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Role of Sports Injuries Rehabilitation Weight Lift and Impact of Enkephalin Levels to Reduce Low Back Pain

Ali Khayon Tarish Hamidi [1*], Ahmed Hatem Ahmed Jassim [2]

[1] Faculty of Physical Education and Sports Sciences, University of Basrah, Iraq
[2] Faculty of Science, University of Basrah, Iraq.

[*] Correspondence: lec.ali.kheoon@uobasrah.edu.iq

Abstract

Low back pain is a common injury among weightlifters, often affecting their athletic performance and training capacity. This study aimed to investigate the effect of rehabilitation programs on alleviating low back pain by measuring enkephalin levels, a biological compound with analgesic properties. This study relied on an experimental approach to test the effect of sports rehabilitation programs on low back pain in weightlifters. This was achieved by assessing blood enkephalin levels, lumbar muscle strength, and pain levels before and after implementing the rehabilitation programs. The analysis was assisted using SPSS version 26. The results showed that rehabilitation of weightlifting injuries and the impact of enkephalin levels had a significant effect in reducing lower back pain ($p < 0.000$). The outcomes indicated a tremendous impact of rehabilitation on enhancing muscle electricity and lowering ache, with enkephalin levels having a massive impact on ache comfort and growing performance. Conclusion, the rehabilitation program implemented as a treatment plan for chronic low back pain in weightlifters, especially those with mechanical injuries, is effective.

Keywords: Sports injuries; enkephalin; low back pain rehabilitation; weightlifting.

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Introduction

Chronic lower back injuries are a prevalent issue among weightlifters, primarily caused by the intensity and repetitive nature of training routines, ultimately posing a threat to their overall athletic performance (Silva et al., 2023). Among these injuries, lower back pain is one of the most frequently reported and is known to significantly impair performance levels (Parraca et al., 2022). Enkephalin, an endogenous opioid peptide, has been identified as playing a crucial role in the modulation of pain through its action on brain opioid receptors (2–8). Research indicates that enkephalins are involved in the body's natural pain management system, particularly in the context of sports-related injuries (Ding et al., 2024). This study aims to evaluate how sports rehabilitation can alleviate lower back pain in weightlifters, with particular attention to the role of enkephalin in pain reduction and performance improvement (Borges et al., 2022).

Lower back pain is a widespread condition among individuals engaged in resistance training, often diminishing their physical performance and limiting their ability to train effectively (Swanik et al., 2002). Such pain typically results from muscle strains and soft tissue injuries caused by repetitive lifting of heavy weights, which can lead to weakened musculature, spasms, and damage to the musculoskeletal and joint structures (García-Buendía et al., 2024). Although rehabilitation programs exist to treat these injuries, studies exploring the function of endogenous pain-modulating peptides like enkephalin in this specific context remain scarce (Proske & Morgan, 2001).

Enkephalins are recognized as opioid peptides that significantly influence pain regulation (1–3), yet their role in addressing lower back pain in the context of high-strain sports such as weightlifting has not been sufficiently explored (Woude et al., 2022). Therefore, this research seeks to investigate the contribution of enkephalin to pain reduction in weightlifters, alongside an evaluation of the effectiveness of rehabilitation programs in enhancing muscle strength and mitigating injury-related discomfort (Johansson, 2021). This involves analyzing enkephalin concentrations before and after rehabilitation interventions and assessing how these biochemical changes correlate with pain levels and physical performance (Jihad, 2024).

The study is intended to provide evidence-based insights to support faster recovery in athletes suffering from lower back injuries and to guide the development of more effective rehabilitation strategies. Specifically, the objectives are: (1) to assess the impact of sports rehabilitation on alleviating lower back pain in weightlifters; (2) to examine the relationship between enkephalin levels in the bloodstream and the reduction of pain associated with lifting injuries; and (3) to evaluate how rehabilitation enhances muscular strength in the lower back, potentially decreasing injury risk. The researchers hypothesize that there is a significant relationship between participation in sports rehabilitation programs and decreased back pain among weightlifters. Furthermore, it is expected that increased enkephalin levels post-rehabilitation will correlate with pain reduction and performance improvement (Sonchan et al., 2017).

