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Influence of motion therapy on daily life activities of people with lumbar pain syndrome

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ABSTRACT

Introduction: Lumbar pain syndrome (LPS) is defined as pain or discomfort localized between the edge of the twelfth rib and the lower gluteal region, with or without spread to the lower extremities, and, depending on the etiology and degree of symptomatology, can have negative consequences and be one of the main reasons for work disability and absenteeism worldwide. The aim of this study was to determine the impact of exercise therapy on the activities of daily living of a person with LPS.

Methods: This prospective, longitudinal, and randomized controlled trial was conducted from June 2014 to June 2016. It included 200 subjects with symptoms of LPS, both sexes, aged 30 to 50 years, sedentary and standing occupations, randomized and equally divided into two groups: Examined (n = 100) and the control group (n = 100). In this study, the Oswestry Low Back Pain Disability Questionnaire was used after clinical examination.

Results: The percentage of disability according to the Oswestry disability index at the first examination was 31.78 ± 14.11% in the participants of the test group and 38.74 ± 17.48% in the participants of the control group (p = 0.002). After the second examination, the percentage of disability was 6.64 ± 3.15% in the test group and 23.92 ± 14.84% in the control group (p = 0.001). At the end of the examination, the percentage of disability was 2.36 ± 0.78% in the subjects of the test group and 13.82 ± 11.25% in the subjects of the control group (p = 0.001). A statistically significant difference was found in all three examinations, and the reduction in the percentage of disability was greater in the study group, $p < 0.05$.

Conclusion: The research conducted showed that motion therapy procedures focused on achieving natural spinal mobility and improving trunk muscle strength are effective in reducing pain intensity, improving activities of daily living, and reducing the percentage of disability in people with LPS.

Keywords: Daily life activities; lumbar pain syndrome; motion therapy; muscle strengthening exercises; Oswestry disability index; spine mobility exercises

INTRODUCTION

Depending on the classification of back pain as local, referral, or radicular, lumbar pain syndrome (LPS) is defined as pain or discomfort localized between the edge of the twelfth rib and the lower gluteal region, with or without spread to the lower extremities (1-3).

The term LPS can range from a symptom to a complex clinical condition that, depending on the etiology and degree of symptomatology, can have negative consequences and is one of the main reasons for work disability and absenteeism worldwide (4-7).

LPS is one of the most common conditions in clinical practice, the second most common pain condition after headache and ahead of 290 other pathological conditions. It can have a very negative impact on quality of life and functioning and is often associated with significant social and economic consequences (8-10).

The percentage of adults who suffer from low back pain at some point in their lives is 84%. According to data from the literature, the annual incidence of a first episode of low back pain ranges from 6.3% to 15.6%, the annual incidence of each episode of low back pain ranges from 1.5% to 36%, and recurrence is estimated to range from 24% to 80% on an annual basis (4,5,11,12).

Low back pain may be mechanical (nonspecific), degenerative, non-mechanical (inflammatory, infectious, metabolic, neoplastic, or a symptom of systemic disease), or a result of incorrect and long-term posture at work, damage to the musculoskeletal and ligamentous apparatus and the musculoskeletal system of the spine and disk, or psychological. According to data from the literature, people with acute pain (<6 weeks) recover in 90% of cases, and 60% of them

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return to their daily tasks within a month. For subacute pain (6-12 weeks), return to daily activities takes up to 3 months. Chronic low back pain (longer than 12 weeks) occurs in 8% of sufferers, and in this case the likelihood of full recovery decreases (8-15).

Pain distribution, dermatomes, reflexes, and myotomes differentiate the clinical picture into local, referential, or radicular pain (radiculitis or radiculopathy), and the distinction between nonspecific/specific and acute/subacute/chronic pain is useful not only for epidemiological studies but also for choosing appropriate strategies for its diagnosis and treatment (8,16-18).

The initial evaluation of patients with LPS includes history taking (19-21), physical examination (22), and identification of features that may indicate serious primary "red flag" disease. Established signs and symptoms indicate that urgent radiography or further investigation may be required (23-25).

Through further detailed analysis of the clinical picture and specific tests, we classify the patient's condition into a specific diagnostic and therapeutic protocol: "yellow flags" (26), specific populations, radicular syndrome, and non-specific back pain, in which symptoms exclude the presence of a specific pathology in more than 90% of cases (27-30), that is, in a very small number of patients with LPS, the cause of symptoms is identified (31).

Laboratory studies are generally reserved for patients with unexplained low back pain and are very useful in identifying malignant, infectious, and inflammatory diseases of the spine (32-34). Finally, simple and specific radiologic examinations can clearly determine the cause of specific low back pain (23,35-37).

