

## Original Research

# Difference in the Effect of PNF with Trunk Exercise on Pain Reduction in Low Back Pain: Systematic Review with Meta Analysis

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## ABSTRACT

**Background:** Low back pain (LBP) is a condition characterized by pain in the lower back region. The pain felt is not a disease or a diagnosis of for a disease, it is the condition of pain syndromes in anatomical areas that experience various time variations in the occurrence of pain.

**Purpose:** To analyze the effects of PNF and trunk exercise on pain reduction in individuals with LBP.

**Method:** search in Pubmed, Google Scholar, and Cochrane Library databases to find and analyze related studies in the form of randomized controlled trials. Analyze related studies in the form of randomized controlled trials (RCT) without meta-analysis systematic review. The keywords used were “PNF”, “trunk exercise” and “low back pain”.

**Result:** The results of the analysis results in this study, showed a decrease in pain in patients who received PNF by 1.70 units compared to patients with low back pain patients who were given trunk exercise (SMD = 1.70; 95% CI = 0.40 to 2.99) and the results were statistically significant ( $p < 0.05$ ). The result was statistically significant ( $p < 0.00001$ ). Heterogeneity of data the study showed  $I^2 = 95\%$  (random effect model).

**Conclusion:** PNF therapy is more effective than trunk exercise in reducing pain in patients with LBP.

## ARTICLE HISTORY

Received	:09 December 2024
Revised	:01 January 2025
Accepted	:15 January 2025
Available Online	:20 February 2025
Published	:28 February 2025

## KEYWORDS

LBP, PNF, Trunk Exercise, Pain

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Cite this as: Samiyem, S., Ishad, M. R., Komalasari, N. U., Andika, A. Z., Ayuninggar, L., Aranti, W. A., & Pristianto, A. (2025). Difference in the Effect of PNF with Trunk Exercise on Pain Reduction in Low Back Pain: Systematic Review with Meta Analysis. Gaster, 23(1), 107–117. <https://doi.org/10.30787/gaster.v23i1.1914>

## INTRODUCTION

Lower Back Pain (LBP) is one of the most common musculoskeletal disorders. This pain is generally felt in the lower back area and can spread to the lower extremities, making it one of the leading causes of disability in the world. Based on data from the World Health Organization (WHO), in 2023 it is estimated that around 619 million people will experience LBP, making it the leading cause of disability globally (World Health Organization, 2023). The incidence of LBP is more common in women with a percentage reaching 72.72% (Pratama et al., 2020). This disorder is very common, with around 60-80% of the population experiencing at least one episode of LBP in their lifetime (Setiya & Rahayu, 2021). In addition, more than 80% of individuals who have experienced low back pain report recurrent pain (Fouda et al., 2021). Several studies have shown that LBP can be caused by compression of the intervertebral disc resulting in lateral widening of the annulus fibrosus, thereby compressing the surrounding nervous system and blood vessels (Isa et al., 2023; De Simone et al., 2024). In addition, ergonomic factors in daily activities also play a role in the emergence and worsening of LBP symptoms (Dąbek et al., 2019). Common symptoms experienced by sufferers include tenderness and repeated attacks of pain (Cahya et al., 2021), which can result in limited movement and impaired body coordination (Fouda et al., 2021). The factors causing LBP can be categorized into two main groups, namely physical and social factors. Physical factors include posture, sitting position, and lifestyle such as rest patterns and physical activity. Meanwhile, social factors such as stress and bad mood can also affect the intensity of low back pain (Junita et al., 2021). Therefore, intervention in the form of physical exercise is needed as a rehabilitation modality to increase strength, endurance, and flexibility of muscles and soft tissues in the back to reduce pain. The two types of exercises that are the focus of this study are PNF exercise and Trunk Exercise.

