ORIGINAL ARTICLE

Annals of Agricultural and Environmental Medicine
www.aaem.pl

Lower back pain in the lumbosacral region of the spine as a social problem for patients attending preventive physiotherapy – a comparison of cohorts

Michał Grzegorczyk[1,A-F] ✉, Piotr Waszak[2,A-C,E-F], Agnieszka Lutek-Sitko[3,B-C,F], Małgorzata Goździewska[4,C-D,F], Ewelina Grywalska[5,1,D-F]

[1] *Department of Rehabilitation and Physiotherapy, Medical University, Lublin, Poland*
[2] *Director of the Polish Social Insurance Institution, Lublin, Poland*
[3] *Department of Management, Faculty of Economics, Maria Curie-Skłodowska University, Lublin, Poland*
[4] *Departament of Medical Anthropology, Institute of Rural Health, Lublin, Poland*
[5] *Department of Experimental Immunology, Medical University, Lublin, Poland*
A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of the article

Grzegorczyk M, Waszak P, Lutek-Sitko A, Goździewska M, Grywalska E. Lower back pain in the lumbosacral region of the spine as a social problem for patients attending preventive physiotherapy – a comparison of cohorts. Ann Agric Environ Med. doi: 10.26444/aaem/200305

Abstract

Introduction and Objective. Lumbar-sacral spine pain is becoming a civilization problem in highly developed countries. The aim of the study was to assess the effect of the frequency and number of physiotherapy treatments in a cycle on pain sensation, and on changes in mobility and muscle tension in subacute and chronic lumbar-sacral spine pain.

Materials and Method. A total of 100 patients (50 women and 50 men) were included in the study and assigned to two groups. It was found that extending the cycle of physiotherapy treatments by reducing their frequency and number and using manual therapy as a special kinesitherapy method produced better results in reducing pain sensation, compared to using physiotherapy treatments every day for two weeks using traditional kinesitherapy in patients with subacute and chronic lumbar-sacral spine pain.

Results. These methods increased lumbar spine mobility compared to daily physiotherapy for two weeks using traditional kinesitherapy in patients with subacute and chronic low back pain, reduced resting muscle tension compared to daily physiotherapy for two weeks using traditional kinesitherapy in patients with subacute and chronic low back pain, and resulted in better quality of life scores compared to daily physiotherapy for two weeks using traditional kinesitherapy in patients with subacute and chronic low back pain. Objective tests, such as assessment of spine mobility using an inclinometer and assessment of paraspinal muscle tension using transcutaneous electromyography, were used to verify subjective results.

Conclusions. In patients with subacute and chronic low back pain, the frequency and number of physiotherapy sessions should be verified to optimize clinical effectiveness and cost-effectiveness of therapy.

Key words

lower back pain, costs, social insurance

INTRODUCTION

Pain in the lumbosacral region of the spine is becoming a lifestyle condition in high-income countries. Studies have shown that currently approximately 72% of Poles under the age of 40 have been treated for lower back pain at least once, and an astonishing 68% have experienced recurring pain within a year. Pain limits professional activity, and the necessity of attending physiotherapy treatments causes work absenteeism which generates economic consequences for both employers and employees. Hence, it would be valuable to assess whether fewer treatments, allowing for the regeneration of damaged structures, would have comparable or better results than a large number of treatments in a short timeframe [1].

✉ Address for correspondence: Michał Grzegorczyk, Department of Rehabilitation and Physiotherapy, Medical University, Lublin, Poland
E-mail: michalgrzegorczyk@umlub.pl

Received: 11.12.2024; accepted: 18.01.2025; first published: 13.03.2025

The aim of this study is to evaluate the impact of the number and frequency of physiotherapy treatments in a cycle on changes in mobility and muscle tension in the lumbosacral spine, as well as on the subjective pain assessments of the patient.

MATERIALS AND METHOD

Patient characteristics.

