SPORT TK-EuroAmerican Journal of Sport Sciences

https://revistas.um.es/sportk Online ISSN: 2340-8812

Received: **30/03/2025.** Accepted: **30/07/2025.** Published: **22/11/2025**

# Effect of a structured physical therapy program on pain, disability, and mobility in chronic nonspecific low back pain

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## ABSTRACT

This study aimed to evaluate the effectiveness of structured physiotherapy program in reducing pain intensity (PI), and in improving functional disability (FD), and functional mobility (FM) in individuals with chronic nonspecific low back pain (CNSLBP). This was a prospective cohort study with an interventional design encompassing 47 outpatients with CNSLBP aged 18-64 (48.0±12.6), comprising 15 males and 38 females. A six-week structured physical therapy program included a two-week (5x/ week) supervised physiotherapy regimen, followed by a four-week home exercise programme (HBE) encompassing stretching, endurance, strengthening and aerobic exercises. PI, FD, and FM were assessed using a numerical rating scale (NRS), the Oswestry Disability Index (ODI), and a 30-second sit-to-stand test (30STS) respectively. NRS scores showed a significant decrease from baseline (5.93±2.95) to six weeks (2.68±1.68) after physiotherapy intervention ($p<0.05$). ODI scores significantly decreased from 16.36±5.70 to 7.39±5.02 ($p<0.05$) indicating an improvement in FD. The 30STS test reviled a significant enhancement following the two-week physiotherapy intervention ($t=3.225$, $p=0.002$). Our study showed a significant reduction in PI and an improvement in FD and FM after a two-week physiotherapy intervention. In addition, the four-week HBE program contributes to continuous improvement in PI and FD, highlighting its effectiveness in supporting and increasing the profits of the supervised phase.

## KEYWORDS

Low Back Pain; Exercise Therapy; Disability; Mobility

## 1. INTRODUCTION

Low back pain (LBP) is the leading cause of disability and the most common of all non-communicable diseases. Approximately 20% of individuals with LBP develop chronic back pain, lasting for 12 weeks or more (Owen et al., 2020; SC Park et al., 2023). It is associated with a range of significant biophysical and social dimensions that affect personal functioning, participation, quality of life, and financial prosperity (Fisher et al., 2020; Mutubuki et al., 2020; O'Keeffe et al., 2020).

Most patients with LBP are diagnosed with 'nonspecific low back pain' (NSLBP), embracing symptoms that cannot be attributed to a recognized specific pathology (Hayden et al., 2012). The prevalence of low back pain increases linearly from the third decade of life to the age of 60, estimating that by 2050 the prevalence of LBP will increase by 36.4% worldwide from 2020 (Nieminen et al., 2021; Ferreira et al., 2023). Therefore, effective interventions that include complex treatments are needed (Wirth & Schweinhardt., 2024), and physiotherapy plays an important role in the treatment of chronic nonspecific low back pain (CNSLBP) (Koppenaal et al., 2020).

The existing literature emphasizes that physiotherapy interventions improve overall outcomes in patients with CNSLBP, suggesting that involving physiotherapy early in the treatment process can also reduce health costs (Tikhile & Patil, 2024). Although there are some guidelines for the treatment of CNSLBP, there are differences between the recommendations given (WHO Guidelines for Nonsurgical Treatment of Chronic Primary Low Back Pain in Adults in Primary and Community Care Settings, 2023). Therefore, it is necessary to assess the effectiveness of physiotherapy interventions in everyday clinical settings, distinguishing the stages of CNSLBP, the duration of physiotherapy treatment techniques, and approaches (Tikhile & Patil, 2024).

Although physiotherapy interventions include a wide range of physiotherapy techniques (Hayden et al., 2021), sports therapy remains a common treatment approach for chronic low back pain (CLBP) (Salehi et al., 2024). This study aims to investigate the effectiveness of structured physiotherapy interventions in reducing pain intensity (PI), and in improving functional disability (FD) and functional mobility (FM) in people with chronic nonspecific low back pain (CNSLBP).

## 2. METHODS

### 2.1. Design and Participants

This prospective cohort study with an interventional design followed the guidelines of Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) (Von Elm et al.,

2008). The study was conducted at the Clinic of Physical Medicine and Rehabilitation of the University of Kosovo Clinical Center, from October 2023 to February 2024. This research followed the principles of the Helsinki Declaration. Permission for this research was obtained from the Ethics Committee of the Faculty of Medicine, Prishtina University (No. 4948).