Proprioceptive Neuromuscular Facilitation (PNF) is an exercise method designed to form movement patterns through proprioceptive stimulation, resulting in optimal neuromuscular responses. PNF aims to increase proprioceptive neuromuscular responses, correct incorrect movement patterns, provide examples of correct movements, treat disorders in the limbs, and stabilize body posture (Malla, 2018). PNF exercises are often used in the rehabilitation of patients with chronic LBP, with the main goal of increasing muscle strength and endurance. Studies show that various PNF exercise techniques have been applied in the treatment of chronic LBP, including isometric and isotonic exercises. One technique that is often used is Rhythmic Stabilization Training (RST), which functions to provide stabilization and help patients with muscle weakness as the main factor (Fouda et al., 2021).

Trunk Exercise is a series of exercises that aim to strengthen and improve the function of the core muscles that play a role in body stability. The main goal of this exercise is to improve the strength of muscle groups that play a role in the balance of the human body. Trunk Exercise has several benefits, including improving body balance and coordination, maintaining good posture, reducing the risk of injury, and improving performance in physical activities and sports. Through regular exercise, individuals can gain strength, stability, and flexibility of the core muscles that play an important role in overall health and physical performance (Jamini, 2019). In addition, stability, flexibility, and mobility are important factors in daily activities such as moving or picking up an object (Wahyuni & Azis, 2021). Another study also stated that one form of Trunk Exercise, namely back exercise, has been shown to be effective in reducing complaints

of lower back pain and increasing physical abilities in the back and waist areas (Afifah & Pristianto, 2022).

Based on the description above, this study aims to evaluate the effectiveness of PNF and Trunk Exercise in reducing pain in patients with Low Back Pain and to compare which exercise method is more effective in relieving symptoms experienced by patients.

## METHOD

Literature study search was conducted on 2 databases, PubMed, Google Scholar, and Cochrane Library. The keywords used were “PNF”, “trunk exercise” and “low back pain”. A total of 7 research articles have been included in the study in the form of a meta-analysis of the Difference in the Effect of PNF with trunk exercise on reducing pain in Low Back Pain. This study involved a total of 330 research subjects.

The inclusion criteria used in this study were (1) studies with a randomized controlled trial design; (2) research with a total of at least 20 subjects and more; (3) research subjects who suffer from low back pain; (4) only English-language studies; (5) literature published in the 2011-2024 period. The exclusion criteria for literature not used in this study were (1) cross sectional study; (2) literature published less than the 2011 period.

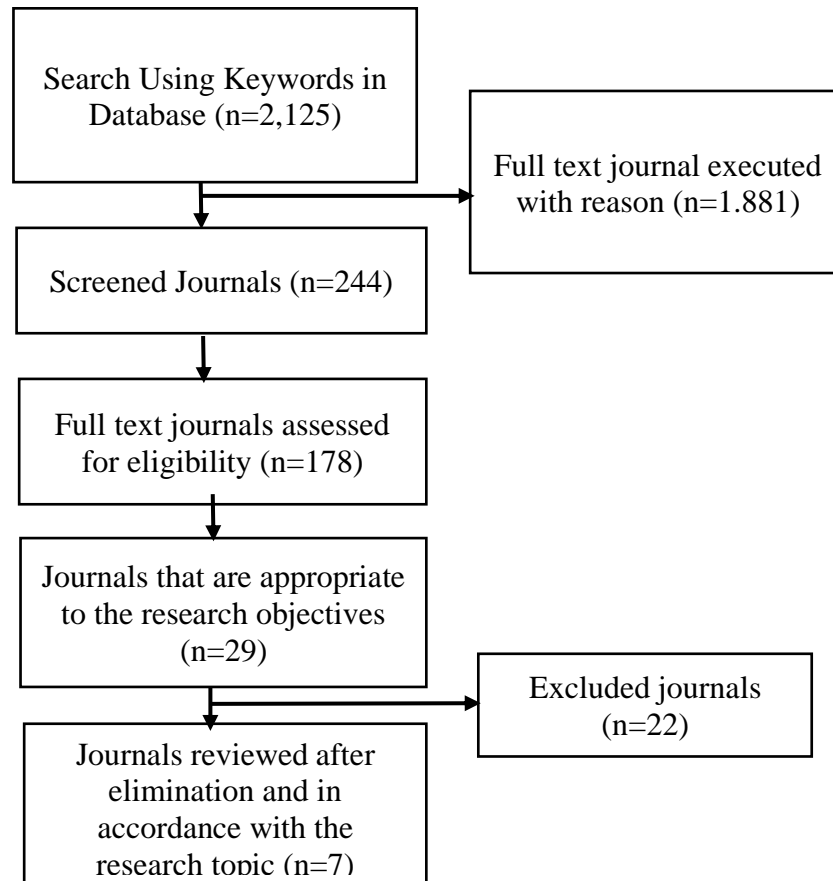
The studies measured in this study used an instrument, namely the Visual Analog Scale (VAS) with pain outcomes. Data analysis was carried out in this meta-analysis using the Revman 5.3 software application by calculating the standard mean deviation value. Data analysis that can be used in meta-analysis research is the random effect model and fixed effect model. In this study, the data analysis used was the random effect model which was determined by looking at the results of the heterogeneity test.