Inclusion criteria:

- 20–60 years of age;
- subacute or chronic lumbosacral back pain diagnosed by a medical specialist;
- informed consent to participate in the study signed by the patient.

Exclusion criteria:

- contraindications to laser therapy, electrotherapy, magnetotherapy, as well as kinesitherapy and manual therapy, as diagnosed by a medical specialist;

- physiotherapy treatments carried out in the lumbosacral spine region for a period of at least 3 months before the start of the study;
- prior surgery in the lumbosacral spine region;
- other physiotherapy carried out in another centre at the time of study participation.

Study procedure. The study was approved by the Bioethics Committee of the Medical University of Lublin (Approval No. KE-0254/361/2018). The study took place from February 2020 – January 2024 at the Medi Sport Rehabilitation and Sports Therapy Centre in Lublin. Patients were selected based on purposive sampling. A total of 100 patients qualified for the study (50 men and 50 women) who were divided into 2 groups: Group I 'ZUS' – 26 men and 24 women, and Group II 'TM' – 24 men and 26 women. Both groups of patients received treatment.

Group I 'ZUS' included patients with chronic pain in the lumbosacral region of the spine, who were referred for rehabilitation by the Polish Social Insurance Institution, as part of disability prevention. Treatments in this group took place over a period of two weeks, Monday – Saturday. A whole cycle of physiotherapy lasted 12 days with a one-day break on Sunday. Medical examinations were conducted on 3 occasions: before the first day of physiotherapy, before the eighth day of physiotherapy (following a one-day break), and on the last day of physiotherapy, after a 30-minute rest period. It was not possible to conduct a fourth medical examination for Group I 'ZUS' at a later date. This group of patients was referred to physiotherapy by the Polish Social Insurance Institution as part of a disability prevention programme. After completing the physiotherapy cycle, participants did not attend further medical examinations as they are not always motivated by the prospect of a positive therapy assessment.

Group II 'TM' included patients with subacute and chronic pain, who were referred to special kinesitherapy treatments (manual therapy) by a medical specialist. Treatments in this group lasted 3 weeks, on Mondays, Wednesdays and Fridays. There were 9 physiotherapy appointments in the cycle.

Additionally, both groups completed Visual Analog Scale (VAS) surveys and were subject to range of motion measurements using a medical inclinometer, and resting muscle tension tests with a MyoPlus2 Pro electromyograph. These measurements took place before the eighth day of treatments for Group I 'ZUS', and before the fifth day of treatments for Group II 'TM'.

As part of physiotherapy, both groups underwent physical treatments (high-energy laser, transcutaneous electric nerve stimulation (TENS), and pulsed low-frequency magnetic field therapy. Additionally, Group I 'ZUS' participants received 2 classic kinesitherapy treatments: general fitness exercises and lumbar spine exercises. Instead of classic kinesitherapy, Group II 'TM' underwent special manual therapy treatments.

RESULTS

A total of 19 patients (38%) from Group I 'ZUS' and 18 patients (36%) from Group II 'TM' were absent from work on one or two occasions due to pain in the lumbosacral region of the spine. A total of 18 patients (36%) from Group I 'ZUS' and 9 patients (18%) from Group II 'TM' were absent from work more than four times. Only 10 patients (20%) in Group I 'ZUS' and 18 patients (36%) in Group II 'TM' were never absent from work (Tab. 1).

Table 1. Absence from work caused by lumbosacral back pain

	Absence from work caused by lumbosacral back pain	Group I "ZUS"		Group II 'TM'		Statistical Analysis
		N	%	N	%	Chi^2=8.029; p=0.046
1	0 times	10	20	18	36	
2	1–2 times	19	38	15	30	
3	3–4 times	3	6	8	16	
4	More than 4 times	18	36	9	18	
Total		50	100	50	100	

There were no statistically significant differences between groups before the planned treatments (Z=-0.74; p=0.462). Before the second treatment there was a statistically significant difference between both groups (Z=-2.34; p<0.05). There were also statistically significant differences between groups before the end of the treatments (Z=-5.83; p<0.0001) (Tab. 2).

