BALNEO RESEARCH Balneo and PRM Research Journal
English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

Research article

Does Combining Ice with Effleurage Massage Enhance Pain Relief and Limb Function in DOMS? A Quasi-Experimental Pre-Posttest Study

Muhamad Arja Bahauddin [1], Muhamad Ichsan Sabillah [1,*], Danny Eka Wahyu Saputra [2], Yovhandra Ockta [3], Yosef Febrian Paska Ardiwana [4]

1 Faculty of Sport and Health Sciences, Universitas Negeri Surabaya, Indonesia;
2 Faculty of Vocational Studies, Universitas Negeri Yogyakarta, Indonesia;
3 Faculty of Health Sciences, Universitas Teuku Umar, Indonesia;
4 Faculty of Sport and Health Sciences, Universitas Negeri Yogyakarta, Indonesia

* Correspondence: muhamadsabillah@unesa.ac.id

Citation: Bahauddin M.A., Sabillah M.I., Saputra D.E.W., Ockta Y., Ardiwana Y.F.P. - Does Combining Ice with Effleurage Massage Enhance Pain Relief and Limb Function in DOMS? A Quasi-Experimental Pre-Posttest Study
Balneo and PRM Research Journal **2025**, *16(3)*: 828

Academic Editor(s):
Constantin Munteanu

Reviewer Officer:
Viorela Bembea

Production Officer:
Camil Filimon

Received: 17.06.2025
Published: 30.09.2025

Reviewers:
Andreea Suciu
Gabriela Dogaru

Publisher's Note: Balneo and PRM Research Journal stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract: This study aimed to compare effleurage massage with and without ice application on pain and limb function in Delayed Onset Muscle Soreness (DOMS). The method used was a quasi-experimental design with two-group pre-posttest design, involving 15 subjects. Based on the results of the study, the majority of subjects who underwent effleurage mas-sage experienced highly significant changes (p-value > 0.01), both with and without ice treatment. Pain and limb function in the effleurage massage without ice group improved significantly from pretest scores of 4.6 ± 1.5 and 10.8 ± 1.7 to posttest scores of 2.7 ± 1.1 and 15.2 ± 1.1 (p = 0.00 and 0.00 for pain and limb function, respectively). Improvement was also found in pain and limb function in the effleurage massage group with ice from pre-test scores of 5.0 ± 1.5 and 11.5 ± 1.9 to posttest scores of 2.0 ± 0.7 and 17.1 ± 1.1 (p = 0.00 and 0.00 for pain and limb function). In addition, it was found that the improvement in pain and limb function in the effleurage massage with ice group was superior compared to the group that only performed effleurage massage (p = 0.040 and 0.001 for pain and limb function, respectively). Based on these results, it can be concluded that both ef-fleurage massage with and without ice can reduce pain and improve limb function in DOMS, but effleurage massage with ice is more effective in improving pain and limb func-tion in DOMS of the limbs.

Keywords: Effleurage, Ice Massage, DOMS, Pain, Limb Function

1. Introduction

Physical activity will gradually reduce a person's fitness, leading to fatigue or decreased mobility, thereby impacting their ability to meet the recommended guidelines [4], [5]. This level of fatigue will also increase the risk of injury, and the severity will escalate with repetitive physical activity. [6], [7], [8]. Adjusting the intensity of exercise to match the condition of sports enthusiasts is crucial, so they can enjoy their activities safely and effectively [9], [10], [11]. The presence of fatigue factors and heavy training loads, along with movements beyond one's initial capabilities, will typically result in complaints on the body commonly referred to as Delayed Onset Muscle Soreness (DOMS) [14], [15]. DOMS is muscle pain and stiffness that develops 24-72 hours after exercise that involves muscles that are not used to physical activity or exercise [16], [17]. The mechanism of DOMS experienced by a person is caused by eccentric training [18]. Eccentric exercises are exercises that require muscle contractions that extend and shorten strongly. DOMS pain usually begins to develop in the first 12-24 hours and reaches its peak within 24-72 hours after exercise [19]. Areas of lower extremity muscles that often experience DOMS are the gastrocnemius muscle, anterior tibial muscle, hamstring muscle and quadriceps muscles [20].