**Table 1.** PICO formulation

Population (P)	Intervention (I)	Comparison (C)	Outcome (O)
Subjects experiencing Low Back Pain	<i>Proprioceptive Neuromuscular Facilitation (PNF)</i>	<i>Trunk exercise</i>	Reduce pain
Types of clinical questions	Therapy		
Study Design	Randomized controlled trial, without systematic review and meta-analysis		

## RESULTS

Based on the number of journals excluded, which is 1,881, 244 studies were obtained which were then analyzed and screened, in conducting screening and creating PRISMA flow chart. Furthermore, 178 journals were assessed for eligibility. Of the 178 journals selected, 29 journals were in accordance with the research objectives, and 12 journals were excluded because they did not meet the inclusion criteria and 7 journals were reviewed after being eliminated with research topics.



**Figure 1.** Journal Search Flow Chart

**Table 2.** Characteristics of Each Journal

No	Title	Author	Year	Respondents
1	<i>Effects of Proprioceptive Neuromuscular Facilitation Techniques in Treating Chronic Nonspecific Low Back Pain Patiens (Fouda et al., 2021)</i>	Khaled Z. Fouda, Ibrahim M. Dewir, Mohammed S. Abdelsalam	2021	60
2	<i>Effect Of Motor Control Exercise on Swiss Ball and PNF Techniques on Non-Specific Low Back Pain (Malla, 2018)</i>	Sapna Malla	2018	30
3	<i>Efficacy of Trunk Balance Exercise for Individuals With Chronic Low Back Pain: A Randomized Clinical Trial (Gatti et al., 2011)</i>	Roberto Gatti, Simone Faccendini, Andrea Tettamanti, Marco Barbero, Angela Balestri, Giliola Calori	2011	79
4	<i>Effect of Proprioceptive Neuromuscular Facilitation Stretching on Pain, Hip Joint Range of Motion, And Functional Disability in Patients with Chronic Low Back Pain (B. Kim et al., 2021)</i>	Beomryong Kima, Taewoo Kangb, Dahee Kimc	2021	45
5	<i>A Randomized Controlled Trial on The Long-Term Effects of Proprioceptive Neuromuscular Facilitation Training, on Pain-Related Outcomes and Back Muscle Activity, In Patients with Chronic Low Back Pain (Areeudomwong et al., 2017)</i>	Pattanasin Areeudomwong1, Witchayut Wongrat, Nertnapa Neammesr, Thanaporn Thongsakul	2017	42
6	<i>The Effects of Proprioceptive Neuromuscular Facilitation Exercise on Pain and Functional Disability Index of Patiens with Chronic</i>	Wang-mo, beom-ryong kim	2017	20

	<i>Lower Back Pain</i> (Jeong & Kim, 2017).			
7	<i>The Effects of Proprioceptive Neuromuscular Facilitation and Stabilizing Exercise on Trunk Repositioning Errors</i> (Byuon & Son, 2012)	Sookhee Byuon, Hohee Son	2012	54