Table 2. VAS pain level scores in Group I 'ZUS' and Group II 'TM'

Frequency of painkiller use	Time of survey: Before planned treatments VAS1	Before the 8th treatment VAS2	After the cycle of treatments VAS3	Statistical analysis
Group I 'ZUS' patients				
Minimum	3	0	0	Friedman test Chi^2=54.48 p<0.001
Maximum	10	8	8	
Average	6.6	5.00	5.1	VAS1 vs VAS2 Z=-5.42; p<0.001
Standard error	1.55	1.95	1.93	VAS2 vs VAS3 Z=0; p=1
Median	7	5	5	
No. of patients	50	50	50	VAS1 vs VAS3 Z=-5.39; p<0.001
Group II 'TM' patients				
Minimum	3	0	0	Friedman test Chi^2=89.17 p<0.0001
Maximum	10	8	5	
Average	6.9	4.1	2.4	VAS1 vs VAS2 Z=-5.78; p<0.001
Standard error	1.43	2.15	1.76	VAS2 vs VAS3 Z=-5.52; p<0.001
Median	7.00	4.00	2.00	
No. of patients	50	50	50	VAS1 vs VAS3 Z=-6.17; p<0.001
Group comparison: Mann-Whitney U test	Z= -0.74 p=0.462	Z=-2.34 p=0.019	Z=-5.83 p<0.0001	

There were statistically significant differences between groups before the start of treatments (t=-2.18; p<0.05), before the second day of treatments (t = 2.67; p<0.05), and at the end of treatment (Z=5.48, p<0.001) (Tab. 3).

There was a statistical difference between groups before planned treatments (Z=-3.13; p<0.05). However, there were no statistically significant differences between the 2 groups before the second treatment (Z=-1.76; p=0.079) and at the end of the treatment cycle (Z=-0.10; p=0.918) (Tab. 4).

There were no statistically significant differences between groups before the start of treatments (Z=-1.58; p=0.114),

Table 3. Measurement of the lumbar lordosis angle before the start of physiotherapy, halfway through treatments, and at the end of treatments in Group I 'ZUS' and Group II 'TM' patients

Statistics	Time of measurement			Statistical test
	Before planned treatments (V1)	After half of treatments (V2)	After the cycle of treatments (V3)	
	Group I 'ZUS' patients			
Minimum	9	10	10	Friedman test Chi^2=16.32 p=0.0003 V1 vs V2 Z=-3.90; p<0.001 V2 vs V3 Z=-0.02; p=1 V1 vs V3 Z=-2.59; p=0.029
Maximum	54	57	57	
Average	26.8	29.5	29.2	
Standard error	10.76	10.54	9.39	
Median	25.5	28.5	29	
No. of patients	50	50	50	
	Group II 'TM' patients			
Minimum	16	18	25	Friedman test Chi^2=51.43 p<0.0001 V1 vs V2 Z=-3.97; p<0.001 V2 vs V3 Z=-5.28; p<0.001 V1 vs V3 Z=-5.65; p<0.001
Maximum	48	52	54	
Average	30.9	34.4	38.4	
Standard error	7.89	7.59	7.19	
Median	30.5	35.5	39	
No. of patients	50	50	50	
Welch Two Sample t-test	T-test (Welch test) t=-2.18; p=0.032	T-test (Welch test) t=-2.67; p=0.009	T-test Z=-5.48; p<0.001	

Table 4. Electromyography (KAN1) before the start of treatments, halfway through treatments and after the series of planned treatments for patients in Group I "ZUS" and Group II "TM"

