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The Effect of Ice Massage and Passive Stretching on the DOMS of the Gastrocnemius Muscle

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Abstract

Delayed onset muscle soreness (DOMS) is a disorder in the form of muscle soreness that occurs as a result of unusual exercise caused by an inflammatory response. DOMS is often experienced by all individuals who do too much physical activity after a long period of inactivity. DOMS can be experienced by anyone who does non-routine sports activities. This study aims to find out about the effect of ice massage and passive stretching on the DOMS of the gatrocnemius muscle. The sample used in this study was 100, which consisted of UTP Surakarta students obtained by purposive random sampling technique. Statistical analysis was carried out on the initial results of DOMS after training and the final results of DOMS after being given ice massage and passive stretching treatment to male and female students. The results of statistical analysis were carried out using the SPSS version 25 program. There is a significant difference in the effect of ice massage and passive stretching on decreasing DOMS in the Gastrocnemius muscles. This is evidenced by the Significance value of $0.036 < 0.05$ ($p < 0.05$). So it can be concluded that giving ice massage has a decrease in DOMS which is different from giving passive stretching which can be accepted.

Keywords : Ice Massage, Passive Stretching, DOMS, Gastrocnemius Muscle

INTRODUCTION

A person is required to always work to fulfill his life's needs, sometimes a person forgets about health and fitness when he has done work (Falaahudin et al., 2020). Doing work that exceeds the body's ability will have a direct or indirect impact on fitness and healthy body condition (Wibowo et al., 2019). Physical work that is done excessively can make the body tired, often exceeding one's abilities or excessive so that it will affect one's physical and physical health (Wibowo et al., 2020). A person's ability to be able to perform physical activities well depends on the condition of a person's physical fitness (Iwandana et al., 2021). Efforts to be able to maintain body fitness is to exercise. Sport is a series of regular and planned movements to maintain movement and improve movement abilities. Sport aims to stimulate physical, spiritual and social growth and development.

Athletes or athletes are people who are trained in strength, agility and speed to be included in competitions. They do exercises to gain body strength, endurance, speed, agility, balance, flexibility and strength in preparing themselves long before the competition starts (Purwanto et al., 2022). Becoming an athlete requires hard work from start to finish, such as preparation for tough training, preparing their physical and body conditions, as well as preparing mentally. As athletes, let alone professionals, they will undergo high-intensity training routines and tight match schedules so that they often experience overuse syndrome, which is an injury characterized by a collection of various symptoms due to excessive use of body structures. Thus athletes, although in general have better health and fitness than the average person, they are actually more vulnerable to an injury that can affect movement activities.

Delayed Onset Muscle Soreness or what is commonly called DOMS occurs more in sports that do a lot of the same movements at high intensity and with explosive movements, for example in swimming, soccer, basketball, badminton and so on. For the leg muscles, the ones that often experience DOMS are the gastrocnemius muscle, the tibialis anterior muscle, the hamstring muscles and the quadriceps muscles (Annafi & Mukarromah, 2022). These muscles are indeed muscles that continuously perform eccentric contractions with high intensity. With DOMS, athletes will experience pain, limited movement, muscle tension, decreased proprioception, decreased strength and also increase the risk of injury.

The location of the muscle experiencing DOMS, Mirawati et al.(2018), stated that the muscles most susceptible to DOMS were the Quadriceps Femoris, Adductor Longus, Tibialis Anterior and Gastrocnemius muscles. This is related to the role and function of these muscles, namely as a support for the body during activities and as a leg mover, especially in movements that require strength, speed and explosive power. From the dominance of the type of contraction, the dominant Gastrocnemius muscle moves using the eccentric type of contraction which increases the risk of experiencing DOMS (Hall, 2016).