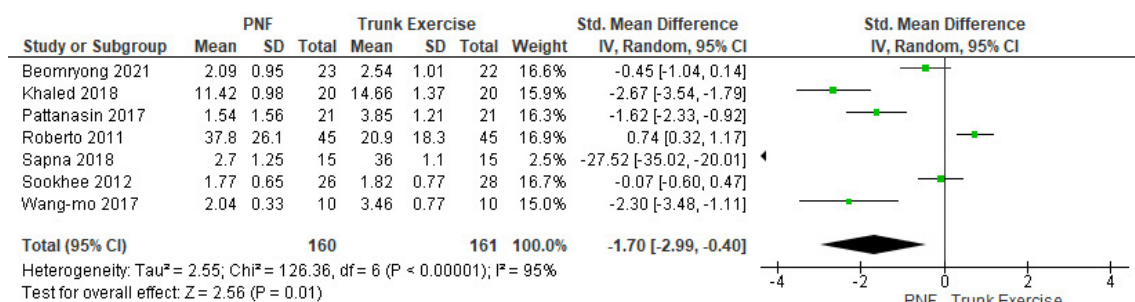
Based on the results of the journals that we have reviewed, there are several studies that come from different countries. From the 7 studies that we have obtained, 3 different continents were found, from the Asian continent there were 5 studies, from the African continent there were 1 study, from the American continent there were 1 study.



**Figure 2.** Distribution of Study Origins

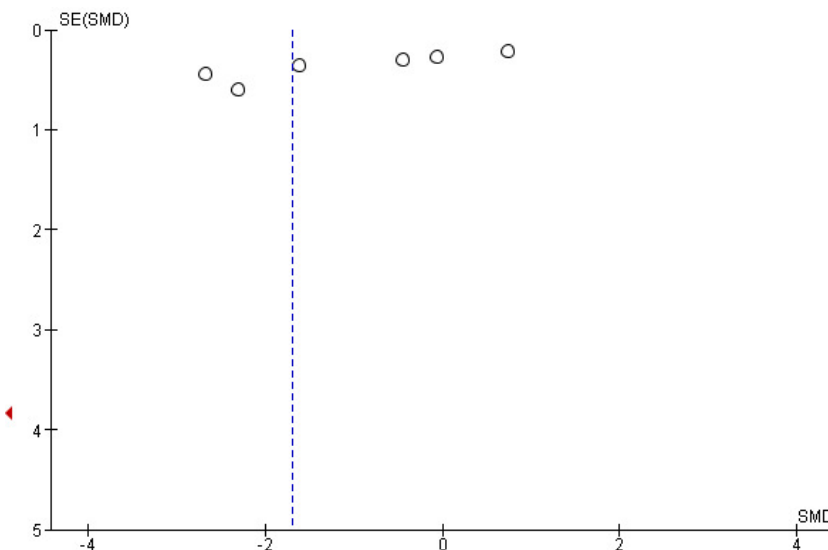
**Table 3.** PEDro Scale Results

<i>PEDro Scale</i>	Khaled Z. Fouda <i>et al.</i> , (2021)	Sapna Malla (2018)	Roberto Gatti <i>et al.</i> , (2011)	Beomryong Kima <i>et al.</i> , (2021)	Pattanasin Areeudomwong1 <i>et al.</i> , (2017)	Wong-mo beom & Ryon kim (2017)	Sookhee Byun & Hohee Son (2012)
<i>Eligibility</i>	yes	yes	yes	yes	yes	yes	yes
<i>Random allocated</i>	1	1	1	1	1	1	1
<i>Concealed allocation</i>	1	1	1	1	1	1	1
<i>Baseline Comparability</i>	1	1	1	1	1	1	1
<i>Blinding all subjects</i>	1	0	1	1	1	1	0
<i>Blinding all therapist</i>	0	0	1	0	1	0	0
<i>Blinding all assessors</i>	0	0	1	0	1	0	0
<i>Adequate follow-up</i>	1	1	1	1	1	1	1
<i>Intention-to-treat analysis</i>	1	1	1	1	1	1	1
<i>Beetwen-group comparisons</i>	1	1	1	1	1	1	1
<i>Point estimated variability</i>	1	1	1	1	1	1	1
<i>Score</i>	8/10	7/10	10/10	8/10	10/10	8/10	7/10
<i>Quality</i>	<i>good</i>	<i>good</i>	<i>excellent</i>	<i>good</i>	<i>excellent</i>	<i>good</i>	<i>good</i>