Statistics	TIME OF MEASUREMENT			Statistical test
	Before planned treatments (V1)	After half of treatments (V2)	After the cycle of treatments (V3)	
	Group I 'ZUS'			
Minimum	1,3	1.2	1.4	Friedman test Chi^2=1.54 p=0.4632
Maximum	9.4	6.0	6.6	
Average	3.44	3.14	3.28	
Standard error	1.67	1.14	1.23	
Median	3.05	2.90	3.00	
No. of patients	50	50	50	
	Group II 'TM'			
Minimum	2.0	1.7	1.7	Friedman test Chi^2=24.00 p<0.0001 V2 vs V2 Z=-3.63; p<0.001 V2 vs V3 Z=-2.21; p=0.081 V1 vs V3_ Z=-3.91; p<0.001
Maximum	24.9	17.9	11.4	
Average	5.05	4.02	3.43	
Standard error	3.77	2.79	1.72	
Median	4.2	3.25	2.95	
No. of patients	50	50	50	
Mann-Whitney U test	Z=-3.13; p=0.002	Z=-1.76; p=0.079	Z=-0.10; p=0.918	

before the second treatment (Z=-1.89; p=0.059), and at the end of treatment (Z=-0.79; p=0.427) (Tab. 5).

Table 5. Electromyography (KAN2) before the start of treatments, halfway through treatments and after the series of planned treatments for patients in Group I "ZUS" and Group II "TM"

Statistics	TIME OF MEASUREMENT			Statistical test
	Before planned treatments (V1)	After half of treatments (v2)	After the cycle of treatments (V3)	
	Group I 'ZUS'			
Minimum	1.4	1.1	1,2	Friedman test Chi^2=4.74 p=0.0937
Maximum	7.7	8.3	7.0	
Average	3.19	2.95	3.03	
Standard error	1.36	1.39	1.24	
Median	2.95	2.80	2.90	
No. of patients	50	50	50	
	Group II 'TM'			
Minimum	1.5	1.7	1.4	Friedman test Chi^2=13.157 p=0.001 V1 vs V2 Z=-2.60; p=0.028 V2 vs V3 Z=-1.10; p=0.809 V1 vs V3 Z=-2.93; p=0.010
Maximum	18.6	20.3	6.3	
Average	4.18	3.64	3.17	
Standard error	2.94	2.80	1.20	
Median	3.25	3.30	2.80	
No. of patients	50	50	50	
Mann-Whitney U test	Z=-1.58; p=0.114	Z=-1.89; p=0.059	Z=-0.79; p=0.427	

DISCUSSION

A review of the available literature concerning the use of physiotherapy in reducing pain of the lumbosacral region of the spinal reveals a lack of data on the amount and frequency of physiotherapy treatments, whereas is a substantial number of articles about combating pain using various types of physiotherapy. There are no comparisons of the frequency and number of treatments.

Currently, many researchers emphasise the efficacy of physical treatments in alleviating lumbosacral back pain, whereas others claim either kinesitherapy, massage, or manual therapy as particular methods of kinesitherapy, and are the most effective for pain relief [2–6]. In the treatment of pain of the lumbosacral region of the spine, many treatments are carried out daily, particularly physiotherapy, which is supported by Fiore, Zaniewska, and Przedborska [7–11]. Kinesitherapy is also a method for reducing lumbosacral back pain, as asserted by Murtezani et al. (2011) who maintain that it should be an integral part of treatment of patients with chronic lower back pain. Their study has shown a statistically significant reduction in pain levels after treatment with high intensity aerobic exercise [12, 13]. Saran et al. (2014) recognised the importance of appropriately selected exercises, not only in the treatment, but also in the prevention of pain of the lumbosacral spine, resulting from spinal overload. The exercises recommended after a medical examination should correct the abnormal tension of the back muscles and strengthen the muscles of the trunk and limbs [14].

The results of the current study confirm the assumptions of the abov-ementioned researchers, and the authors of the current study consider kinesitherapy to be a key element in

the management of lower back pain, which is in agreement with Murtezani et al. In the current study, kinesitherapy was used in Group I 'ZUS', enabling a comparison of its efficacy with manual therapy and also allowed patients to become familiar with preventive exercises, which was also postulated by Saran et al. [14].

