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The Effect of Combined Treatment with Passive Therapy, Physical Exercises, Lumbar Traction, and Walking Program on Chronic Low Back Pain

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Abstract

Chronic low back pain (CLBP) is one of the most common musculoskeletal disorders worldwide with far-reaching implications for social, economic, and public health. The study aimed to compare the effect of combined physiotherapy treatment in patients with CLBP. This observational retrospective randomized controlled study involved reviewing medical records of patients who were treated during a period of 6 weeks in the physiotherapy department of the Special Hospital for General Rehabilitation "Banja e Klokotit," Klokot, Republic of Kosovo. The observational research was conducted for 60 patients, divided into two groups: Group 1: experimental group (n=30), with mean age of 41.7 years, average height of 1.68 cm, and average body mass index (BMI) of 21.7 for both sexes; Group 2: control group (n=30) with mean age of 43.1 years, average height of 1.66 cm, and average body mass index (BMI) of 21.5 for both sexes. In Group 1, combined treatment with passive therapy [thermotherapy and transcutaneous electrical nerve stimulation (TENS)], physical exercises, lumbar traction, and walking program was applied, while in Group 2, passive therapy like thermotherapy and TENS was applied. Outcome measurements included pain intensity, lumbar flexibility, revised Oswestry disability index (ODI), and self-confidence, which were assessed pre-treatment, at 3 weeks, and after 6 weeks of clinical treatment. The results showed significant improvement in both groups. However, the improvement was greater and with a significant difference only after 6 weeks in Group 1 compared to Group 2. The differences were observed in various outcome measures, including the visual analog scale for pain (VAS; $p < 0.0001$), fingertip-to-floor distance (FTF; $p < 0.0001$), ODI ($p < 0.0001$), and Rosenberg self-esteem scale (RSE; $p = 0.0002$). According to our data, combined treatment with thermotherapy, therapeutic exercises, lumbar traction, TENS, and walking program was more effective and can be considered as a treatment protocol for patients with CLBP. However, further research is recommended on the efficacy of combined physiotherapy treatment, especially lumbar traction for longer periods.

Keywords: back pain, modalities, therapeutic exercise, lumbar flexibility, traction

Introduction

Low back pain (LBP) has a high prevalence in many countries around the world and is a major health problem in modern society (Zheng et al., 2012; Ibrahim-Kaçuri, 2015). LBP is a complex condition; it is one of the most common musculoskeletal complaints and causes of disability global-

ly. It can be attributed to various causes, including trauma, degenerative conditions, inflammatory disorders, oncologic, spinal infections, and occupational factors (Vos et al., 2010; Patrick et al., 2014). Several factors increase the risk of developing back pain: smoking, obesity, longevity, female gender, physical work, sedentary job, high levels of stress,



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job dissatisfaction, and psychological factors such as anxiety or depression (Hartvigsen, 2018; Shiri et al., 2019). In addition to these factors, the rapid development of the industrial world and modern lifestyle has further increased the likelihood of developing LBP, particularly among young people. Physiotherapy, with a combination of various interventions such as electrotherapy, different therapeutic exercise protocols, and lumbar traction, represents one of the primary treatment approaches for CLBP. It has shown promising results in terms of pain reduction, improved flexibility, prevention of disability progression, and restoration of patient's ability to engage in daily activities (Eleswarapu et al., 2016; Choi et al., 2016; Foster et al., 2018; Shipton, 2018; Hayden et al., 2021; Tanabe et al., 2021).

There is scientific evidence that the application of different physiotherapeutic methods can reduce pain and disability due to LBP (Moseley, 2002; Hayden et al., 2005; Petersen et al., 2011). This study aimed to compare the effect of different combinations of physiotherapy treatment methods like thermotherapy, physical exercises, lumbar traction, electrotherapy TENS, and walking program on the treatment of patients with CLBP.

