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Differences in the Effect of Sacroiliac Joint Mobilization and Joint Stretches on Lumbar Range of Motion in Sacroiliac Joint Dysfunction–Related Low Back Pain

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Abstract

Aims: This study aimed to determine the difference in the effects of Sacroiliac Joint Mobilization and Sacroiliac Joint Stretches on improving lumbar ROM in low back pain caused by sacroiliac joint dysfunction. This quasi-experimental research used a randomized pre-test-post-test two-group design.

Methods: The study involved 20 participants, randomly allocated into two groups: 10 participants in Group 1 receiving Sacroiliac Joint Mobilization and 10 participants in Group 2 receiving Sacroiliac Joint Stretches. Data were collected by measuring lumbar ROM during flexion and extension in both the pre-test and post-test phases.

Results: Paired sample t-test analysis showed significant improvements in ROM for both groups with $p = 0.000$. Furthermore, the independent sample t-test revealed a significant difference between the two groups, with $p = 0.034$ for flexion (mean difference: 15.2 in Group 2 > 9.6 in Group 1) and $p = 0.001$ for extension (mean difference: 14.7 in Group 2 > 10.2 in Group 1).

Conclusion: These findings indicate that Sacroiliac Joint Stretches provide a greater improvement in both lumbar flexion and extension ROM compared to Sacroiliac Joint Mobilization in patients with low back pain caused by sacroiliac joint dysfunction.

Keywords: Low Back Pain; Sacroiliac Joint Disfunction; Sacroiliac Joint Mobilization

Introduction

The lumbar region is the area that bears the greatest load when the body moves and supports weight. This makes the lumbar spine highly susceptible to injury or damage, often leading to disturbances such as low back pain [1]. Low back pain is a chronic global problem that primarily affects the musculoskeletal system. This condition causes pain, tension, and stiffness in the lower back, with no specific identifiable cause. Various structures in the lower back, including joints, discs, and connective tissues, can contribute to the symptoms of low back pain [2].
Low back pain affects about two-thirds of adults and is caused by various conditions, one of which is sacroiliac joint dysfunction (SIJD). The sacroiliac joint (SIJ) is widely recognized as a primary source of low back pain [3]. Sacroiliac joint dysfunction (SIJD) refers to pain in the

lower back area caused by changes in the normal movement of the joint, typically due to hypomobility. SIJD has been identified as a major cause of low back pain in 15% to 40% of patients. Pain in the Sacroiliac Joint (SIJ) can also radiate to the groin and dorsal thigh. Pain in the Sacroiliac Joint during palpation or tenderness in the SIPS area is a sign that the SIJ is the source of pain, influenced by various pathological changes, with biomechanical inefficiency in the SIJ being the most common cause [4].

The prevalence of sacroiliac syndrome with chronic mechanical low back pain, diagnosed through clinical examination, screening methods, and intra-articular blocking tests, ranges from 16% to 30%. Research has shown that the prevalence of sacroiliac syndrome as a primary source of low back pain increased from 0.4% in 1978 to 35% in 1995, and reached 98% in 1992 [4]. Sacroiliac joint (SIJ) dysfunction has been globally recognized as one of the primary sources of low back pain, with prevalence rates varying across different countries. In Indonesia, although specific epidemiological data on SIJ dysfunction remains limited, several hospital-based studies indicate a significant incidence rate. For example, at Haji General Hospital in Surabaya and several other hospitals, SIJ dysfunction has been identified as one of the common causes of low back pain, with incidence rates ranging from 3% to 17%. Additionally, observations conducted by researchers at Tenriawaru General Hospital in Bone Regency recorded 188 cases of low back pain caused by SIJ dysfunction during the period from January to October 2022. Preliminary studies using the Gillet Test on patients at this hospital revealed asymmetry in the SIJ, leading to postural changes in the lumbar and pelvic areas, SIJ hypomobility, pain, and reduced lumbar range of motion. These findings highlight the importance of increasing awareness, accurate diagnosis, and further epidemiological research to better understand the prevalence and impact of SIJ dysfunction in Indonesia. Such research is expected to contribute to the development of more targeted interventions and effective healthcare strategies to address this condition [5][6].

