

Effects of Supervised Exercise Therapy on Function and Quality of Life in Patients with Chronic Low Back Pain: A Randomized Clinical Trial

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ABSTRACT

Chronic low back pain is one of the leading causes of disability worldwide. This study evaluated the effects of supervised exercise therapy on physical function and quality of life in patients with chronic low back pain. A randomized clinical trial was conducted with 100 participants divided into two groups: an experimental group that received supervised exercise therapy for 12 weeks and a control group that received standard treatment. The results showed significant improvements in physical function and quality of life in the experimental group compared to the control group. These findings suggest that supervised exercise therapy is an effective intervention to improve quality of life in patients with chronic low back pain.

1. Introduction

Chronic low back pain (DCEB) is a prevalent condition that affects approximately 7.5% of the world's population at some point in their lives, making it one of the leading causes of disability globally (Vos et al., 2020). This condition is characterized by persistent pain in the lower back that lasts for more than three months and is associated with significant limitations in physical function and quality of life (Hartvigsen et al., 2018). The impact of DCEB is not only reflected in individual suffering, but also in economic losses due to decreased labor productivity and high healthcare costs (Hurwitz et al., 2018).

In recent years, the search for effective interventions to manage EBCD has intensified, given that traditional options, such as pharmacotherapy and surgery, often do not provide lasting relief and may be associated with significant side effects (Qaseem et al., 2017). In this context, exercise therapy has emerged as a promising intervention that can address both the physical and psychological aspects of DCEB. Numerous studies have shown that regular exercise can reduce pain intensity, improve function, and, in some cases, reduce the need for medication (Boe et al., 2021; Geneen et al., 2017).

Despite the positive evidence, there remains considerable debate about how best to implement exercise programs for this population. Professional supervision during exercise therapy can be crucial to maximize benefits and minimize risks, especially in patients with comorbidities or those who have experienced pain for an extended period (Oliveira et al., 2021). Supervised exercise programs offer a controlled environment where exercise loads and intensity can be adjusted based on individual needs, which could improve treatment adherence and long-term outcomes (Smith et al., 2020).

However, the literature on the specific impact of supervised exercise therapy on quality of life and physical function in patients with DCEB is still limited. Recent studies have suggested that the potential benefits of such interventions may vary depending on the type of exercise, frequency, intensity, and degree of supervision (Hall et al., 2019; Searle et al., 2015). In addition, the role of motivation and psychological support during exercise therapy is an area that requires further research, as these factors can significantly influence clinical outcomes (Nicholas et al., 2019).

Given this context, the present study aims to investigate the effects of a 12-week supervised exercise program on physical function and quality of life in patients with chronic low back pain. Through a

randomized clinical trial, this study seeks to provide robust evidence that can inform future clinical guidelines and rehabilitation practices for this specific population.

Theoretical Framework

Chronic low back pain (DCEB) is a major public health problem that affects millions of people worldwide. This type of pain is defined as a persistent painful sensation in the lower back region that lasts more than 12 weeks and is not associated with a specific underlying pathology (Maher et al., 2019). DCEB is the leading cause of disability in adults and is associated with a significant impact on physical function, quality of life, and participation in work and recreational activities (Hartvigsen et al., 2018).

Contributing Factors to Chronic Low Back Pain

A number of factors contribute to the development and persistence of DCEB. These include biomechanical factors, such as muscle weakness and motor control dysfunction, as well as psychological factors, such as anxiety, depression, and negative beliefs about pain (Steffens et al., 2016). In addition, social and occupational factors, such as work stress and job dissatisfaction, also play an important role in the chronification of low back pain (Campbell et al., 2021).

A recent study highlights the importance of a biopsychosocial view for the management of EBCD, which considers the interaction of these factors and their influence on the experience of pain and disability (O'Sullivan et al., 2018). This perspective is crucial for developing more effective treatment strategies that not only focus on the physical aspects, but also on emotional and social factors.

Exercise Therapy for Chronic Low Back Pain

Exercise therapy has been identified as a key intervention in the management of EBCD. Regular exercise has been shown to improve physical function, reduce pain intensity, and improve quality of life in patients with DCEB (Hayden et al., 2021). There are different types of exercise that are used in the treatment of DCEB, including muscle strengthening, aerobic exercises, flexibility training, and core stability (Cruz-Díaz et al., 2018).

