



# Evaluation of the impact of comprehensive physiotherapy with core on the functional status of patients with lumbar spine pain

Grzegorz Mańko<sup>1,2,\*</sup>, Agnieszka Dudek<sup>2</sup>, Natalia Palka<sup>2</sup>, Beata Stach<sup>2,3</sup>, Wojciech Kurzydło<sup>2,4</sup>  
Kamila Makulec<sup>5</sup>, Paulina Dobranowska<sup>6</sup>

<sup>1</sup> Department of Biomechanics and Kinesiology, Institute of Physiotherapy, Faculty of Health Sciences, Jagiellonian University Medical College, Cracow, Poland

<sup>2</sup> Małopolska Rehabilitation Hospital in Krzeszowice

<sup>3</sup> Department of Physiotherapy, Institute of Physiotherapy, Faculty of Health Sciences, Jagiellonian University Medical College, Cracow, Poland

<sup>4</sup> Department of Clinical Rehabilitation, Institute of Physiotherapy, Faculty of Health Sciences, Jagiellonian University Medical College, Cracow, Poland

<sup>5</sup> Department of Physiotherapy, Faculty of Health Sciences, Andrzej Frycz Modrzewski Krakow University, Cracow, Poland

<sup>6</sup> District Hospital in Chrzanów

corresponding author: g.manko@uj.edu.pl

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**Introduction.** Chronic and recurrent pain in the lumbosacral spine is becoming a problem for younger and younger people and affects the deterioration of the functional condition of patients.

**Aim.** Estimation of the impact of comprehensive Physiotherapy with Biofeedback on the functional state of patients with Lumbar Spine pain.

**Material and methods.** The study included two groups of 20 patients with lower back pain attending outpatient physiotherapy two weeks. The study group received comprehensive physiotherapy, while the control group only received physical treatments. The following were used to assess the therapy: the VAS scale, the Functional Stratford Low Back Pain Assessment Scale, the two-scale test and the Pressure Bio-Feedback Stabilizer device to test the activation of the transverse abdominal muscle.

**Results.** In the group treated with comprehensive physiotherapy, compared to the group treated with physical therapy, a significantly lower level of pain was achieved ( $p < 0.05$ ), assessed both in terms of VAS scale ( $p = 0.003$ ) and in terms of improved functioning significantly ( $p = 0.017$ ) a higher level of functional capabilities (by 17.4%). In the group with a comprehensive physiotherapy program, significantly ( $p = 0.011$ ) more patients achieved the correct value of the load symmetry index of the kkd, which is in the range of 1-1.15. All (100%) treated with comprehensive physiotherapy achieved an improvement in the activation of the transverse abdominal muscle TrA.

**Applications.** The use of comprehensive physiotherapy reduces pain and improves functional capabilities. It contributes to an even load on the lower limbs in the anteroposterior plane and improves the kkd symmetry index. It is a more effective form of treating patients than using physical therapy alone. Incorporating transverse abdominal training as part of a comprehensive treatment reduces pain severity and increases daily fitness.

## Introduction

Nowadays, back pain in the lumbosacral region is a common ailment. These pains are both a functional and social problem [1]. Lower back pain is most common in the working-age group, but it is becoming more and more common among children and adolescents [1, 2]. We can distinguish between specific pain, caused by a specific disease entity, and non-specific pain, occurring in 90% of the respondents, in whom specific causes cannot be determined [3, 4].

In the literature, the cause of non-specific pain in the lower spine is given as the summation of overloading of spinal tissues subjected to excessive static and dynamic loads [2, 5]. Burdens are caused by a sedentary lifestyle, type of work, stress, limited or excessive physical activity [2, 6].