Sacroiliac joint blockade, classified as a disorder of the sacrum in the International Statistical Classification of Diseases and Related Health Problems (ICD), can lead to body function impairments such as pain and discomfort from harmful stimuli (ICF code b2703). Additionally, SIJ dysfunction impacts mobility (ICF code b710) both unilaterally and bilaterally, affecting the pelvic joint structure (ICF code s7401). This directly affects an individual's functional capacity in daily activities, including lying down, sitting, standing, walking, exercising, and performing other activities such as working, worshiping, and engaging in intimate relationships (ICF code d2303, d429, d4501, d5701). Therefore, SIJ dysfunction can reduce quality of life and affect participation in various activities[7][8]

To address this issue, standard exercise interventions such as Transcutaneous Electrical Nerve Stimulation (TENS), Short Wave Diathermy, William Flexion exercises, McKenzie exercises, and stretching exercises are commonly used. However, these interventions often fail to target the affected tissue adequately, leading to frequent recurrences of low back pain in patients. Manual therapy is effective in managing low back pain due to sacroiliac joint dysfunction. Manual therapy involves passive movements applied by the physical therapist, targeting the hypomobile joint. One recommended technique is pelvic rotation mobilization, which provides stretching effects on the SIJ ligament capsule and improves SIJ mobility [9].

In addition to manual therapy, specific stretching exercises, such as Sacroiliac Joint Stretches, can be beneficial for patients with sacroiliac joint dysfunction. These exercises are designed to stretch muscles experiencing spasms or tightness, commonly in the quadratus lumborum and piriformis muscles, which are involved in low back pain with sacroiliac joint dysfunction. By

providing stretching to these muscles, the goal is to reduce tension, improve joint mobility, and alleviate lower back pain [10].

Method

This study employed a quasi-experimental design with a randomized pretest–posttest two-group approach. Two sample groups were randomly assigned using a simple random sampling technique through a lottery method to receive two different interventions. The first group (treatment group 1) received the Sacroiliac Joint Mobilization intervention, while the second group (treatment group 2) received the Sacroiliac Joint Stretching intervention. Prior to the intervention, lumbar range of motion (ROM) was measured for both groups (pretest). After the respective interventions were administered, lumbar ROM was measured again (posttest) to evaluate the changes in each group. This research was conducted from January to March 2023 at Tenriawaru General Hospital, Bone Regency.

The population of this study consisted of all patients with low back pain caused by sacroiliac joint dysfunction who sought treatment at the Physiotherapy Outpatient Clinic of Tenriawaru General Hospital, Bone Regency. The sample included 50 patients who met the inclusion criteria. The minimal sample size was determined using a sample size calculation for comparing two independent means, with a significance level (α) of 0.05, a statistical power of 80%, and an expected effect size of 0.8 based on a previous study with a similar design. The calculation indicated that a minimum of 25 participants per group was required, resulting in a total of 50 participants. The sampling method used was simple random sampling.

The inclusion criteria were: (1) patients with low back pain due to sacroiliac joint dysfunction; (2) based on physiotherapy examination findings, patients must have limited lumbar flexion–extension ROM, a positive Gillet test, and tenderness upon palpation of the posterior superior iliac spine (PSIS) area; and (3) willingness to participate until completion of the study. The exclusion criteria were: (1) low back pain accompanied by radicular pain and a positive slump test, (2) history of lumbar or iliac fractures, (3) history of internal diseases, and (4) current use of pain medication. The drop-out criteria were: (1) patients who discontinued therapy and (2) those who passed away during the study.

At the initial stage, the researcher identified the research problem by collecting patient data from the General Hospital Tenriawaru, Bone Regency. Based on patient records from January to October 2022, a total of 188 visits for low back pain caused by sacroiliac joint dysfunction were identified. The researcher then reviewed related literature and journals to formulate the research problem, objectives, framework, hypothesis, and research design.