DOMS is also often an unusual condition and exceeds limits that can cause interference with limb performance [14], [23]. The long recovery period of 5 - 7 days makes it very difficult for sportsmen who can do physical activity and exercise [24]. For example, after going through heavy performance, especially in the lower extremities, will give interference to the hamstring muscles, so that in giving treatment to the hamstring muscles will experience heavier compression, both with and without the use of ice [25]. The increased load will affect the level of endurance of the hamstring muscles after the appearance of DOMS after training or matches, so it requires more specific emphasis on giving massage to the area that feels very painful [26]. This situation shows that handling the emergence of DOMS can be done after training so that the next training program or match can be done with the return of fitness and strength of the hamstring muscles. Some studies have combined several techniques to be able to provide treatment for DOMS such as warm up, stretching and massage, warm underwater, water jet massage and ice massage [27], [28]. But some also only use one technique in dealing with DOMS, such as massage and stretching, massage and electric stimulation, pre exercise warm up with stretching and post exercise with massage [29], [30]. Pain and damage to the muscles can occur due to continuous or continuous exercise.

One of the therapies that can be done to reduce pain in DOMS is by doing massage [31]. Masase therapy is one way for athletes to help speed up recovery after training or competition [32]. Various kinds of masase therapy offered include shiatsu, tsubo, acupuncture, sport masase, deep tissue masase, frirage and many others [33]. Each of the masase techniques above has different manipulation techniques, especially in masase frirage. There are four ways of manipuasi masase frirage, namely a combination of efflurage and friction techniques performed simultaneously using the thumb for massaging, traction, and repositioning which aims to reduce muscle tension and injury recovery [34]. Massage therapy has been widely used to alleviate DOMS-related pain and accelerate recovery. Among various massage techniques, effleurage a gentle stroking method—has shown promise in reducing muscle tension and improving circulation. The effleurage technique involves rubbing the skin without moving the underlying muscles [35]. However, in this study, the effleurage technique will be performed using ten open fingers to perform the massage. The existence of massage effleurage techniques is very important to provide treatment to DOMS. In addition, the emergence of assistance techniques in massage, namely by giving ice packs or without ice packs is expected to reduce pain by lowering blood flow tissue by causing vasoconstriction and reducing tissue metabolism [36]. This situation shows that ice will help in reducing pain and facilitate handling of DOMS. Then, with the reduction of pain, it is expected to improve the function of limb movement.

Limb function is very crucial for young athletes, especially in football [37], [38], [39]. After doing the exercise, many individuals experience DOMS and fatigue, so they need immediate treatment in order to participate in the next training session [40], [41], [42]. In addition, there are some people who are absent from the next training session due to pain and still have muscle problems or injuries after doing the exercise [43]. This situation indicates that the subject has not received adequate post-exercise interference treatment, so that the student's attendance in practice sessions becomes inconsistent. Therefore, this study aims to investigate the effectiveness of the application of effleurage massage in young athletes who regularly practice soccer by comparing the effect of effleurage massage using ice and without ice on pain and motion function in limbs experiencing DOMS.

2. Materials and methods

Research Design

This study employed a quantitative approach with a comparative pseudo-experimental method using a within-subjects Two-Group Pretest-Posttest Design. The research design involved two treatment conditions applied to different limbs of the same subjects to control individual variability. One limb received effleurage massage without ice (effleurage-only group), and the other received effleurage massage combined with ice application (effleurage-with-ice group).The research process was carried out in four stages including, training treatment to achieve DOMS which was then continued with pretest, treatment, and posttest. To induce DOMS, subjects performed a standardized plyometric exercise protocol known to trigger muscle soreness, particularly in the lower extremities. The protocol consisted of 5 sets of 15 squat jumps with 1-minute rest between sets. Each subject was instructed to perform the jumps with full effort and proper form, ensuring eccentric loading of the quadriceps and gluteal muscles. This protocol has been previously validated in similar studies to reliably induce DOMS within 24–48 hours post-exercise. For more details, you can see figure 1 below:

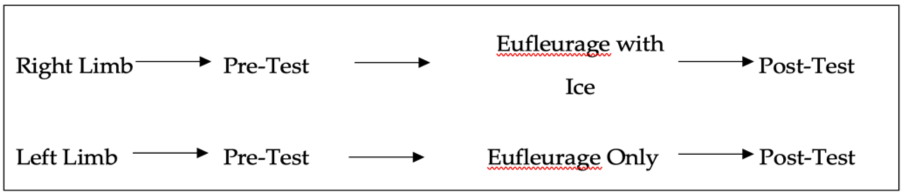

Figure 1. Two Group Pretest-Posttest Design

Subjects of study

The study population comprised 25 male students enrolled in the Seyegan United Football School, aged 15–18 years. Based on an assumed effect size of 0.5, power of 80%, and a significance level of 0.05 (one-tailed test), a minimum of 15 subjects was determined using G*Power software. The sampling technique used was purposive sampling, with inclusion criteria being: 1) Students enrolled in Seyegan United Soccer Club, 2) Gender: Male, 3) Age 15 – 18 years, 4) Active Training and experiencing DOMS. Exclusion criteria: 1) not being sick, 2) not being injured, 3) not having a history of heart disease.

