives, opinions, and behavioral reactions associated with pain, enhances patient outcomes [7].

Cognitive reorganization, problem-solving education, distracting techniques, imagery, establishing goals, activity pace, relaxation techniques like progressive muscle relaxation and deep breathing, and graded activity are examples of CBT-based techniques [8].

This research aimed to explore the effectiveness of CBT training on pain, disability, range of motion (ROM), and the ability of back muscles to stabilize the lumbar spine in patients with lumbosacral radiculopathy.

## 2. PATIENTS AND METHODS

- **Study design:**

The study was conducted to determine the CBT's impact on functional outcomes in patients with lumbosacral radiculopathy. It took place at Mataria Teaching Hospital Clinic from January 2024 to December 2024 after the authorization from the Cairo University's Faculty of Physical Therapy's Ethics Committee (No. P.T.REC/012/004486).

- **Participants**

Fifty-two patients (male: 23, female: 29) with ages ranging from 30 to 45 years had complained of lumbosacral radiculopathy at least 6 months to one year ago with a moderate pain level according to the visual analogue scale scoring (4-8 points). Exclusion criteria were patients with previous lumbosacral surgery, spondylolithesis of the lumbar spine, osteoarthritis of knee or hip joints, systemic disease, tumors, uncontrolled hypertension, and pregnancy or gynecological problems in females that may cause LBP [9].

- **Sample size**

The G*power statistical software (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany) was employed to compute the sample size with the expectation of a significant difference across groups. The results indicated that 26 patients per group were the required sample size for this research. Using $\alpha$=0.05, power=80%, effect size=0.8, and allocation ratio N2/N1=1, calculations were performed.

- **Randomization:**

Following an initial assessment to determine the patient's eligibility criteria, sixty-four patients with lumbosacral radiculopathy were identified; six declined to take part, and six did not fulfill the eligibility criteria. After signing a consent form, eligible patients were split into two equal groups at random. The study group (GA) had the odd numbers, whereas the control group (GB) had the even numbers in a single-blind randomization. There was no participant withdrawal from the study after randomization (Figure 1).

- **Interventions**

The study group (GA) included 26 patients who received cognitive behavioral therapy, two sessions a week for two months, whereas the control group (GB) included 26 patients who received a selected physiotherapy program, two sessions a week for two months.

- **Assessment procedures**

- Every patient had their complete medical history taken after being randomly assigned, including their age, sex, height, weight, and body mass index (BMI); clinical manifestations including pain, sensory and motor symptoms, previous back injuries or surgeries, local examination by observation to posture and spinal alignment, inspection to spine and both legs, palpation to spine and legs, neurological examination including sensory, motor, and reflex examination, and special tests including straight leg raise test, slump test, and crossed straight leg raise test were done. The environment was constant throughout the assessment for all patients. All the variables were compared prior to and after the intervention.

- *Visual analogue scale (VAS)* was provided as a simple technique for measuring the subjective experiences [10].

- *The Fear-avoidance beliefs questionnaire (FABQ) was* utilized to evaluate the impact of fear-avoidance beliefs linked to work and physical activities for lumbar radiculopathy patients. It comprises two subscales: the first is a 7-item working subscale (FABQ-W), with a possible score varying from 0 to 42, and the second is a 4-item physical activity subscale (FABQ-P), with a possible score varying from 0 to 24 [11]. Using a standard 7-point Likert-type scale, every item on the two subscales is evaluated; higher scores indicate better fear-avoidance beliefs [12].