The choice of therapeutic procedures in the acute phase aims to eliminate pain, improve functionality, prevent the development of chronic symptoms, and return to activities of daily living as early as possible. Treatment includes various degrees of activity restriction (19,38), local injections or systemic drug therapy (39-41), physical therapy (42,43), manual therapy, and neuromobilization (7,44,45). After acute pain has resolved, exercise therapy and education are provided. Many randomized controlled trials have shown that lower back stabilization and trunk strengthening exercises, as well as motor control exercises, help relieve pain and improve function in patients with LPS (46-48). Dry needling is proving to be a useful technique for pain relief and correction of the neurologic sequelae of LPS (49). The condition of most patients does not require surgical treatment, but rather causal and symptomatic treatment and lifestyle modification or orientation to modern techniques to stimulate disk regeneration (stem cells, growth factors, and gene therapy) (16,50).

The goal of treatment for chronic LPS is to maintain physical activity, prevent permanent disability, and restore work ability, even if it is not possible to achieve complete elimination of pain. Treatment strategies should aim to reduce the impact of low back pain on the psychosocial component of patients' daily lives (25,51).

The aim of this study was to determine the effects of exercise therapy procedures on the activities of daily living of people with LPS, hypothesizing that treatment with exercise therapy procedures is effective in improving the activities of daily living of people with LPS.

METHODS

The research was conducted in the private practice "Praxis - Dr. Pecar" in the period from June 20, 2014, to June 1, 2016. The respondents were patients with symptoms of LPS (local, referential, and radicular pain). The study involved 200 subjects diagnosed with low back pain by clinical examination, both sexes, aged 30 to 50 years, sedentary and standing occupations, randomized, and equally divided into two groups: The test group (n = 100) and the control group (n = 100). In the test group, respondents from sedentary occupations were engineers, economists, teachers, civil servants, lawyers, and doctors, and respondents from standing occupations were manual workers. Respondents from sedentary occupations of the control group were engineers, economists, teachers, civil servants, lawyers, and veterinarians, and respondents from standing occupations were manual workers. The criteria for the study included respondents of both sexes with symptoms of LPS (local, referential, and radicular pain) aged 30 to 50 years who volunteered to participate in the study and who underwent a clinical examination and an assessment of their condition using the Oswestry Low Back Pain Disability Questionnaire. Subjects under 30 or over 50 years of age and those who did not voluntarily consent were not included in the study, while the criteria for exclusion from the study were failure to assess the subjects' condition using the Oswestry Low Back Pain Disability Questionnaire, noncompliance with the therapeutic protocol, and discontinuation of treatment. The study was conducted as a prospective, longitudinal, randomized controlled trial, and allowed adequate monitoring of the subjects' condition while performing activities of daily living. The test group (n = 100) included subjects who underwent a clinical examination and completed an exercise program consisting of the following elements:

- Exercises to improve the mobility of the spine
- Exercises to strengthen the anterior abdominal muscles
- Exercises to strengthen the lateral abdominal muscles and
- Exercises to strengthen the back muscles.

Respondents with an acute form of LPS began treatment with exercises after the 2nd week after the onset of symptoms to achieve a reduction in pain intensity. Respondents with subacute and chronic forms of LPS were treated with exercises immediately after clinical examination.

The first part of the training program consisted of exercises to improve spinal mobility. Subsequently, subjects began exercises to strengthen the anterior and lateral abdominal muscles and finally exercise for the back muscles. Subjects were informed that the initial exercise program included five repetitions of each exercise, with a gradual increase of one repetition each week up to a maximum of 10 repetitions, and that they should maintain this intensity of exercise performance. Subjects were instructed to perform the exercises gradually, without sudden movements, and to adjust the speed and amplitude of the exercises to the intensity of the pain. The exercise program included two sessions per day (morning and afternoon), each lasting 20 min.

The control group (n = 100) consisted of subjects with a clinical examination and a single treatment with mobilization and manual massage of the lumbar spine or a single treatment with mobilization of the lumbar spine and local instillation of depot corticosteroids without the use of an exercise program.

Analysis of the ability to perform activities of daily living with the Oswestry Low Back Pain Disability Questionnaire of subjects in the test and control groups was performed at the first examination, the second follow-up examination after 6 months, and the third follow-up examination after 1 year of treatment.

The instrument used in this study after the clinical examination was the Oswestry Low Back Pain Disability Questionnaire. The questionnaire assesses people's current symptoms and functional status when performing activities of daily living and can be used before and after treatment in people with low back pain syndrome (52).

The study was approved by the Ethics Committee of the University of Sarajevo-Faculty of Health Studies under the number 04-7-114-10/13. It was conducted exclusively on a voluntary basis, and informed consent was obtained from each respondent to participate in the study. The identity of the respondents is protected in accordance with ethical and privacy principles.