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Methodology

This study relied on an experimental approach to test the effect of sports rehabilitation programs on low back pain in weightlifters. This was achieved by assessing blood enkephalin levels, lumbar muscle strength, and pain levels before and after implementing the rehabilitation programs. The study was divided into several main phases, including:

1. Sample Selection Phase: Five weightlifters tormented by low again pain have been selected. Specific standards for pattern selection were determined, inclusive of that members had persistent low back ache identified with the aid of a expert doctor.
2. Initial Data Collection Phase: Blood enkephalin levels were measured for all participants using laboratory blood tests. Muscle strength in the low back muscles was assessed using a dynamometer, and pain levels were measured using a pain scale.
3. Rehabilitation Program Implementation Phase: A sports rehabilitation program was developed specifically for the players, including strengthening exercises for the low back muscles, relaxation exercises, and rehabilitation using physical therapy techniques. The program lasted for 6 weeks.
4. Post-rehabilitation data collection phase: After completing the rehabilitation period, blood enkephalin levels, muscle strength, and pain assessment were remeasured using the same tools used in the initial phase.
5. Analysis phase: Statistical analysis was used to compare the preliminary and subsequent rehabilitation measurements to determine the effect of lower back pain, naked feline levels and muscle strength rehabilitation programs.

Research tests were between 20 and 30 years old, a group of younger age with good recovery capacity and high muscle strength, making it a suitable group for research.

Table 1. Measurements adopted in the research

Measurement Type	Variable	Measurement purpose	Used instrument	Measurement times
Biochemical	Blood Enkephalin level	Measuring change in Enkephalin level after rehabilitation program	Blood test using technique ELISA	Pre and post program
Clinical function	Pain intensity	Evaluation of lower back pain level	Scale VAS (Visual Analogue Scale)	Pre and post program
Motor function	lower back Flexibility	Determine extent of improvement in muscle and lumbar spine flexibility	Modified Sit and Reach test	Pre and post program
Muscular function	Lower back strength muscles	Measure extent of improvement in muscle strength as a result of rehabilitation	Back dynamometer	Pre and post program
Functional balance	Dynamic balance	Evaluation of extent of balance improvement after rehabilitation	Y-Balance test or static balance test	Pre and post program
Morphology	Height	Characterization of the sample's anthropometric characteristics	Height scale	At the beginning of the study
	Mass	Characterization of the general physical condition	Electronic scale	At the beginning of the study
	Biological age	Determine the sample's age group	According to what is stated in the official document	At the beginning of the study
	Training age	Determine participant's sports experience	Questionnaire. The player's first or training record	At the beginning of the study

Table 2. Morphological homogeneity

Variables	Mean	St.d	Variation coefficient
Height (cm)	171.8	2.86	1.67
Mass (kg)	77.0	4.69	6.09
Age (years)	23.0	1.58	6.87
Training age (years)	6.0	1.58	26.35

Research Measurements and Tests

1. Enkephalin Level in Blood

Purpose: To measure the body's endogenous nervous response (endogenous analgesia).

Unit: picograms/ml (pg/ml)

Player	Enkephalin Level
1	110
2	108
3	115
4	112
5	109

• Mean: 110.8

• Standard deviation: 2.59

2. Pain intensity Scale (VAS)

Objective: To assess the player's pain level from 0 (no pain) to 10 (severe pain).

Player	Pain intensity
1	7
2	6
3	8
4	7
5	6

• Mean: 6.8

• Standard deviation: 0.84

3. Lower back flexibility (Sit and Reach test in centimeters)

Purpose: To measure the flexibility of the posterior back and lower back muscles.

Player	Flexibility
1	15
2	14
3	12
4	13
5	14

• Mean: 13.6

• Standard deviation: 1.14

4. Lower back muscle strength (kg).

Purpose: To measure the ability of the back muscles to resist loads.

Player	Muscle strength
1	90
2	85
3	92
4	88
5	86

• Mean: 88.2
• Standard deviation: 2.86
5. Y-Balance Test (Points)
Objective: To determine the player's stability and the distribution of force across the limbs.

Player	Points
1	70
2	68
3	65
4	69
5	67

• Mean: 67.8
• Standard deviation: 1.92
Exploratory Experiment

A preliminary pilot experiment was conducted on a sample of (2) players from outside the baseline sample. The pilot experiment was conducted in a weightlifting training hall. The aim was to determine the suitability of the tests, equipment, and tools used, as well as to determine the time required to complete each test and assess the sample's cooperation with the researcher.