In the implementation phase, the researcher directly approached patients at the General Hospital Tenriawaru, Bone Regency, to obtain their consent as research subjects. After obtaining consent, the researcher explained the purpose and procedure of the study to the patients and conducted a physiotherapy assessment to identify patients with low back pain related to sacroiliac joint dysfunction. Following this, the researcher selected the research population based on inclusion and exclusion criteria, resulting in a sample for the study.

Data collection was performed by measuring the range of motion (ROM) for lumbar flexion–extension using a bubble inclinometer for each participant as pre-test data. The participants were then randomly allocated into two treatment groups using a simple randomization method through a lottery draw. Each participant’s name was written on a piece of paper, placed into a sealed container, and drawn randomly to assign them to either Group 1 or Group 2. Group 1 received the Sacroiliac Joint Mobilization intervention according to the predetermined dosage, while Group 2 received the Sacroiliac Joint Stretching intervention with the same dosage. After

the interventions were administered, the lumbar flexion–extension ROM was measured again to obtain post-test data.

The pre-test and post-test data for each group were analyzed to assess changes in lumbar flexion-extension ROM. Furthermore, the post-test data between the two groups were analyzed to evaluate the effectiveness of each intervention. The results of the study will be presented in tables and narratives, followed by a discussion and conclusion, with suggestions for further research.

The collected data will be analyzed through several stages to ensure the accuracy and validity of the research results. First, the data will be cleaned and prepared by checking for completeness, and if there is missing or inconsistent data, appropriate steps will be taken, such as data imputation or exclusion. Descriptive statistics, such as mean, standard deviation, and frequency distribution, will be calculated to identify the spread and trends of the data on ROM measurements before and after the intervention in both groups. A normality test (e.g., Shapiro-Wilk test) will be conducted to determine if the data follows a normal distribution. The data analysis in this study was conducted to determine the effect of each intervention and to compare the effectiveness between groups. Prior to hypothesis testing, the data were tested for normality using the Shapiro–Wilk test. If the data were normally distributed, a paired sample *t*-test was used to compare the pre- and post-intervention lumbar ROM values within each group, since this test is appropriate for comparing two related (dependent) measurements from the same participants. For data that were not normally distributed, the Wilcoxon Signed-Rank Test was used as a non-parametric alternative to the paired *t*-test. To compare the post-intervention lumbar ROM between the two independent groups (Sacroiliac Joint Mobilization vs. Sacroiliac Joint Stretching), an independent sample *t*-test was used for normally distributed data, whereas the Mann–Whitney U test was applied if the data did not meet normality assumptions. These statistical tests were chosen because they appropriately assess within-group and between-group differences according to the data distribution and the design of the study (pretest–posttest two-group design).

Result

Sample Characteristic

Table 1. Percentage of Gender and Mean Age of Samples

Sample Characteristics	Treatment Group 1		Treatment Group 2	
	n	%	n	%
Gender				
Male	10	40.0	8	32.0
Female	15	60.0	17	68.0
	Rerata	SB	Rerata	SB
Age (Years)	31.40	4.115	30.50	6.852

Both treatment groups consisted predominantly of female participants. The mean age of participants in both groups was around 30 years, indicating that most of the samples were classified as young adults. Overall, the demographic characteristics between the two groups were comparable (Table 1).