The database was created using Microsoft Office Excel 2013 program and the data obtained during the survey were entered into it. After checking the integrity of the data, statistical analysis was performed using the program IBM SPSS Statistics v. 20.0 for Windows.

The data were presented in the form of tables and graphs, using classical methods of descriptive statistics depending on the type of data and measurement scale.

To describe the sample, we used appropriate methods of classical descriptive statistics depending on the type of data: Arithmetic mean (A.S.), standard deviation (S.D.), median (Med.), interquartile range (25^{th} perc. and 75^{th} perc.), absolute frequency (N), and relative frequency (%).

Distribution normality testing of continuous numerical variables was performed by inspection of histograms, quantile plots, and formal tests using the Kolmogorov–Smirnov test. Analysis of categorical variables was performed with the Pearson χ^2-test or Fisher's exact probability test. The arithmetic mean and standard deviation were used for symmetrical distribution of continuous variables to represent the mean and measures of dispersion, and parametric tests (Anova test, Dunnett test) were used to compare these variables.

When the continuous variables were not distributed symmetrically, the median and interquartile range were used to represent the mean and measures of dispersion, and nonparametric tests (ANOVA test, Bonferroni test) were used to compare them. Pearson's and Spearman's rank correlation coefficients were used to examine the linear relationship between ratio and ordinal characteristics. The threshold of statistical significance was set at the conventional level of $\alpha = 0.05$. In addition to statistical significance of the difference, a point and interval score of parameters and measures of effect size were calculated, in accordance with the recommendations of the CONSORT statement.

The results are presented in contingency tables (numbers with three decimal places). The significance level is $p < 0.05$

RESULTS

The study involved 200 subjects who were divided into two groups according to the criteria for inclusion in the study: The test group (n = 100) and the control group (n = 100).

When analyzing the gender structure of the respondents, it was found that 51 (51%) of the respondents were male and 49 (49%) of the respondents were female. In the control group, there were 65 (65%) male respondents and 35 (35%) female respondents. The application of the Chi-square test revealed a statistically significant difference in the gender structure of the respondents of the studied groups, $\chi^2 = 4.003$; $p = 0.031$.

The average age of the respondents of the test group was 39.20 ± 6.57 years (30-50 years), while that of the respondents of the control group was 41.12 ± 6.83 years (30-50 years). When the ANOVA test was applied, a statistically significant difference was found in the average age of the respondents of the studied groups, and the respondents of the control group were statistically significantly older, F = 4.097; $p = 0.044$.

In the test group, most of the respondents, 29 (29%), belonged to the 35-39-years-old group, while in the control group, most of the respondents, 37 (37%), belonged to the 45-50-years-old group.

Of the total number of respondents in the test group, 24 (24%) performed their work while standing, while this number was 46 (46%) in the control group. In the test group, 76 (76%) respondents performed their work in a sitting position, while in the control group 54 (54%) respondents performed their work in a sitting position. Using the Chi-square test, a statistically significant difference in posture during work performance was found, $\chi^2 = 10.584$; $p = 0.002$ (Table 1).

Of the total number of respondents in the test group, 42 (42%) respondents had acute pain, and nine had subacute pain, while 49 (49%) respondents had chronic pain. In the control group, 44 (44%) respondents had acute pain, 13 (13%) had subacute pain, and 43 (43%) respondents had chronic pain. Using the Chi-square test, no statistically significant difference was found in the type of pain according to the studied group, $\chi^2 = 0.358$; $p = 0.550$.

TABLE 1. Breakdown of respondents of the studied groups by profession

Profession	EXAMINED GROUP		Total
	Test	Control	
Standing			
Number	24	46	70
%	24	46	35
Sedentary			
Number	76	54	130
%	76	54	65
Total			
Number	100	100	200
%	100	100	100

χ^2=10.584; *P*=0.002

Pain intensity at the first examination was 1.94 ± 1.23 in the test group and 2.52 ± 1.29 in the control group (p = 0.001). At the second examination, pain intensity was 0.14 ± 0.02 in the test group and 1.25 ± 1.20 in the control group (p = 0.001). At the end of the study, pain intensity was 0.06 ± 0.04 in the test group and 0.49 ± 0.07 in the control group (p = 0.001). When the ANOVA test was applied, a statistically significant lower pain intensity was found in the test group compared to the control group, p = 0.001 (Table 2).