Many researchers observe the efficacy of using combined methods in reducing lumbosacral back pain. Gworys et al. (2012) randomised patients with lower back pain into 2 groups. Laser therapy, magnetotherapy, electrotherapy and kinesitherapy exercises were used as treatments in the first group, whereas only physical treatments were used in the second group. Patients attended physiotherapy session for 5 days per week for 2 weeks. There was a statistically significant difference in reducing lower back pain, measured using VAS [11, 15]. Gur et al. (2003) compared the efficacy of laser therapy and kinesitherapy in which the study participants were divided into 3 groups, with 25 participants in each group. Patients were treated with laser therapy combined with kinesitherapy, laser therapy, and kinesitherapy in groups I, II, and III, respectively. VAS results, as well as results from the Schober test, the Roland-Morris questionnaire and a modified Oswestry Index, did not demonstrate a statistically significant difference between groups [16, 17].

Manual therapy leads to rapid results in the treatment of lower back pain through the reduction of muscle tension of shortened muscles and by mobilising hypermobile segments. Research conducted by Zaworski et al. (2015) and Niewiński et al. (2009) show the efficacy of this method in pain relief, as well as its impact on patient quality of life [18, 19].

According to a report of the European Agency for Safety and Health at Work, musculoskeletal conditions are the most common work-related health problem. Muscle pain in the case of the lumbosacral region of the spine affects 25% of all professionally active people. Przysada et al. (2019) state that 33.44% of patients referred for rehabilitation as part of Polish social security disability prevention have pain in the lumbosacral region of the spine. This condition is most prevalent in people aged 40–54 [13, 18, 20–24].

In other studies, Przysada et al. describe the work ability assessment of people with chronic conditions of the musculoskeletal system after the completion of rehabilitation as part of the disability prevention programme of the Polish Social Insurance Institution. A total of 607 physiotherapy patients took part in the study between 2011–2013. Medical documentation included patient medical history and the results of a 'functional test', recommended by the Institution. An analysis of the results demonstrated that most patients received a recommendation to resume their work activities. After 2 years, a telephone survey was conducted with the patients who had attended physiotherapy as part of social security disability prevention. Participants were asked whether they had returned to work and whether they were currently working. The results showed that despite previous results and issued recommendations to work, most of the respondents were receiving rehabilitation benefits (60.62%), or a sickness allowance (33.11%), 4.94% were receiving a disability pension. Only 1.33% of those surveyed were not receiving any benefits [24].

The results of the current study correspond to those obtained by Przysada et al. (2019). In both studies it was observed that most people who participated in social security disability prevention did so in order to receive social security benefits. This is demonstrated by the frequent increase in pain levels in these patients towards the end of the physiotherapy cycle. Also, some patients seem to intentionally underestimate the value of their functioning during functional tests. According to experts of the Polish Social Security Institution, rehabilitation is effective if the patient did not receive any benefits as part of disability prevention for a minimum of 12 months, with the exception of a sickness allowance for not more than 20 days [24].

In the opinion of the authors of this study, reducing the number of days of treatment and carrying out therapy every other day, as in the case in Group II 'TM', should be considered. The results of the study show that a smaller number of treatments in the same timeframe, the efficacy of which has been demonstrated in clinical studies, would provide more benefit to both patients and the national budget.

CONCLUSIONS

In patients with subacute and chronic pain in the lumbosacral region of the spine, increasing the timeframe of physiotherapy cycles by reducing the amount and frequency of treatments, as well as the use of manual therapy as a special method of kinesitherapy, provided better results in pain reduction, increased mobility, and reduced muscle tension, when compared to patients who had daily traditional kinesitherapy treatments for a period of 2 weeks.

Patients treated as part of the social security disability prevention for subacute and chronic lower back pain should have objective tests implemented into their clinical assessments, such as a range of motion measurements using a medical inclinometer, and spinal muscle tension tests using an electromyograph. These may help verify the results of subjective tests.