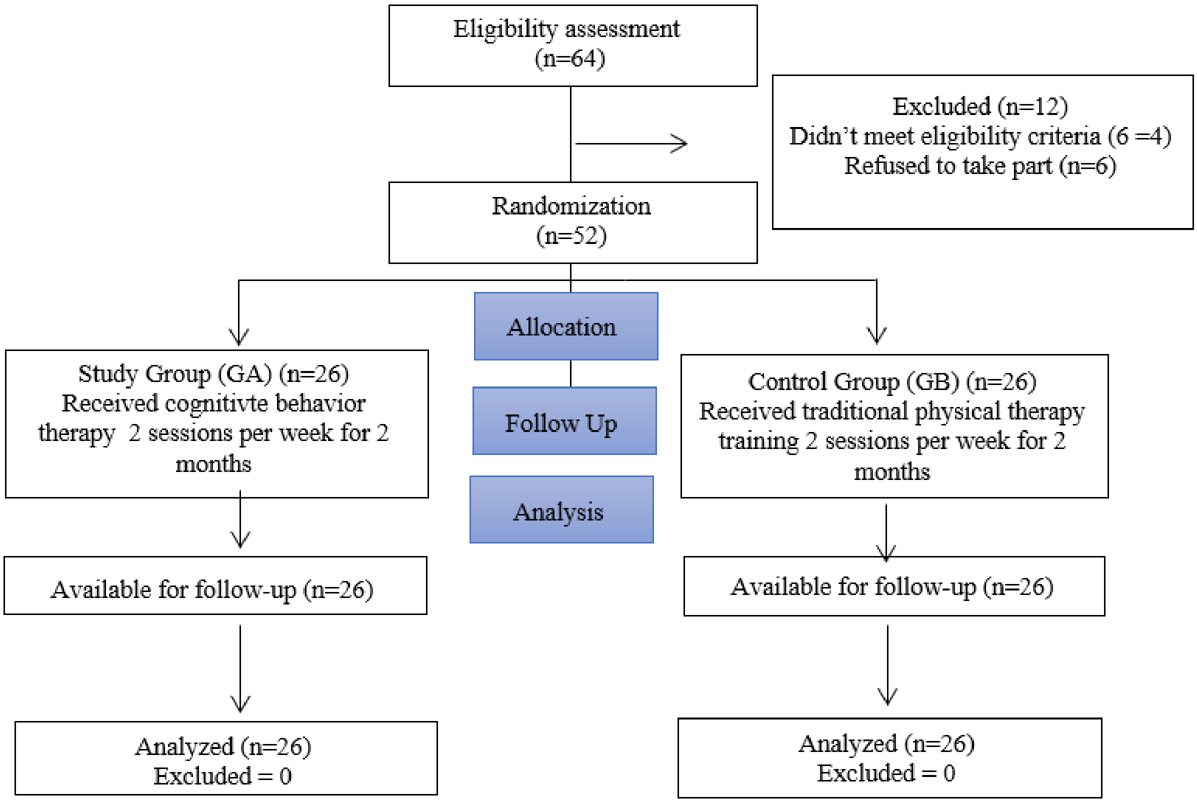


**Figure 1: Flow chart of the study**

- *Oswestry low back pain disability questionnaire (ODI):* Using the Arabic ODI, the patients filled it out and provided a percentage score representing their degree of function in routine activities. Scores ranged from 0 to 5 for each of the six categories. The result is computed as follows if all ten sectors are completed: (score x 100 =… %). Ratings: 1-0% to 20%: minimally disabled, 2 between 21 and 40 %: moderately disabled, 3- From 41 to 60 %: Severely disabled, 4- sixty-one to eighty %: crippled, 5- eighty-one to 100 %: exaggerated symptoms [12].

- *Electro-goniometer:* the patient was asked to do active straight leg raising from a supine lying position, and the hip flexion ROM was measured [13].

- *Stabilizer pressure biofeedback* was applied by asking each patient to make a single active straight leg raising (ASLR) from a supine lying position while putting the cuff under the lumbar spine and elevating the pressure up to 40 mmHG and asking him to do ASLR while keeping the pressure at 40 mmHG in the pressure gauge indicator, then the first reading of the pressure biofeedback device was recorded (Stabilizer Pressure Biofeedback, Chattanooga Group, Chattanooga, USA) [14].