The average rating of ability to perform personal care during the first examination was 1.03 ± 0.55 for subjects in the test group and 1.23 ± 0.70 for subjects in the control group (p = 0.028). After the second examination, the average evaluation of the ability of personal care was 0.09 ± 0.08 for the respondents of the test group and 0.73 ± 0.04 for the respondents of the control group (p = 0.001). At the end of the examination, the rating of the ability for personal care was 0.04 ± 0.01 for the respondents of the test group and 0.32 ± 0.08 for the respondents of the control group (p = 0.001). A statistically significant difference was found in all three examinations (p < 0.05) (Table 3).

The average rating of walking ability at the first examination was 1.02 ± 1.00 for subjects in the test group and 1.43 ± 1.19 for subjects in the control group (p = 0.011). After the second examination, the average evaluation of walking ability was 0.09 ± 0.05 in subjects of the test group and 0.75 ± 0.14 in subjects of the control group (p = 0.001). At the end of the examination, the assessment of walking ability was 0.04 ± 0.01 in the subjects of the test group and 0.31 ± 0.05 in the subjects of the control group (p = 0.001). A statistically significant difference was found in all three examinations (p < 0.05) (Table 4).

The average rating of the ability to maintain a sitting position during the first examination was 2.06 ± 1.11 for subjects in the test group and 2.11 ± 1.18 for subjects in the control group (p = 0.760). After the second examination, the average evaluation of the ability to maintain a sitting position was 0.48 ± 0.22 for the subjects of the test group and 1.33 ± 0.92 for the subjects of the control group (p = 0.001). At the end of the examination, the evaluation of the ability to maintain a sitting position was 0.20 ± 0.09 in the subjects of the test group and 0.81 ± 0.80 in the subjects of the control group (p = 0.001). A statistically significant difference was found in the second and third tests (p < 0.05) (Table 5).

The average rating of the ability to maintain a standing position during the first examination was 2.41 ± 1.11 for subjects in the test group and 2.72 ± 1.13 for subjects in the control group (p = 0.053). After the second examination, the average evaluation of the ability to maintain a standing position was 0.64 ± 0.53 for the subjects of the test group and 1.83 ± 1.00 for the subjects of the control group (p = 0.001). At the end of the examination, the evaluation of the ability to maintain a standing position was 0.18 ± 0.05 for the subjects of the test group and 1.12 ± 0.83 for the subjects of the control group (p = 0.001). A statistically significant difference was found in the second and third tests (p < 0.05) (Table 6).

The percentage of disability according to the Oswestry disability index (ODI) at the first examination was 31.78 ± 14.11% in subjects of the test group and 38.74 ± 17.48% in subjects of the control group (p = 0.002). After the second examination, the percentage of disability was 6.64 ± 3.15% for the respondents of the test group and 23.92 ± 14.84% for the respondents of the control group (p = 0.001). At the end of the study, the percentage of disability was 2.36 ± 0.78% for the respondents of the test group and 13.82 ± 11.25% for the respondents of the control group (p = 0.001). A statistically significant difference (p < 0.05) was found in all three examinations (Table 7).

In the test group, respondents who performed their work while sitting had a statistically significant higher percentage

TABLE 2. Pain intensity in both examined groups

Examination	Examined groups	n	X	SD	SEM	Minimum	Maximum
I examination	Test	100	1.94	1.23	0.12	0.00	5.00
	Control	100	2.52	1.29	0.12	0.00	5.00
	F=10.453; *p*=0.001						
II examination	Test	100	0.14	0.02	0.04	0.00	3.00
	Control	100	1.25	1.20	0.12	0.00	4.00
	F=75.862; *p*=0.001						
III examination	Test	100	0.06	0.04	0.03	0.00	3.00
	Control	100	0.49	0.07	0.07	0.00	4.00
	F=25.917; *p*=0.001						

TABLE 3. Analysis of the ability of to carry out personal care in both studied groups

Examination	Examined groups	n	X	SD	SEM	Minimum	Maximum
I examination	Test	100	1.03	0.55	0.05	0.00	3.00
	Control	100	1.23	0.70	0.07	0.00	4.00
	F=4.912; *p*=0.028						
II examination	Test	100	0.09	0.08	0.02	0.00	1.00
	Control	100	0.73	0.04	0.06	0.00	3.00
	F=81.263; *p*=0.001						
III examination	Test	100	0.04	0.01	0.01	0.00	1.00
	Control	100	0.32	0.08	0.04	0.00	2.00
	F=28.112; *p*=0.001						

TABLE 4. Analysis of the ability to walk in both examined groups

Examination	Examined groups	n	X	SD	SEM	Minimum	Maximum
I examination	Test	100	1.02	1.00	0.107	0.00	4.00
	Control	100	1.43	1.19	0.119	0.00	5.00
	F=6.540; *p*=0.011						
II examination	Test	100	0.09	0.05	0.035	0.00	2.00
	Control	100	0.75	0.14	0.084	0.00	4.00
	F=51.995; *p*=0.001						
III examination	Test	100	0.04	0.01	0.019	0.00	1.00
	Control	100	0.31	0.05	0.050	0.00	2.00
	F=24.691; *p*=0.001						