Methods

Participants

In this retrospective observational randomized study, 60 patients, who were treated at the Special Hospital for General Rehabilitation "Banja e Klllokotit" in Klllokot, Republic of Kosovo, were selected through the review of medical documentation. These patients were referred by specialists in different fields during the period between September 2020 and November 2021. All patients included in the study met the research criteria, such as age between 18 and 65 years, male or female, LBP with or without iridescence along the leg, and duration of symptoms of more than 12 weeks. Patients with the following conditions were excluded from the study: compression of the nerve roots (positive neurological tests), osteomyelitis of the spine, ankylosing spondylitis, vertebral fracture, malignant disease, structural scoliosis, spinal instability, previous spine surgery, spondylolisthesis, and retrolisthesis. The sample was divided into two groups. Group 1 was the experimental group ($n=30$); it included 15 women and 15 men with mean age of 41.7 years ($SD\pm 9.0$ years), average height of 1.68 cm, and average body mass index (BMI) of 21.7 for both sexes. Group 2 was the control group ($n=30$); it included 15 women and 15 men, with mean age of 43.1 years ($SD\pm 10.7$ years), average height of 1.66 cm, and average body mass index (BMI) of 21.5 for both sexes.

Assessment

General data were obtained through subjective examination. Pain intensity was observed and evaluated using the visual analog scale (VAS; Delgado et al., 2018). Lumbar flexibility or fingertip-to-floor distance (FTF; Perret et al., 2001) was assessed with a measuring tape. Functional disability was evaluated with the Oswestry disability index (ODI), also known as the Oswestry Low Back Pain Disability Questionnaire (Fairbank & Pynsent, 2000). The Rosenberg self-esteem scale (RSE) was used to assess self-worth by measuring both positive and negative feelings patients had about themselves (Rosenberg, 1965). All these parameters were measured before treatment, at 3 weeks, and after 6 weeks of treatment.

Physiotherapy treatment

The duration of treatment for both groups was 3 weeks in the hospital, and after 3 weeks, they continued to come to the hospital for treatment for 3 more weeks (3 times a week). In the first group, combined treatment with thermotherapy, physical exercises, lumbar traction, TENS, and walking program was applied, while in the second group (control) passive modalities, such as thermotherapy and TENS, were applied.

For 90% of patients, the physiotherapeutic treatment started from the first day of hospitalization, while for 20%, it started one day after hospitalization, after all general examinations were completed. Treatment lasted for 6 weeks. The physiotherapeutic program was modified and the application was conducted as follows:

During the first 3 weeks, thermotherapy was applied 5 days a week with hot pieces in the lumbosacral area and along the affected leg for a duration of 15–20 minutes. Then the application continued for another 3 weeks, 3 times a week with the same procedure and duration.

During the first 3 weeks, the exercises were performed 3 times a week for 15–20 minutes until the limit of pain. It was continued for another 3 weeks, 3–5 times a week for 20–30 minutes. The physical exercise regimen consisted of static and dynamic exercises for strengthening the muscles of the back, with a specific focus on the lumbar region, abdominal region, pelvic muscles, and the lower extremities in general (Koumantakis et al., 2005; Ferreira et al., 2006).

Lumbar traction treatment was administered 3 times a week for 6 weeks, with each session lasting for up to 30 minutes (around 3–30 minutes). Weight-bearing was applied intermittently by progressively increasing the weight to about one-third of the patient's body weight, based on their reported tolerance (Rasmussen & Kyle, 2017; Oh et al., 2018).

TENS current was applied through four cutaneous electrodes of medium size (2.5 cm) along the pain points, with a frequency of 7 Hz and pulse duration of 0.1 ms, progressively increasing the intensity until the patient indicated that they could tolerate it. TENS was applied 3 times a week for a duration of 20–30 minutes from the first day of treatment up to 6 weeks.

The walking program was conducted 5 days a week. The patients first started with walking for 10 minutes (1200 steps per day) and then reached 30 minutes of moderate-intensity physical activity. The patients had the option to choose to walk up to the limit of pain, walk with minimal pain (1–3/10) for 15–20 minutes, or walk 4 times a day for 4–5 minutes (Park et al., 2019).

Physical exercises, lumbar traction, and walking program were applied to Group 1 only, while thermotherapy and TENS were applied similarly to both groups. So the treatment for both groups lasted a total of 6 weeks, 3 weeks inside the Special Hospital and another 3 weeks on an outpatient basis in the same hospital. Additionally, during the treatment period, the patients were given recommendations for different standing positions and advice and instructions for engaging in daily life activities.