Table 2. Mean Lumbar ROM values in treatment groups 1 and 2

Sample Group	Mean and Standard Deviation		
	Pre test	Post test	Difference
Treatment Group 1			
Lumbal Flexion	42.50±9.490	52.10±6.226	9.60±4.526
Lumbar Extension	21.10±4.149	31.10±4.932	10.20±2.573
Treatment Group 2			
Lumbal Flexion	41.00±12.304	56.20±3.293	15.20±6.250
Lumbar Extension	14.40±4.427	29.10±3.665	14.70±2.406

Table 2 above shows the mean values of lumbar flexion and extension ROM in treatment groups 1 and 2, with the following data:

a. Treatment Group 1: There was a change in lumbar flexion and extension ROM based on the mean value changes from pre-test to post-test after the Sacroiliac Joint Mobilization intervention. Specifically, there was an increase in lumbar flexion ROM with an average increase of 9.60 degrees and an increase in lumbar extension ROM with an average increase of 10.20 degrees.
b. Treatment Group 2: There was a change in lumbar flexion and extension ROM based on the mean value changes from pre-test to post-test after the Sacroiliac Joint Stretches intervention. Specifically, there was an increase in lumbar flexion ROM with an average increase of 15.20 degrees and an increase in lumbar extension ROM with an average increase of 14.70 degrees.

Hypothesis Test

Table 3. Test of the Difference in the Mean Lumbar ROM in Group 1

Sample Group	Pre test	Post test	t	p
Lumbar Flexion				
Mean	42.50	52.10	-6.707	0.000
Standard Deviation	9.490	6.226		
Lumbar Extension				
Mean	21.10	31.10	-11.180	0.000
Standard Deviation	4.149	4.932		

t: Hypothesis test
*P: Significant, P<0.05

The results of the paired sample t-test show a p-value < 0.05 for all ROM data, indicating that the Sacroiliac Joint Mobilization intervention significantly improves lumbar ROM (flexion and extension) in individuals with low back pain caused by sacroiliac joint dysfunction (Table 3).

Table 4. Test of the Difference in the Mean Lumbar ROM in Group 2

Sample Group	Pre test	Post test	t	p
Lumbar Flexion				
Mean	41.00	56.20	-7.690	0.000
Standard Deviation	7.572	3.293		
Lumbar Extension				
Mean	14.40	29.10	-19.321	0.000
Standard Deviation	4.427	3.665		

t: Hypothesis test
*P: Significant, P<0.05

The results of the paired sample t-test show a p-value < 0.05 for all ROM data, indicating that the Sacroiliac Joint Stretches intervention can significantly improve lumbar ROM (flexion and extension) in individuals with low back pain caused by sacroiliac joint dysfunction (Table 4).

Table 5. Test of Difference in Mean Lumbar ROM Difference Between Treatment Group 1 and 2

Data Group	Treatment Group 1	Treatment Group 2	t	p
Lumbar Flexion				
Average	9.60	15.20	-2.295	0.034
Standard Deviation	4.526	6.250		
Lumbar Extension				
Average	10.20	14.70	-4.039	0.001
Standard Deviation	2.573	2.406		

t: Hypothesis test
*P: Significant, P<0.05

The results of the independent sample t-test show a p-value < 0.05, which indicates that there is a significant difference in the mean lumbar ROM difference between Treatment Group 1 and Treatment Group 2. Looking at the mean difference in flexion, the value of 15.2 degrees (Treatment 2) is greater than the value of 9.60 degrees (Treatment 1), and the mean difference in extension shows that 14.7 degrees (Treatment 2) is greater than 10.2 degrees (Treatment 1). Therefore, it can be concluded that Sacroiliac Joint Stretches lead to a significantly greater improvement in lumbar flexion-extension ROM than Sacroiliac Joint Mobilization in patients with low back pain caused by sacroiliac joint dysfunction (Table 5).

Discussion

The Effect of Sacroiliac Joint Mobilization on the Improvement of Lumbar Flexion-Extension ROM in Patients with Low Back Pain Due to Sacroiliac Joint Dysfunction.

Based on hypothesis testing using the paired sample t-test, it was found that Sacroiliac Joint Mobilization can result in a significant improvement in lumbar flexion-extension ROM in patients with low back pain due to sacroiliac joint dysfunction.