The Polish Social Security Institution's disability prevention rehabilitation programme of patients with subacute and chronic lumbosacral back pain should be verified according to the amount and frequency of physiotherapy treatments in a cycle.

Ethics approval statement. The study was conducted in accordance with the Declaration of Helsinki, Good Clinical Practice (GCP), and applicable local regulations. The study was approved by the Bioethics Committee of the Medical University of Lublin (Approval No. KE-0254/361/2018).

REFERENCES

1. Charłasz M, Gasztych J, Irzmański R, Kujawa J. Analiza skuteczności przeciwbólowej wybranych metod fizykoterapii u osób z zespołami bólowymi części lędźwiowo-krzyżowej kręgosłupa. Ortopedia Traumatol Rehabil. 2010;3(6):225–236.
2. Ciavarella D, Palazzo A, De Lillo A, et al. Influence of vision on masticatory muscles function: Surface electromyographic evaluation. Ann Stomatol (Roma). 2014 Jun 18;5(2):61–3.
3. Domaniecki J. Przegląd metod fizjoterapeutycznych stosowanych w przeciążeniu odcinka lędźwiowego kręgosłupa ze szczególnym uwzględnieniem programu ćwiczeń wzmacniających gorset mięśniowy. Warszawa: Wydawnictwo AWF J. Piłsudskiego w Warszawie; 2006.
4. Hayden JA, Ellis J, Ogilvie R, Malmivaara A, van Tulder MW. Exercise therapy for chronic low back pain. Cochrane Database Syst Rev. 2021 Sep 28;9(9):CD009790. doi:10.1002/14651858.CD009790.pub2; PMID: 34580864; PMCID: PMC8477273.