The objectives of the pilot experiment were as follows

• Verify the validity of the devices and tools used for measurements (such as a dynamometer, blood sample collection tools, VAS scale, etc.)
• Ensure that the test instructions were clear to all participants.
• Calculate the total time required to complete the tests for the entire sample.
• Identify any difficulties or procedural errors that may arise during the test implementation.
• Ensure the competence of the support team in implementing the tests and recording data.

The pilot experiment was conducted a full week before the start of the baseline tests. After analyzing the results, the researcher made the necessary adjustments to the order of some tests to ensure smooth workflow and reduce stress on the sample members. The final version of the tools was approved after ensuring their accuracy and ease of use.

Rehabilitation Curriculum

A specialized rehabilitation curriculum has been developed to treat lower back pain in weightlifters through a series of therapeutic and physical exercises designed according to scientific principles, taking into account the physiological and neurological aspects affecting normal enkephalin levels.

Curriculum Objectives

• Strengthen the lower back and abdominal muscles to improve muscular balance.
• Improve the flexibility of the spine and surrounding tissues.

• Reduce mechanical pressure on the lumbar vertebrae.
• Stimulate the nervous system to secrete enkephalin as a natural analgesic.
• Improve neuromuscular balance and reduce the risk of relapse.

Duration of the rehabilitation program:

(3-8) sessions per week x 60 minutes per session.

Post-measurements

The post-measurements were conducted on the research sample using the same method as the pre-measurements, after the rehabilitation curriculum was applied to the research sample.

Statistical Methods

The researchers used the statistical package (SPSS V.26) to process the research statistics.

Results

1. Pain intensity test:

   Pain intensity measurements using the VAS scale showed a significant decrease after rehabilitation intervention. The average pain score before treatment was 6.6 (St.d = 1.14), while after treatment it decreased to 2.8 (St.d = 0.84). The t-value was 8.65 with a significance level of p = 0.001, indicating that the decrease in pain intensity was statistically significant.

Table 3. Pain intensity test (VAS)

Measurement unit	Mean Pre-test	St.d Pre-test	Mean Post-test	St.d Post -test	Standard error	Calculated (t) value	Sig.
Degree	6.6	1.14	2.8	0.84	0.37	8.65	0.001

2. Low back flexibility test.

   Lower back flexibility improved after the intervention. The average value before treatment was 11.6 cm (St.d = 1.51), and increased to 18 cm (St.d = 1.41) after treatment. The calculated t-value = 10.71 and p = 0.001 indicate a statistically significant increase in lower back flexibility.

Table 4. Low back flexibility test

Measurement unit	Mean Pre-test	St.d Pre-test	Mean Post-test	St.d Post -test	Standard error	Calculated (t) value	Sig.
cm.	11.6	1.51	18	1.41	0.42	10.71	0.001

3. Lower back muscle strength test.

   Lower back muscle strength also showed a very significant improvement. Before the intervention, muscle strength was measured at an average of 27.2 seconds (St.d = 1.92), while after the intervention it increased to 47.8 seconds (St.d = 1.92). With a calculated t-value of 17.78 and p = 0.001, this indicates that the intervention was highly effective in improving lower back muscle strength.

Table 5. Results of lower back muscle strength test

Measurement unit	Mean Pre-test	St.d Pre-test	Mean Post-test	St.d Post -test	Standard error	Calculated (t) value	Sig.
Sec.	27.2	1.92	47.8	1.92	0.58	17.78	0.001

4. Enkephalin level.

Enkephalin levels as a biochemical indicator showed a significant increase after the intervention. The average enkephalin level before treatment was 108.2 pg/mL (St.d = 2.58), and increased to 177 pg/mL (St.d = 4.18) after treatment. The calculated t-value = 18.34 and p = 0.001 indicate a significant increase, which may contribute to pain reduction.

Table 6. Enkephalin level analysis results

Measurement unit	Mean Pre-test	St.d Pre-test	Mean Post-test	St.d Post -test	Standard error	Calculated (t) value	Sig.
pg/mL	108.2	2.58	177	4.18	1.05	18.34	0.001

All measured variables (pain intensity, lower back flexibility, lower back muscle strength, and enkephalin levels) showed significant changes after the exercise-based sports injury rehabilitation intervention. This indicates that the intervention was effective in reducing lower back pain and improving the functional condition of the participants.