Ethics

The study was approved by the Ethical Committee of Special Hospital for General Rehabilitation "Banja e Klllokotit," (Nr. 123) Klllokot, Republic of Kosovo.

Statistical analysis

Data processing was done with the statistical package SPSS 22.0 (SPSS Inc., Chicago, IL, USA). Data are presented as mean and standard deviation. Data testing was conducted using the Chi-square test, Mann–Whitney test, Friedman test, and Dunn's multiple comparison test. A p-value <0.05 was

considered significant.

Results

The general characteristics of patients are presented in Table 1, which shows the significant differences according to age (p=0.608), weight (p=0.918), and height (p=0.231).

Table 1. Distribution of demographic data among groups

	Group1 n = 30	Group2 n = 30	P-value
Gender			
Men	15 (50.0%)	15 (50.0%)	1.000
Women	15 (50.0%)	15 (50.0%)	
Age (years)	41.7 ± 10.7	43.1 ± 9.8	0.608
Weight (kg)	71.7 ± 7.3	71.5 ± 5.1	0.918
Height (cm)	168.3 ± 5.8	166.8 ± 5.0	0.231

Note: Group 1 was given Thermotherapy, physical exercises, lumbar traction, TENS, and walking program; Group 2 was given thermotherapy and TENS

Table 2 presents the outcome measurements. After 6 weeks, both groups demonstrated a significant improvement in the pain level. However, the improvement was greater and

with a significant difference only after 6 weeks in Group 1 compared to Group 2 in the VAS (p<0.0001), FTF (p<0.0001), ODI (p<0.0001), and RSE (p=0.0002).

Table 2. Outcome measures for subjects by groups and times

	Group1 n = 30	Group2 n = 30	P-value
VAS			
Baseline	6.7 ± 0.8	6.6 ± 1.0	0.237
3 Week	4.4 ± 0.9	4.4 ± 0.9	0.100
6 Week	2.4 ± 1.1	3.9 ± 1.1	< 0.0001
P-value ¹	< 0.0001	< 0.0001	
OSW			
Baseline	43.9 ± 4.6	42.9 ± 5.1	0.573
3 Week	32.4 ± 6.0	34.9 ± 5.8	0.073
6 Week	17.7 ± 6.8	27.2 ± 6.4	< 0.0001
P-value ¹	< 0.0001	< 0.0001	
FTF			
Baseline	53.0 ± 5.7	51.5 ± 5.1	0.166
3 Week	39.9 ± 7.1	43.0 ± 5.7	0.058
6 Week	24.0 ± 7.4	34.4 ± 7.0	< 0.0001
P-value ¹	< 0.0001	< 0.0001	
RSE			
Baseline	11.6 ± 2.5	12.4 ± 2.8	0.279
3 Week	17.4 ± 3.0	16.5 ± 3.2	0.347
6 Week	24.0 ± 3.0	20.5 ± 3.1	0.0002
P-value ¹	< 0.0001	< 0.0001	

Note *Mann-Whitney test, ¹Friedman test and Dunn's multiple comparison test; Group 1 was given thermotherapy, physical exercises, lumbar traction, TENS, and walking program; Group 2 was given thermotherapy and TENS; VAS - Visual Analogue Scale; FTF- Fingertip-to-Floor Distance; OSW - Oswestry Disability Questionnaire; RSE - Rosenberg Self Esteem Scale.

Discussion

The success of different methods of physiotherapy treatment in producing symptomatic and functional change by decreasing pain, increasing lumbar flexibility, and improving quality of life in LBP patients and other outcomes have

been documented in numerous studies all over the world (Moseley, 2002; Garcia, 2011; Şahin et al., 2017). Studies have reported that using thermotherapy and different electrical modalities like TENS in combination with various exercise protocols has a positive effect on pain reduction in patients