Forty-seven consecutive outpatients with a previous diagnosis of CNSLBP were referred for a structured physical therapy program, consisting in two-week supervised physiotherapy regiment followed by four-week home-based exercise (HBE) program. The inclusion criteria consisted of patients diagnosed with nonspecific chronic low back pain that lasted for more than three months, between 18 and 65 years (for descriptive purposes patients were grouped into 5-year interval), of both sexes, without cognitive impairment, and who had the ability to understand, read and write in Albanian. Patients were excluded from the study if they had spondylolisthesis, spinal stenosis, heart failure (NYHA Class III and IV), kidney or liver failure, severe psychiatric disorders, spinal infections or tumors, inflammatory or metabolic rheumatic diseases, a history of previous or planned spinal surgery, neurological deficits, urinary incontinence, or pregnancy. Patients who meet the inclusion criteria provide their written consent before participating in the study. During the two-week supervised physiotherapy regiment followed by four-week HBE program, the patients were restricted to using any form of drug therapy.

### 2.2. Measurement Procedure

Sociodemographic and clinical data were collected using a structured questionnaire. The sociodemographic information collected included the participants' name, surname, age, gender, marital status, education level, and occupation. In addition, lifestyle factors such as smoking and alcohol consumption, along with the duration of CNSLBP, were recorded. Patients' weight and height were measured, and their body mass index (BMI) was then calculated. Clinical data include PI, FM, and FD assessments. This research was conducted by two experienced physiotherapists. PI, FM and FD were evaluated at the time of patient enrollment and again two weeks after the supervised physiotherapy regiment. Furthermore, PI and FD are reassessed after completing the HBE program.

The exercise program includes stretching, endurance, strengthening and aerobic exercises. Pain intensity was assessed using the Numerical Rating Scale (NRS), where patients rate their pain on a scale from 0 (no pain) to 10 (worst pain imaginable) based on their experiences in the past 24 hours. The final pain intensity score was found by calculating an average of three ratings (Breivik et al., 2008). FM was assessed using a 30-second sit-to-stand test (30STS), which measures the number

of times a patient can transition from a sitting to a standing position in a 30-second period The primary aim of 30STS test is to evaluate lower extremity strength and endurance, which are main components of functional mobility (Kahraman et al., 2016). FD was assessed using the self-reported Oswestry Disability Index (ODI) questionnaire, which evaluated the physical limitations and social impact of disability in patients with low back pain. The questionnaire consisted of 10 items, each graded on a scale of 0 to 5, with higher scores indicating higher levels of disability (Fairbank et al., 1980; Fairbank & Pynsent, 2000).

After two weeks of supervised physiotherapy treatment, patients are re-evaluated for PI, FM, and FD. Each patient receives an informational leaflet summarizing the exercise program. Four weeks after completing the HBE program, patients are contacted and reassessed for PI and FD. Structured Physiotherapy Program consists in two-week supervised physiotherapy regiment followed by four-week HBE program.

### 2.2.1. Supervised Physiotherapy Regiment

The two-week group-supervised physiotherapy program includes a five-day-per-week physiotherapy regimen consisting of an exercise program and physiotherapy treatment modalities, with each session lasting between 45 and 60 minutes. The exercise program is complemented by a variety of physiotherapy treatment modalities, which are chosen for their ability to provide pain relief and support overall functional improvement in patients with CNSLBP. The specific physiotherapy modalities provided during the supervised treatment period are detailed in Table 1 below.

**Table 1.** Physiotherapy treatment modalities

| **Physiotherapy treatment modalities** | **n** | **%** |
|---|---|---|
| **IFT + IR** | 8 | 17% |
| **TENS + IR** | 15 | 31.9% |
| **DOZENS + IR + US** | 16 | 34% |
| **TEN** | 7 | 14.9% |
| **IFT** | 1 | 2.1% |

TENS is applied using the conventional method described by Traves et al. (2020). The IR lamp with a power of 150 W is placed 60 cm from the waist area and applied for 10-15 minutes.

IFT is applied for 20 minutes using one of the alternating currents at 4000 Hz, while the other alternating current frequencies are adjusted between 4000 and 4250 Hz, resulting in a low 'beat' frequency modulated by an amplitude of 0-250 Hz (Rampazo et al., 2023). Therapeutic US was

calibrated at a frequency of 1MHz and an intensity of 1.5 W/cm2 for 5-10 minutes in the lumbar region (Ozen et al., 2023).