Delayed Onset Muscle Soreness (DOMS) is always associated with unusual circumstances, muscle overwork and eccentric contractions can trigger DOMS (Lesmana, 2019). Eccentric muscle contractions can be seen from the presence of muscle extension during muscle contraction. The mechanism of DOMS can be related to the stimulation of pain caused by the formation of lactic acid, muscle stiffness, damage to connective tissue, muscle damage, inflammation, and others. Symptoms that can appear within 24-42 hours after exercise and can disappear after 5-7 days (Veqar, 2013; Murray & Cardinale, 2015). DOMS is a symptom that arises due to a higher level of physical activity so that a DOMS effect will appear after that activity. However, DOMS can heal on its own without treatment for a longer period of time, namely 5-7 days after the appearance of the DOMS.

The pain that is felt in DOMS lasts for 48-72 hours after doing the exercise. The pain that is felt when experiencing DOMS is mild to moderate, not to severe pain. DOMS can heal on its own, but it takes a long time. The time it takes for DOMS to heal can interfere with training programs, daily activities, and even when DOMS matches can occur. DOMS that is experienced is rarely felt because DOMS is the result of training that has not been carried out for a long time. DOMS can disappear immediately also assisted by the body with adaptations made by the body that is used to the movement or exercise being performed. The location where DOMS occurs can be triggered by the dominant part of the body used in a sport. The more it is used the greater the risk of getting DOMS. Signs and symptoms are felt such as muscle stiffness, bruising, swelling, and decreased range of motion of the joints (Prihantoro & Ambardini, 2019).

One of the problems after exercise in individuals who lack physical activity that can occur is delayed onset muscle soreness (DOMS). DOMS can occur when you first do high-intensity sports and there is excessive muscle work. Symptoms of DOMS often occur in people who are not used to sports, especially sports that require extra muscle contractions. DOMS is always associated with unusual circumstances, excessive muscle work and eccentric contractions that can trigger DOMS (Wang et al., 2015). Symptoms that can appear within 24-42 hours after exercise and can disappear after 5-7 days. Muscle damage in eccentric activity causes stiffness, decreased strength, decreased range of motion (ROM), decreased endurance, pain and inflammation around the myotendon junction (Amriyana, 2018).

Based on the facts that occurred in the field with the presence of several problems that arise in the athlete's organs after the match, a series of massage techniques was developed, namely the technique of effleurage, pressure and then tapotement. These three techniques have never been done to reduce the DOMS effect. The effleurage technique is a technique by rubbing the skin without internal muscle movement, but the effleurage technique in this study will be carried out using the ten fingers of the open hand for massage. The second technique is the pressure technique, namely hand movements carried out with the muscle pressure technique from the deep tissue. Pressure techniques can be done with one hand or both hands with wavy, rhythmic, uninterrupted movements and tied to one another. The movement is repeated several times in the same place, then the hand is moved little by little along the muscle bundle. The third technique, tapotement clapping, is a technique that is done with the hands which involves wrists and fingers that are relaxed and moved quickly alternately right-left.

Ice massage is a therapeutic technique that is useful for avoiding inflammation of the ligaments, tendons and muscles and preventing tissue damage. All members of the body can be given this therapy. In addition, giving ice massage is good for healing or reducing pain that is due to swelling or muscle strain after an injury. Ease of application at any time and one of the efforts to deal with acute injuries based on the severity of the injury is the goal of implementing ice massage therapy. Meanwhile, patient comfort can still be obtained in administering this therapy because its application is very simple.

The application of ice massage after an injury can provide a cold sensation from ice which is useful in reducing the risk of swelling and inflammatory processes in the connective tissue. Muscle tissue will experience a sedative effect due to the relaxing effect of ice massage therapy. The process of giving ice massage when metabolism decreases can make blood flow return to bring nutrients and can speed up the healing process. Handling using ice massage is seen from the process of trauma or injury to soft tissue. Application using ice massage can provide changes in the skin, subcutaneous tissue, intramuscular and temperature in the joints. Decreased temperature in soft tissues can stimulate receptors to release sympathetic adrenergic fibers due to local vessel constriction in arteries and veins. This shows a decrease in edema and reduces the occurrence of metabolic processes by decreasing the inflammatory reaction, circulatory permeability and swelling. This shows that cryotherapy (ice) can facilitate the recovery of muscle soreness (Amriyana, 2018).

