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# Acute Effects of Combined Massage Therapy and Sun Salutation Yoga on Pain Reduction and Range Of Motion in Patients with Nonspecific Low Back Pain

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**Abstract***:* Globalization has changed people's physical activity patterns, increasing the risk of musculoskeletal disorders, including nonspecific low back pain (LBP) that often occurs due to less ergonomic postures and sedentary lifestyles. LBP can lead to decreased functional activity and quality of life. Various therapeutic methods have been developed to treat this condition, one of which is a combination of massage therapy and Sun Salutation Yoga. This study aims to test the effectiveness of the combination of these therapies in reducing pain and increasing Range of Motion (ROM) in patients with nonspecific LBP. Using a pre-experimental design with One Group Pretest-Posttest Design, this study involved 33 participants at Kasihan II Health Center, Bantul, Yogyakarta, during November 2024 - January 2025. Pain was measured using Visual Analogue Scale (VAS), while ROM was assessed using Modified Schober Test. The intervention consisted of 20 minutes of massage therapy and 20 minutes of Sun Salutation Yoga before the posttest measurement. The results showed a significant reduction in pain with $p < 0.05$, where the majority of participants experienced a reduction in acute pain by 55.71%. In addition, ROM increased by 19.35%, demonstrating the effectiveness of this combination of therapies in improving lumbar flexibility. Statistical analysis using MANOVA confirmed that this combination of therapies had a significant impact on pain reduction and ROM improvement. The conclusion of this study confirms that massage therapy and Sun Salutation Yoga can be an effective alternative nonpharmacological therapy for patients with nonspecific LBP. Practically, the results of this study can be adopted in physiotherapy and rehabilitation practices to reduce the incidence of LBP due to less ergonomic work postures.

**Keywords**: nonspecific low back pain, massage therapy, sun salutation yoga

## INTRODUCTION

Globalization has brought about significant changes in lifestyles and work patterns in various countries. These shifts impact physical activity patterns, which if reduced, can increase the risk of obesity, non-communicable diseases and musculoskeletal disorders. Physical activity acts as a protective factor against musculoskeletal disorders, but diverse work patterns also have the potential to cause fatigue and reduce body capacity (Pravalya, 2021).

Low back pain (LBP) is one of the musculoskeletal disorders that often occurs due to repeated ergonomic errors. LBP is defined as localized pain between the costae border and the inferior gluteal fold that lasts for several days (Fujii et al., 2019). About 80% of the population has experienced LBP at least once in their lives (Simanjuntak et al., 2020). Causes include acute tension in the lumbar-sacral area, muscle and ligament weakness, arthritis, and narrowing of the spinal canal.

In Indonesia, the incidence of LBP reaches 3.71% of the population (Kemenkes, 2021), with about 85% of cases classified as nonspecific low back pain-a disorder without obvious structural changes or inflammation (Kurniawan, 2021). This condition can progress to chronic low back pain, leading to decreased functional activity and spinal instability.

Management of musculoskeletal pain includes pharmacological (anti-inflammatory drugs, opioids, steroids) and nonpharmacological (physical therapy, acupuncture, psychotherapy) therapies (El Geziry et al., 2018). One of the widely used nonpharmacological therapies is massage therapy, which functions to improve blood circulation, relieve muscle tension, and stimulate the release of endorphin hormones (Gasibat et al., 2017).