Treatment Procedure

The massage treatment used the effleurage technique, a light to moderate pressure massage applied longitudinally along the muscle fibers. The massage was performed by a licensed physiotherapist who had received training to standardize both the rhythm and pressure of the strokes. Each session lasted 10 minutes per limb, with strokes performed at a consistent pace of 20 strokes per minute using a pressure of approximately 2–3 kg, measured using a palpation pressure guide in pre-study training. The ice application was administered using a commercial gel ice pack stored at approximately 5°C, wrapped in a thin towel to prevent frostbite. Ice was applied for 10 minutes immediately after the massage on the designated limb in the effleurage-with-ice group. The other limb, serving as the effleurage-only group, received the same massage protocol without the ice application.

Research Instruments

Tests and measurements including pain assessment are performed using the VAS pain scale (Visual Anale Scale). The instrument used in taking pain scales is the Visual Analogue Scale (VAS) with a range of numbers 0-100. The VAS used is application-based on the device. Before the measurements began, the study subjects were asked to sit comfortably and then the authors applied finger presses on the muscles to be measured [44]. Furthermore, the study subjects were asked to determine pain by sliding up the red line button on the screen according to the perception of pain felt and ending by pressing the finish button to find out the pain level scale. The lower extremity functional scale (LEFS) is a valid measure of patient assessment results for lower extremity function measurements. It was first developed by Bleakley et al (2004) in a group of patients with various musculoskeletal conditions. The scale was originally developed in English and according to western culture. This instrument has a reliability of 0.75 and validity of 0.82.

Table 1. Limb Motion Function Scale

Activity	Very Difficult	Difficulty	Moderate Difficulty	A little difficulty	No Difficulty
Walk between rooms for 20 meters	0	1	2	3	4
Squat	0	1	2	3	4
Go up and down 3 steps	0	1	2	3	4
Jump 4 times	0	1	2	3	4
Get up from sitting in a chair	0	1	2	3	4

Analyzes Data

The normality test is used to test the normality of the distribution of the experimental group and the control group. The normality test used is the Shapiro Wilk test. Test the difference in pairs using the Paired sample t-Test. Paired sample tests were carried out between pretest and posttest each treatment and between the difference in pretest and posttest data between the two treatment groups.

3. Results

Normality Test

The normality test in this study used the Shapiro Wilk test. It can be seen that all data are normally distributed (p-value > 0.05), as in table 2. On the results of this calculation, it can then be continued with parametric statistical calculations to determine the impact of treatment comparisons.

Table 2. Test normality

Difference between Post-test and Pre-test	Sig.	Information
Function - Massage efleurage with ice	0,830	
Function - Massage efleurage	0,052	Normal
Pain - Massage efleurage with ice	0,122	
Pain - Massage efleurage	0,062	

Differential Test

The calculation of the difference test in this study used paired t-test by comparing the function of motion using and without ice, pain with and without ice, and limb function and pain in both feet. The majority of treatments experienced very significant changes (p-value > 0.01), both using massase and ice treatment, as well as masase without ice, while pain between the two limbs decreased significantly (p-value > 0.05). There is no treatment with masase that does not experience significant changes, so the treatment of masase after training or matches is considered capable of accelerating the recovery period.

Table 3. Paired t-test

Variabel	Pretest	Posttest	Mean Different	p-value	Information
Function - Massage efleurage with ice	10.2 ± 1.5	15.8 ± 1.6	5.6	< 0.001	Sig.
Function - Massage efleurage	9.9 ± 1.7	14.3 ± 1.9	4.4	< 0.001	
Pain - Massage efleurage with ice	6.8 ± 1.2	3.9 ± 1.1	-2.9	< 0.001	
Pain - Massage efleurage	6.5 ± 1.4	4.7 ± 1.3	-1.8	< 0.001	
Functions between the two limbs	11.5 ± 2.1	12.7 ± 2.0	1.2	< 0.001	
Pain between the two limbs	5.2 ± 1.5	4.2 ± 1.4	-1.0	0.040	