with LBP (Hayashi, 2004; Rojhani-Shirazi, & Rezaeian, 2015; Sanjana & Yatish 2021). Besides pain reduction, studies have reported that therapeutic exercise also has a positive effect on improving back flexibility and reducing functional disability, thus enabling patients to perform daily life activities (Bronfort et al., 2011; Geneen et al., 2017; Hayden et al., 2021; Hrkać et al., 2022). Thus, the results of this study are consistent with existing research. This research indicates that the use of thermotherapy and TENS had a positive impact on LBP patients in terms of pain reduction, but applied thermotherapy and TENS in combination with therapeutic exercises, lumbar traction, and walking program proved to be more effective in pain management, functional disability reduction, and improvement of quality of life. Regarding the application of lumbar traction, previous systematic reviews have concluded that it has little or no value on the clinical outcomes like pain intensity and functional status of patients with LBP (Clark et al., 2005, 2006; Alrwaily et al., 2018; Wegner et al., 2013). Nevertheless, many clinicians and physical therapists continue to use lumbar traction, primarily as an additional modality, and it is accepted as a treatment for patients with CLBP in many countries. Tanabe et al. (2021) reported that lumbar traction can improve pain and functional status immediately in patients with CLBP. Beyki et al. (2007) also found that the application of traction in a prone position for 4 weeks showed improvements in pain intensity and ODI in a sample of patients with activity-limiting LBP. However, to understand the long-term effect of the relationship between traction and their findings, they suggest a long-term follow-up. Positive results regarding the application of traction therapy in CLBP have also been reported by / and Rasmussen and Kyle (2017).

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Conflict of interest

The authors declare that there are no conflicts of interest.

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References

- Alrwaily, M., Almutiri, M., & Schneider, M. (2018). Assessment of variability in traction interventions for patients with low back pain: a systematic review. *Chiropractic & Manual Therapies*, 26, 35. <https://doi.org/10.1186/s12998-018-0205-z>
- Burns, S. A., Cleland, J. A., Rivett, D. A., & Snodgrass, S. J. (2018). Effectiveness of physical therapy interventions for low back pain targeting the low back only or low back plus hips: a randomized controlled trial protocol. *Brazilian Journal of Physical Therapy*, 22(5), 424–430.
- Beyki, M., Abedi, M., Soleimani, F., Mousavi, M., & Roghani, R. (2007). Efficacy of prone lumbar traction on chronic discogenic low back pain and disability. *Iranian Rehabilitation Journal*, 5 (1), 20–23.
- Bronfort, G., Maiers, M. J., Evans, R. L., Schulz, C. A., Bracha, Y., Svendsen, K. H., Grimm, R. H., Jr, Owens, E. F., Jr, Garvey, T. A., & Transfeldt, E. E. (2011). Supervised exercise, spinal manipulation, and home exercise for chronic low back pain: a randomized clinical trial. *The Spine Journal: Official Journal of the North American Spine Society*, 11(7), 585–598. <https://doi.org/10.1016/j.spinee.2011.01.036>
- Clark, S., & Horton, R. (2018). Low back pain: a major global challenge. *Lancet (London, England)*, 391(10137), 2302. [https://doi.org/10.1016/S0140-6736\(18\)30725-6](https://doi.org/10.1016/S0140-6736(18)30725-6)
- Clarke, J., van Tulder, M., Blomberg, S., de Vet, H., van der Heijden, G., & Bronfort, G. (2006). Traction for low back pain with or without sciatica: an updated systematic review within the framework of the Cochrane collaboration. *Spine*, 31(14), 1591–1599.
- Clarke, J. A., van Tulder, M. W., Blomberg, S. E., de Vet, H. C., van der Heijden, G. J., & Bronfort, G. (2005). Traction for low-back pain with or without sciatica. *The Cochrane Database of Systematic Reviews*, (4), CD003010.

In this study, it was found that Group 1 (where therapeutic exercise, walking program, and lumbar traction were applied besides passive modalities) exhibited significant improvements in the degree of pain, lumbar flexibility, and functional disability. It is worth noting that in addition to exercises, traction, and passive modalities, walking is one of the most frequent recommendations preferred by patients with this problem. Walking is easy to perform and highly accessible and can be recommended for the prevention or management of CLBP; it has been found to be as effective as other interventions for pain and disability reduction (Sittipornvorakul et al., 2018; Shiri et al., 2019). Moreover, in our study, the group of patients that was recommended the walking program reported more improvement in disability and pain relief.