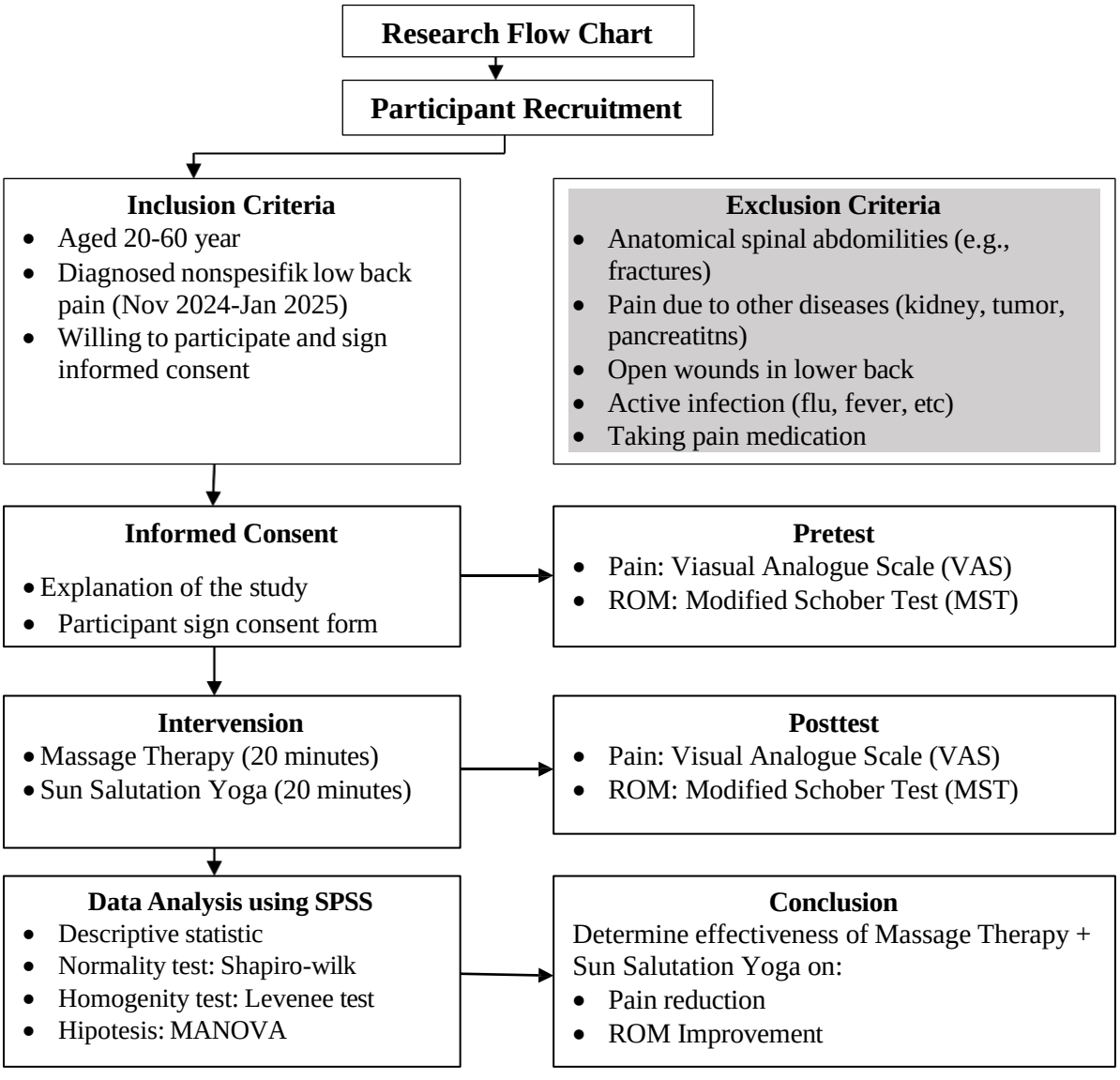
Massage therapy has mechanical and physiological effects, helping to increase blood flow, stimulate the nervous system, and lower stress hormones (Syarifudin & Roepajadi, 2020). Commonly used techniques include effleurage, petrissage, tapotement, and friction (Priyambada, 2021).

In addition, yoga has also been shown to be effective in reducing pain and increasing flexibility. Sun Salutation Yoga or Surya Namaskar is a series of 12 movements that involve stretching, jumping, and other body movements. The study by Arovah et al., (2022) showed that Surya Namaskar can reduce pain, increase flexibility, and improve quality of life for people with LBP. Yoga can also increase nervous system activity and reduce the expression of inflammatory mediators (Opplert & Babault, 2018).

This study aims to examine the effect of a combination of massage therapy and Sun Salutation Yoga in reducing pain and increasing Range of Motion (ROM) in patients with nonspecific low back pain (LBP).

## METHODS

This study used a pre-experimental design with the One Group Pretest-Posttest Design method to measure the effectiveness of a combination of massage therapy and Sun Salutation Yoga on pain and Range of Motion (ROM) in patients with nonspecific low back pain. The study was conducted at Puskesmas Kasihan II, Bantul, Yogyakarta, on November 1, 2024 - January 15, 2025. This location was chosen because it has a high prevalence of low back pain based on data from the Bantul Health Office. The stages of this research implementation are explained in the following flowchart



## RESULTS AND DISCUSS

### Results

This study involved 33 participants who experienced nonspecific low back pain, consisting of 14 men and 19 women. Based on the results of the study, there were more female participants than male. This can be seen from the percentage of women at 58% of the total participants, while men at 42% (see Figure 1).

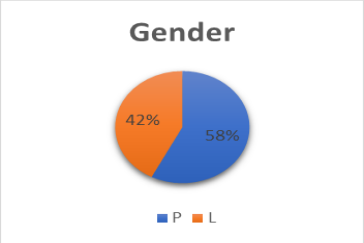



**Figure 1.** Probandus Research Based on Gender

The age range of the study participants (probandus) was between 20 and 60 years, with an average age of 38 years. The age groups of the study participants are presented in Table 1.