The exercise program is designed in accordance with evidence-based guidelines as outlined by George et al. (2021); Hayden et al. (2021), ensuring its effectiveness and clinical relevance in the treatment of CNSLBP. Based on the training program provided, exercises are categorized into four main groups: A) active stretching exercises, B) strengthening exercises, C) waist stabilization exercises, and D) aerobic exercises.

Below is a detailed academic description of each category, including the specific exercises within each group, along with the targeted muscle groups.

- ***A) Active stretching exercises*** are designed to improve flexibility and reduce muscle stiffness in the lumbar spine and lower extremities. These include single and double chest knee stretches, which target the erector spine, gluteus maximus, and hamstrings, improving lumbar spinal flexion. The Piriformis Stretch focuses on the deep hip rotator, while the Hamstring Stretch improves hamstring flexibility using a non-elastic band. Stretching the child's pose helps to lengthen the erector spinae, latissimus dorsi, and gluteus maximus by facilitating deep lumbar flexion.
- ***B) Strengthening exercises*** aim to improve muscle endurance, stability, and postural control, with a focus on the core, lower back, and lower extremities**.** Bridging exercises activate the gluteus maximus, hamstrings, and core muscles by lifting the hips, while back extensions strengthen the erector spine and multifidus through controlled upper body lifts. In addition, the hip abduction that lies sideways targets the gluteus medius and minimus, improving lateral hip stability. Prone back strengthening exercises, including arm and leg lifts, involve the spinae, trapezius, and rhomboid erectors, improving spinal and postural support.
- ***C) Lumbar stabilization exercises*** focus on increasing core strength, improving motor control, and minimizing excessive lumbar movements**.** The Isometric Oblique Core Press activates the rectus abdominis, oblique, and transversus abdominis by incorporating resistance-based foot movements in a bent knee position, improving deep core stability. Bridging exercises also contribute to lumbar stabilization by engaging the gluteus maximus, erector spinae, and core muscles, supporting spinal alignment and reducing strain on the lower back.

- ***D) Aerobic exercise;*** Patients are advised to include aerobic activities such as walking, cycling, or swimming at least three times a week, for 30-45 minutes.

#### *2.2.1.1. HBE program*

The informational leaflet includes a brief description of non-specific chronic low back pain, exercise precautions and warnings, contact information, and detailed instructions on the duration and frequency of exercise, along with illustrations. The physiotherapy intervention was homogeneous across all age groups. Exercise intensity and progression were adjusted based on individual tolerance. The exercises given are the same as those used in the two-weeks supervised training program (see Supplemental materials).

### 2.3. Statistical Analysis

G-power software (Kang, 2021) has shown that a sample of 43 people has enough statistical power to detect statistically significant differences. For statistical analysis, the SPSS v21 program was used and $p<0.05$ was considered statistical significance. Continuous variables are summarized and presented with mean and standard deviation or median and interquartile levels, as appropriate, while categorical variables are presented with frequency and percentage. The difference between variable repeated measurements is analyzed by ANOVA test and post hoc Bonferroni test. The difference between the two averages was analyzed using an independent sample t-test, while the Chi-square test was used for a comparison of the distribution of categorical variables.

## 3. RESULTS

Table 2 shows the sociodemographic characteristics of patients with nonspecific chronic low back pain (NSCLBP). The sample had a mean age of 48 years (48.0±12.6). Most participants were women (68.1%), and more than half of the participants were unemployed (57.4%). A total of 53.2% of participants used medications for chronic diseases (53.2%), while almost none used orthopaedic aids (2.1%). The average BMI was 26.8, placing the group in the overweight range. Regarding the duration of chronic nonspecific low back pain, the majority had symptoms for one year or more (72.3%) (Table 2).

**Table 2**. Sociodemographic characteristics of research participants

| Variable | Mean±SD | n (%) |
|---|---|---|
| **Age** | 48.0±12.6 | |
| **Gender** | | |
| Man | | 15 (31.9) |
| Woman | | 32 (68.1) |
| **Marital status** | | |
| Married | | 5 (10.6) |
| Never married | | 40 (85.1) |
| Divorced / Widowed | | 2 (4.3) |
| **Education level** | | |
| Primary school | | 13 (22.7) |
| Secondary school | | 16 (34.0) |
| University Education | | 18 (38.3) |
| **Work** | | |
| Used | | 20 (42.6) |
| Unemployed | | 27 (57.4) |
| **Cigarette** | | |
| Yes | | 6 (12.8) |
| No | | 41 (87.2) |
| **Alcohol Consumption** | | |
| Yes | | 2(4.3) |
| No | | 45(95.7) |
| **Use of drugs for chronic diseases** | | |
| Yes | | 25 (53.2) |
| No | | 22 (46.8) |
| **Use of orthopaedic aids** | | |
| Yes | | 1 (2.1) |
| No | | 46 (97.9) |
| **BMI** | 26.8±4.6 | |
| **Duration of CNSPBP** | | |
| 3 months | | 9 (19.1) |
| 6 months | | 4 (8.5) |
| 1 year and more | | 34 (72.3) |