4. Discussion

This study found that both effleurage massage with and without ice significantly reduced pain and improved limb function in athletes with DOMS. However, the combination of effleurage and ice showed greater effectiveness. These results indicate that adding ice enhances the benefits of massage, supporting its use as a recovery strategy after intense physical activity. The acute effects of effleurage massage with ice and without ice on pain and functional movement in cases of DOMS in the limbs show a significant difference in limbs function between treatments. Specifically, there is a significant difference in pain levels between effleurage massage with ice and without ice. These results indicate that the pretest and posttest outcomes demonstrate better results with the use of effleurage massage with ice compared to without ice. This difference occurs because respondents are more stimulated by the addition of ice. The application of ice is able to reduce pain, making respondents more comfortable in movement [46], [47]. In contrast, the effleurage massage without ice still leaves the sensation of pressure on the limbs, resulting in more noticeable pain compared to massage with ice. The study results show that respondents experienced changes in function and pain scale after experiencing DOMS in the limbs. Treatment using two different methods for DOMS in the limbs yielded significant results. This indicates that both massage methods contributed effectively to reducing pain levels and improving limb function. Improvement in function was also more pronounced in the treatment group (p=0.004). The final results showed that deep tissue massage could reduce DOMS pain and improve limb function more effectively than without deep tissue massage. These findings suggest that administering treatment or stimulation in cases of DOMS can better alleviate pain and improve functional movement compared to using only standard effleurage massage.

Conversely, for limbs treated with effleurage massage without ice, 80% of respondents initially experienced moderate pain, 13.33% experienced severe pain, and 6.67% experienced mild pain [51]. After the massage without ice, the proportion of respondents with moderate pain decreased to 60%, while those with mild pain increased to 33.33% [52], [53]. This demonstrates that both methods effectively reduce limb pain following DOMS. However, the comparison indicates that effleurage massage with ice provides better pain reduction results compared to without ice. However, the difference between the two methods indicates that effleurage massage with ice provides a better contribution compared to effleurage massage without ice. Pain and muscle damage resulting from continuous or repetitive exercise decrease after massage treatment. This consideration includes the recovery time from DOMS, which is an unusual condition that exceeds normal limits and can disrupt bodily function. Symptoms can emerge within 24 to 42 hours post-exercise and may dissipate after 5 to 7 days. The long recovery period of 5 to 7 days poses significant challenges for athletes in resuming physical activities and training [54], [55]. The difference between the two methods demonstrates a better contribution of effleurage massage with ice compared to without ice. Different treatments will yield different results. The application of ice massage can induce changes in the skin, subcutaneous tissue, intramuscular tissue, and joint temperature [56], [57].

The changes that occur in the limbs after effleurage massage with ice can significantly affect and stimulate the skin, subcutaneous tissue, intramuscular tissue, and joints. This indicates that using ice therapy is highly effective in helping to reduce pain in the limbs after DOMS. Besides providing significant contributions, ice therapy can also provide comfort to subjects experiencing DOMS, allowing them to resume training effectively. Therefore, the application of effleurage massage therapy becomes one of the ways for athletes to accelerate recovery after exercise or competition with minimal risk of side effects.

This study has several limitations. First, the number of students in this study is relatively limited which may pose a risk of positive findings. positive findings. Second, the participants of this study were male only. Additional studies should aim to address this. In addition, severe muscle soreness at the time of exercise has not been investigated in this study. Therefore, further studies should investigate changes in muscle activity using electromyography.

5. Conclusions

There is a significant reduction in pain and improvement in limb function both in effleurage massage with ice and in effleurage massage without ice. However, the reduction in pain and improvement in functional movement are more pronounced in effleurage massage with ice compared to effleurage massage without ice. Understanding the acute effects of effleurage massage with and without ice on pain in cases of DOMS in the limbs, this study's findings can contribute to the knowledge of alleviating pain and enhancing limb function after experiencing DOMS.

Author Contributions: Conceptualization, M.A.B. and M.I.S.; methodology, M.I.S.; software, D.E.W.S. and Y.O.; validation, M.I.S. and M.A.B.; formal analysis, D.E.W.S.; investigation, Y.O.; resources, M.A.B.; data curation, Y.O.; writing—original draft preparation, M.I.S.; writing—review and editing, M.I.S. and D.E.W.S.; visualization, Y.F.P.A.; supervision, M.A.B.; project administration, M.A.B.; funding acquisition, M.A.B. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest: The authors declare no conflict of interest

References

1. Khairuddin, Alnedral, A. Komaini, Syharastani, and Masrun, "Effect of learning approach and motor skills on physical fitness," J. Phys. Educ. Sport, vol. 22, no. 9, pp. 2273–2280, 2022, doi: 10.7752/jpes.2022.09289.
2. E. Sepdanius, S. K. Harefa, P. M. Indika, H. Effendi, M. S. Rifki, and R. Afriani, "Relationship between Physical Activity, Stress and Sleep Quality and Emotional Intelligence," Int. J. Hum. Mov. Sport. Sci., vol. 11, no. 1, pp. 224–232, 2023, doi: 10.13189/saj.2023.110126.