TABLE 5. Analysis of the ability to maintain a sitting position in both examined groups

EXAMINATION	Examined groups	n	X	SD	SEM	Minimum	Maximum
I examination	Test	100	2.06	1.11	0.11	0.00	4.00
	Control	100	2.11	1.18	0.11	0.00	5.00
	F=0.094; *p*=0.760						
II examination	Test	100	0.48	0.22	0.06	0.00	3.00
	Control	100	1.33	0.92	0.09	0.00	4.00
	F=58.119; *p*=0.001						
III examination	Test	100	0.20	0.09	0.04	0.00	2.00
	Control	100	0.81	0.80	0.08	0.00	3.00
	F=42.153; *p*=0.001						

TABLE 6. Analysis of the ability to maintain a standing position in both examined groups

EXAMINATION	Examined groups	n	X	SD	SEM	Minimum	Maximum
I examination	Test	100	2.41	1.11	0.11	0.00	5.00
	Control	100	2.72	1.13	0.11	0.00	5.00
	F=3.800; *p*=0.053						
II examination	Test	100	0.64	0.53	0.07	0.00	3.00
	Control	100	1.83	1.00	0.10	0.00	4.00
	F=91.540; *p*=0.001						
III examination	Test	100	0.18	0.05	0.04	0.00	2.00
	Control	100	1.12	0.83	0.08	0.00	3.00
	F=97.936; *p*=0.001						

TABLE 7. Analysis of the disability percentage in both examined groups

EXAMINATION	Examined groups	n	X (%)	SD	SEM	Minimum	Maximum
I examination	Test	100	31.78	14.11	1.41	10.00	78.00
	Control	100	38.74	17.48	1.74	10.00	84.00
	F=9.597; *p*=0.002						
II examination	Test	100	6.64	3.15	0.81	0.00	44.00
	Control	100	23.92	14.84	1.48	0.00	70.00
	F=104.007; *p*=0.001						
III examination	Test	100	2.36	0.78	0.57	0.00	32.00
	Control	100	13.82	11.25	1.12	0.00	46.00
	F=82.021; *p*=0.001						

of work disability at the first examination compared to respondents who performed their work while standing, $F = 4.140$; $p = 0.045$. No statistically significant difference was found at the second and third examinations. In the control group, no statistically significant difference was found in the percentage of disability among respondents with standing and sedentary jobs at all three examinations. In terms of percentage of disability at baseline, there was a greater improvement in both types of occupations among test group respondents compared to control group respondents, $p < 0.05$ (Table 8).

Among the respondents in the test group at the beginning of the study, the respondents who had subacute pain had the highest percentage of disability, F = 4.579; $p = 0.013$. After the second study, there was a statistically significant decrease in the percentage of disability in the test group, and no statistically significant difference was found in the percentage of disability among the respondents who had acute, subacute, or chronic pain, F = 0.352; $p = 0.704$. At the end of the study, the percentage of disability decreased even further. However, respondents with subacute pain had a higher percentage of disability, F = 3.502; $p = 0.034$.

Among the control group respondents at the beginning of the study, the respondents with acute pain had the highest percentage of disability, F=3.871; p = 0.024. After the second examination, there was a statistically significant decrease in the percentage of disability, but no statistically significant difference was found in the percentage of disability among the respondents who had acute, subacute, or chronic pain, F = 0.186; p = 0.846. At the end of the study, the percentage of disability decreased further. However, respondents with acute pain had a higher level of disability, F = 0.090; p = 0.914 (Table 9).

DISCUSSION

The analysis of the gender structure of the respondents revealed a statistically significant difference between the studied groups. There were more male respondents in the control group than in the test group, χ^2 = 4.003; p = 0.031. Applying the ANOVA test, it was found that the respondents in the control group were statistically significantly older, F = 4.097; p = 0.044.

