

A Study on the Effect of Exercise Intervention on Function and Pain in Patients with Low Back Pain

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Abstract: Lower back pain (LBP) has a relatively high incidence across various age groups, characterized by discomfort in the lumbosacral and iliosacral regions above the gluteal striatum and within the region below the costal margins. Some patients also experience varying degrees of leg pain, with many experiencing prolonged and recurrent symptoms. International consensus confirms that exercise intervention is an effective treatment method for lower back pain, offering safe and efficient physical therapy. Extensive practical experience suggests that Pilates exercises can effectively regulate the strength of muscle tissue in the peripheral region of the spine, improve muscle endurance, and alleviate low back pain caused by muscular factors. This study analyzes the effects of exercise intervention on the function and pain of patients with lower back pain. It explores various exercise modalities, utilizes SPSS26 statistics to gather data, and draws conclusions with the aim of providing theoretical references for exercise interventions in patients with lower back pain.

Keywords: Exercise intervention; Low back pain; Lumbar spine function

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1. Literature review

1.1. Progress of foreign studies

Zhu *et al.* ^[1] identified differences in the effectiveness of non-exercise therapy compared to yoga therapy by conducting a search across online databases. They selected randomized controlled trials conducted between mid-2019 and 2020, evaluating the impact of yoga on pain, disability, and quality of life in patients with chronic low back pain. Wieland *et al.* ^[2] found moderately conclusive evidence from clinical trials indicating that increased back pain was primarily associated with the risk of adverse events related to yoga. Valenza *et al.* ^[3], in their related research, conducted a randomized study on lower back pain patients meeting diagnostic criteria. The control group did not undergo any exercise intervention, while the research group implemented Pilates exercises. The results revealed a significant advantage in functional scores for the research group compared to the control group, suggesting that Pilates plays a role in restoring lumbar mobility and promoting back mobility recovery. Sonmezer *et al.* ^[4] conducted a controlled group study involving 40 pregnant women with low back pain. Their findings indicated that pregnant women who regularly practiced Pilates experienced less low back

pain and a significantly higher quality of life. Yao *et al.* [5] analyzed 20 cases of diagnosed lower back pain and randomly divided them into experimental and control groups. The study group underwent regular tai chi training, while the control group did not receive any exercise interventions. The results demonstrated a clear advantage in balance and gait for the study group, suggesting that tai chi has a positive impact on alleviating lower back pain. Yan *et al.* [6] demonstrated that regular and standardized practice of the Five Birds exercises by lower back pain patients resulted in reduced lumbar pain, improved overall sleep quality, and significantly enhanced lumbar muscle strength.

1.2. Progress of domestic research

Li *et al.* [7], in their research on lower back pain, analyzed a comprehensive sample of 72 patients, dividing them into two groups: treatment and control. The control group received Tuina treatment, while the treatment group underwent Tuina combined with Yijinjing training. Results indicated a significant advantage in pain reduction and improved lumbar mobility for the treatment group. Li *et al.* [8] studied 24 patients with low back pain, instructing them to practice Yijinjing daily. After 3 months of intervention, patients reported significantly reduced pain levels and improved lumbar function. Zhu conducted a research study on lower back pain, surveying emergency medical personnel through a questionnaire. Findings revealed a prevalence rate of 85.9% for lower back pain [9]. Yang *et al.* [10] conducted a professional meta-analysis of lower back pain, determining McKenzie therapy as the most effective intervention program for this condition, with positive implications for patient recovery. He [11] introduced a classification model of motor system damage during the study of lower back pain. Patients underwent stability training of core function, resulting in improved pain and dysfunction in the late stage of training. Xia *et al.* [12] instructed patients with lower back pain to undergo recumbent cushion traction therapy and McKenzie therapy training. Results demonstrated improved pain levels among patients.

2. Materials and methods

2.1. General information

Patients with low back pain who were admitted and admitted to the First Affiliated Hospital of Hainan Medical College from May 2022 to May 2023 and met the diagnostic criteria were selected as the base sample, and the sample size was 92 cases. Inclusion criteria included: (1) Age 18–60 years old; (2) All patients were able to engage in work during the trial period; (3) Through the comprehensive examination and evaluation of the disease, it was in line with the diagnostic criteria of the disease set by the American Physical Therapy Association. Exclusion criteria included: (1) Previous combination of underlying lumbar diseases and lower limb lesions, the waist and lower limbs can not be moved normally, and accompanied by underlying cardio-cerebral and cerebral vascular diseases, mental disorders, and cognitive dysfunction, etc., which may affect the results of the study; (2) The nervous system has a certain degree of lesions, and the patient is unable to maintain a conscious state throughout the treatment. During the study, the patients were randomly divided into experimental and control groups by the numerical table method, with 46 samples in each group, and the specific matters of the study were reported to the Medical Ethics Committee for approval.

2.2. Methods

Throughout the patient's hospitalization, the medical staff provided comprehensive and systematic health guidance [13]. This included detailed explanations of the causes and symptoms of low back pain, informing patients about daily activity precautions, outlining the treatment process and precautions, and addressing any questions raised by the patients.