The consequence of spinal disorders is reduced efficiency and activity in everyday activities due to pain, as well as impaired muscle balance, proprioception and stability [7, 8]. Abnormal activation of the transverse abdominal muscle, local atrophy of the multifidus muscle, impaired postural function of the diaphragm due to its high position, problems with incorrect posture and symmetrical loading of the lower limbs were also noted [9,10,11]. One of the important factors in the prevention of spinal pain is its active stabilization, which is the responsibility of muscles [12]. Deep stabilizers, such as the transverse abdominal muscle, play an important role here. Loss of motor control by these muscles is considered to be one of the causes of recurrence of back pain [7,12,13]. Treatment of back pain should be selected individually and comprehensively. Pain in the lumbosacral area results from the overlapping of many components. Properly selected therapy consists of appropriately selected physical treatments, kinesitherapy, re-education of central stabilization and proprioception. One should also not forget about educating the patient, explaining the essence of the disease, changing habits and acting in the event of aggravation [5,6,14]. In the era of modern technologies, it is worth using elements of surrogate feedback-biofeedback in therapy. This increases the patient's motivation, he can observe his progress and analyze and correct his movements or muscle contractions accordingly [15].

Conscious involvement of the patient in the therapy brings therapeutic success in the form of a reduction in the number of recurrences of back pain. It is important to continue exercise and therapy after the pain disappears or outpatient treatment. Patients can exercise at home or during "Back School" classes [16, 17]. Regularity and technique of exercises, care for ergonomics at work and correctness of activities performed at home are important [18].

## Material and methods

The research was carried out at the Małopolska Rehabilitation Hospital in Krzeszowice and the District Hospital in Chrzanów. The research and therapies were carried out as part of a intercenter program from October 7 to 21, 2024.

Out of 54 people rehabilitated on an outpatient basis due to chronic pain in the lumbosacral spine, 40 people were deliberately selected for the experiment. Participants with a medical diagnosis according to ICD-10 were qualified to participate in the study as follows: M47 Osteoarthritis of the spine, M54.5 Pain of the lumbosacral spine, M51 Diseases of the intervertebral disc. The patients were informed about the course of the research and voluntarily agreed to participate in it. The exclusion criterion was; occurrence of CNS diseases, rheumatic diseases, obesity, sciatica, cervicoacromial complex pain and joint arthroplasty. Two groups were distinguished: research and control, each group included 20 people. In the study group, comprehensive physiotherapy was used, in the control group, patients underwent only physiotherapeutic treatments.

For the 10-day cycle of treatments ordered by the doctor, patients came every day, except for Saturdays and Sundays, in the morning for 2 weeks.

Therapy assessment tests and measurements in all patients, as well as physiotherapy treatments, were always performed in the same way, by the same physiotherapist.

In both groups, patients with pain in the lumbosacral region received the same physical therapy treatments:

1. A low-frequency pulsed magnetic field was applied to the LS section Parameters: fre-

quency 15-20Hz, sinusoidal shape, break time 0-1ms, dose 2.5-4mT, treatment time 15 minutes. Taken on Astar device.

2. Ultrasound was performed on both sides of the lumbar spine. The 1 MHz probe was guided in a circular motion along the spine, not crossing its line with the emission of ultrasonic waves on. Parameters: the average intensity was 1.0-1.2 W/cm<sup>2</sup>, continuous impulse and filling factor 100%, treatment time 6-8 minutes. Applied from a BTL device.
3. The interference currents were made using two independent circuits, the electrodes of which were arranged in such a way that the lines connecting the centers of each pair crossed at the site of pain. Parameters; frequency 0-100Hz, intensity individually to the patient's clear feelings, treatment time 15 minutes. Taken on Duoter Plus device.

In the study group, in addition to physical therapy, an individual exercise program conducted by a physiotherapist was also used. It consisted of learning how to activate the muscles stabilizing the spine, deep sensation training, deep stabilization using Biofeedback, and patient education. It was shown how to properly sit, bend down, stand, what positions relieve the spine, how to safely change position, it was recommended to take care of the correct body weight, balance between work and rest.