The sacroiliac joint mobilization applied to the samples consists of anterior and posterior rotation mobilizations. The anterior rotation mobilization produces passive rotation of the pelvic bones around its axis, causing an innominate movement toward the superior anterior direction along with accompanying accessory movements in the joint. On the other hand, posterior rotation mobilization produces passive rotation of the pelvic bones around its axis, causing an innominate movement toward the inferior posterior direction.This anterior-posterior accessory

motion of the innominate can stretch the sacroiliac joint capsule, improving the mobility of the sacroiliac joint. Additionally, the accessory movement can correct minor positional faults in the sacrum-pelvic region [11]. Improvement in sacroiliac joint mobility will be followed by the correction of pelvic positioning, which in turn affects the improvement of lumbar posture, ultimately resulting in improved lumbar flexion-extension ROM.

In the treatment group 1, there was one sample that significantly improved lumbar flexion ROM with a score difference of 15 degrees, and two samples that significantly improved lumbar extension ROM with a score difference of 13 degrees. Based on the researcher's observation, these samples did not experience a change in lumbar posture and only experienced pain at the sacroiliac joint. Additionally, two samples showed improvement in lumbar flexion ROM with a score difference of 5 degrees, and two samples showed improvement in lumbar extension ROM with a score difference of 8 degrees. This was because the lumbar flexion ROM in these samples was not severely limited, as indicated by the pre-test results, which showed 55° for flexion and 25° for extension. One other sample showed a change in lumbar posture toward a flat back, leading to a smaller difference in ROM scores.

A study revealed that Maitland Posterior-Anterior mobilization can increase extension ROM in patients with low back pain [12]. Two other studies on Posterior-Anterior mobilization found that the group receiving this mobilization experienced an increase in extension ROM [13]. Another study reported significant changes in active lumbar ROM in patients with low back pain due to sacroiliac joint dysfunction, showing improvements in both flexion and extension ROM following Posterior-Anterior mobilization [14].

In addition, research supports these findings by showing that sacroiliac joint mobilization reduces muscle tension around the lower back, such as the erector spinae and quadratus lumborum muscles, contributing to improved lumbar mobility [15][16]. Furthermore, another study emphasizes that manual mobilization, including Posterior-Anterior mobilization, not only increases ROM but also reduces pain symptoms associated with SIJ dysfunction [11]. Research also highlights the benefits of a manual approach to the sacroiliac joint in improving postural control and overall lumbar function [4]. These findings support that Posterior-Anterior mobilization can be an effective intervention for improving lumbar ROM in patients with low back pain due to SIJ dysfunction.

The Effect of Sacroiliac Joint Stretches on The Improvement of Lumbar ROM in Patients With Low Back Pain Due to Sacroiliac Joint Dysfunction.

Based on hypothesis testing using the paired sample t-test, it was shown that the Sacroiliac Joint Stretches intervention significantly improved lumbar flexion-extension ROM in patients with low back pain due to sacroiliac joint dysfunction.

Sacroiliac joint stretches are a manual therapy technique that utilizes controlled muscle energy before joint mobilization and muscle stretching. In this study, the applied technique involves mobilization of the lower lumbar region combined with pelvic rotation in a side-lying position, initiated with the patient's static muscle contraction. This static contraction of the erector spinae, quadratus lumborum, and lumbar rotator muscles induces relaxation by activating the Golgi tendon organs, which inhibit hyperactive gamma and alpha motor neurons, thereby reducing muscle tone. The reduction in muscle tension facilitates easier mobilization of the lower lumbar spine and pelvis while simultaneously stretching the erector spinae and quadratus lumborum muscles [7].

The application of lower lumbar and pelvic mobilization following static contraction exerts a mechanical effect on the sacroiliac joint, improving its mobility and reducing muscle tension.

Enhanced sacroiliac joint mobility promotes better pelvic alignment, which, combined with decreased tension in the erector spinae and quadratus lumborum, results in improved lumbar flexion and extension range of motion (ROM). This improvement is supported by the kinematic relationship between the sacroiliac joint, pelvis, and lumbar spine, which is integral to lumbopelvic rhythm. In this rhythm, lumbar movements are closely synchronized with pelvic movements, ensuring that increased pelvic mobility and reduced muscle tension lead to greater improvements in lumbar flexion and extension ROM [18].