The evidence cited above shows that physical therapy treatment should be routinely used in the long term. While the treatment program suggested in this study was effective, it is important to acknowledge that CLBP requires long-term treatment and ongoing follow-up. So the existing literature often includes longer follow-up periods for patients with CLBP, which were not incorporated in this study (Goldby et al., 2006; Oh et al., 2018). Thus, this can be considered a limitation of this study.

Conclusions

According to this study, a combination of thermotherapy, therapeutic exercises, lumbar traction, TENS, and walking program was effective and can be considered a treatment protocol for patients with CLBP. However, it is recommended that future studies should examine the efficacy of combined physiotherapy treatment, especially lumbar traction, for longer periods.

- Choi, H. K., Gwon, H. J., Kim, S. R., Park, C. S., & Cho, B. J. (2016). Effects of active rehabilitation therapy on muscular back strength and subjective pain degree in chronic lower back pain patients. *Journal of Physical Therapy Science*, 28(10), 2700–2702. <https://doi.org/10.1589/jpts.28.2700>
- Davidson, M., & Keating, J. L. (2002). A comparison of five low back disability questionnaires: reliability and responsiveness. *Physical Therapy*, 82(1), 8–24.
- Delgado, D. A., Lambert, B. S., Boutris, N., McCulloch, P. C., Robbins, A. B., Moreno, M. R., & Harris, J. D. (2018). Validation of digital visual analog scale pain scoring with a traditional paper-based visual analog scale in adults. *Journal of the American Academy of Orthopaedic Surgeons. Global research & reviews*, 2(3), e088. <https://doi.org/10.5435/JAOSGlobal-D-17-00088>
- Eleswarapu, A. S., Divi, S. N., Dirschl, D. R., Mok, J. M., Stout, C., & Lee, M. J. (2016). How effective is physical therapy for common low back pain diagnoses? A multivariate analysis of 4597 Patients. *Spine*, 41(16), 1325–1329. <https://doi.org/10.1097/BRS.0000000000001506>
- Fairbank J, Pynsent P. (2000). The Oswestry disability index. *Spine*, 25:2490–2453.
- Foster, N. E., Anema, J. R., Cherkin, D., Chou, R., Cohen, S. P., Gross, D. P., Ferreira, P. H., Fritz, J. M., Koes, B. W., Peul, W., Turner, J. A., Maher, C. G., & Lancet Low Back Pain Series Working Group (2018). Prevention and treatment of low back pain: evidence, challenges, and promising directions. *Lancet (London, England)*, 391(10137), 2368–2383. [https://doi.org/10.1016/S0140-6736\(18\)30489-6](https://doi.org/10.1016/S0140-6736(18)30489-6)
- Ferreira, P. H., Ferreira, M. L., Maher, C. G., Herbert, R. D., & Refshauge, K. (2006). Specific stabilisation exercise for spinal and pelvic pain: a systematic review. *The Australian Journal of Physiotherapy*, 52(2), 79–88. [https://doi.org/10.1016/S0004-9514\(06\)70043-5](https://doi.org/10.1016/S0004-9514(06)70043-5)
- Garcia, A. N., Gondo, F. L., Costa, R. A., Cyrillo, F. N., & Costa, L. O. (2011). Effects of two physical therapy interventions in patients with chronic non-specific low back pain: feasibility of a randomized controlled trial. *Revista Brasileira de Fisioterapia [Sao Carlos (Sao Paulo, Brazil)]*, 15(5), 420–427. <https://doi.org/10.1590/s1413-35552011005000019>
- Geneen, L. J., Moore, R. A., Clarke, C., Martin, D., Colvin, L. A., & Smith, B. H. (2017). Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. *The Cochrane Database of Systematic*