The following were used as research tools: a patient examination card, a two-scale test to check the symmetry of lower limb loading, the Pressure Bio-Feedback Stabilizer device to assess the activity of the transverse abdominal muscle (TrA), the VAS scale for subjective pain assessment, and the Back Pain Function Scale (BPFS) Functional Questionnaire to compare functional limitations in daily activities.

Tests and questionnaires were performed and completed twice: on the first day of the treatment cycle before the start of therapy and on the last day after the end of treatments.

**Results**

There were 16 women and 4 men in both study and control groups. In both groups there were patients

with a medical diagnosis according to ICD-10: M47 Spinal degenerative disease, M54.5 Lumbosacral spine pain, M51 Intervertebral disc disease.

**TABLE 1. Comparison of patients in groups in terms of diagnosis**

DIAGNOSIS (ICD-10)	CONTROL GROUP		RESEARCH GROUP		P*
	n	%	n	%	
M47	6	30	6	30	0,928
M51	6	30	5	25	
M54.5	8	40	9	45	

p\* based on test Chi<sup>2</sup>

In both the study group and the control group, age, weight, height and BMI were distributed in accordance with the normal distribution (based on the Shapiro Wilk test, p > 0.05). The significance of the differences between the groups was assessed using the t-Student test.

**TABLE 2. Comparison of the quantitative characteristics of patients in the control and study groups**

Variable	CONTROL GROUP			RESEARCH GROUP			p*
	n	mean	SD	n	mean	SD	
AGE	20	44.70	11.56	20	43.30	12.18	0.711
Weight [kg]	20	69.45	10.78	20	69.40	8.48	0.987
Body height [m]	20	1.65	0.09	20	1.68	0.06	0.232
BMI [kg/m <sup>2</sup> ]	20	25.53	3.12	20	24.70	2.77	0.377

p\* based on t-Student test

The average scores of lumbosacral spine pain assessment determined by patients using the VAS scale between the groups were compared. Before treatment, there were no statistically significant differences between the groups (p=0.277) in the sense of pain sensation on the VAS scale. After the end of therapy, a statistically significant (p=0.003) reduction in pain was achieved in both groups. In the study group, the mean pain on the VAS scale decreased from 4.98 to 1.30, while in the

control group, the mean pain decreased from 5.54 to 2.87.

**TABLE 3. Comparison of VAS intensity on the pre- and post-treatment scale between groups**

SCALE VAS	CONTROL GROUP			RESEARCH GROUP			p*
	n	mean	SD	n	mean	SD	
Before	20	5.54	1.41	20	4.98	1.78	0.277
After	20	2.87	1.82	20	1.30	1.26	0.003

p\* based on t-Student test

Before treatment, there were no statistically significant differences in the combined score of the Functional Stratford Low Back Pain Rating Scale (BPFS) in the two groups, meaning that patients in the study and control groups showed similar levels of functional ability.

**TABLE 4. Comparison of the results of the Functional Stratford Low Back Pain Scale (BPFS) Questionnaire before and after treatment in study groups**

FUNCTIONAL STRATFORD LBP RATING SCALE	CONTROL GROUP			RESEARCH GROUP			p*
	n	mean	SD	n	mean	SD	
Total score							
Before treatment	20	37	8.56	20	40.8	6.7	0.126
After treatment	20	43.25	8.86	20	51.25	3.6	0.001

p\* based on t-Student test

A significantly higher average of 51.25 points (85.4%) of the total on the Stratford BPFS Scale was recorded in the study group undergoing comprehensive physiotherapy. In the control group, after treatment with physical procedures alone, the average score was 43.25 (72.1%).

The indices of symmetry of lower limb load in the study and control groups before and after physiotherapy were compared.

On the basis of the index of symmetric load of lower limbs calculated from the two-weight test, it was observed that there were differences in the symmetric load of the CC between the groups before treatment. After treatment, an improvement in

the symmetry of the load index was noted in both groups. However, a greater improvement was observed in the research group.