- **Treatment procedures:**

***The session duration for all the patients was 45-50 minutes for two sessions per week for two months.***
*Cognitive behavioral therapy (CBT), including:*

- *Visual biofeedback training* using Pressure stabilizer biofeedback: The device was placed on the lumbar portion, and the patient was asked to use the visual feedback obtained via the dials of the device. First, the airbag beneath the lumbar region was inflated to 40 mm Hg, and then the participant tried to maintain it at the same level while he/she did an active straight leg raising exercise.

- *Diaphragmatic (deep) breathing:* the patient was asked to lie on his back or sit comfortably, then placed a hand on the chest and the other beneath the ribcage, then inhaled slowly through the nose and felt the belly move out against the patient's hand. Pull the abdominal muscles into the rib cage and exhale through pursed lips while maintaining the hand on the chest as still as possible [15].

- *Progressive muscle relaxation (PMR):* It was a methodical approach to reaching a profound level of relaxation created by Dr. Edmund Jacobson in 1938. The patients were directed to close their eyes while lying comfortably. They were told to pay close attention and carefully follow the instructions. The relaxation included tensing the body's particular muscle groups for seven to ten seconds, then letting them relax for fifteen to twenty seconds [16].

- Visualization (body image) technique: It was an effective way to divert attention from pain by concentrating on an outside stimulation rather than bodily motion. Through the division of attention duties, it lessens attention to pain. To start body imaging, each patient was instructed to lie down or choose a comfortable posture where they would not be disturbed. "Close your eyes and let your mind concentrate only on your body." When you notice that your mind is straying, return it to your physical body. Breathe deeply through your abdomen, holding it for a few seconds, and then gently release the breath. Breathe in and out again, feeling your lungs fill with air and your stomach rise. Remind yourself that your body tension is being released as you exhale. Your body is already beginning to relax. Now, focus on your body while you continue to breathe. Feel how your body presses on the surface you are sitting or sleeping on"[17].

***The selective physiotherapy program for lumbar radiculopathy including:***

- Conventional TENS with low-intensity, high-frequency current for 30 minutes [18].
- Heat therapy using a hot pack for 10-15 minutes [19].
- Sciatic nerve neurodynamic mobilization from the SLR position: Every session's SLR was determined by the pre-intervention level of positive SLR. Five minutes were spent continuously performing five glides [20].

- *Lumbar spine stability exercises (LSE):*

*The cat-camel exercise* involved quadrupedal spinal flexion and extension for six to eight rounds. The patient was taught to bend their spine by lowering their back toward the floor and raising their head. Eject a large breath simultaneously, then tuck your head and tailbone in, arching your spine to resemble a camel's hump. Take a deep breath simultaneously [21, 22].

*Curl-up exercise:* The patient was told to keep one knee straight whereas bending the opposite knee to 90 degrees while lying supine. To maintain a neutral spine posture, a towel was positioned beneath the lumbar spine. After that, the patient was told to lift their head and shoulders off the pillow. The patient was advised to raise the extended lower leg with both shoulders and the head after being in this posture for seven seconds ten times, with a one-minute break in between. Additionally, the position was held for seven seconds [23].

*The side-bridge exercise:* From a side lying position with knees flexed at 90 degrees, with elbow and hip support, the patient put his free hand on the opposite hip and was told to elevate their torso till their body was supported by their knee and elbow. This position was held for seven seconds ten times with a one-minute break in between each repetition [24].

The bird-dog exercise: The subject was quadruped with the opposing arm and leg extended. Ten repetitions of the posture were performed, each lasting seven seconds, with a one-minute break in between. As the participants' endurance increased, the exercise version advanced to a harder position that required dynamic motions of the extended lower and upper extremities [25].