In the following, Table 3 illustrates a comparison of NRS scores recorded at baseline, two weeks and six weeks after physiotherapy intervention. The results revealed a statistically significant improvement in both outcomes ($p<0.05$). Furthermore, paired comparisons using Bonferroni corrections showed significant differences in NRS scores between baseline and two weeks, baseline and six weeks, and between two and six week evaluations, the latter corresponding to the four-week continuation period of the HBE program. ($p<0.05$). At baseline, the PI was 5.93 ± 2.95, which

decreased to 3.73 ± 1.69 after two weeks of physiotherapy and further decreased to 2.68 ± 1.68 after six weeks.

**Table 3**. Comparison of numerical rating scale (NRS) scores at baseline, 2 weeks, and 6 weeks after physiotherapy

| Numerical Rating Scale | Average ± SD | F value | p value |
|---|---|---|---|
| Basis | 5.93 ± 2.95 | | |
| After 2 weeks | 3.73 ± 1.69 | 49.213, | <0.0001 |
| After 6 weeks | 2.68 ± 1.68 | | |

Table 4 presents the comparison of Oswestry Disability Index (ODI) scores measured at three time points—baseline, two weeks, and six weeks after physiotherapy.

**Table 4**. Comparison of Oswestry Disability Index (ODI) scores at baseline, two weeks, and six weeks after physiotherapy

| Oswestry Disability Index | Average ± SD | F value | p value |
|---|---|---|---|
| Basis | 16.36 ± 5.70 | | |
| After 2 weeks | 10.34 ± 5.15 | 77.420, | <0.0001 |
| After 6 weeks | 7.39 ± 5.02 | | |

Based on the results of Table 4, paired comparisons using Bonferroni correction revealed statistically significant differences in ODI scores between baseline and two-week evaluation, between baseline and six-week evaluation, and between two- and six-week evaluations ($p < 0.05$). These findings are consistent with the four-week follow-up period of the HBE program. Furthermore, the functional disability FD parameter showed a progressive decline, decreasing from 16.36 ± 5.70 at baseline to 10.34 ± 5.15 at two weeks, and then to 7.39 ± 5.02 at six weeks.

Table 5 presents the performance of the 30-second sit-to-stand test measured before and after the two-week physiotherapy intervention.

**Table 5**. Comparison of 30-second sit-to-stand test scores at the beginning and two weeks after the physiotherapy program

| 30-second sit-to-stand test | Average ± SD | t value | p value |
|---|---|---|---|
| Basis | 8.70 ± 2.95 | 3.225 | 0.002 |
| After 2 weeks | 10.45 ±3 .41 | | |

Paired sample t-tests revealed a statistically significant improvement in test performance after intervention ($t = 3.225$, $p = 0.002$). At baseline, the mean score was $8.70 \pm 2.95$, with further improvement observed at the two weeks of follow-up.

## 4. DISCUSSION

Our results suggest that physiotherapy treatment consisting of an exercise program combined with physiotherapy modalities is effective in reducing PI, FD and improving FM in patients with CNSLBP.

A study published in 2019 (Suh et al., 2019) compared four types of exercise for chronic low back pain, showing that walking exercises and lumbar stabilization exercises were effective in reducing PI and increasing physical endurance, while functional impairment was improved in all types of exercise. In our study, we have used lumbar stabilization exercises in combination with other types of exercises, resulting in increased PI and FD. The effectiveness of sports therapy for CNSLBP was also confirmed by Park et al. who showed that PI and FD increased significantly between the fourth and eighth weeks of treatment (Park & Song, 2022). However, our study showed a significant improvement in patients as early as two weeks after supervised physical therapy treatment. These previous positive effects can be attributed to supervised 'face-to-face' physiotherapy programs, the benefits of which have been shown elsewhere (Poredos et al., 2021).