**TABLE 5. Comparison of kkd load symmetry indices based on a two-weights test between groups before and after treatment**

LOAD SYMMETRY INDEX KKD	CONTROL GROUP				RESEARCH GROUP				p*
	n	q2	q1	q3	n	q2	q1	q3	
Before treatment	20	1.17	1.09	1.33	20	1.10	1.05	1.18	0.048
After treatment	20	1.13	1.07	1.26	20	1.06	1.03	1.12	0.011

p\* based on Mann Whitney test

In both groups, the ability to activate the transverse abdominal muscle was tested. The subjects were divided into 2 subgroups. In one of them, there were people with a lack of proper activation of the transverse abdominal muscle, and in the other, people with at least partial activation of this muscle.

**TABLE 6. Evaluation of transverse abdominal muscle activation prior to treatment in both groups**

	NO CORRECT ACTIVATION		CORRECT ACTIVATION (AT LEAST PARTIAL)		P*
	n	%	n	%	
Control group (n=20)	18	90	2	10	0.028
Research group (n=20)	12	60	8	40	

p\* based on test Chi2

Prior to treatment, most of the subjects in both groups had incorrectly activated the transverse abdominal muscle. In the control group, only 10% of people were able to activate the transverse abdominal muscle better, and in the research group it was 40% of patients.

In the study group, after treatment, all (100%) were able to properly activate the transverse abdominal muscle. In the control group, on the other hand, 45% of the subjects showed proper activation of

the transverse abdominal muscle.

**TABLE 7. Evaluation of transverse abdominal muscle activation after treatment in both groups**

	NO CORRECT ACTIVATION		CORRECT ACTIVATION (AT LEAST PARTIAL)		P*
	n	%	n	%	
Control group (n=20)	11	55	9	45	0.0001
Research group (n=20)	0	0	20	100	

p\*based on test Chi2

## Discussion

Based on the tests performed, it can be concluded that comprehensive physiotherapy applied to people with lower back pain has a greater impact on the functional condition of patients than the application of physical therapy alone.

In many cases, pain makes it significantly impossible to work, limits daily activities, disrupts the mechanisms of joint protection and leaves many consequences. Taking this into account, it is also worth using many remedies and healing techniques. Starting with careful observation and assessment of the patient, it is necessary to find the cause of pain, control the symptoms in order to be able to propose an individual program of various exercises and actively involve the patient in the rehabilitation process.

Pain in the lumbosacral region is a serious health problem due to its prevalence, difficulty in determining the cause, recurrent nature and appearance in younger and younger people [1,19,20]. Comprehensive physiotherapeutic treatment places the greatest emphasis on the fight against pain, but also on regaining lost mobility in the spine and strengthening stabilization and improving proprioception [21].

On the basis of their research, Jarzb et al. conclude that electrotherapy is an effective method in relieving pain in the lumbosacral spine and should be used as an alternative to pharmacological agents with analgesic effects, a reduction in the amount of analgesics has been observed at the level of 50-60% [22]. Similarly, in our own research,

interference currents were used in both groups with positive reception of patients and an effective analgesic effect. In the conducted research, ukowicz et al. observed the effects of combined ultrasound therapy with kinesiotherapy, which turned out to be more effective than the use of exercises alone [23]. Kinesiotherapy can also be complemented by magnetotherapy treatments, as they significantly reduce pain and restore mobility [24, 25]. In our own research, a satisfactory analgetic effect was obtained after the use of interference currents, sonotherapy and magnetotherapy in both research groups. This speaks for the rightness of using these physical treatments as part of comprehensive physiotherapy. Mobility is restored by reducing the tension of the paravertebral muscles. Due to such preparation of the patient, it is possible to introduce targeted stabilization exercises. After the physical procedures used traditionally, patients achieve effective pain relief. Thanks to this, they regain their mobility capabilities. However, a return to a sedentary lifestyle or physical work can quickly restore overload of the lumbosacral area not protected by stabilization. It is estimated that among patients who have undergone an episode of low back pain, in 90% of patients up to a year it will reappear, often with severe symptoms. Lack of causal treatment causes a recurrence of the symptoms [10, 26].