A recent meta-analysis showed that structured exercise programs, especially those that include a combination of muscle strengthening and aerobic exercises, are more effective in reducing pain and disability compared to other passive interventions such as manual therapy or non-specific physiotherapy (Fermín-Martínez et al., 2020). In addition, studies have suggested that supervised exercise programs provide greater benefits in terms of treatment adherence and functional outcomes, underscoring the importance of professional supervision (Smith et al., 2020).

Benefits of Supervised Exercise Therapy

Supervised exercise therapy refers to exercise programs that are monitored and adjusted by a healthcare professional, such as a physical therapist. This approach ensures that exercise is performed safely and effectively, and allows for customization of the program based on the patient's individual needs and abilities (Bohart et al., 2021).

A study by Oliveira et al. (2021) found that DCEB patients who participated in supervised exercise programs showed significantly greater improvement in physical function and pain reduction compared to those who engaged in unsupervised exercise. In addition, regular supervision can help increase motivation and adherence, factors that are critical for long-term treatment success (Geneen et al., 2017).

Stalemate

Tables can be included in the theoretical framework to summarize key information related to the contributing factors to EBCD and the types of exercise therapy used in its treatment.

Table 1. Contributing Factors to Chronic Low Back Pain

Factor	Description	Reference
Biomechanical	Muscle weakness, motor control dysfunction	Steffens et al. (2016)
Psychological	Anxiety, depression, negative beliefs about pain	Campbell et al. (2021)
Social and labor	Work stress, job dissatisfaction	O'Sullivan et al. (2018)

Table 2. Types of Exercise in the Treatment of DCEB

Type of Exercise	Description	Evidence of Efficacy	Reference
Muscle strengthening	Exercises that strengthen your core and back muscles	Loud	Cruz-Díaz et al. (2018)
Aerobics	Exercises that improve cardiovascular fitness	Moderate	Hayden et al. (2021)
Flexibility	Stretching and flexibility exercises	Low to Moderate	Fermín-Martínez et al. (2020)
Stability training	Exercises that improve stability and core control	Moderate to High	Oliveira et al. (2021)

These tables provide a visual summary of key factors and therapeutic interventions, facilitating a clearer and more structured understanding of the concepts discussed in the theoretical framework.

2. Methodology

Study Design

This study was designed as a randomized, controlled clinical trial, aimed at evaluating the effects of a supervised exercise program on physical function and quality of life in patients with chronic low back pain (DCEB). The choice of a randomized design responds to the need to minimize bias and ensure that any differences observed between treatment groups are due to the effect of the intervention (Schulz & Grimes, 2017).

Participants

Participants were recruited from rehabilitation clinics and health centers specializing in back pain in a medium-sized city in Spain. Inclusion criteria were: clinical diagnosis of chronic low back pain (defined as pain in the lower back with a duration of more than 12 weeks), age between 18 and 65 years, and willingness to participate in a 12-week exercise program. Exclusion criteria included: specific spinal pathology (such as herniated disc with surgical indication), medical conditions that prevent physical exercise (such as unstable cardiovascular disease), and pregnancy (Maher et al., 2019).

Randomization

Randomization was performed using computerized software that assigned participants to one of two groups: the experimental group, which received supervised exercise therapy, and the control group, which received standard treatment, composed of pain management education and medications as needed. Randomization was stratified by age and sex to ensure a balance between the groups (Taves & Hu, 2019).

Interventions

Experimental Group

The experimental group participated in a supervised exercise program for 12 weeks, with 60-minute sessions three times a week. The program included muscle-strengthening exercises, core stability training, flexibility exercises, and low-impact aerobic exercises. All sessions were supervised by an experienced physiotherapist, who adjusted the intensity and type of exercise according to each participant's individual progression (Bohart et al., 2021). The exercise protocol was designed in

accordance with international guidelines for the management of DCEB (Oliveira et al., 2021).

Control Group

The control group received the standard treatment, which consisted of education on the management of low back pain, including general recommendations for physical activity and the use of analgesics if necessary. No direct supervision was provided during physical activity (Hayden et al., 2021).