**Statistical analysis:**

To compare the patient characteristics across groups, an unpaired t-test was utilized. The chi-squared test was applied to distinguish the sex distribution across the groups. The effects of time and treatment and the interaction between time and treatment on VAS, ODI, hip flexion angle, and lumbar stability were examined using mixed MANOVA. For the subsequent multiple comparisons, post-hoc analyses were employed by the Bonferroni correction [26]. For every statistical test, the significance level was determined at $p < 0.05$. The Statistical Package for Social Studies (SPSS) version 25 for Windows was employed to conduct the statistical analysis [27].

## 3. RESULTS

Comparing the patients' general demographics in the two groups indicated no significant change across the groups in the patients' age mean value (P = 0.48), weight (P = 0.44), height (P = 0.87), BMI (P = 0.40), and sex distribution (P = 0.78), **(Table 1)**

**Table 1: Comparing subject characteristics of the two groups**

| | | Group A | Group B | MD | t- value | p-value |
|---|---|---|---|---|---|---|
| **Age (years)** | | 46.35 ± 4.86 | 47.54 ± 7.20 | -1.19 | -0.70 | 0.48 |
| **Weight (kg)** | | 79.69 ± 6.55 | 78.27 ± 6.62 | 1.42 | 0.78 | 0.44 |
| **Height (cm)** | | 165.35 ± 6.61 | 165.04 ± 7.42 | 0.31 | 0.16 | 0.87 |
| **BMI (kg/m²)** | | 29.19 ± 2.45 | 28.72 ± 1.28 | 0.47 | 0.85 | 0.40 |
| **Sex** | **Females** | 15 (58%) | 14 (54%) | | ($\chi^2$ = 0.08) | 0.78 |
| | **Males** | 11 (42%) | 12 (46%) | | | |

*Data are presented as mean ± SD or frequency (%). SD, Standard deviation; MD, Mean difference; χ2, Chi squared value; p value, Probability value.*

Mixed MANOVA was utilized to determine the impact of treatment on VAS, ODI, hip flexion angle, and lumbar stability. Treatment and time were found to have a significant interaction effect (p = 0.001). The main impact of the treatment was significant (p = 0.02). The main impact time was significant (p = 0.001). **(Table 2)**

**Table 2: Impact of treatment on VAS, ODI, hip flexion angle and lumbar stability**

| **Mixed MANOVA** | |
|---|---|
| **Interaction effect (treatment * time)** | |
| **F = 7.69** | **p = 0.001** |
| **Effect of treatment (group effect)** | |
| **F = 3.13** | **p = 0.02** |
| **Effect of time** | |
| **F = 158.59** | **p = 0.001** |

*F value: Mixed MANOVA F value ,  p value: Probability value.*

A significant reduction in VAS and ODI of the two groups was indicated after treatment compared to baseline values (p < 0.05). Before treatments, no significant change existed across the groups. Group A's VAS and ODI significantly decreased after treatments as compared to group B's (p < 0.05) **(Table 3).**

**Table 3: Mean VAS and ODI before and after treatment of the studied groups**

| | **Group A** | **Group B** | **MD** | **P value** |
|---|---|---|---|---|
| | | **VAS** | | |
| **Pre treatment** | 7.77 ± 1.39 | 7.27 ± 1.28 | 0.5 | 0.18 |
| **Post treatment** | 3.88 ± 1.11 | 4.81 ± 1.13 | -0.93 | **0.005** |
| **MD** | 3.89 | 2.46 | ---- | ---- |
| **% of change** | 50.06 | 33.84 | ---- | ---- |
| **P value within group** | **p = 0.001** | **p = 0.001** | ---- | ---- |
| | | **ODI (%)** | | |
| **Pre treatment** | 62.04 ± 13.96 | 61.65 ± 14.71 | 0.39 | 0.92 |
| **Post treatment** | 38.60 ± 7.93 | 48.29 ± 8.04 | -9.69 | **0.001** |
| **MD** | 23.44 | 13.36 | ---- | ---- |
| **% of change** | 37.78 | 21.67 | ---- | ---- |
| **P value within group** | **p = 0.001** | **p = 0.001** | ---- | ---- |