**Table 1.** Age Group of Study Probandus

| Age Range | Number of probandus | Percentage |
|---|---|---|
| 20-30 Years | 12 Probandus | 36 % |
| 31-40 Years | 7 Probandus | 21 % |
| 41-50 Years | 6 Probandus | 18 % |
| 51-60 Years | 8 Probandus | 24 % |
| Total | 33 Probandus | 100% |

The age group data of the study participant in this study are also illustrated in the diagram below.

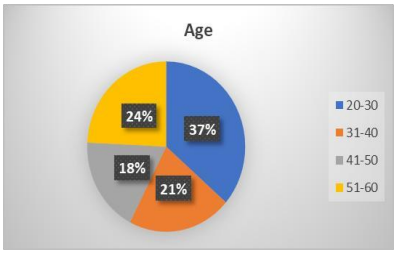



**Figure 2.** Age diagram of the participants

Based on interviews with study participants, several factors were found to increase the risk of nonspecific low back pain, especially in the productive age group who are actively working. These factors include a sedentary lifestyle, where individuals often sit for long periods of time, either while working at a computer or in other activities that require a static sitting position. In addition, incorrect sitting postures and poor work ergonomics also contribute to ischemia (reduced blood supply carrying oxygen and nutrients to body tissues), which in turn triggers inflammation.

Patients with nonspecific low back pain were most commonly found in the student group, with a total of 9 people (27%). According to Koswara et al. (2024), the high prevalence of low back pain in students is caused by the habit of sitting too long with non-ergonomic postures, which can cause muscle tension and musculoskeletal disorders.

The participants in this study had various occupations, including: teacher, housewife, self-employed, private-employed, builders, student, nurse, banker, and farmer. The data on the number of participants by occupation are presented in the table 2:

**Table 2.** Number and Occupation of Probandus

| Jobs | Number of probandus | Percentage |
|---|---|---|
| Teacher | 3 Probandus | 9,09% |
| Housewife | 4 Probandus | 12,12% |
| Self-employed | 5 Probandus | 15,15% |
| Student | 9 Probandus | 27,27% |
| Builders | 2 Probandus | 6,06% |
| Private Employee | 3 Probandus | 9,09% |
| Nurse | 3 Probandus | 9,09% |
| Banker | 1 Probandus | 3,03% |
| Farmer | 3 Probandus | 9,09% |
| Total | 33 Probandus | 100% |

The occupational data of the study participants are also presented in the bar chart below

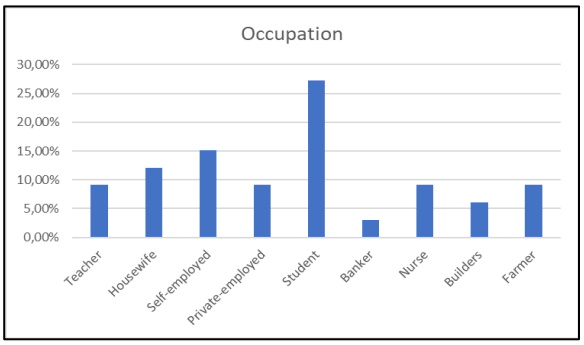



**Figure 3.** Occupation chart of the participants

The highest duration or phase of injury experienced by the study probandus was the subacute phase (4-12 weeks) with 18 people (54%). Furthermore, the acute phase was found in 8 people (24%), while the chronic phase was the lowest, experienced by 7 people (21%).

**Table 3.** Duration of Probandus Injury

| Duration of Injury | Number of probandus | Percentage |
|---|---|---|
| < 4 Weeks (Acute) | 8 Probandus | 24% |
| 4 - 12 Weeks (Sub Acute) | 18 Probandus | 54% |
| > 12 weeks (Chronic) | 7 Probandus | 21% |
| Total | 33 Probandus | 100% |

Based on interviews with probandus, the majority of them only undergo massage therapy (massage) without combining it with yoga or exercise therapy. In addition, many probandus reported that their pain was recurrent, appearing and disappearing repeatedly.