- Reviews, 1(1), CD011279. <https://doi.org/10.1002/14651858.CD011279>
- Goldby, L. J., Moore, A. P., Doust, J., & Trew, M. E. (2006). A randomized controlled trial investigating the efficiency of musculoskeletal physiotherapy on chronic low back disorder. *Spine*, 31(10), 1083–1093. <https://doi.org/10.1097/01.brs.0000216464.37504.64>
- Hartvigsen, J., Hancock, M. J., Kongsted, A., Louw, Q., Ferreira, M. L., Genevay, S., Hoy, D., Karppinen, J., Pransky, G., Sieper, J., Smeets, R. J., Underwood, M., & Lancet Low Back Pain Series Working Group (2018). What low back pain is and why we need to pay attention. *Lancet (London, England)*, 391(10137), 2356–2367. [https://doi.org/10.1016/S0140-6736\(18\)30480-X](https://doi.org/10.1016/S0140-6736(18)30480-X)
- Hayden, J. A., Ellis, J., Ogilvie, R., Malmivaara, A., & van Tulder, M. W. (2021). Exercise therapy for chronic low back pain. *The Cochrane Database of Systematic Reviews*, 9(9), CD009790. <https://doi.org/10.1002/14651858.CD009790.pub2>
- Hayden, J. A., van Tulder, M. W., Malmivaara, A. V., & Koes, B. W. (2005). Meta-analysis: exercise therapy for nonspecific low back pain. *Annals of Internal Medicine*, 142(9), 765–775. <https://doi.org/10.7326/0003-4819-142-9-200505030-00013>
- Hayashi, Y. (2004). Physical therapy for low back pain. *Japan Medical Association Journal*, 47(5): 234–239.
- Hrkač, A., Bilić, D., Černy-Obdržal, E., Baketarić, I., & Puljak, L. (2022). Comparison of supervised exercise therapy with or without biopsychosocial approach for chronic nonspecific low back pain: a randomized controlled trial. *BMC Musculoskeletal Disorders*, 23(1), 966. <https://doi.org/10.1186/s12891-022-05908-3>
- Ibrahimi-Kaçuri, D., Rrecaj-Malaj, S., & Shaqiri, B. (2015). Outcome of physical therapy in low back pain. *Sport Mont*, XIII(43–45), 206–210.
- Koumantakis, G. A., Watson, P. J., & Oldham, J. A. (2005). Trunk muscle stabilization training plus general exercise versus general exercise only: randomized controlled trial of patients with recurrent low back pain. *Physical Therapy*, 85(3), 209–225.
- Moseley L. (2002). Combined physiotherapy and education is efficacious for chronic low back pain. *The Australian Journal of Physiotherapy*, 48(4), 297–302. [https://doi.org/10.1016/S0004-9514\(14\)60169-0](https://doi.org/10.1016/S0004-9514(14)60169-0)
- Oh, H., Choi, S., Lee, S., Choi, J., & Lee, K. (2018). The impact of manual spinal traction therapy on the pain and Oswestry disability index of patients with chronic back pain. *Journal of Physical Therapy Science*, 30(12), 1455–1457. <https://doi.org/10.1589/jpts.30.1455>
- Patrick, N., Emanski, E., & Knaub, M. A. (2014). Acute and chronic low back pain. *The Medical Clinics of North America*, 98(4), 777–xii. <https://doi.org/10.1016/j.mcna.2014.03.005>
- Park, S. M., Kim, G. U., Kim, H. J., Kim, H., Chang, B. S., Lee, C. K., & Yeom, J. S. (2019). Walking more than 90minutes/week was associated with a lower risk of self-reported low back pain in persons over 50years of age: a cross-sectional study using the Korean National Health and Nutrition Examination Surveys. *The Spine Journal: Official Journal of the North American Spine Society*, 19(5), 846–852. <https://doi.org/10.1016/j.spinee.2018.11.007>
- Petersen, T., Larsen, K., Nordsteen, J., Olsen, S., Fournier, G., & Jacobsen, S. (2011). The McKenzie method compared with manipulation when used adjunctive to information and advice in low back pain patients presenting with centralization or peripheralization: a randomized controlled trial. *Spine*, 36(24), 1999–2010. <https://doi.org/10.1097/BRS.0b013e318201ee8e>