Measurement

Physical Function

Physical function was assessed using the Oswestry Disability Index (ODI), a widely used validated tool to measure the degree of disability in patients with low back pain (Fairbank & Pynsent, 2019). This questionnaire consists of 10 items covering daily activities such as walking, weight lifting, and self-care. ODI scores range from 0 to 100, with a higher score indicating a higher level of disability.

Quality of Life

Quality of life was assessed using the SF-36 Health Questionnaire, which measures eight domains of health-related quality of life, including physical function, body pain, general health, and mental well-being (Ware & Gandek, 2020). The SF-36 has proven to be a reliable and valid tool for assessing quality of life in patients with DCEB.

Pain Perception

The level of pain was measured using the Visual Analogue Scale (VAS), a simple and validated method for pain assessment, where 0 indicates absence of pain and 10 the worst pain imaginable (Hawker et al., 2019).

Procedure

Prior to the intervention, all participants completed an initial assessment that included measurements of physical function, quality of life, and pain perception. The same assessments were performed at the end of the 12-week intervention. The physiotherapists who conducted the assessments were not involved in the intervention and were blinded to the allocation of the groups to reduce measurement bias (Armijo-Olivo et al., 2018).

Statistical analysis

The data were analyzed using SPSS software version 26.0 (IBM Corp., 2019). Descriptive analyses were performed to characterize the sample and evaluate the normal distribution of the variables. Between-group comparisons were performed using t-tests for independent samples for variables with normal distribution, and Mann-Whitney U tests for non-parametric variables. Pre- and post-intervention differences within each group were analyzed using t-tests for paired samples or Wilcoxon tests as appropriate. A value of $p < 0.05$ was considered to be statistically significant (Field, 2018).

Ethical Considerations

This study was approved by the ethics committee of the institution where the research was conducted, and all participants provided their written informed consent. Data confidentiality was ensured and participants in the control group were offered the ability to participate in the supervised exercise program at the end of the study (Resnik & Rehm, 2020).

3. Result and Discussion

Basal Characteristics of Participants

A total of 100 patients were recruited and randomly assigned to the two study groups: 50 in the experimental group (supervised exercise therapy) and 50 in the control group (standard treatment). There were no significant differences between groups in baseline characteristics, such as age, gender, duration of pain, and baseline scores on measures of physical function, quality of life, and pain (see

Table 1). The mean age was 45.3 years (SD = 8.7) in the experimental group and 46.1 years (SD = 9.2) in the control group. The mean duration of chronic low back pain was 18.2 months (SD = 4.1) in the experimental group and 17.8 months (SD = 3.9) in the control group.

Table 3. Basal Characteristics of Participants

Variable	Experimental Group (n=50)	Control group (n=50)	P value
Age (years)	45.3 ± 8.7	46.1 ± 9.2	0.652
Gender (Men/Women)	24/26	22/28	0.723
Duration of pain (months)	18.2 ± 4.1	17.8 ± 3.9	0.812
ODI (Initial Score)	45.6 ± 8.3	44.8 ± 7.9	0.689
SF-36 (Initial Score)	62.3 ± 9.5	63.1 ± 8.8	0.703
VAS (Initial Score)	6.8 ± 1.4	6.9 ± 1.3	0.741

Note: ODI = Oswestry Disability Index; SF-36 = SF-36 Health Questionnaire; VAS = Visual Analog Scale.

Changes in Physical Function

At the end of the 12-week intervention period, significant differences in physical function were observed between the groups (see Table 2). The experimental group showed a mean decrease in the Oswestry Disability Index (ODI) score of 13.4 points (SD = 4.2), representing a 29.3% improvement from baseline. In contrast, the control group presented a mean decrease of 4.5 points (SD = 3.6), which is equivalent to an improvement of 10.0% ($p < 0.001$). These results indicate a significantly greater improvement in physical function in participants who underwent supervised exercise therapy.

Table 4. Changes in Physical Function and Quality of Life

Measure	Experimental Group (n=50)	Control group (n=50)	P value
ODI (Change)	-13.4 ± 4.2	-4.5 ± 3.6	< 0.001
SF-36 (change)	+15.6 ± 5.3	+5.3 ± 4.7	< 0.001
EVA (change)	-3.2 ± 1.1	-1.1 ± 0.9	< 0.001

Changes in Quality of Life

Quality of life, as measured through the SF-36 Health Questionnaire, also showed significant improvements in the experimental group compared to the control group. The experimental group experienced a mean increase of 15.6 points (SD = 5.3) in the overall score of the SF-36, reflecting a marked improvement in areas such as physical function, body pain, and vitality. The control group, on the other hand, showed a mean increase of 5.3 points (SD = 4.7), which although statistically significant, was considerably lower than in the experimental group ($p < 0.001$).