The research data show that the injuries experienced by the study participants had a variety of causes, including accidents caused by driving or slipping, physical activity factors, occupational factors, and sports-related factors. The data on the causes of injury are presented in the following table:

**Table 4.** Causes of Probandus Injury

| Causes | Number of probandus | Percentage |
|---|---|---|
| Accidens | 3 Probandus | 9,09% |
| Physical Activity | 14 Probandus | 42,42% |
| Work | 9 Probandus | 27,27% |
| Sports | 7 Probandus | 21,21% |
| Total | 33 Probandus | 100% |

The data on the causes of nonspecific low back pain are also presented in the following diagram

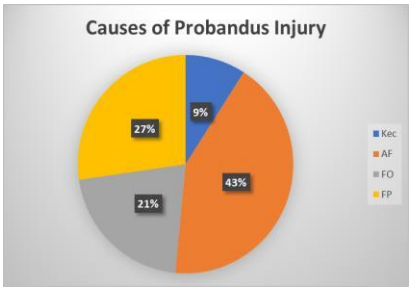



**Figure 4.** Injury cause diagram of the participants

The results of measuring the pain scale before the intervention (pretest) showed that the majority of probandus experienced moderate pain as many as 23 people (69.70%). Meanwhile, severe pain was experienced by 7 people (21.21%), and mild pain only occurred in 3 people (9.09%). After the intervention (posttest), there was a significant decrease in the pain scale. A total of 32 people (96.97%) experienced mild pain, and only 1 person (3.03%) still experienced moderate pain. These results indicate that the therapy provided is effective in reducing pain in patients with nonspecific low back pain.

**Table 5.** Classification of Pain Scale Measurements

| Indicator | Pretest | Percentage | Posttest | Percentage |
|---|---|---|---|---|
| Mild | 3 | 9,09% | 32 | 96,97% |
| Medium | 23 | 69,70% | 1 | 3,03% |
| Severe | 7 | 21,21% | 0 | 0% |

Measurement of lumbar Range of Motion (ROM) in this study using the Modified Schober Test (MST). The measurement results showed a significant increase after the intervention. Before the intervention (pretest), the average lumbar ROM of the probandus was 18.09 cm. After the intervention (posttest), there was an increase with the average ROM reaching 21.5 cm. The difference or mean increase in ROM after the intervention was 3.5 cm. The following is a diagram of the ROM measurement results from the pretest and posttest of the study participants.

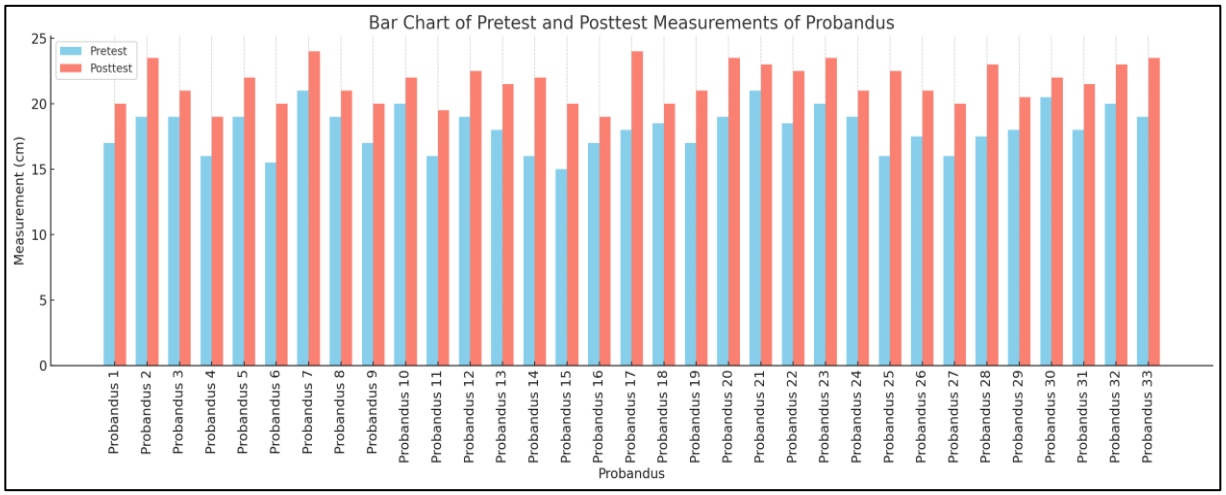



**Figure 5.** Diagram of ROM Measurement Pretest-Posttest for Subjects

The data normality test in this study was carried out using the Shapiro-Wilk test, with the criteria p> 0.05 for normally distributed data and p < 0.05 for data that were not normally distributed. Based on the normality test results, the pretest pain variable has a p value = 0.151 (p> 0.05), the posttest pain variable has a p value = 0.366 (p> 0.05), the pretest ROM variable has a p value = 0.236

(p> 0.05), and the posttest ROM variable has a p value = 0.107 (p> 0.05). All variables show normal distribution, so the analysis can proceed to the homogeneity test as the next requirement before hypothesis testing.