3. B. Apriyano, Z. A. Zainuddin, and A. H. M. Hashim, “Physical Activity Module in Health Sports Physical Education Learning on Physical Fitness and Health,” Int. J. Hum. Mov. Sport. Sci., vol. 10, no. 4, pp. 716–722, 2022, doi: 10.13189/saj.2022.100412.
4. P. Polero et al., “Physical activity recommendations during COVID-19: Narrative review,” Int. J. Environ. Res. Public Health, vol. 18, no. 1, pp. 1–24, 2021, doi: 10.3390/ijerph18010065.
5. P. D. Hoang, S. Lord, S. Gandevia, and J. Menant, “Exercise and Sports Science Australia (ESSA) position statement on exercise for people with mild to moderate multiple sclerosis,” J. Sci. Med. Sport, vol. 25, no. 2, pp. 146–154, 2022, doi: 10.1016/j.jsams.2021.08.015.
6. E. F. P. Delgado, J. Villafuerte-Holguín, and J. L. Vélez, “Physical activity and motivation for learning English as a foreign language in young children in Ecuador,” Retos, vol. 45, no. February, pp. 988–998, 2022, doi: 10.47197/retos.v44i0.90137.
7. E. Alarcón Meza and J. Hall-López, “Actividad física en estudiantes deportistas universitarios, previo y en el confinamiento por pandemia asociada al COVID-19,” Retos, vol. 39, pp. 572–575, 2020.
8. J. Piñeiro-Cossio, R. Pérez-Ordás, G. Bermejo-Martínez, M. Alcaráz-Iborra, and A. Nuviala, “Development and validation of a scale to assess Psychological Well-being in physical activity and sports: the PWBPA scale Desarrollo y validación de una escala para evaluar Bienestar Psicológico en Actividad física y deporte: la escala PWBPA,” Retos, vol. 49, pp. 401–407, 2023.
9. M. S. Rifki, Ilham, J. Ndayisenga, and J. Bin Zakaria, “The effect of combined continuous run, circuit training, and high-intensity interval training on lung function, asthma control, and VO2max in asthma patients: A quasi-experimental study,” J. Phys. Educ. Sport, vol. 23, no. 12, pp. 3264–3270, 2023, doi: 10.7752/jpes.2023.12373.
10. N. W. Kusnanik, N. Ayubi, L. Herawati, T. Jatmiko, A. Muin, and S. P. Bird, “Curcumin reduce creatine kinase (CK) levels without decreasing malondialdehyde (MDA) levels after 24 hours of high-intensity physical exercise,” Retos, vol. 48, pp. 878–882, 2023.
11. L. Baraldo et al., “The correlation between low back pain and strength training in elite athletes: a literature review,” Retos, vol. 48, pp. 727–731, 2023.
12. Liza, Bafirman, Masrun, M. S. Rifki, Ilham, and D. P. Sari, “Effectiveness of manipulative massage therapy in pain reduction, enhancing range of motion, and improving shoulder function: A study in injury rehabilitation,” J. Phys. Educ. Sport, vol. 23, no. 12, pp. 3205–3211, 2023, doi: 10.7752/jpes.2023.12366.
13. K. Anam et al., “Functional movement screen score to predict injury risk of sports students: a review of foot shape and body mass index,” Pedagog. Phys. Cult. Sport., vol. 28, no. 2, pp. 116–123, 2024, doi: 10.15561/26649837.2024.0206.
14. B. Sonkodi, “Delayed onset muscle soreness (Doms): The repeated bout effect and chemotherapy-induced axonopathy may help explain the dying-back mechanism in amyotrophic lateral sclerosis and other neurodegenerative diseases,” Brain Sci., vol. 11, no. 1, pp. 1–18, 2021, doi: 10.3390/brainsci11010108.
15. R. Furrer, J. A. Hawley, and C. Handschin, “Themolecular athlete: Exercise physiology frommechanisms to medals,” Physiol. Rev., vol. 103, no. 3, pp. 1693–1787, 2023, doi: 10.1152/physrev.00017.2022.
16. C. A. Liakou et al., “Recovery kinetics following sprint training: resisted versus unresisted sprints,” Eur. J. Appl. Physiol., vol. 124, no. 3, pp. 881–896, 2024, doi: 10.1007/s00421-023-05317-x.
17. I. Markus, K. Constantini, J. R. Hoffman, S. Bartolomei, and Y. Gepner, “Exercise-induced muscle damage: mechanism, assessment and nutritional factors to accelerate recovery,” Eur. J. Appl. Physiol., vol. 121, no. 4, pp. 969–992, 2021, doi: 10.1007/s00421-020-04566-4.
18. Z. Qian, L. Ping, and Z. Xuelin, “Re-examining the mechanism of eccentric exercise-induced skeletal muscle damage from the role of the third filament, titin (Review),” Biomed. Reports, vol. 20, no. 1, 2024, doi: 10.3892/br.2023.1703.
19. E. Hohenauer, G. Bianchi, V. Wellauer, W. Taube, and R. Clijsen, “Acute physiological responses and muscle recovery in females: a randomised controlled trial of muscle damaging exercise in hypoxia,” BMC Sports Sci. Med. Rehabil., vol. 16, no. 1, pp. 1–13, 2024, doi: 10.1186/s13102-024-00861-1.
20. T. Gönen, S. Usgu, Y. Yakut, and S. Akbayram, “Evaluation of the Viscoelastic Properties of Lower-Extremity Muscles of Pediatric Hemophilia Patients Using Myotonometric Measurements,” Children, vol. 11, no. 2, 2024, doi: 10.3390/children11020229.
21. P. Cormier et al., “Within Session Exercise Sequencing During Programming for Complex Training: Historical Perspectives, Terminology, and Training Considerations,” Sport. Med., no. October, 2022, doi: 10.1007/s40279-022-01715-x.
22. L. M. Koon, J. P. Hall, K. A. Arnold, J. E. Donnelly, and K. M. Heinrich, “High-Intensity Functional Training: Perceived Functional and Psychosocial Health-Related Outcomes from Current Participants with Mobility-Related Disabilities,” Sports, vol. 11, no. 6, pp. 1–20, 2023, doi: 10.3390/sports11060116.
23. M. Paoletta et al., “Ultrasound imaging in sport-related muscle injuries: Pitfalls and opportunities,” Med., vol. 57, no. 10, pp. 1–15, 2021, doi: 10.3390/medicina57101040.
24. B. Wolska et al., “Multiple cryosauna sessions for post-exercise recovery of delayed onset muscle soreness (DOMS): a randomized control trial,” Front. Physiol., vol. 14, no. September, pp. 1–10, 2023, doi: 10.3389/fphys.2023.1253140.