The mechanism of DOMS can be related to the stimulation of pain caused by the formation of lactic acid, muscle stiffness, damage to connective tissue, muscle damage, inflammation, and others. Various theories about DOMS show that DOMS is lactic acid accumulation, muscle spasms, connective tissue damage, mechanical muscle damage, cellular inflammation and enzymes (Muttaqien et al., 2020).

METHODS

The type of research used is the experimental method with a 2 x 2 factorial design. The experimental method was chosen to determine certain symptoms through the treatments applied to the experimental sample. In a factorial design, two or more variables are manipulated simultaneously to determine the effect of each on the dependent variable, besides the effects caused by interactions between variables. The form of the factorial design of the study can be described in the table matrix as follows**:**

Table 1. Research Design Framework

Treatment	*Ice Massage*	*Passive Strethching*
Sample	A1	A2
Male Student B (1)	A_1B_1	A_2B_1
Female Student B (2)	A_1B_2	A_2B_2

Information :

A_1B_1 : Student Group with Ice Massage Against DOMS Decreasing

A_1B_2 : Student Group with Ice Massage Against DOMS Reduction

A_2B_1 : Student Groups with Passive Stretching Against DOMS Decreasing

A_2B_2 : Student Group with Passive Stretching Against DOMS Decreasing

The sample used in this study was 100, which consisted of UTP Surakarta students obtained by purposive random sampling technique. Statistical analysis was carried out on the initial results of DOMS after training and the final results of DOMS after being given ice massage and passive stretching treatment to male and female students. The results of statistical analysis were carried out using the SPSS version 25 program.

RESULT

Presentation of research results is based on statistical analysis performed on the initial results of DOMS after training and the final results of DOMS after being given ice massage and passive stretching treatment to male and female students. Following is the presentation of the analysis regarding data description, analysis requirements test, hypothesis testing and discussion of research results. The results of statistical analysis were carried out using the SPSS version 25 program.

1. Data Description

The results of DOMS on male and female students after training in each treatment group calculated the average value obtained, then statistically analyzed using SPSS version 21. The data from the results of DOMS on male and female students after being given *ice massage treatment* and *passive stretching* was obtained according to the groups being compared. The data are described as follows:

Table 2. DOMS data description for men

Gender	Exercise					
	Ice Massage (A1)			*Pasive Stretching* (A2)		
	PreTest	PostTest	Decline	PreTest	PostTest	Decline
Man (B1)	8	3	5	7	3	4
	8	1	7	8	4	4
	9	4	5	9	6	3
	8	2	6	9	7	2
	9	1	8	9	6	3
	9	2	7	6	1	5
	8	3	5	6	3	3
	8	3	5	6	4	2
	8	4	4	6	3	3
	6	2	4	7	4	3
Average	81	25	56	73	41	32

Amount	8.1	2.5	5.6	7.3	4.1	3.2

Table 3. DOMS data description for women

Gender	Exercise					
	Ice Massage (A1)			Pasive Stretching (A2)		
	PreTest	PostTest	Decline	PreTest	PostTest	Decline
Woman (B2)	7	3	4	6	1	5
	8	6	2	7	1	5
	8	3	5	9	5	4
	9	6	3	6	2	4
	9	7	2	7	2	5
	6	2	4	9	7	2
	7	4	3	8	4	3
	6	3	3	8	4	4
	8	5	3	8	5	3
	6	4	2	7	2	5
Average	74	43	31	75	33	40
Amount	7.4	4.3	3.1	7.5	3.3	4.0

Table 4. DOMS Decrease Value of Each Treatment Group

Number	Treatment Group	DOMS Drop Value
1	A_1B_1	5,6
2	A_1B_2	3,1
3	A_2B_1	3,2
4	A_2B_2	4,0