In the studied group, the majority of respondents, 29 (29%), belonged to the 35-39-years-old group, while in

TABLE 8. The influence of the occupation type on the percentage of disability during all three examinations in both examined groups

EXAMINATION	GROUPS		n	X	SD	SEM	Minimum	Maximum
I examination	Test	Standing	24	26.75	11.89	2.42	10.00	56.00
		Sitting	76	33.36	14.44	1.65	12.00	78.00
		F=4.140; p=0.045						
	Control	Standing	46	40.43	17.94	2.64	10.00	84.00
		Sitting	54	37.29	17.11	2.32	10.00	80.00
		F=0.799; p=0.374						
II examination	Test	Standing	24	7.83	5.04	2.25	0.00	44.00
		Sitting	76	6.26	5.06	0.80	0.00	32.00
		F=0.673; p=0.414						
	Control	Standing	46	24.86	15.85	2.33	0.00	70.00
		Sitting	54	23.11	14.03	1.91	0.00	60.00
		F=0.346; p=0.558						
III examination	Test	Standing	24	1.50	1.01	0.81	0.00	18.00
		Sitting	76	2.63	1.24	0.71	0.00	32.00
		F=0.695; p=0.406						
	Control	Standing	46	12.60	10.53	1.55	0.00	42.00
		Sitting	54	14.85	11.83	1.61	0.00	46.00
		F=0.987; p=0.323						

TABLE 9. The influence of the pain type on the disability percentage during all three examinations in both examined groups

Examination	Groups		n	X	SD	SEM	Minimum	Maximum
I examination	Test	Acute	42	35.00	13.01	2.00	14.00	60.00
		Subacute	9	38.88	20.93	6.97	16.00	78.00
		Chronic	49	27.71	12.54	1.79	10.00	56.00
		F=4.579; p=0.013						
	Control	Acute	44	43.95	19.98	3.01	14.00	84.00
		Subacute	13	37.07	17.13	4.75	10.00	72.00
		Chronic	43	33.90	13.20	2.01	10.00	66.00
		F=3.871; p=0.024						
II examination	Test	Acute	42	6.90	5.60	1.32	0.00	44.00
		Subacute	9	8.44	4.80	3.60	0.00	32.00
		Chronic	49	6.08	4.32	1.04	0.00	30.00
		F=0.352; p=0.704						
	Control	Acute	44	24.86	14.13	2.13	6.00	70.00
		Subacute	13	22.61	12.84	3.56	8.00	40.00
		Chronic	43	23.34	16.31	2.48	0.00	62.00
		F=0.168; p=0.846						
III examination	Test	Acute	42	1.90	4.73	0.73	0.00	20.00
		Subacute	9	7.11	5.83	3.94	0.00	32.00
		Chronic	49	1.87	1.67	0.66	0.00	28.00
		F=3.502; p=0.034						
	Control	Acute	44	14.13	9.37	1.41	0.00	34.00
		Subacute	13	12.61	11.23	3.11	0.00	28.00
		Chronic	43	13.86	13.11	1.99	0.00	46.00
		F=0.090; p=0.914						

the control group, the majority of respondents, 37 (37%), belonged to the 45-50 years old group.

The results of the study showed that in both studied groups, a greater number of respondents belonged to the group of sedentary occupations, $\chi^2 = 10.584$; $p = 0.002$. There was also no statistically significant difference in the type of pain by duration between the studied groups, $\chi^2 = 0.358$; $p = 0.550$.

Analysis of the Oswestry Low Back Pain Disability Questionnaire determined pain intensity, ability to perform personal hygiene, and ability to walk, sit, and stand, as well as the degree of disability in subjects in the test and control groups.

Smith et al. conducted a systematic literature search and meta-analysis to examine the effectiveness of trunk stabilization exercises in treating nonspecific low back pain syndrome and to compare them with other types of exercises. Electronic databases were searched from October 2006 to October 2013: PubMed, CINAHL, AMED, PEDroi CochraneLibrary, and 29 studies were included in the study. The research instruments were the Visual Analog Pain Scale, the Roland-Morris Disability Questionnaire, the ODI, and the Fear Avoidance Questionnaire. Twenty-two high-quality studies involving 2258 respondents demonstrated significant benefits of trunk stabilization exercises in reducing pain intensity due to low back pain syndrome over short, medium, and long periods of time compared with any alternative treatment option. 2.359 respondents in 24 high-quality studies showed a statistically significant benefit of trunk stabilization exercises in reducing the degree of disability as a result of LPS over the short- and long-term compared to any other alternative treatment option. The results of the literature review conducted are consistent with the results of our study (53).

At the end of the study, subjects in the test and control groups were able to tolerate their pain without using analgesics. In both groups studied, there was a decrease in pain intensity compared with the beginning of the study, but pain intensity was statistically significantly lower in the test group than in the control group.

At the first examination, subjects in the test and control groups were able to perform personal hygiene normally with additional pain, while at the end of the treatment they were able to perform personal hygiene without additional pain.

An analysis of the subjects' walking ability showed that the subjects in the test group were unable to walk more than 1 km at the first examination due to pain, while they were unable to walk any distance at the second and third examinations due to pain. Subjects in the control group were prevented from walking more than 1 km at the first and second examinations because of pain, and at the third examination, pain did not prevent them from walking any distance.