In the treatment group 2, there was 1 respondent who experienced a significant improvement in lumbar flexion ROM with a score difference of 28 degrees, and 1 respondent who experienced a significant improvement in lumbar extension ROM with a score difference of 18 degrees. Based on the researcher's observations, these samples did not exhibit postural deviation and only presented with muscle spasms in the erector spinae and quadratus lumborum muscles. Additionally, 1 sample showed an improvement in lumbar flexion-extension ROM with a score difference of 10 degrees due to the results of a specific leg length difference examination, which revealed that the respondent's right leg was slightly longer than the left.

A study revealed that several patients with low back pain caused by sacroiliac joint dysfunction experienced an immediate improvement in their range of motion after receiving sacroiliac joint stretches intervention [19]. This intervention provides evidence supporting the argument that sacroiliac joint stretches have a direct effect on lumbar ROM. Furthermore, these findings are supported by a previous study explaining that the application of sacroiliac joint stretches can improve lumbar ROM[20]. These results support the rationale for using sacroiliac joint stretches in sacroiliac joint dysfunction to enhance lumbar ROM.

The Difference in Effect Between Sacroiliac Joint Mobilization and Sacroiliac Joint Stretches on the Improvement of Lumbar ROM in Patients with Low Back Pain Due to Sacroiliac Joint Dysfunction.

The results of the current study show a significant difference in the effect of Sacroiliac Joint Mobilization (SJ) and Sacroiliac Joint Stretches (SJS) on the improvement of lumbar flexion-extension range of motion (ROM) in patients with Low Back Pain (LBP) due to sacroiliac joint dysfunction. The statistical analysis reveals that SJS demonstrated a greater improvement in ROM compared to SJ mobilization. Specifically, the mean difference in ROM improvement was more pronounced in the SJS group, indicating that sacroiliac joint stretches are more effective in enhancing lumbar flexibility compared to sacroiliac joint mobilization.

This finding aligns with previous research highlighting the therapeutic benefits of sacroiliac joint stretches (SJS) in improving joint mobility and muscle flexibility. Ronald and Ray reported that SJS directly enhance the range of motion (ROM) of the lumbar spine in individuals with low back pain due to sacroiliac joint dysfunction [19]. They observed significant improvements in joint movement after applying SJS interventions, supporting the idea that this technique can effectively address sacroiliac dysfunction and its related lumbar mobility limitations. In addition, Suresh et al. also corroborated these findings by demonstrating that SJS led to increased lumbar ROM in patients experiencing similar dysfunctions [20].

The underlying mechanisms contributing to the superior efficacy of SJS may be explained through the biomechanical and neurophysiological effects of stretching. The application of sacroiliac joint stretches facilitates passive motion at the sacroiliac joint, which subsequently enhances the mobility of the pelvic region and the lumbar spine. SJS promotes lengthening of the muscles surrounding the sacroiliac joint, such as the erector spinae and quadratus

lumborum, which are often involved in low back pain [19]. This passive movement and muscle elongation likely reduce muscle stiffness and improve the flexibility of the lumbar spine, thus enhancing the overall ROM.

On the other hand, while sacroiliac joint mobilization also has a positive effect on ROM, its impact appears to be less pronounced compared to SJS. The mobilization technique typically involves a mechanical movement of the joint to restore its function and alleviate pain. Although it can effectively improve joint mobility and decrease pain, it may not have the same profound impact on muscle elongation and overall flexibility as SJS. Thus, while SJ mobilization serves as a useful treatment for pain relief and functional restoration, SJS may offer more significant benefits in terms of improving lumbar flexibility in patients with sacroiliac joint dysfunction.