5. Durkin JL. The effects of lumbar massage on muscle fatigue, muscle oxygenation, low back discomfort and driver performance during prolonged driving. Ergonomics 2006;49(1):28–44.
6. Daneau C, Cantin V, Descarreaux M. Effect of Massage on Clinical and Physiological Variables During Muscle Fatigue Task in Participants With Chronic Low Back Pain: A Crossover Study. J Manipulative Physiol Ther. 2019 Jan;42(1):55–65. doi:10.1016/j.jmpt.2018.12.001. Epub 2019 Apr 5. PMID: 30955910
7. Fiore P, Panza F, Cassatella G, et al. Short-term effects of high-intensity laser therapy versus ultrasound therapy in the treatment of low back pain: a randomized controlled trial. Eur J Phys Rehabil Med. 2011 Sep;47(3):367–73. Epub 2011 Jun 8.
8. Przedborska A, Leszczyńska A, Pruszyńska M, et al. Ocena skuteczności terapeutycznej głębokiej stymulacji elektromagnetycznej u pacjentów z przewlekłymi zespołami bólowymi kręgosłupa lędźwiowo-krzyżowego – doniesienia wstępne. Kwartalnik Ortopedyczny. 2012;4:600 ISSN 2083-8697.
9. Przedborska A, Kilon M, Leszczyńska A, Misztal M, Raczkowski JW. Assessment of the effectiveness of deep electromagnetic stimulation in the treatment of low back pain depending on the area of application. Fizjoterapia Pol. 2019;19(2):148–156.
10. Przedborska A, Misztal M, Raczkowski JW. Ocena skuteczności terapeutycznej głębokiej stymulacji elektromagnetycznej u pacjentów z zespołami bólowymi dolnego odcinka kręgosłupa. Ortopedia Traumatol Rehabil. 2015;5(6):531–541.
11. Zaniewska R, Okurowska-Zawada D, Kułak W, Damian K. Analiza jakości życia pacjentów z zespołem dolnego odcinka kręgosłupa po zastosowaniu przezskórnej elektrycznej stymulacji nerwów- Tens. Medycyna Pracy. 2012;63(3):295–302.
12. Murtezani A, Hundozi H, Orovcanec N, et al. Comparison of high intensity aerobic exercise and passive modalities for the treatment of workers with chronic low back pain: a randomized, controlled trial. Eur J Phys Rehabil Med. 2011 Sep;47(3):359–66.
13. Wasser JG, Vasilopoulos T, Zdziarski LA, Vincent HK. Exercise Benefits for Chronic Low Back Pain in Overweight and Obese Individuals. PM R. 2017 Feb;9(2):181–192. doi:10.1016/j.pmrj.2016.06.019; Epub 2016 Jun 23; PMID: 27346092.
14. Saran T, Matera K, Maruszewska A, Kasprzyk-Kościk B. Badanie przydatności ćwiczeń profilaktycznych kręgosłupa lędźwiowo-krzyżowego w zapobieganiu utracie mineralnej masy kostnej u kobiet w okresie pomenopauzalnym. Acta Balneol. 2014;LVI(4):138.
15. Gworys K, Rosiakowska J, Adamczewski T, et al. Analiza skuteczności przeciwbólowej różnych metod fizjoterapii stosowanych w przewlekłym zespole bólowym kręgosłupa lędźwiowo-krzyżowego. Kwartalnik Ortoped. 2012;4:511. ISSN 2083–8697
16. Gur A, Karakoc M, Cevik R, et al. Efficacy of low power laser therapy and exercise on pain and functions in chronic low back pain. Laser Surg Med. 2003;32(3):233–8.
17. Alfredo PP, Bjordal JM, Junior WS, Marques AP, Casarotto RA. Efficacy of low-level laser therapy combined with exercise for subacromial impingement syndrome: A randomised controlled trial. Clin Rehabil. 2021 Jun;35(6):851–860. doi:10.1177/0269215520980984; Epub 2020 Dec 14; PMID: 33307783.
18. Niewiński A, Latosiewicz R, Rutkowska I, Dakowicz A. Przydatność wybranych technik terapii manualnej (trakcji i mobilizacji) w leczeniu zachowawczym objawowej dyskopatii L5-S1. Postępy Rehabil. 2009;(1): 35–39.
19. Zaworski K, Latosiewicz R, Majcher P, Derewiecki T. Terapia manualna w diagnozowaniu i leczeniu zespołu mięśnia gruszkowatego – studium przypadku. Med Og Nauk Zdr. 2015;21(2):2015–220.
20. Karczewicz E, Kania A. Wydatki na świadczenia z ubezpieczeń społecznych związane z niezdolnością do pracy w 2016 r. Zakład Ubezpieczeń Społecznych, Departament Statystyki i Prognoz Akturialnych, Warszawa 2017.
21. Koczur W. Restytucja zdolności do pracy w powszechnym systemie ubezpieczeń społecznych – zarys problematyki. In: Bieniek P, Rawski O, editors. Niezdolność do pracy jako ryzyko w społecznym ubezpieczeniu rentowym. Zakład Ubezpieczeń Społecznych. Warszawa-Chorzów: Polskie Stowarzyszenie Ubezpieczenia Społecznego; 2014. p. 129–156.
22. Nietopiel M. 20 lat rehabilitacji w ramach prewencji rentowej ZUS. Przewodnik Rehabilitacyjny. 2016;2–3:3–13.
23. Polit Ł, Strączyński M, Śliwiński Z. Najczęstsze przyczyny skierowań na rehabilitację narządu ruchu w ramach prewencji rentowej Zakładu Ubezpieczeń Społecznych. Stud Med. 2013;29(1):57–62.
24. Przysada G, Kilian J, Wiśniowska-Szurlej A, et al. Ocena zdolności do podejmowania pracy po zakończeniu rehabilitacji w ramach prewencji rentowej Zakładu Ubezpieczeń Społecznych u osób z chorobami przewlekłymi narządu ruchu. Med Pr. 2019;70(4):459–473.