**Tests of Normality**

| | | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|---|
| | Kelas | Statistic | df | Sig. | Statistic | df | Sig. |
| Nyeri | Pretest | .095 | 33 | .200* | .952 | 33 | .152 |
| | Postest | .112 | 33 | .200* | .965 | 33 | .366 |
| ROM | Pretest | .137 | 33 | .122 | .959 | 33 | .236 |
| | Postest | .130 | 33 | .173 | .947 | 33 | .107 |

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

**Figure 6.** Normality Test Results and Data Distribution

Data homogeneity analysis was performed using Levene's Test to ensure the similarity of variance between groups. The criteria used are p> 0.05 indicating homogeneous data, while p < 0.05 indicating inhomogeneous data. Based on the results of Levene's Test, the pain variable has a p value = 0.097 (p> 0.05), while the ROM variable has a p value = 0.765 (p> 0.05). This indicates that both variables are homogeneously distributed. With the fulfillment of the prerequisite tests of normality and homogeneity, the analysis can proceed with hypothesis testing using the MANOVA parametric statistical test.

**Levene's Test of Equality of Error Variances[a]**

| | | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| Nyeri | Based on Mean | 2.844 | 1 | 64 | .097 |
| | Based on Median | 2.376 | 1 | 64 | .128 |
| | Based on Median and with adjusted df | 2.376 | 1 | 62.469 | .128 |
| | Based on trimmed mean | 2.899 | 1 | 64 | .093 |
| ROM | Based on Mean | .091 | 1 | 64 | .765 |
| | Based on Median | .088 | 1 | 64 | .767 |
| | Based on Median and with adjusted df | .088 | 1 | 62.045 | .767 |
| | Based on trimmed mean | .090 | 1 | 64 | .766 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Kelas

**Figure 7.** Homogeneity Test Results

Parametric statistical analysis was performed using Multivariate Analysis of Variance (MANOVA). The criteria used were p < 0.05 indicating a significant difference, while p > 0.05 indicating no significant difference. Based on the results of the MANOVA test, the pain variable has a p value = 0.000 (p < 0.05), which indicates that the combination of massage therapy and sun salutation yoga has a significant effect on reducing pain in patients with nonspecific low back pain. Meanwhile, the ROM variable also has a p value = 0.000 (p < 0.05), which indicates that the combination of these therapies has a significant effect on increasing Range of Motion (ROM). Thus, it can be concluded that there is an acute effect of the combination of massage therapy and sun salutation yoga on reducing pain and increasing ROM in patients with nonspecific low back pain.

**Tests of Between-Subjects Effects**

| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Corrected Model | Nyeri | 19381.227[a] | 1 | 19381.227 | 164.896 | .000 |
| | ROM | 202.125[b] | 1 | 202.125 | 83.214 | .000 |
| Intercept | Nyeri | 129985.470 | 1 | 129985.470 | 1105.921 | .000 |
| | ROM | 25981.670 | 1 | 25981.670 | 10696.547 | .000 |
| Kelas | Nyeri | 19381.227 | 1 | 19381.227 | 164.896 | .000 |
| | ROM | 202.125 | 1 | 202.125 | 83.214 | .000 |
| Error | Nyeri | 7522.303 | 64 | 117.536 | | |
| | ROM | 155.455 | 64 | 2.429 | | |
| Total | Nyeri | 156889.000 | 66 | | | |
| | ROM | 26339.250 | 66 | | | |
| Corrected Total | Nyeri | 26903.530 | 65 | | | |
| | ROM | 357.580 | 65 | | | |

a. R Squared = ,720 (Adjusted R Squared = ,716)
b. R Squared = ,565 (Adjusted R Squared = ,558)

**Figure 8.** MANOVA Test Results

## Discuss

Based on the results of the study, the combination of massage therapy and sun salutation yoga has an acute effect on reducing pain in patients with nonspecific low back pain. The results showed a decrease in the average pain scale from 61.5152 at pretest to 27.2424 at posttest, with a deficiency of 34.2728 after the intervention.

Low back pain is often associated with pain nociceptors, which are sensory receptors that are sensitive to potentially harmful stimuli. When a pain stimulus hits a nociceptor, signals are sent through local blood vessels to mast cells, which then release histamine. This histamine can increase pain perception and worsen pain sensation. In this study, massage therapy was given with effleurage, friction, tapotement, and walken techniques. The intervention was performed once with moderate pressure, adjusted to the patient's pain level. The massage technique was applied to the musculus latissimus dorsi, musculus erector spinae, and musculus trapezius in a face-down position for 20 minutes.

According to (Döner & Taşcı, 2022), massage therapy is effective in reducing pain through mechanisms of improving blood circulation, reducing inflammation, reducing stress hormones, and increasing beta endorphins and serotonin. Sutami & Laksmi (2021) explain that massage therapy also improves circulation and reduces sympathetic nervous system activity, which helps reduce muscle tension and pain.