2. Prerequisite Analysis Tester

a. Normality test

Before conducting data analysis, it is necessary to test the normal distribution. The data normality test in this study used the Shapiro-Wilk method using SPSS version 21. The results of the data normality test conducted in each group are as follows:

Table 5. Summary of Data Normality Test Results

Group Treatment	df	Sig.	Conclusion
A_1B_1	10	0,198	Normal distribution
A_1B_2	10	0,152	Normal distribution
A_2B_1	10	0,149	Normal distribution
A_2B_2	10	0,074	Normal distribution

From the results of the normality test conducted on A_1B_1, a significance value of 0.198 was obtained, where the value was greater than 0.05, which meant that the data in the group were normally distributed. While the results of normality in the A_1B_2 group obtained a value of 0.152 where the value is greater than 0.05, which means that the data in this group is normally distributed. The significance value for the A_2B_1 group is 0.149, which means that this group is normally distributed. In the last group it was found that group A_2B_2 had a normal distribution because the significance value was 0.075 greater than 0.05.

b. Homogeneity Test

Homogeneity test is intended to test the similarity of variance between groups. Homogeneity test was carried out with the Levene test. The results of the data homogeneity test between groups are as follows:

Table 6. Summary of Data Homogeneity Test Results

Levene statistic	df1	df2	Sig.
1.000	3	36	.404

The table above based on the Levene test found a significance value of 0.404> 0.05 (P> 0.05), so the data has a homogeneous variant

c. Hypothesis test

Testing the research hypothesis was carried out using the ANOVA technique (Analysis of variance). For the purposes of testing the hypothesis, data analysis was carried out using ANOVA analysis of variance, namely two-way ANOVA. All calculations were performed using the SPSS 25 program.

This calculation technique aims to determine the main effect of the experimental treatment (*main effect*) and to determine the effect of interaction (*interaction effect*).

Table 7. Hypothesis Testing Results

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	40.075[a]	3	13.358	11.210	.000
Intercept	632.025	1	632.025	530.371	.000
Treatment	5.625	1	5.625	4.720	.036
Gender	7.225	1	7.225	6.063	.019
Treatment * Gender	27.225	1	27.225	22.846	.000
Error	42.900	36	1.192		
Total	715.000	40			
Corrected Total	82.975	39			

a. R Squared = .483 (Adjusted R Squared = .440)

d. Hypothesis test

From the results of the study, it was shown that the decrease in DOMS by giving ice massage had a decrease that was different from the decrease in DOMS by giving passive stretching. This is evidenced by the Significance value of $0.036 < 0.05$ ($p < 0.05$). Which means that giving ice massage has a decrease in DOMS which is different from giving passive stretching which can be accepted.

DISCUSSION

Based on testing the first hypothesis, it turns out that there is a difference in the effect between the student group by giving ice massage and the student group by giving passive stretching. Giving ice massage will cause vasoconstriction so that it can slow down bleeding and allow platelets to make repairs. Then a chemical reaction occurs that causes vasodilation of blood vessels. This will cause the injured area to receive a lot of blood supply and can increase the permeability of the blood vessels themselves. The reaction that elicits this reaction removes leukocytes and toxins that remain after the injury. By increasing blood flow by administering ice massage, it will prevent the number of neutrophils and reduce further damage that can cause an inflammatory process.

The mechanism for repairing cells or muscle tissue that has been damaged requires appropriate and appropriate treatment that can support the tissue repair process to take place properly. When DOMS occurs, the tissue around the injury or in the Gastrocnemius muscle undergoes changes in tissue structure and metabolism (Sari, 2016). Changes in tissue structure that are damaged or torn will interfere with the activity of these muscles to contract optimally.