25. B. Amirshakeri, A. Soltani-someh, and M. Ahmadi-kahjoogh, “The Effect of the Lower Leg Sensory Feedback on Force Sense of the Knee Extensor Muscles in Healthy Young Men : A Cross-Sectional Study,” J. Res. Rehabil. Sci., vol. 16, no. November, pp. 287–294, 2020, doi: 10.22122/jrrs.v16i.3631.
26. M. K. Marwat, M. Shah, M. Arshad, M. S. Yousaf, S. Saman, and K. Mehmood, “Benefits of Massage Therapy in Recovery and Sports Performance (A Review of Qualitative Literature),” Research, vol. 9, no. 1, pp. 98–114, 2024.
27. J. G. Adamczyk, “Support Your Recovery Needs (SYRN) - a systemic approach to improve sport performance,” Biomed. Hum. Kinet., vol. 15, no. 1, pp. 269–279, 2023, doi: 10.2478/bhk-2023-0033.
28. M. Dakić, L. Toskić, V. Ilić, S. Đurić, M. Dopsaj, and J. Šimenko, “The Effects of Massage Therapy on Sport and Exercise Performance: A Systematic Review,” Sports, vol. 11, no. 6, 2023, doi: 10.3390/sports11060110.
29. S. Wiecha, P. Posadzki, R. Prill, and M. Płaszewski, “Physical Therapies for Delayed Onset Muscle Soreness: A Protocol for an Umbrella and Mapping Systematic Review with Meta-Meta-Analysis,” J. Clin. Med., vol. 13, no. 7, pp. 1–11, 2024, doi: 10.3390/jcm13072006.
30. R. M. Ferreira et al., “The Effects of Massage Guns on Performance and Recovery: A Systematic Review,” J. Funct. Morphol. Kinesiol., vol. 8, no. 3, pp. 1–20, 2023, doi: 10.3390/jfmk8030138.
31. P. Angelopoulos et al., “Cold-Water Immersion and Sports Massage Can Improve Pain Sensation but Not Functionality in Athletes with Delayed Onset Muscle Soreness,” Healthc., vol. 10, no. 12, 2022, doi: 10.3390/healthcare10122449.
32. F. R. Kafrawi et al., “Massage Has the Potential to Accelerate Recovery and Decrease Muscle Soreness after Physical Exercise (Literature Review),” Int. J. Hum. Mov. Sport. Sci., vol. 11, no. 1, pp. 170–175, 2023, doi: 10.13189/saj.2023.110120.
33. K. Anam, L. Evitamala, and D. Rizwandi, “PKMS Karang Taruna in Creating a Creative Economy through Training of Sport Therapist and Fitness Trainer in Mandalika Area,” Asian J. Community Serv., vol. 1, no. 2, pp. 75–82, 2022, doi: 10.55927/ajcs.v1i2.1029.
34. F. Putra, P. Sumaryanti, and E. Susanto, “Effect of Combined Therapy Manipulation on Upper Extremity Injury,” Heal. Educ. Heal. Promot., vol. 10, no. 4, pp. 747–752, 2022.
35. A. Hassan Ahmed, N. Ismail Abdel Aziz Ismail, and N. Mohamed Mahmoud Hassan, “Effect of effleurage massage versus water immersion with exercise on physiological foot edema among primigravidae,” Egypt. J. Heal. Care, vol. 12, no. 2, pp. 345–356, 2021, doi: 10.21608/ejhc.2021.159852.
36. M. N. H. Kusuma, Komarudin, T. Suhartoyo, A. D. Listiandi, D. Nugroho, and B. N. Putro, “Effect of cold water and contrast immersion on physiological and psychological responses of elite athletes after high-intensity exercises,” J. Phys. Educ. Sport, vol. 21, no. 6, pp. 3278–3287, 2021, doi: 10.7752/jpes.2021.s6446.