Hasanah & Sumartiningsih (2023) found that massage manipulation can reduce muscle tension and increase blood flow, and stimulate the parasympathetic nervous system to reduce physiological stress. Çetinyol et al., (2025) also showed that masase therapy has a significant acute effect on pain reduction through the release of fascial adhesions and increased blood circulation in the low back area. Sun salutation yoga in this study contributed to increasing core stability, improving posture, and increasing lumbar ROM. Dos Santos et al., (2021) state that yoga movements can increase ROM and reduce pain through increased blood circulation and cortisol levels.

Fatimah (2023) in her research shows that the sun salutation yoga movement helps improve blood circulation, provides a relaxing effect, reduces stress, and increases flexibility and muscle strength, which has an impact on reducing pain from the moderate pain category to minimal pain.

In this study, the sun salutation yoga intervention was performed once after massage therapy, with 7 main asanas, namely pranamasana, hastauttasana, padahastana, ashwa sanchalasana, partavasana, astanga namaskara, and bhujangasana. Each asana is performed 2 times in 1 set, with 4 sets in total, duration of 5 minutes per set, and moderate intensity, adjusted to the patient's condition.

The combination of massage therapy and sun salutation yoga has an acute effect on increasing Range of Motion (ROM) in patients with nonspecific low back pain. The difference in the average ROM value from the pretest of 18.0909 to 21.5909 in the posttest showed an increase of 3.5 cm after treatment. ROM is an important factor in individual mobility, especially for people with low back pain who experience limited flexibility. The combination of massage therapy and sun salutation yoga contributes to increasing ROM through the following mechanisms.

Massage therapy works by applying mechanical pressure to muscle tissue through effleurage, friction, tapotement, and walken techniques, which helps reduce tissue adhesion due to injury. According to the mechanotransduction theory, pressure and stretching during massage converts mechanical stimuli into biochemical signals that stimulate tissue repair processes, reduce adhesions, and increase flexibility.

Thampy et al., (2020) in the Journal of Bodywork and Movement Therapies support this theory by showing that mechanical pressure in massage therapy increases fibroblast activity, which improves tissue structure and reduces adhesions. Rahmatika & Sifaq (2024) also found that sport massage significantly improved low back flexibility in handball athletes with an average increase of 13.3%.

Research by Çetinyol et al., (2025) in the journal "Acute effects of myofascial release technique on flexibility and pain: Outcome for chronic low back pain" showed that massage therapy can reduce fascial fibrosis and increase tissue elasticity, thereby improving blood circulation, tissue oxygenation, reducing muscle spasm, and increasing flexibility. In addition, a meta-analysis by Davis et al., (2020) in "Effect of sports massage on performance and recovery: a systematic review and meta-analysis" found that massage therapy can significantly improve flexibility with an average increase of 7%.

Sun salutation yoga also plays a role in improving flexibility and muscle stability. Each asana in sun salutation yoga is designed to stretch and strengthen the muscles of the body, which contributes to the mobility of the back and hip joints. Mustaqim et al., (2024) state that yoga can increase the production of collagen protein, which plays a role in the recovery of muscle tissue and ligaments and improves joint function.

Arovah et al. (2022) in the study "Sun salutation yoga in Patients with Subacute Low Back Pain: a Feasibility Study" evaluated the effect of sun salutation yoga on patients with subacute low back pain. The results show that this yoga can reduce pain, improve function, and improve the quality of life of patients. Based on the results of research and hypothesis testing using the MANOVA test, the combination of massage therapy and sun salutation yoga has a significance value of 0.000 (<0.05). This shows that this therapy has an effect on reducing pain and increasing Range of Motion (ROM) in patients with nonspecific low back pain, so H1 is accepted and H0 is rejected. Its effectiveness was recorded at 55.71% for pain deficiency and 19.35% for ROM improvement.

The combination of massage therapy and yoga has been widely studied in research related to musculoskeletal disorders, showing optimal synergistic effects through biomechanical, physiological, biochemical, and physical mechanisms in injury rehabilitation. Joseph et al., (2018) in "Effects of Massage as a Combination Therapy with Lumbopelvic Stability Exercises as Compared to Standard Massage Therapy in Low Back Pain: a Randomized Cross-Over Study" found that the combination of massage therapy with lumbopelvic stability exercises was more effective in reducing pain than massage therapy alone. This combination also improved low back mobility function and muscle balance in the long term.