Giving ice massage with a duration of 15 minutes will help reduce the degree of muscle damage which can make DOMS worse. If the DOMS condition is left unchecked and treatment is not given quickly, it is possible that the pain and damage that occurs in the muscles will take longer to repair and can have an effect that can damage the structures and tissues in the muscles, which will result in damage to the wider muscle structure. So it can be concluded that in the group that was given ice massage after 24 hours of exercise or after the appearance of DOMS, significant results were obtained for DOMS, namely in reducing DOMS pain (reducing the occurrence of more extensive damage) compared to the passive stretching group which experienced an increase in DOMS pain value from 24 hours.

Passive stretching is a form of passively stretching or stretching the muscles in each limb so that in every sport there is readiness and to reduce the impact of injuries that are very prone to occur (Oktafianti et al., 2020), used for both healthy and sick people to stretch, flex or increase the flexibility of muscles that are considered problematic (Achmad Ali Fikri, Syamsul Arifin, 2022). The mechanism of pain reduction in Passive Stretching is when there is a passive stretching of the muscles, the initial lengthening occurs in the sarcomeres followed by myofibrils. When the stretch in the muscle is released, each sarcomere will return to its resting length position so that it will cause relaxation. With relaxation, pain can be reduced (Wahyono & Utomo, 2016).

Efflurage is a method of ice massage therapy that can be used to treat DOMS pain. In general, efflurage is performed to follow muscle extension and toward the heart. The calming effect is the effect of applying the efflurage technique. The benefits of accelerating the flow of blood containing oxygen and nutrients, facilitating the flow of lymph, and accelerating the distribution of blood containing carbohydrates and waste substances are the effects of the efflurage movement (Herinawati et al., 2019).

Passive Stretching is an effort made by individuals to increase strength through muscle stretching in order to develop joint range of motion and increase muscle flexibility. (Handayani & Riyadi, 2022) explained that stretching is an activity carried out to stretch muscle groups in order to obtain comfort and elasticity. Meanwhile, (Satriadi, A. A., Fitriangga, A., Zakiah, M., Rahmayanti, 2018) explained that stretching is an exercise that functions to obtain individual physical development and prepare various organs of the body to face the various activities that will be carried out. According to Anderson (2010), there are various benefits that the body gets when stretching muscles, namely (1) makes the body feel better, (2) reduces the risk of injury, (3) improves mental alertness, (4) reduces fatigue, feelings of stress, and anxiety, (5) improve blood circulation, and (6) reduce muscle tension.

Passive stretching is a stretching technique commonly used in the athlete's and clinical settings to increase both active and passive range of motion with a view to optimizing motor performance and rehabilitation. Stretching exercises are very effective for increasing ROM, especially with short-term changes in ROM (Hariadi & Samodra, 2023). Stretching technique used to increase muscle elasticity and has been shown to have a positive effect on the active and passive range of motion. Good muscle elasticity can reduce the pain caused by DOMS after exercise.

High-intensity exercise with eccentric movements causes tissue damage to the muscles which is followed by an inflammatory response which will begin in 12-24 hours resulting in DOMS pain (Suri & Mourisa, 2020). The interventions given are ice massage and passive stretching which are methods that can be used to prevent tissue damage and prevent inflammation in muscles, tendons and ligaments. Ice massage can be applied to the gastro muscles. Its application can be given for 10 minutes. In its application it is very simple, namely a comfortable patient position before the therapy is carried out. Giving ice massage will cause vasoconstriction so that it can slow down bleeding and allow platelets to repair and improve blood circulation so that it can reduce pain in DOMS. Stretching has been shown to have the effect of reducing muscle soreness caused by DOMS by increasing the Gastrocnemius pressure pain threshold.

CONCLUSION

There is a significant difference in the effect of ice massage and passive stretching on decreasing DOMS in the Gastrocnemius muscles. This is evidenced by the Significance value of $0.036 < 0.05$ ($p < 0.05$). Which means that giving ice massage has a decrease in DOMS which is different from giving passive stretching which can be accepted.

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