**Figure 3.** Funnel Plot





**Figure 4.** Forest Plot

## DISCUSSION

The critical appraisal process in this study used the PEDro Scale which had been analyzed based on each journal reviewed. The PEDro Scale is a tool used to assess the quality of a study with a critical research design, such as a Randomized Controlled Trial (RCT) (Rahman et al., 2022). This scale consists of 11 assessment criteria, namely: 1) Eligibility criteria; 2) Random allocation; 3) Concealed allocation; 4) Similarity of baseline characteristics between groups (baseline comparability); 5) Subjects are made unaware of the treatment given (blind subject); 6) Therapists are made unaware of the treatment given (blind therapists); 7) Assessors are made unaware of the treatment given (blind assessors); 8) At least one primary outcome has a follow-up rate > 85% (adequate follow-up); 9) Intention-to-treat analysis; 10) Between-group comparison; and 11) Point estimates and variability (Pristianto, A et al., 2021).

Based on the results of the analysis of this study, it was found that patients with Low Back Pain who underwent PNF therapy experienced a decrease in pain of -1.70 units compared to patients who did trunk exercise (SMD = -1.70; 95% CI = -2.99 to -0.40), with statistically significant results ( $p < 0.00001$ ). In addition, the heterogeneity analysis showed an  $I^2$  value of 95%, which was analyzed using a random effect model.

The funnel plot visualization shows that the distribution of effect estimates from primary studies using a randomized controlled trial (RCT) design in this meta-analysis is more on the right side of the vertical line of the average estimate than on the left side. This indicates publication bias. Because the publication bias tends to be more inclined to the right side of the average vertical line, which is opposite to the position of the diamond shape in the forest plot, the bias tends to cause an overestimation of the effect on reducing pain in patients with low back pain (overestimate).

The findings of this systematic review and meta-analysis indicate that both Proprioceptive Neuromuscular Facilitation (PNF) and Trunk Exercise significantly reduce pain in individuals with Low Back Pain (LBP). However, PNF appears to provide superior pain relief compared to Trunk Exercise, as evidenced by multiple randomized controlled trials (Fouda et al., 2021; Kim et al., 2021). The mechanism behind this effectiveness lies in the proprioceptive stimulation that PNF provides, which enhances neuromuscular coordination and stabilization, leading to reduced muscle spasms and



improved pain modulation (Areeudomwong et al., 2017). Moreover, studies have shown that PNF stretching significantly increases range of motion and functional mobility, which are crucial in managing chronic LBP (Jeong & Kim, 2017). Similar conclusions were also found in a study conducted by Gao et al. (2022), which showed that PNF exercise can improve functional abilities, including flexibility and endurance, thereby contributing to reducing pain in patients with low back pain. On the other hand, Trunk Exercise primarily focuses on strengthening the core muscles, which supports spinal stability and posture (Afifah & Pristianto, 2022). While Trunk Exercise is beneficial for long-term rehabilitation, its immediate impact on pain relief appears to be slightly lower than PNF-based interventions (Malla, 2018).

Furthermore, the meta-analysis revealed a considerable heterogeneity among studies, likely due to variations in intervention protocols, sample characteristics, and outcome measures. Despite these variations, the pooled results consistently demonstrate the positive effects of both interventions in pain reduction, as measured by the Visual Analog Scale (VAS) (Fouda et al., 2021; Kim et al., 2021). The superiority of PNF may be attributed to its dynamic nature, which not only strengthens muscles but also improves proprioceptive awareness, leading to better motor control and reduced pain perception. Nevertheless, the effectiveness of both PNF and Trunk Exercise underscores the importance of incorporating structured physical rehabilitation programs in LBP management. Future research should focus on long-term follow-ups to determine the sustained impact of these interventions and explore their combined effects for optimizing LBP rehabilitation strategies.