Both groups of patients received physical therapy three times a week for 12 consecutive weeks. The study group underwent power cycling combined with Pilates exercise intervention. After completing routine physical therapy, patients were instructed to perform routine muscle stretching and pedal the power bicycle for 30 minutes, three times a week, over a 12-week treatment cycle. Subsequently, patients were guided through Pilates exercise therapy [14], combined with standing postures and yoga poses such as flying swallow pose, bridge pose, shoulder bridge pose, and side plank pose. Each movement was held statically for 8 seconds per repetition, repeated 10 times. This exercise intervention was also performed three times a week over a 12-week treatment cycle. Following this, patients were followed up with phone calls to assess their pain and functional status.

All subjects underwent pre- and post-intervention tests, and the results were statistically analyzed. These included the Pain Visual Analog Scale (VAS), which assessed pain levels on a scale of 1 to 10, and the Oswestry Dysfunction Inventory (ODI), a 10-question questionnaire covering various areas of dysfunction. Both assessment indicators were evaluated by the same therapist before and after the intervention in both groups, ensuring consistency.

2.3. Statistical analysis

The data were processed and analyzed using SPSS 26.0 software. The paired sample t-test was employed to compare the indexes at 0 and 12 weeks of intervention, with a significance level set at 0.05 and a very significant difference level set at 0.01. Additionally, the distances from the tip of the patient’s fingers during lumbar anterior flexion to the ground (in cm) and the distances from the left and right sides of the patient’s lumbar lateral flexion to the ground (in cm) were compared between the data at 0 and 12 weeks. A *P* value of less than 0.05 indicated a statistically significant difference.

3. Results

According to the analysis of the subjects’ general data, there were no significant differences between the two groups in terms of age, height, and weight (*P* > 0.05). However, after 12 weeks of therapeutic intervention, patients in the study group exhibited lower VAS scores, ODI scores, lumbar anterior flexion fingertip-to-floor distance, and lumbar lateral flexion left and right side-to-floor distances compared to those in the control group (*P* < 0.05), as shown in **Table 1**.

Table 1. Comparison of VAS scores, ODI scores, lumbar anterior flexion fingertip-to-floor distance, and lumbar lateral flexion left and right side-to-floor distances between the two groups before and after treatment

Group	VAS score		ODI score		Distance from fingertips to the ground with forward lumbar flexion (cm)		Distance from left and right side of lumbar lateral flexion to the ground (cm)	
	Before	After	Before	After	Before	After	Before	After
Study group (<i>n</i> = 46)	4.89 ± 1.05	1.48 ± 0.36	38.26 ± 5.44	19.27 ± 2.08	19.26 ± 3.18	7.24 ± 1.03	28.84 ± 3.69	17.29 ± 2.45
Control group (<i>n</i> = 46)	4.94 ± 1.07	2.77 ± 0.69	38.19 ± 5.53	27.96 ± 4.15	19.33 ± 3.25	11.35 ± 2.46	28.95 ± 3.77	22.04 ± 3.88
<i>t</i>	0.200	9.945	0.054	11.232	0.092	9.247	0.125	6.211
<i>P</i>	0.842	0.000	0.957	0.000	0.927	0.000	0.901	0.000

4. Training safety

The state of the body's health is crucial during training. To ensure the safety and effectiveness of training, we advise patients to cease training under the following circumstances. First, if the patient experiences obvious discomfort such as dyspnea, chest tightness, shortness of breath, nausea, or vomiting. Second, if the patient develops a fever, experiences hypoglycemia, abdominal pain, or shows signs of pallor and sweating, among other symptoms. Third, if the patient's lower back pain does not improve and becomes more intense, or if they experience general fatigue, muscle pain, etc., during or after training, they should stop the training and seek medical treatment promptly.

5. Conclusion of the study

- (1) Exercise intervention significantly improves lower back pain.
- (2) While analyzing the timing of exercise intervention, this study aimed to maintain each training session at 30 minutes, which is reasonable. A total of 12 weeks of training yielded relatively satisfactory results. However, this study also encountered issues with an insufficient sample size, necessitating adjustments and improvements to the research protocol.

6. Discussion and reflection

The occurrence of lower back pain is closely linked to various unhealthy habits in our daily lives. These habits include tilting forward with the head down while working or studying, lounging on the bed or sofa to use cell phones, reading books, watching TV, or playing games. While these postures may seem comfortable, they silently disrupt the balance of your spine, gradually leading to lower back pain over time. Therefore, it is essential to correct these bad habits to prevent lower back pain and its associated complications.

Furthermore, the specific stress placed on the lower back is influenced by body posture. According to relevant data, the lower back experiences less strain when lying down compared to standing or sitting^[15]. Changing these bad habits is crucial for preventing the development of chronic low back pain. For individuals who spend prolonged periods sitting or standing, incorporating regular breaks for lumbar muscle stretching or short walks every 2 hours can help relieve tension and prevent chronic low back pain.

Individuals need to prioritize the health of their lumbar tissues in their daily lives. They should avoid prolonged periods of immobility and engage in daily lumbar exercises and rehabilitation training to relax muscle and joint tissues and improve muscle strength. Additionally, individuals should monitor their condition independently and seek medical treatment promptly if they notice worsening back pain. During treatment, adhering to medical advice regarding medication and physical therapy as well as maintaining a stable psychological state is essential for recovery.

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Disclosure statement

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