37. B. Wilczyński, Ł. Radzimiński, A. Sobierajska-Rek, K. de Tillier, J. Bracha, and K. Zorena, “Biological Maturation Predicts Dynamic Balance and Lower Limb Power in Young Football Players,” Biology (Basel)., vol. 11, no. 8, 2022, doi: 10.3390/biology11081167.
38. V. Nikolaienko, M. Vorobiov, T. Chopilko, I. Khimich, and V. Parakhonko, “Aspects of increasing efficiency of young football players physical training process,” Sport Mont, vol. 19, pp. 3–9, 2021, doi: 10.26773/smj.210909.
39. J. Baron, A. Bieniec, A. S. Swinarew, T. Gabryś, and A. Stanula, “Effect of 12-week functional training intervention on the speed of young footballers,” Int. J. Environ. Res. Public Health, vol. 17, no. 1, 2020, doi: 10.3390/ijerph17010160.
40. F. De Oliveira et al., “Effects of Different Recovery Modalities on Delayed Onset Muscle Soreness, Recovery Perceptions, and Performance Following a Bout of High-Intensity Functional Training,” Int. J. Environ. Res. Public Health, vol. 20, no. 4, pp. 1–12, 2023, doi: 10.3390/ijerph20043461.
41. J. I. Priego-Quesada, C. De la Fuente, M. R. Kunzler, P. Perez-Soriano, D. Hervás-Marín, and F. P. Carpes, “Relationship between skin temperature, electrical manifestations of muscle fatigue, and exercise-induced delayed onset muscle soreness for dynamic contractions: A preliminary study,” Int. J. Environ. Res. Public Health, vol. 17, no. 18, pp. 1–13, 2020, doi: 10.3390/ijerph17186817.
42. M. García-Sillero, J. Benítez-Porres, J. García-Romero, D. A. Bonilla, J. L. Petro, and S. Vargas-Molina, “Comparison of interventional strategies to improve recovery after eccentric exercise-induced muscle fatigue,” Int. J. Environ. Res. Public Health, vol. 18, no. 2, pp. 1–11, 2021, doi: 10.3390/ijerph18020647.
43. V. Karabinov and G. P. Georgiev, “Lateral epicondylitis: New trends and challenges in treatment,” World J. Orthop., vol. 13, no. 4, pp. 354–364, 2022, doi: 10.5312/wjo.v13.i4.354.
44. A. M. Castro-Sánchez et al., “Comparing an e-Health program vs home rehabilitation program in patients with non-specific low back pain: A study protocol randomized feasibility trial,” J. Back Musculoskelet. Rehabil., vol. 35, no. 2, pp. 239–252, 2022, doi: 10.3233/BMR-210040.
45. C. Bleakley, S. McDonough, and D. MacAuley, “The Use of Ice in the Treatment of Acute Soft-Tissue Injury: A Systematic Review of Randomized Controlled Trials,” Am. J. Sports Med., vol. 32, no. 1, pp. 251–261, 2004, doi: 10.1177/0363546503260757.
46. Y. E. Pujiastutik, P. R. Gayatri, and E. Isnaeni, “Comparison Of Endorphine Massage And Effleurage Massage On Primigravida 1st Stage Latent Phase Pain In Indonesia,” Malaysian J. Public Heal. Med., vol. 21, no. 2, pp. 45–51, 2021, doi: 10.37268/mjphm/vol.21/no.2/art.713.