Data are presented as mean ± SD or frequency (%). VAS: visual analogue scale, ODI: Oswestry disability index, SD, Standard deviation; MD, Mean difference; CI, Confidence interval; p-value probability value , ES: Effect size

A significant reduction in lumbar stability and a significant increase in hip flexion angle of the two groups were indicated after treatment in comparison to baseline (p < 0.05). No significant changes across groups were detected before treatment. After treatment, group A's hip flexion angle and lumbar stability significantly increased in comparison to that of group B (p < 0.05). **(Table 4).**

**Table 4: Mean hip flexion angle and lumbar stability before and after treatment of the studied groups**

| | **Group A** | **Group B** | **MD** | **P value** |
|---|---|---|---|---|
| | | **Hip flexion angle (degrees)** | | |
| **Pre treatment** | 41.42 ± 6.68 | 40.08 ± 8.88 | 1.34 | 0.54 |
| **Post treatment** | 67.31 ± 6.36 | 58.65 ± 7.94 | 8.66 | **0.001** |
| **MD** | -25.89 | -18.57 | ---- | ---- |
| **% of change** | 62.51 | 46.33 | ---- | ---- |
| **P value within group** | **p = 0.001** | **p = 0.001** | ---- | ---- |
| | | **Lumbar stability (mmHg)** | | |
| **Pre treatment** | 69.92 ± 11.35 | 67.88 ± 10.10 | 2.04 | 0.49 |
| **Post treatment** | 42.62 ± 8.80 | 51.42 ± 9.03 | -8.8 | **0.001** |
| **MD** | 27.3 | 16.46 | ---- | ---- |
| **% of change** | 39.04 | 24.25 | ---- | ---- |
| **P value within group** | **p = 0.001** | **p = 0.001** | ---- | ---- |

Data are presented as mean ± SD or frequency (%). SD, Standard deviation; MD, Mean difference; CI, Confidence interval; p-value, probability value ; ES: Effect size

## 4. DISCUSSION

In the current study, the patients were between the ages of 30 and 45 years to get the best effect of CBT, as it is an efficient therapy for subjects with chronic pain among various age groups, especially younger adults [28]. Wetherell et al. [28] indicated that older adults with LBP had higher probability to engage in acceptance and commitment therapy (ACT), yet younger adults with LBP had a greater response to CBT. Also, this age was detected because it is the most common age of incidence of LBP in adults. This agrees with Mustafa [11], who found that the LBP’s incidence increases in middle age, with the frequently prevalent age ranging from 35 to 55 years old. Our study's findings demonstrated that group A experienced a significant reduction in VAS after treatment in comparison to baseline (p = 0.001), with a percentage change of 50.06%, and group B experienced a significant decrease in VAS after treatment in comparison to baseline (p = 0.001), with a change percentage of 33.84%. Additionally, group A's VAS significantly reduced after intervention in comparison to group B's (p = 0.005). This can be interpreted as physical therapy sessions and CBT had a good influence on pain in lumbar radiculopathy patients with the superiority of the CBT group. Both techniques decrease the disability level for the patients. This causes a decrease in pain level. These improvements occur because pain is not just a physical condition, but it is influenced by the patients behaviors and beliefs, illness behaviors, and psychological stress. So, both physical and CBT can affect the patients’ pain [29].

In the same line, Elshiwi et al. [30] indicated a significant lowering in VAS in the patients' group who underwent CBT plus a selected traditional physiotherapy program after intervention in comparison to baseline (p = 0.001).

Furthermore, it comes in agreements with a study done by Aliyu et al. [9] who combined lumber stabilization exercises with CBT, which found an improvement with a significant change between baseline and after treatments for pain severity in both groups.

In explanation of our results, patients' pain, distress, and pain behaviors decreased with CBT and behavioral therapies for chronic pain, and their daily function improved [31].