Another factor may be attributed to the age of the patient, as we have included patients up to the age of 65, in contrast to Park & Song (2022) which included patients over 65 years of age. Nayyab et al. (2021) suggest that a supervised core stabilization exercise program is more effective in reducing pain, disability, and improving core muscle activation compared to an unsupervised exercise program performed at home (Nayyab et al., 2021). A recent study showed that combining core exercises with electrotherapy, specifically interferential therapy, for 12 weeks had a greater effect on reducing pain and disability than applying core exercises and IFT separately (Zuo et al., 2024). In our study, in the first two weeks of physiotherapy treatment, we applied a combined program of therapeutic exercises and physiotherapy treatment modalities. Although the modality was only applied in the first two weeks of rehabilitation, our results are consistent with the results of the studies mentioned above (Zuo et al., 2024).

In addition to exercise programs, TENS and IRT are common modalities often used for the treatment of CLBP (Tella et al., 2022; Rampazo et al., 2023). In our study, TENS was applied to 80.85% of participants, either as self-medication or in combination with other modalities. In addition

to two weeks of supervised physical therapy treatment performed in a clinical setting, our patients receive a four-week HBE program. Fernández-Rodrguez et al. in their study concluded that all types of physical exercise are effective in improving pain and disability, with the exception of stretching exercises (to reduce pain) and exercises according to the McKenzie method (to reduce disability) (Fernández-Rodrguez et al., 2022). Our studies have shown a significant improvement in pain and disability after a six-week exercise program, including some types of exercise. Other studies also provide evidence that 'active therapies', such as Pilates, resistance training, motor stabilization/control, and aerobic exercise are more effective in managing pain (Owen et al., 2020). A literature review of 18 studies suggests that yoga may be more effective in reducing pain and improving disability than without treatment. However, no significant differences were found compared to the exercise group (Zhu et al., 2020).

A study by Miftari et al. (2024) showed that pain intensity and functional disability increased significantly after six weeks of treatment that included therapeutic exercises, TENS, traction, and thermotherapy in people with chronic low back pain. Similarly, our study shows that physiotherapy exercise programs combined with physiotherapy modalities are effective in reducing pain intensity and functional disability in patients with NSCLBP (Miftari et al., 2024). Matarán-Pearrocha et al. (2020) suggested the implementation of an exercise program, supervised by a physiotherapist for the treatment of CLBP, as they showed better results in reducing PI and FD than the group that only underwent an informational session and was instructed to continue exercising at home, without the supervision of a physiotherapist. However, the difference is small and clinically insignificant (Matarán-Pearrocha et al., 2020). We support the suggestion of Matarán-Pearrocha et al. (2020) however, we would like to emphasize the importance of the HBE program, as we have found a significant improvement in pain and disability.

Our results are supported by a systematic review showing that HBE improves PI and functional limitations in patients with CLBP, regardless of modality, duration of treatment, and frequency of exercise (Quentin et al., 2021). Özden et al. (2022) compared the use of telerehabilitation software with conventional paper-based rehabilitation programs. After 8 weeks of treatment, the telerehabilitation group achieved more significant improvements in pain, function, and motivation compared to the paper-based conventional rehabilitation group (Özden et al., 2022). Although we have been using paper-based leaflets, we have found a significant improvement after four weeks of the HBE program. Otherwise, Koppenaal et al. report that electronic exercise programs are no more effective than conventional physiotherapy in improving physical function in patients

with CLBP. Improvements in physical function and PI were statistically significant and clinically significant in both groups (Koppenaal et al., 2022).

An important point of our study is that we have used supervised physical therapy treatment for two weeks in a clinical setting, followed by a four-week home exercise program, while patients performed the exercises according to our instructions and learned how to apply them at home. However, this research has certain limitations that are important to acknowledge. More studies, including control groups without HBE program leaflets, as well as longer patient follow-ups, are desirable. We also recommend developing a variety of applications through live video or real-time communication, which will allow for participant supervision when implementing the HBE program.

## 5. CONCLUSIONS

Our study showed that a structured physiotherapy program resulted in significant improvements in pain reduction, functional disability and functional mobility. Notably, it has been shown that after two-weeks of physiotherapy intervention, functional mobility enhanced effectively, along with a significant decrease in pain intensity (PI) and an improvement in functional disability (FD) and functional mobility (FM) . In addition, the findings suggest that a 4-week home exercise program (HBE) contributes to a sustained reduction in PI and FD, underscoring its effectiveness in supporting and further enhancing the therapeutic gains achieved during the supervised phase.

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## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

## FUNDING

This research received no external funding.

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