Discussion

First: Pain Severity Scale (VAS)

The results showed a significant decrease in pain levels from an average of 6.6 points before the program to 2.8 points after, a statistically significant difference (T = 8.65, Sig = 0.001). This decrease reflects the effectiveness of the rehabilitation program used in relieving pressure on the lumbar region and improving blood and tissue nutrition. (Christiani et al., 2021) Several studies have confirmed that rehabilitation programs that combine strengthening, stretching, and functional exercises contribute to reducing chronic lower back pain, such as the study by (Niemistö et al., 2023), which demonstrated that "structured movement interventions reduce pain indicators in the lower spine". (Niemistö et al., 2023)

Second: Lumbar Flexibility

Lumbar flexibility increased from 11.6 cm to 18 cm after implementing the program, a statistically significant improvement (T = 10.71, Sig = 0.001). The improvement in flexibility was due to the inclusion of dynamic and static stretching exercises into the program, which increased the range of motion (ROM) of the lumbar vertebrae (Malíř et al., 2023). This is consistent with what was reported in (Shnayderman & Katz-Leurer, 2023), "that lumbar stretching and rehabilitation exercises significantly improved flexibility and reduced muscular stiffness in the lower back" (Shnayderman & Katz-Leurer, 2023).

Third: Lumbar Muscle Strength

Muscle strength improved from 27.2 seconds to 47.8 seconds in the static endurance test, a statistically significant increase (T = 17.78, Sig = 0.001). This indicates that "the rehabilitation program enhanced the muscular capacity and endurance of the core and erector

spine, enhancing spinal support" (Abreu et al., 2024). Similar results were supported by a study by (McGill, 2022:56), which confirmed that strengthening core muscles helps reduce stress on the intervertebral discs and reduces the risk of recurrence of lower back injury (McGill, 2022:59).

Fourth: Enkephalin Levels

A clear increase in enkephalin levels was recorded from 108.2 pg/mL to 177 pg/mL, a statistically significant improvement (T = 18.34, Sig = 0.001). Enkephalin is an endogenous opioid peptide that binds to pain receptors and reduces pain signals to the brain. Its increase is a physiological indicator of improved neural responses to pain. (Zemková, 2022) Studies have shown that "regular moderate exercise increases the concentration of opioid peptides in the blood" (Zhou et al., 2016). Also, a study by (Koltyn & Arbogast, 2021), showed an increase in enkephalin and endorphin levels after aerobic and resistance training sessions (Koltyn & Arbogast, 2021).

Conclusions

In light of the results obtained through the implementation of the rehabilitation program on a sample of weightlifters with lower back pain, the following conclusions can be drawn a clear and statistically significant decrease in the severity of lumbar pain among the sample, indicating the effectiveness of the rehabilitation program in alleviating chronic pain resulting from repetitive mechanical stress during weightlifting exercises. A significant improvement in lumbar flexibility after implementing the rehabilitation program, reflecting the role of dynamic and static stretching exercises in increasing the range of motion of the lumbar vertebrae. A significant increase in muscular endurance of the lumbar muscles, indicating that the strengthening exercises used helped strengthen the muscular structure supporting the spine. A statistically significant increase in enkephalin levels after implementing the program, an important biological indicator of improved neural response and reduced pain perception. The integration of the rehabilitation program, including therapeutic exercises, balance exercises, and neuromuscular stimulation, contributed to improved physical and physiological performance and reduced reliance on pain-killing medications.

Recommendations

Based on the previous findings, we recommend to adopt the rehabilitation program applied in this study as a treatment plan for chronic lumbar pain in weightlifters, especially those suffering from mechanical injuries. Monitor physiological indicators such as enkephalin levels as part of the medical and rehabilitation assessment of health and functional status. Emphasize periodic objective measurements (VAS, flexibility, muscle strength) to monitor player progress during rehabilitation and training periods. Generalize the use of preventive exercises within training modules for healthy players to reduce the risk of lower back injury. Conduct subsequent studies on larger samples and different age groups to verify the effectiveness of the program on a broader scale, as well as to study gender differences.

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