Subjects in both study groups had pain at the first examination that prevented them from sitting for more than 1 h. Subjects in the studied group showed at the second and third examinations that they were able to sit in any chair and for any length of time without pain. The subjects in the control group were able to maintain a seated position for any period of time at the second and third examinations, but only in their favorite chair.

When analyzing the ability to maintain a standing position, it was found that subjects in the test group experienced pain at the first examination, which prevented them from standing for more than 1 h. At the second examination, subjects were able to stand for as long as they wished, but with additional pain, and at the third examination, without additional pain. At the first examination, subjects in the control group felt pain that prevented them from standing for more than 30 min. At the second examination, subjects could not stand for more than 1 h due to pain, and at the third examination, they could stand as long as they wanted but with additional pain.

The results of our study on pain intensity and functional status are consistent with the study by Stankovic et al. on the effects of trunk stabilization exercises and trunk strengthening and stretching exercises on reducing pain intensity and improving function in patients with chronic LPS. The study was conducted at the Clinical Center in Niš and included a test group (n = 100) performing a program of specific trunk stabilization exercises, while a control group (n = 60) performed a traditional exercise program for chronic LPS based on strengthening and stretching exercises of the large superficial back muscles. The assessment tools were the ODI and the Quality of Life Questionnaire (Short-form - SF-36). The results of the treatment proved that both the trunk stabilization exercises and the traditional exercise program for chronic LPS were effective in reducing pain intensity and functional improvement in the subjects with chronic LPS, with statistical significance in favor of the test group (54).

Reduction in pain intensity, improvement in the ability to perform carry out personal care and walking ability were observed in both studied groups, which showed no statistically significant difference when comparing the studied groups. A statistically significant difference between the studied groups was found in the ability to maintain a sitting and standing position. The improvement in the ability to maintain a sitting position was 1.83 in the test group and 1.30 in the control group, while the improvement in the ability to maintain a standing position was 2.23 in the test group and 1.6 in the control group.

A study comparing the short-term effects of stabilization exercises and trunk muscle strengthening on pain intensity, quality of life, and function in patients with nonspecific chronic LPS - and whose results are consistent with those of our study - was conducted by Carmo et al. in 2013. It included ten subjects with non-specific chronic LPS who were divided into group A (trunk strengthening exercises) and Group B (trunk stabilization exercises) and received two sessions per week of 50 min duration over a 4-week period. The study instruments were the visual analog pain scale, the quality of life questionnaire (Short-form - SF-36) and the Rolland-Morris questionnaire. The results of the study showed that stabilization exercises and trunk strengthening exercises had short-term effects on patients' pain intensity, quality of life, and function, with a statistically significant difference in favor of trunk stabilization exercises (55).

The percentage of disability according to the ODI scoring was statistically significantly lower in subjects of both

studied groups at the end of the study than at the beginning of the study ($p < 0.05$). There is a statistically significant difference between the studied groups, and the improvement, that is, reduction in the percentage of disability, was greater in the test group, $p < 0.05$.

Kim and coworkers (2014) investigated the effects of spinal stabilization exercises on muscle cross-sectional area (mm. multifidi, m. psoas major), pain intensity, and muscle strength of the lumbar spine in patients with degenerative disk disease. Research instruments (visual analog scale, ODI, CENTAUR 3D muscle strength measuring device, and CT for measuring muscle cross-sectional space at the L4 level were used) were used to evaluate the effects of spinal stabilization exercises in 33 subjects (14 men and 19 women) aged 25 to 65 years who performed exercises twice a week for 45 to 50 min over an 8-week period. After 8 weeks, pain due to degenerative disk disease had significantly decreased. The average disability rating decreased significantly (X = 8.81%) compared to the beginning of the study (X = 20.18). The study also showed a significant increase in the strength and size of the muscles mentioned (56). The results of the tests performed are consistent with the results of our study.

The effects of stabilization exercises and dynamic exercises to strengthen the lumbar spine in patients with chronic LPS lasting more than 3 months were studied by Moon and coworkers (2013). The test group (n = 11) included subjects performing a program of lumbar stabilization exercises, while the control group (n = 10) performed a program of dynamic lumbar strengthening exercises. Subjects in both groups performed the exercises twice a week for 1 h over an 8-week period. The results showed an increase in back muscle strength in both groups, but a significantly higher one in the test group. Pain intensity on the visual analog scale decreased significantly after 8 weeks, with no difference between the studied groups. The percentage of disability (Oswestry low back pain disability questionnaire) improved significantly only in the test group (57). The results of the study conducted were found to correlate with the results of our study.

Pearson correlation was used to analyze the relationship between the age of the respondents and the percentage of disability in the test and control groups. At the first examination, a statistically significant positive correlation was found in the test (r = 0.281; $p = 0.005$) and control (r = 0.245; $p = 0.014$) groups, which means that the percentage of disability increased with age among respondents in the test and control groups. No statistically significant correlation was found between these two analyzed variables in the second and third tests.