The research offers verifiable evidence that the management of chronic LBP should prioritize pain education and CBT. As a result, patients can actively participate in their pain management. A qualified therapist could give it to the patient in group or one-on-one sessions [32].

The majority of earlier research was applied to the effectiveness of CBT in addition to other modalities on pain, so further studies should be conducted to identify the impact of CBT only on pain or in comparison with other modalities.

Our study indicated a significant reduction in ODI in group A after intervention in comparison to baseline (p = 0.001) with a percentage of change of 37.78%. Furthermore, a significant decrease in ODI was observed in group B after intervention in comparison to baseline (p = 0.001), with the percentage of change being 21.67%. A significant reduction in ODI of group A was revealed after treatment in comparison to that of group B. The probable explanation for our results is that CBT decreases pain for lumbar radiculopathy patients, as by its role it would decrease disability levels.

Regarding the results, a significant increase in hip flexion angle in group A was revealed after the intervention compared to baseline (p = 0.001), with a percentage of change of 62.51%. Furthermore, a significant increase in hip flexion angle in group B was revealed after treatment in comparison to baseline (p = 0.001), with the percentage of change being 46.33%. In comparison to group B, group A's hip flexion angle significantly increased following treatment (p = 0.001).

Instead, a significant improvement in lumbar stability was detected in group A after intervention in comparison to baseline (p = 0.001), with the percentage of change being 39.04%. A significant improvement in lumbar stability was observed in group B after intervention in comparison to before intervention, with the percentage of change being 24.25%. So, a significant improvement in the lumbar stability of group A was observed after treatment in comparison to that of group B.

These improvements in hip flexion angle and lumbar stability occur as a result of decreasing pain and improving musculature of the lumbar region. By relieving the muscle spasm after using the CBT technique, the ROM of the hip joint improved, especially at the site of radiculopathy.

Our findings were confirmed by Magalhães et al. [33], who demonstrated that integrating behavioral and cognitive strategies into graded exposures and graded activities improved the activity threshold for lumbar radiculopathy. Further studies should be done on the effect of CBT on hip flexion and lumbar stability in patients with lumbar radiculopathy.

**Research’s limitations**

The limitations of the current study were that psycho-physiological factors and personal and individual differences among the patients may affect the results. Our study may not have the power to entirely investigate the precise effectiveness of cognitive behavior therapy on hip flexion ROM because of the limited sample size; therefore, additional research on larger populations is necessary to accurately detect its significant clinical impact on patients with lumbar radiculopathy. Additional research is necessary to examine the long-term efficacy of CBT on lumbosacral pain, and further research should be conducted on the effect of CBT plus traditional physiotherapy programs on pain in the lumbosacral population.

**Conclusions**

Cognitive behavior therapy (CBT) is an effective technique in alleviating pain and functional impairment in patients with LBP and lumbar radiculopathy. Furthermore, CBT is effective in improving hip flexion angle and lumbar stability in patients with LBP and radiculopathy.

**Authors' Contributions:**

**SAE** conceived and designed the study. **SAE, ES, SS, and SSM** collected the data. **SAE, ES, SFS, and SSM** performed data analysis and interpretation. **SAE, ES, SFS, MAN, and SSM** drafted the manuscript. **All authors** contributed to the critical revision, approved the final version of the article, and participated in the statistical analysis.

**LIST OF ABBREVIATIONS:**

| | |
|---|---|
| **BMI** | Body mass index |
| **CBT** | Cognitive behavioral therapy |
| **FABQ** | Fear-avoidance beliefs questionnaire |
| **LBP** | Lower back pain |
| **LSE** | Exercise of lumbar stabilization |
| **ODI** | Oswestry disability index |
| **PMR** | Progressive muscle relaxation |
| **RCT** | Randomized controlled clinical trial |
| **ROM** | Range of motion |
| **VAS** | Visual Analogue scale |

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