## CONCLUSION

This study concludes that Proprioceptive Neuromuscular Facilitation (PNF) exercise therapy is more effective than trunk exercise in reducing pain in patients with Low Back Pain, as evidenced by a significant reduction in pain scores ( $SMD = -1.70$ ,  $p < 0.00001$ ). However, the high heterogeneity ( $I^2 = 95\%$ ) and potential publication bias should be considered when interpreting these results. Further research with larger sample sizes and long-term follow-up is needed to confirm the effectiveness of PNF and explore its broader applications in rehabilitation settings.

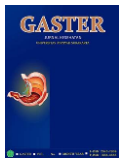
## ACKNOWLEDGEMENT

The authors state there is no conflict of interest with the parties involved in this study.

## REFERENCES

- Afifah, I. N. N., & Pristianto, A. (2022). Penyuluhan Program Back Exercises Guna Mengatasi Keluhan Nyeri Punggung Bawah Pada Ibu PKK Desa Klewor Boyolali. *Jurnal Pengabdian Masyarakat Multidisiplin*, 5(2), 48–54. <https://doi.org/10.36341/jpm.v5i2.2265>
- Areeudomwong, P., & Buttagat, V. (2019). Comparison Of Core Stabilisation Exercise and Proprioceptive Neuromuscular Facilitation Training on Pain-Related and Neuromuscular Response Outcomes for Chronic Low Back Pain: A Randomised Controlled Trial. *Malaysian Journal of Medical Sciences*, 26(6), 77–89. <https://doi.org/10.21315/Mjms2019.26.6.8>

- Areeudomwong, P., Wongrat, W., Neammesri, N., & Thongsakul, T. (2017). A Randomized Controlled Trial on The Long-Term Effects of Proprioceptive Neuromuscular Facilitation Training, On Pain-Related Outcomes and Back Muscle Activity, in Patients with Chronic Low Back Pain. *Musculoskeletal Care*, 15(3), 218–229. <https://doi.org/10.1002/Msc.1165>
- Cahya S, A., Santoso, W. M., Husna, M., Munir, B., & Nandar Kurniawan, S. (2021). Low Back Pain. *JPHV (Journal of Pain, Vertigo and Headache)*, 2(1), 13–17. <https://doi.org/10.21776/Ub.Jphv.2021.002.01.4>
- Dąbek, J., Piotrkowicz, J., Korzeń, D., & Gąsior, Z. (2019). Knowledge And Use of Ergonomic Principles in Psychicians and Nurses With Low Back Pain. *Health Problems of Civilization*, 13(3), 217–224. <https://doi.org/10.5114/Hpc.2019.81342>
- De Simone, M., Choucha, A., Ciaglia, E., Conti, V., Pecoraro, G., Santurro, A., Puca, A. A., Cascella, M., & Iaconetta, G. (2024). Discogenic Low Back Pain: Anatomic and Pathophysiologic Characterization, Clinical Evaluation, Biomarkers, AI, and Treatment Options. *Journal of Clinical Medicine*, 13(19), 5915. <https://doi.org/10.3390/jcm13195915>
- Fouda, K. Z., Dewir, I. M., & Abdelsalam, M. S. (2021). Effects Of Proprioceptive Neuromuscular Facilitation Techniques in Treating Chronic Nonspecific Low Back Pain Patients. *Physiotherapy Quarterly*, 29(2), 32. <https://doi.org/10.5114/Pq.2020.100273>
- Isa, I. L. M., Teoh, S. L., Mohd Nor, N. H., & Mokhtar, S. A. (2023). Discogenic Low Back Pain: Anatomy, Pathophysiology and Treatments of Intervertebral Disc Degeneration. In *International Journal of Molecular Sciences*, 24(1). <https://doi.org/10.3390/Ijms24010208>
- Jamini, T. (2019). Pengaruh Trunk Stability Exercise Terhadap Keseimbangan Tubuh Lanjut Usia Di Pstw Jakarta Timur.
- Jeong, W.-M., & Kim, B.-R. (2017). The Effects of Proprioceptive Neuromuscular Facilitation Exercise on The Pain and Functional Disability Index of Patients with Chronic Lower Back Pain. *PNF and Movement*, 15(2), 195-200. <https://doi.org/10.21598/JKPNFA.2017.15.2.195>
- Gao, P., Tang, F., Liau, W., & Mo, Y. (2022). The effects of proprioceptive neuromuscular facilitation in treating chronic low back pain: A systematic review and meta-analysis. *Journal of Back and Musculoskeletal Rehabilitation*, 35(1), <https://doi.org/10.3233/BMR-200306>
- Junita, R. G., Pristianto, A., Supriyadi, A., & Susilo, T. E. (2021). Hubungan Aktivitas Duduk Lama Dengan Keluhan Musculoskeletal Pada Punggung Bawah: Critical Review. *FISIO MU: Physiotherapy Evidences*, 2(3), 150–161. <https://doi.org/10.23917/fisiomu.v2i3.15199>
- Kim, B., Kang, T., & Kim, D. (2021). Effect Of Proprioceptive Neuromuscular Facilitation Stretching on Pain, Hip Joint Range of Motion, And Functional Disability in Patients with Chronic Low Back Pain. *Physical Therapy Rehabilitation Science*, 10(2), 225–234. <https://doi.org/10.14474/Ptrs.2021.10.2.225>
- Malla, S. (2018). Effect Of Motor Control Exercise on Swiss Ball and PNF Technique on Non-Specific Low Back Pain. *International Journal of Medical Research & Health Sciences*, 7(4), 114–124. [www.Ijmrhs.Com](http://www.Ijmrhs.Com)
- Puntumetakul, R., Saiklang, P., Yodchaisarn, W., Hunsawong, T., & Ruangsri, J. (2021). Effects of Core Stabilization Exercise versus General Trunk-Strengthening Exercise on Balance Performance, Pain Intensity and Trunk Muscle Activity Patterns in Clinical Lumbar Instability Patients: A Single Blind Randomized Trial. *Walailak*