The analysis of the percentage of disability of the respondents in standing occupations in both studied groups showed a greater decrease in the percentage of disability in the respondents of the test group compared to the control group.

The results of our study correlate with the results of the study conducted by Tonosu J. and co-workers (2016), who conducted a non-randomized control study on the effects of the standing back stretch exercise program "One Stretch" - based on the McKenzie Method - on the prevention and improvement of pain and disability due to low back pain syndrome among nurses in Japan. Using the Oswestry Index of Disability, the condition of 89 workers in the test group (written exercise instructions, a 30-min seminar on low back pain syndrome, and group exercise) and 78 workers in the control group (written exercise instructions) was assessed at baseline and 1 year after treatment. Compared with the control group, a greater number of participants in the test group experienced improvement in symptoms and prevention of LPS without seeing a physician. In addition, significantly fewer respondents in the test group had a disability due to LPS at the end of the study (58).

A greater reduction in the percentage of disability among subjects in the test group compared with the control group was also found among subjects with sedentary occupations in both groups studied.

In a randomized control trial, Kim et al. investigated the effects of the CORE exercise program on pain at rest, pain from movement or secondary pain, active range of motion, and trunk proprioception in female office workers with chronic LPS. Fifty-three female subjects with chronic LPS were divided into a test group that participated in a CORE exercise program (30 min daily, 5 times weekly, and 8 weeks), the use of warm compresses and transcutaneous electrical nerve stimulation (TENS), and a control group that participated in warm compresses and TENS only. The research results demonstrate the effectiveness of the exercise program CORE in reducing pain from stasis and movement and improving active range of motion and trunk proprioception in office workers with chronic LPS, which is consistent with the results of our research (59).

In the test group, subjects with subacute pain had the highest percentage of work disability at all three examinations, whereas in the control group, subjects with acute pain had the highest.

To evaluate the effectiveness of segmental stabilization exercises for acute, subacute, chronic, and recurrent LBS, Kriese et al. conducted a systematic review of clinical and randomized control trials. An electronic search of the PubMed database from November 2008 to March 2009 included 17 studies. Results showed that for acute LPS, both segmental stabilization exercises and primary care physician treatment were effective in reducing pain and disability in the short term. In the long term, after an acute episode of LPS, segmental stabilization exercises are effective in reducing recurrence. In chronic LPS, segmental stabilization exercises are more effective than primary care level interventions and may be as effective as other physical therapy treatments in reducing pain and disability. Equivalent improvements were noted compared with surgical treatment. There were no results regarding subacute LPS (60).

In all three studies, the percentage of disability was statistically significantly higher in subjects in the control group compared with the test group for acute (1.9%: 14.3%), subacute (7.11%: 12.61%), and chronic pain (1.87%: 13.86%), $p < 0.05$.

The results of our study are consistent with the meta-analysis of randomized control trials by Byström et al., who investigated the effectiveness of motor control exercises in reducing

pain intensity and disability in people with chronic LPS. A search of electronic databases through October 2011 and use of RevMan5 software revealed superiority of motor control exercises compared with manual spine therapy in reducing disability over the observed time periods, but not in reducing pain intensity. The superiority of motor control exercises was also found when compared with general exercises and interventions at the primary care level (61).

The results of a randomized control trial by Bronfort et al. on the effectiveness of guided exercise, spinal manipulation, and a home exercise program in people with chronic LBS are at odds with the results of our study. Respondents (n = 301) aged 18 to 65 years were assessed for pain intensity, level of disability, general health, medication adherence, overall improvement, satisfaction with treatment, muscle strength, and endurance at weeks 12 and 52 after the start of LPS. A qualitative interview was also conducted at week 12 after the start of LPS. Supervised exercise had significantly greater effects on muscle strength and endurance compared with spinal manipulation and a home exercise program, as well as greater respondent satisfaction with treatment. Other research instruments showed the benefit of supervised exercise, but without statistical significance (62).

CONCLUSION

Considering the direct influence of trunk muscles on the condition of the spine and the impact on the performance of activities of daily living, it is of great importance to establish strategies for incorporating movements into the daily routine. The application of the most effective movement patterns to prevent the onset or treat existing low back pain is still the subject of worldwide research. The study conducted analyzed longitudinally and found that exercise therapy techniques focused on achieving natural spinal mobility and improving trunk muscle strength are effective in reducing pain intensity, improving activities of daily living, and reducing the percentage of disability in people with LPS.

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DECLARATION OF INTERESTS

There are no conflicts of interest to declare by any of the authors of this study.

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