These findings have important clinical implications. The choice between Sacroiliac Joint Mobilization and Sacroiliac Joint Stretches should be based on the specific needs of the patient and the desired outcomes. For patients with low back pain caused by sacroiliac joint dysfunction who require greater flexibility and ROM in the lumbar spine, Sacroiliac Joint Stretches may be a more effective intervention. Moreover, combining both techniques could potentially enhance overall treatment outcomes by addressing both the structural and muscular aspects of the dysfunction.

Conclusion

The study findings indicate a significant difference between Sacroiliaca Joint Mobilization (SJ) and Sacroiliaca Joint Stretches (SJS) in improving lumbar range of motion (ROM) in patients with low back pain caused by sacroiliac joint dysfunction. The results showed that SJS had a more substantial effect on increasing both flexion and extension ROM of the lumbar spine compared to SJ. This can be attributed to the direct effect of SJS on the sacroiliac joint and surrounding muscles, promoting better flexibility and reducing muscle tension, which enhances overall lumbar mobility.

Based on the results, it is recommended that Sacroiliaca Joint Stretches be considered as a primary intervention for patients with low back pain due to sacroiliac joint dysfunction, especially when the goal is to improve lumbar flexion and extension ROM. Clinicians should prioritize SJS, as it demonstrated more significant improvements in lumbar mobility. However, Sacroiliaca Joint Mobilization can still be utilized as a complementary therapy for pain relief and joint function restoration, particularly in the acute phase of treatment.

Further research is suggested to explore the long-term effects of Sacroiliaca Joint Stretches in combination with other rehabilitation techniques, as well as to investigate the underlying neurophysiological mechanisms that make SJS more effective in improving lumbar ROM. Additionally, studies with larger sample sizes and varied demographics could provide more comprehensive insights into the generalizability of these findings across different populations with low back pain.

Author Contribution

All authors have accepted responsibility for the entire content of this manuscript and approved its submission.

Conflict of interest

Authors state no conflict of interest.

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References
1. Tanderi EA, Kusuma TA, Hendrianingtyas M. Hubungan kemampuan fungsional dan derajat nyerii pada pasien low back pain mekanik di instalasi rehabilitasi medik RSUP DR. KARIADI Semarang. Diponegoro Medical Journal. 2017;6(1):63-72. Doi: https://doi.org/10.14710/dmj.v6i1.16236
2. Hameed S, Mohamed P, Seyed MA. Low back pain: A comprehensive review on the diagnosis, treatment options, and the role of other contributing factors. J Pain Res. 2021;9:347–59. Doi: https://doi.org/10.3889/oamjms.2021.6877
3. Barros G, McGrath L, Gelfenbeyn M. Sacroiliac Joint dysfunction in patients with low back pain. Fed Pract. 2019 Aug;36(8):370-375. From: https://pmc.ncbi.nlm.nih.gov/articles/PMC6707638/
4. Javadov, Aghalar, Aysegül Ketenci, and Cihan Aksoy. The efficiency of manual therapy and sacroiliac and lumbar exercises in patients with sacroiliac joint dysfunction syndrome. J Rehabil Sci. 2021;223–233. From: https://www.painphysicianjournal.com/current/pdf?article=NzIzNw%3D%3D&journal=135
5. Pane, Rita Vivera, Eko Agus Subagio, and Aufar Zimamuz Zaman Al Hajiri. The most common causes of low back pain in Surabaya Hajj General Hospital. J Health Sci Med. 2023;12(June):92–99. Doi: https://doi.org/10.36803/indojpmr.v12i01.350
6. Siahaan, Yusak MT, and Vinson Hartoyo. Sacroiliac joint pain: A study of predisposing factors in an Indonesian hospital. Open Orthop J. 2019;13:1–5. Doi: http://dx.doi.org/10.2174/1876386301912010001
7. World Health Organization. International classification of functioning, disability and health (ICF). Geneva: WHO; 2001. From: https://www.who.int/classifications/international-classification-of-functioning-disability-and-health
8. Cher D, Polly D, Berven S. Sacroiliac joint pain: Burden of disease. Med Devices (Auckl). 2014;7:73–81. Doi: https://doi.org/10.2147/mder.s59437.
9. Bishop MD, Torres-Cueco R, Gay CW, Lluch-Girbés E, Beneciuk JM, Bialosky JE. What effect can manual therapy have on a patient's pain experience. Pain Manag. 2015;5:455–464. Doi: https://doi.org/10.2217/pmt.15.39
10. Bhosale, Siddhi V., and Mayuri Burungale. Effectiveness of myofascial release, muscle energy technique and stretching of quadrartus lumborum muscle in patients with non-specific low back pain. J Ecophysiol Occup Health. 2022: 132-141. Doi: https://doi.org/10.18311/jeoh/2021/28561
11. Hengeveld E, Banks K, Newton M. Maitland's Vertebral Manipulation. 8th ed. Elsevier; 2014. From: https://www.inspectioncopy.elsevier.com/book/details/9780702040665
12. Javaherian M, Tajali SB, Moghaddam BA, Keshtkar AA, Azizi M. Immediate effects of Maitland mobilization and Mulligan techniques on flexion and extension range of motion in patients with chronic nonspecific low back pain: A randomized pilot study. J Mod Rehabi. 2017;11(2):127–132. From: https://www.academia.edu/download/56013078/7
13. Shum GL, Tsung BY, Lee RY. The immediate effect of posteroanterior mobilization on reducing back pain and the stiffness of the lumbar spine. Arch Phys Med Rehabil. 2013;94:674–679. Doi: https://doi.org/10.1016/j.apmr.2012.11.020