47. M. Ulfa and L. P. Monica, “The Effectiveness of Giving Cold Compress in Pain Reduction Intensity of Perineal Wound of Postpartum Mother,” J. Ners dan Kebidanan (Journal Ners Midwifery), vol. 7, no. 3, pp. 398–403, 2020, doi: 10.26699/jnk.v7i3.art.p398-403.
48. J. Dommerholt, J. N. Thorp, L. W. Chou, and T. Hooks, “A critical overview of the current myofascial pain literature – January 2020,” J. Bodyw. Mov. Ther., vol. 24, no. 2, pp. 213–224, 2020, doi: 10.1016/j.jbmt.2020.04.001.
49. K. Cheung, P. A. Hume, and L. Maxwell, “Delayed Onset Muscle Soreness Treatment Strategies and Performance Factors,” Sport. Med., vol. 33, no. 2, pp. 145–164, 2003.
50. A. Purwandari, S. O. Tuju, S. Tombokan, M. Korompis, F. Nancy Losu, and P. Kesehatan Kementerian Kesehatan Manado, “Effleurage Massage by Husband on the Level of Pain in Maternal When the 1 Phase is Active,” J. Posit. Sch. Psychol., vol. 2022, no. 5, pp. 5527–5540, 2022.
51. N. Youssef Abd-Ella, “Effect of Effleurage Massage on Labor Pain Intensity in Parturient Women,” Egypt. J. Heal. Care, vol. 9, no. 2, pp. 331–341, 2018, doi: 10.21608/ejhc.2018.161901.
52. S. Idris, “The Effect of Guide Imagery Relaxation Techniques on Anxiety Levels of Pre-Op Vitrectomy Patients at Smec Eye Specialist Hospital Medan in 2021,” Sci. Midwifery, vol. 10, no. 3, pp. 2303–2312, 2022, doi: 10.35335/midwifery.v10i3.647.
53. F. Ma et al., “Effects of Photobiomodulation and Low-Intensity Stretching on Delayed-Onset Muscle Soreness: A Randomized Control Trial,” Photobiomodulation, Photomedicine, Laser Surg., vol. 40, no. 12, pp. 810–817, 2022, doi: 10.1089/photob.2022.0055.
54. L. Boyd, G. B. Deakin, B. Devantier-Thomas, U. Singh, and K. Doma, “The Effects of Pre-conditioning on Exercise-Induced Muscle Damage: A Systematic Review and Meta-analysis,” Sport. Med., vol. 53, no. 8, pp. 1537–1557, 2023, doi: 10.1007/s40279-023-01839-8.
55. J. K. Davis et al., “In-Season Nutrition Strategies and Recovery Modalities to Enhance Recovery for Basketball Players: A Narrative Review,” Sport. Med., vol. 52, no. 5, pp. 971–993, 2022, doi: 10.1007/s40279-021-01606-7.
56. Z. R. Wang and G. X. Ni, “Is it Time to put Traditional Cold Therapy in Rehabilitation of Soft-tissue Injuries out to Pasture?,” World J. Clin. Cases, vol. 9, no. 17, pp. 4116–4122, 2021, doi: 10.12998/wjcc.v9.i17.4116.
57. A. Radecka, W. Pluta, and A. Lubkowska, “Assessment of the dynamics of temperature changes in the knee joint area in response to selected cooling agents in thermographic tests,” Int. J. Environ. Res. Public Health, vol. 18, no. 10, 2021, doi: 10.3390/ijerph1810532.