Winiowska and wirlej-Sozaska have shown in their studies that people who did not take care of their posture during everyday activities were more likely to experience pain in the lumbosacral region. The authors found that education and conscious control of body position by the patient reduces low back pain [27]. Nowotny J. et al. report that even in people with proper posture, performing daily activities and professional work in non-ergonomic positions can provoke back pain [28].

In physiotherapeutic procedures, attention should be paid to the consequences of pain. By adopting anti-algic positions, asymmetry of the kkd load, trunk asymmetry or postural destabilization may occur in the body [29]. Research by Sipko et al. indicated pain-related asymmetric loading of the lower limbs [30]. Similarly, Derewiecki et al. They concluded that disc-derived pain in the lumbar spine

affects the position of the body's center of gravity, as well as the load on the lower limbs [29]. On the other hand, other researchers report in their work that patients with less severe pain showed a smaller disturbance in the symmetry of the load on the lower limbs, and the assessment of the symmetry index is an objective measure of the effects of therapy [9]. A similar relationship was demonstrated in this study using the two-weight test for evaluation. In the group treated with comprehensive physiotherapy, more people achieved the correct BC load. In addition to physical procedures, patients in the study group performed proprioception and stabilization exercises according to individual instruction. Thanks to comprehensive physiotherapy, the effect was greater than in the group treated only with physical therapy.

Many researchers agree that individually determined exercises for the patient included during outpatient or sanatorium comprehensive therapy bring satisfactory results. Kinesitherapy is the most important in the treatment of soft tissue pain in the lumbosacral spine [6, 32]. However, the exercises should be continued systematically by the patient at home or in organized activities. The comprehensive physiotherapy program also improves the quality of life of patients [19, 31].

According to literature reports, abnormal activity of the deep muscles stabilizing the lumbar spine may be responsible for lower spine pain. In the case of impaired function of the transverse abdominal muscle, the stabilization tasks are taken over by the superficial muscles.

In the experiment conducted by Kocharński et al. in two groups of people, with current lumbosacral spine pain and in participants without complaints, the activity of the transverse abdominal muscle was assessed twice. It turned out that patients with pain had abnormal activity of the transverse muscle. As many as 68% of the patients observed abnormal activation of this particular muscle [33]. During our own research, the activity of the transverse abdominal muscle was also assessed in the patients. Before treatment, both in the study and control groups, most people were unable to activate and maintain TrA tension for 10 seconds. Only in the group where transverse abdominal mus-

cle training and stabilization exercises were used, improvement was noted in all subjects, 100% of the group. In the control group without exercise, 45% reported partial tension.

Kokosz et al., on the basis of studies performed in people aged 20-30, showed that even with minor pain in the lower spine, there is already weakness of deep muscles. A test assessing the activity of the TrA muscle, the most important deep stabilizer, is often used in physiotherapy research [33,34,35].

In his own work, performing a test assessing the possibilities of tension of the transverse abdominal muscle, he met with great interest from patients, and the study triggered motivation in the exercisers to improve their performance. The only difficulty during the test and during the exercises was the coordination of the tension of the transverse abdominal muscle with breathing.

The diaphragm and the transverse abdominal muscle show synergistic tension in stabilizing and intra-abdominal pressure. Recent research by Kolar et al. showed in people with low back pain a decrease in diaphragm activity and high position in the costal and middle parts, which may limit its activity and participation in the postural function. Re-education of the breathing pattern along the diaphragmatic track and coordination with the transverse abdominal muscle are required to perform the stabilizing role effectively [36]. Due to the frequency and number of cases in younger and younger people, and taking into account the risk factors brought by civilization, it seems that the problem of low back pain is a considerable challenge for modern medicine. Modern computer technologies can prove to be a beneficial element of virtual rehabilitation. The virtual environment allows for the assessment and improvement of executive functions, and the tasks of the virtual exercise program are performed in relation to everyday activities. A beneficial effect of virtual rehabilitation on the improvement of functional efficiency has been noted [37, 38].