Further support came from Coulter et al., (2018) in "Manipulation and mobilization for treating chronic low back pain: a systematic review and meta-analysis," which showed that the combination of manipulation or massage therapy with mobilization or exercise tends to reduce pain and improve function in patients with chronic low back pain through biomechanical and physiological mechanisms.

Recent research by Baharsyah (2024) in "The Effect of Massage Therapy and Stretching Therapy on Chronic Low Back Pain in Athletes" also found a significant reduction in pain levels after

the intervention, as well as improved low back motion function. The results of this study indicate that massage therapy is more dominant in reducing pain, while stretching exercises are more dominant in improving motion function. In line with the research of Utomo & Kushartanti (2019), the combination of masase and stretching therapy is more effective in overcoming chronic low back pain than masase therapy alone. Thus, the combination of massage therapy and yoga is proven to have high effectiveness in rehabilitation of nonspecific low back pain, especially in reducing pain and increasing ROM.

The limitation in this study is the measurement of lumbar Range of Motion (ROM) which only includes lumbar flexion movements, so other aspects of lumbar movement are not measured thoroughly. In addition, this study did not conduct follow-up supervision of the subjects after the intervention, which could potentially affect the results of the study due to the possibility of uncontrolled external factors.

## CONCLUSION

The combination method of massage therapy and sun salutation yoga is proven to have a significant effect on pain deficiency and Range of Motion (ROM) improvement in patients with nonspecific low back pain. Specifically, this combination of therapy is effective in reducing acute pain by 55.71% and increasing ROM by 19.35%. Thus, the combination of massage therapy and sun salutation yoga has an average effectiveness of 37.53% in reducing pain and increasing ROM acutely.

In terms of research implications, theoretically, the results of this study indicate that the combination of massage therapy and sun salutation yoga is effective in reducing pain and increasing ROM in patients with acute nonspecific low back pain. This combination of therapies can be further developed to support treatment and rehabilitative therapy research with a non-pharmacological approach. Practically, this combination of therapies can be applied in the management of acute nonspecific low back pain, especially for traditional health workers in Indonesia, so that it can help reduce the morbidity rate due to this condition.

## REFERENCES

Arovah, N., Kushartanti, W., & Ambardini, R. (2022). Sun salutation yoga in patients with subacute low back pain: a feasibility study. *Physiotherapy Quarterly*, *30*(4), 1–6.

Baharsyah, A. S. (2024). The Effect of Massage Therapy and Stretching Therapy on Chronic Low Back Pain in Athletes. *Journal of Physical Education and Sports*, *4*(4), 2020–2025.

Çetinyol, O., Saka, S., & Çetinkaya, A. (2025). Acute effects of myofascial release technique on flexibility and pain: Outcome for chronic low back pain. *Journal of Bodywork and Movement Therapies*, *41*, 194–198. https://doi.org/10.1016/j.jbmt.2024.11.035

Coulter, I. D., Crawford, C., Hurwitz, E. L., Vernon, H., Khorsan, R., Booth, M. S., & Herman, P. M. (2018). Manipulation and mobilization for treating chronic low back pain: a systematic review and meta-analysis. *The Spine Journal*, *18*(5), 866–879. https://doi.org/10.1016/j.spinee.2018.01.013

Davis, H. L., Alabed, S., & Chico, T. J. A. (2020). Effect of sports massage on performance and recovery: a systematic review and meta-analysis. *BMJ Open Sport & Exercise Medicine*, *6*(1), e000614. https://doi.org/10.1136/bmjsem-2019-000614

Döner, A., & Taşcı, S. (2022). Effect of massage therapy with lavender oil on severity of restless legs syndrome and quality of life in hemodialysis patients. *Journal of Nursing Scholarship*, *54*(3), 304–314.

dos Santos, E. B., Andrade, R. M., & de Sousa Santos, I. (2021). Runtime testing of context-aware variability in adaptive systems. *Information and Software Technology*, *131*, 106482. https://doi.org/10.1016/j.infsof.2020.106482

El Geziry, A., Toble, Y., Al Kadhi, F., Pervaiz, M., & Al Nobani, M. (2018). Non-pharmacological pain management. *Pain Management in Special Circumstances*, 1–14.

Fatimah, S. (2023). *EFEKTIVITAS YOGA SURYA NAMASKAR TERHADAP NYERI PUNGGUNG IBU HAMIL TRIMESTER III DI WILAYAH KERJA PUSKESMAS MOJOLABAN KABUPATEN SUKOHARJO*. Universitas Kusuma Husada Surakarta.