*Journal of Science and Technology (WJST)*, 18(7), 1-13.  
<https://doi.org/10.48048/wjst.2021.9054>

- Pratama, C. S. P., Pristianto, A., Herawati, I., Ervianta, W., & Ridhuwan, M. (2020). Efektivitas Program Aquatic Exercise Terhadap Penurunan Nyeri Pasien Chronic Low Back Pain. *FISIOMU*, 1(2), 49–53.  
<https://doi.org/10.23917/fisiomu.v%vi%i.10525>
- Rahman, F., Budi, I. S., Al Athfal, M. A., Hisanah, H. A., & Haya, A. F. (2022). Program Latihan Keseimbangan Untuk Peningkatan Profil Keseimbangan Individu Lanjut Usia: Critical Review. *Jurnal Riset Kesehatan Poltekkes Depkes Bandung*, 14(1), 23–30. <https://doi.org/10.34011/Juriskesbdg.V14i1.1852>
- Setiya, A., & Rahayu, U. B. (2021). Pengaruh Penambahan Back School Terhadap Penurunan Nyeri Dan Peningkatan Kemampuan Fungsional Pada Kondisi Low Back Pain Myogenik. *FISIO MU: Physiotherapy Evidences*, 2(1), 30–35.  
<https://doi.org/10.23917/Fisiomu.V2i1.12912>
- Wahyuni, W., & Azis, M. A. R. (2021). Pengaruh Core Stabilization Exercise Terhadap Penurunan Nyeri Chronic Low Back Pain: Critical Review. *Urecol Journal. Part C: Health Sciences*, 1(1), 29–36. <https://doi.org/10.53017/Ujhs.45>
- World Health Organization. (2023, June 19). *Low Back Pain*.  
<https://www.who.int/news-room/fact-sheets/detail/low-back-pain>