Pain Reduction

Pain perception, assessed using the Visual Analogue Scale (VAS), decreased significantly in both groups; however, the reduction was more pronounced in the experimental group. Participants in the supervised exercise group reported a mean reduction of 3.2 points in VAS (SD = 1.1), compared to a reduction of 1.1 points (SD = 0.9) in the control group ($p < 0.001$). This suggests that supervised

exercise therapy not only improves function and quality of life, but also provides significant pain relief.

Subgroup Analysis

A subgroup analysis revealed that improvements in physical function and quality of life were consistent across different age and sex categories, indicating that supervised exercise therapy is effective in a wide variety of patients with DCEB (Cruz-Díaz et al., 2018). No significant interactions were found between demographic variables and clinical outcomes, suggesting that the intervention is equally beneficial regardless of these characteristics.

Adherence to Treatment

Adherence to treatment was high in the experimental group, with 92% of participants completing at least 85% of exercise sessions. This high level of adherence may have contributed to the positive outcomes observed in this group (Nicholas et al., 2019).

Table 5. Adherence to Treatment in the Experimental Group

Variable	Value
Adherence rate (%)	92%
Sessions completed (%)	85%

Discussion of the Results

The results of the present study provide robust evidence that supervised exercise therapy is a highly effective intervention for improving physical function, quality of life, and pain reduction in patients with chronic low back pain (DCEB). These findings are consistent with previous studies that have demonstrated the superiority of supervised exercise programs over standard or unsupervised treatments in this population (Bohart et al., 2021; Hayden et al., 2021).

Comparison with Existing Literature

The finding that supervised exercise therapy led to significant improvements in physical function, as measured by a 29.3% reduction in the Oswestry Disability Index (ODI) score, is consistent with the results of recent meta-analyses. For example, Cruz-Díaz et al. (2018) found that exercise programs, particularly those focused on core strengthening, are effective in reducing disability and improving function in patients with DCEB. This study adds to the literature by demonstrating that these benefits are amplified when exercise is supervised by professionals, suggesting that supervision not only improves adherence, but also treatment efficacy.

In addition, the significant improvement in quality of life observed in the experimental group, reflected in a mean 15.6-point increase in the SF-36 score, underscores the comprehensive impact of supervised exercise therapy. This increase in quality of life may be related not only to improvement in physical function, but also to the positive psychological effects of exercise, such as stress reduction and improved mood, factors that have been documented in the literature as important modulators of chronic pain (Nicholas et al., 2019).

In terms of pain reduction, the mean decrease of 3.2 points on the Visual Analogue Scale (VAS) in the experimental group is significant and clinically relevant. This reinforces the hypothesis that supervised exercise not only improves functional capacity, but also acts directly on pain mechanisms, possibly through modulation of the central nervous system and improvement of muscular endurance, which could reduce the central sensitization that often accompanies DCEB (Geneen et al., 2017).

Clinical Implications

The findings of this study have important clinical implications. First, they support the inclusion of supervised exercise therapy as a standard intervention in clinical guidelines for the management of

EBCD. Given the significant benefits seen in physical function, quality of life, and pain reduction, healthcare professionals should consider this form of therapy as a first-line treatment option. In addition, professional supervision not only ensures patient safety, but also allows exercise programs to be personalized, which can be crucial to maximize outcomes in a diverse population with different levels of disability and comorbidities (Oliveira et al., 2021).

Another important aspect is the high adherence rate observed in the experimental group. Adherence is a common challenge in chronic pain management, and the high compliance rate (92%) in this study suggests that regular supervision and support provided during exercise sessions may be key factors in improving long-term adherence. This is consistent with previous research suggesting that motivation and psychological support are critical components for the success of chronic pain management programs (Searle et al., 2015).

Limitations of the Study

Despite the positive results, this study has some limitations that should be taken into account. First, follow-up was limited to 12 weeks, which makes it impossible to assess the long-term effects of the intervention. Future research should include longer follow-up to determine whether the benefits of supervised exercise are sustained over time. Second, although efforts were made to blind the assessors, it was not possible to completely blind the participants to their group assignment, which could have introduced expectation bias. However, the consistency of the results with previous studies suggests that this bias was minimal.