Fujii, T., Oka, H., Takano, K., Asada, F., Nomura, T., Kawamata, K., Okazaki, H., Tanaka, S., & Matsudaira, K. (2019). Association between high fear-avoidance beliefs about physical activityand chronic disabling low back pain in nurses in Japan. *BMC Musculoskeletal Disorders*, *20*(1), 1–10. https://doi.org/10.1186/s12891-019-2965-6

Gasibat, Q., Suwehli, W., Rehema Bawa, A., Adham, N., M.Kheer, Al turkawi, R., & Mohamed Baaiou, J. (2017). The Effect of an Enhanced Rehabilitation Exercise Treatment of Non-Specific Low Back Pain- A suggestion for Rehabilitation Specialists. *American Journal of Medicine Studies*, *5*(1). https://doi.org/10.12691/ajms-5-1-3

Hasanah, S., & Sumartiningsih, S. (2023). A The Acute Effects of Sport Massage on Decreased Heart Rate After Exercise (Case Study on PSHT Pencak Silat Athletes in Karangsambung). *Journal of Physical*, *12*(2), 75–80.

Joseph, L. H., Hancharoenkul, B., Sitilertpisan, P., Pirunsan, U., & Paungmali, A. (2018). Effects of massage as a combination therapy with lumbopelvic stability exercises as compared to standard massage therapy in low back pain: A randomized cross-over study. *International Journal of Therapeutic Massage and Bodywork: Research, Education, and Practice*, *11*(4), 16–22. https://doi.org/10.3822/ijtmb.v11i4.413

Kemenkes. (2021). *Laporan Hasil Survei*.

Kurniawan, A. (2021). Kombinasi Infrared, Transcutaneus Electrical Nerve Stimulation dan Terapi Latihan untuk Menurunkan Keluhan Nyeri Punggung Bawah: Case Study. *Indonesia Journal of Physiotherapy*, *1*(1), 90–97.

Mustaqim, R., Paramitha, S. T., & Rasydiq, H. (2024). *Masase Olahraga: Pertolongan Pertama pada Cedera Olahraga*. Eureka Media Aksara.

Opplert, J., & Babault, N. (2018). Acute Effects of Dynamic Stretching on Muscle Flexibility and Performance: An Analysis of the Current Literature. *Sports Medicine*, *48*(2), 299–325. https://doi.org/10.1007/s40279-017-0797-9

Pravalya, A. A. (2021). *Hubungan Beban Kerja Fisik dan Kelelahan Kerja dengan Produktivitas Kerja pada Tenaga Kerja di PT. Jamu Air Mancur Surakarta*. UNS.

Priyambada, G. (2021). *Tata Laksana Sport Massage : Persiapan Menghadapi Pertandingan Cabang Olahraga Pencak Silat*. AHLIMEDIA PRESS.

Rahmatika, H. eka, & Sifaq, A. (2024). Efektifitas Sport Mssage Terhadap Tingkatkan Fleksibilitas Punggung Bawah Pada Cabor Bola Tangan. *JPO:Jurnal Prestasi Olahraga*, *7*(1), 107–112.

Simanjuntak, E. Y. B., Silitonga, E., & Aryani, N. (2020). Latihan Fisik dalam Upaya Pencegahan Low Back Pain (LBP). *Jurnal Abdidas*, *1*(3), 119–124. https://doi.org/10.31004/abdidas.v1i3.21

Sutami, N. K. D., & Laksmi, I. A. A. (2021). Hubungan Durasi Kerja Dan Posisi Kerja Dengan Kejadian Nyeri Punggung Bawah Pada Petani. *Journal of Borneo Holistic Health*, *4*(2), 85–96. https://doi.org/10.35334/borticalth.v4i2.2028

Syarifudin, A., & Roepajadi, J. (2020). PENGARUH MEKANIS MASASE LOKAL EKSTREMITAS BAWAH SEBAGAI PEMULIHAN PASIF TERHADAP KEKUATAN OTOT TUNGKAI ATLET JU JITSU. *Jurnal Kesehatan Olahraga*, *8*(1), 105–110.

Thampy, V., Fong, A. Y., Calta, N. P., Wang, J., Martin, A. A., Depond, P. J., Kiss, A. M., Guss, G., Xing, Q., Ott, R. T., van Buuren, A., Toney, M. F., Weker, J. N., Kramer, M. J., Matthews, M. J., Tassone, C. J., & Stone, K. H. (2020). Subsurface Cooling Rates and Microstructural Response during Laser Based Metal Additive Manufacturing. *Scientific Reports*, *10*(1), 1–9. https://doi.org/10.1038/s41598-020-58598-z

Utomo, A., & Kushartanti, B. M. (2019). Efektivitas massage frirage dan kombinasi back massage-stretching untuk penyembuhan nyeri pinggang. *Jurnal Keolahragaan*, *7*(1), 43–56.