It is extremely important to combine in comprehensive physiotherapy a variety of means and modern methods that emphasize the fight against pain, achieving stabilization and intermuscular coordina-

tion, and implementing prevention at every stage of human life. Physical treatments should prepare the patient for properly selected kinesitherapy. Conscious and active participation of the patient in the fight against ailments, work on the correct activation of deep muscles and systematic stabilization exercises are an effective method of treatment and prevention of low back pain.

In this study, the analysis of the results indicates the effectiveness of the applied comprehensive physiotherapy program demonstrated after the end of two weeks of outpatient treatment. Only the reduced number of relapses in people who participated in the studies can be an assessment of effectiveness. This requires further tests and a thorough objective assessment, taking into account the patient's subjective feelings.

## Applications

1. The program of comprehensive physiotherapy and patient education significantly reduces pain in patients with lumbosacral spine ailments and significantly improves the functioning of patients and is a more effective form of treatment of the lower spine than the use of physical procedures alone.
2. Comprehensive physiotherapy contributes much more to the improvement of the kkd symmetry index than physical therapy.
3. Including central stabilization exercises improves the activation of the transverse abdominal muscle.
4. Comprehensive physiotherapy significantly affects the functional condition of patients with lumbosacral spine pain.

## Resumo

**Enkonduko.** Kronika kaj ripetiĝanta doloro en la lumbosakra spino fariĝas problemo por pli kaj pli junaj homoj kaj influas la difektiĝon de la funkcia stato de pacientoj. Celo. Takso de la efiko de ampleksa fizioterapio kun bioreligo sur la funkcia stato de pacientoj kun lumbosakra doloro.

**Materialoj kaj metodoj.** La studo inkluzivis du grupojn de 20 pacientoj kun lumbosakra doloro, kiuj ĉeestis ambulatorian fizioterapion dum du semajnoj. La studgrupo ricevis ampleksan fizioterapion, dum la kontrolgrupo

ricevis nur fizikajn traktadojn. La jenaj estis uzitaj por taksi la terapion: la VAS-skalo, la Funkcia Stratford-Skalo por Takso de Malsupra Dorsa Doloro, la du-skala testo kaj la Prema Bioreliga Stabiliga aparato por testi la aktivigon de la transversa abdomena muskolo.

**Rezultoj.** En la grupo traktita per ampleksa fizioterapio, kompare kun la grupo traktita per fizioterapio, oni atingis signife pli malaltan nivelon de doloro ( $p < 0,05$ ), taksitan kaj laŭ VAS-skalo ( $p = 0,003$ ) kaj laŭ plibonigita funkciado - signife ( $p = 0,017$ ) pli altan nivelon de funkciaj kapabloj (je 17,4%). En la grupo kun ampleksa fizioterapia programo, signife ( $p = 0,011$ ) pli da pacientoj atingis la ĝustan valoron de la ŝarĝsimetria indekso de la kkd, kiu estas en la intervalo de 1-1,15. Ĉiuj (100%) traktitaj per ampleksa fizioterapio atingis plibonigon en la aktivigo de la transversa abdomena muskolo TrA.

**Aplikoj.** La uzo de ampleksa fizioterapio reduktas doloron kaj plibonigas funkciajn kapablojn. Ĝi kontribuas al egala ŝarĝo sur la malsupraj membroj en la antaŭa malantaŭa ebena kaj plibonigas la kkd-simetrian indekson. Ĝi estas pli efika formo de traktado de pacientoj ol uzi nur fizioterapion. La enkorpiĝo de transversa abdomena trejnado kiel parto de ampleksa traktado reduktas la severecon de la doloro kaj pliigas la ĉiutagan taŭgecon.

## Conflict of Interest

The authors of this article declare that there is no conflict of interest.

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