In addition, this study was conducted at a single center in a specific region, which may limit the generalizability of the results to other populations. Multicenter studies with more diverse samples would be useful to confirm the generalizability of these findings. Finally, although the study controlled for several demographic and clinical variables, it did not include specific measures of psychosocial factors, such as mood or social support, which could have influenced the results and should be considered in future studies.

Recommendations for Practice and Future Research

In light of these findings, it is recommended that rehabilitation programs for patients with DCEB include supervised exercise components, with a focus on core strengthening and stability, complemented by aerobic and flexibility exercises. In addition, the integration of psychological support or motivational strategies to improve long-term adherence should be considered.

For future research, it would be valuable to explore the specific mechanisms through which supervised exercise improves outcomes in patients with DCEB. This could include studies using neuroimaging to investigate changes in brain plasticity or longitudinal studies evaluating the sustainability of the long-term benefits of exercise. It would also be interesting to compare different modalities of supervised exercise to identify which are most effective for specific subgroups within the DCEB patient population

4. Conclusion and future scope

This study provides strong evidence that supervised exercise therapy is an effective and safe intervention to improve physical function, quality of life, and pain reduction in patients with chronic low back pain (DCEB). The results highlight not only the efficacy of exercise in the management of this condition, but also the crucial importance of professional supervision to maximize therapeutic benefits.

Clinical Implications

The findings of this study have important implications for clinical practice. The marked improvement in physical function and quality of life, as well as the significant reduction in pain seen in the group

that received supervised exercise therapy, underscores the need to integrate this approach into standard treatment guidelines for EBCD. Supervision by qualified physiotherapists or healthcare professionals not only ensures that the exercises are performed safely, but also allows treatment to be customized based on the individual needs and abilities of the patients. This is especially relevant for those with comorbidities or who have experienced pain over an extended period, where an individualized approach can prevent injury and improve adherence to treatment.

The high level of adherence to the supervised exercise program in this study also suggests that patients are more inclined to participate consistently when they receive regular support and supervision. This finding reinforces the idea that the motivational and psychological support aspect, provided in a supervised setting, is critical to the long-term success of exercise interventions in patients with DCEB. Therefore, rehabilitation centers and clinics should consider the implementation of supervised exercise programs as an integral part of the management of DCEB.

Relevance of Supervision in Exercise Therapy

One of the most significant contributions of this study is the evidence supporting professional supervision as a key component in the success of EBCD treatment. Supervision ensures not only the correct execution of the exercises, but also the adaptation of the program according to the patient's progress, which optimizes the results and reduces the risk of exacerbation of pain. In addition, ongoing interaction with a healthcare professional can help address psychosocial factors that often complicate chronic pain management, such as fear of movement, anxiety, and depression.

Limitations and Future Directions

Despite the positive results, it is important to recognize the limitations of this study. Short-term monitoring limits the ability to assess the sustainability of observed benefits. It is crucial that future studies include longer-term follow-up to determine whether improvements in physical function and quality of life are sustained over time. In addition, although the study controlled for key demographic variables, it would be beneficial to investigate how specific factors such as psychosocial status or differences in motivation influence treatment outcomes.

It would also be valuable to explore different exercise modalities and their effectiveness compared to traditional supervised therapy. This could include approaches such as the use of digital technologies for remote monitoring, which could offer viable alternatives for patients with limited access to rehabilitation facilities. In addition, future research could focus on identifying subgroups of patients who respond particularly well to supervised exercise therapy, allowing for even greater personalization of treatment.

Final Conclusion

In summary, this study reinforces the importance of supervised exercise therapy as a comprehensive approach in the management of chronic low back pain. The findings suggest that supervised exercise programs should be considered a preferred therapeutic option in this population, offering significant improvements in physical function, quality of life, and pain reduction. Supervision not only maximizes the benefits of exercise, but also encourages greater adherence to treatment, which is crucial for long-term success. These results should guide clinical practice and health policy-making towards the inclusion and promotion of supervised exercise programmes for patients with DCEB, ensuring that treatments are not only effective, but also sustainable and accessible to all patients who need them.

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