- Perret, C., Poiraudeau, S., Fermanian, J., Colau, M. M., Benhamou, M. A., & Revel, M. (2001). Validity, reliability, and responsiveness of the fingertip-to-floor test. *Archives of Physical Medicine and Rehabilitation*, 82(11), 1566–1570. <https://doi.org/10.1053/apmr.2001.26064>
- Rasmussen, K. (2017). The use of manual lumbar traction and therapeutic exercise in the treatment of a patient with low back pain: a case report. *Case Report Papers*, 85. https://dune.une.edu/pt_studcrpaper/85
- Rosenberg, M. (1965). *Society and the Adolescent Self-Image*. Princeton University Press. <http://www.jstor.org/stable/j.ctt183pjih>
- Rojhani-Shirazi, Z., & Rezaei, T. (2015). The effects of transcutaneous electrical nerve stimulation on postural control in patients with chronic low back pain. *Journal of Medicine and Life*, 8(Spec Iss 2), 19–27.
- Sanjana, M., & Yatish, R. (2021). Comparative study on the Mckenzie technique with tens versus neural mobilization with tens in chronic low back pain with radiculopathy. *International Journal of Physical Education, Sports and Health*; 8(1), 08–13
- Şahin, N., Karahan, A. Y., & Albayrak, İ. (2017). Effectiveness of physical therapy and exercise on pain and functional status in patients with chronic low back pain: a randomized-controlled trial. *Turkish Journal of Physical Medicine and Rehabilitation*, 64(1), 52–58. <https://doi.org/10.5606/tftrd.2018.1238>
- Sittipornvorakul, E., Klinsophon, T., Sihawong, R., & Janwantanakul, P. (2018). The effects of walking intervention in patients with chronic low back pain: a meta-analysis of randomized controlled trials. *Musculoskeletal Science & Practice*, 34, 38–46. <https://doi.org/10.1016/j.msksp.2017.12.003>
- Shipton, E. A. (2018). Physical therapy approaches in the treatment of low back pain. *Pain and Therapy*, 7(2), 127–137. <https://doi.org/10.1007/s40122-018-0105-x>
- Shiri, R., Falah-Hassani, K., Heliövaara, M., Solovieva, S., Amiri, S., Lallukka, T., Burdorf, A., Husgafvel-Pursiainen, K., & Viikari-Juntura, E. (2019). Risk factors for low back pain: a population-based longitudinal study. *Arthritis Care & Research*, 71(2), 290–299. <https://doi.org/10.1002/acr.23710>
- Tanabe, H., Akai, M., Doi, T., Arai, S., Fujino, K., Hayashi, K., & for Low back-pain Traction Therapy (LTT) Study (2021). Immediate effect of mechanical lumbar traction in patients with chronic low back pain: a crossover, repeated measures, randomized controlled trial. *Journal of Orthopaedic Science: Official Journal of the Japanese Orthopaedic Association*, 26(6), 953–961. <https://doi.org/10.1016/j.jos.2020.09.018>
- Madson, T. J., & Hollman, J. H. (2015). Lumbar traction for managing low back pain: a survey of physical therapists in the United States. *The Journal of Orthopaedic and Sports Physical Therapy*, 45(8), 586–595. <https://doi.org/10.2519/jospt.2015.6036>
- Vos T, Flaxman AD, Naghavi M, et al. (2012). Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*, 380, 2163–2196. [https://doi.org/10.1016/S0140-6736\(12\)61729-2](https://doi.org/10.1016/S0140-6736(12)61729-2)
- Wegner, I., Widyahening, I. S., van Tulder, M. W., Blomberg, S. E., de Vet, H. C., Brönfort, G., Bouter, L. M., & van der Heijden, G. J. (2013). Traction for low-back pain with or without sciatica. *The Cochrane Database of Systematic Reviews*, 2013(8), CD003010. <https://doi.org/10.1002/14651858.CD003010.pub5>
- Zheng, Z., Wang, J., Gao, Q., Hou, J., Ma, L., Jiang, C., & Chen, G. (2012). Therapeutic evaluation of lumbar tender point deep massage for chronic non-specific low back pain. *Journal of Traditional Chinese Medicine (Chung i tsa chih ying wen pan)*, 32(4), 534–537. [https://doi.org/10.1016/s0254-6272\(13\)60066-7](https://doi.org/10.1016/s0254-6272(13)60066-7)