14. Powers CM, Beneck GJ, Kulig K, Landel RF, Fredericson M. Effects of a single session of posterior-to-anterior spinal mobilization and press-up exercise on pain response. Phys Ther. 2008;88(4):485–493. Doi: https://doi.org/10.2522/ptj.20070069
15. Kulyapa P, Yodchai B, Preeda A. Sacroiliac joint mobilization immediate improved clinical features of non-specific low back pain with sacroiliac joint dysfunction. KKU Res J (Graduate Stud). 2013;13(June):71–84. From: https://ph02.tci-thaijo.org/index.php/gskku/article/view/23047
16. Reza M, Motealleh A, Abtahi F, Panjan A, Ghaffarinejad F, Šarabon, N. Effect of sacroiliac manipulation on postural sway in quiet standing: A randomized controlled trial. Braz J Phys Ther. 2018;22(2):120–126. Doi: https://doi.org/10.1016/j.bjpt.2017.09.002
17. Selkow N, Grindstaff TL, Cross KM, Pugh K, Hertel J, Saliba S. Short-term effect of muscle energy technique on pain in individuals with non-specific lumbopelvic pain: A pilot study. J Man Manip Ther. 2009;17(1):14E–18E. Doi: https://doi.org/10.1179/jmt.2009.17.1.14E
18. Son JH, Gi Duck P, Hoo Sung P. The effect of sacroiliac joint mobilization on pelvic deformation and the static balance ability of female university students with sacroiliac joint dysfunction. J Phys Ther Korea. 2014;21(3):45–52. Doi: https://doi.org/10.1589/jpts.26.845
19. Ray D, Hamidie RD, Firmansah TA, Giriwijoyo S. The effect of static and dynamic stretching techniques to increase spine range of movement (ROM) on low back pain (LBP) patients. J Eng Sci Technol. 2016;23–33. From: https://jestec.taylors.edu.my/Special%20Issue%20on%20AASEC%202016/AASEC%202017_paper%203
20. Suresh AMR, Kashyap D, Behera TP, Tarsolia A. Effect of muscle energy technique in patients with non-traumatic lumbo-pelvic pain in the age group of 30–40 years. J Phys Med Rehabil Stud Rep. 2021;3(2):1–9. From: https://www.researchgate.net/profile/Amr-Suresh/publication/354060872_effect-of-muscle-energy-technique-in-patients-with-nontraumatic-lumbopelvic-pain-in-the-age-group-of-3040-years_3pdf/