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Effect *Stretching and Recovery* on Delayed Onset Muscle Soreness (DOMS) After Exercise

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Abstract. DOMS (Delayed Onset Muscle Soreness) is pain that a person feels within 24-72 hours after doing sports activities, and recovery occurs within 4-6 days. Pain is caused by metabolic waste such as lactic acid in muscles and extracellular fluids, irritating the ends of the sensory fibers. An exercise that is not adequately controlled can cause muscle damage, inflammation, and muscle pain. Recovery should be made after each exercise that aims to eliminate lactic acid in muscles. The study aimed to see the effect of stretching and recovery on DOMS after physical activity. This research method is a quasi-experimental research design using a randomized pre and post-test group design. The subjects in this study were students of the Department of Sport Science, Medan State University, who assessed 16 people. The research subjects were randomly divided into two groups. Group P1, namely the physical exercise group without stretching and recovery; Group P2 in the physical exercise group with stretching and recovery. This research will be conducted at the Physiology Laboratory and Physiology Laboratory, Faculty of Sport Sciences, State University of Medan. The results showed that there was an effect of stretching and recovery on the reduction of DOMS after physical exercise.

1. Introduction

DOMS (Delayed Onset Muscle Soreness) is pain that a person feels within 24-72 hours after doing sports activities, and recovery occurs within 4-6 days. DOMS causes stiffness, swelling, decreased strength, and pain in muscles. The presence of pain recognizes DOMS found 12-24 hours after exercise and peaks 24-48 hours after exercise. DOMS will cause sufferers to feel the pain deemed a few days after doing sports [1].

Pain is also caused by a build-up of metabolic waste such as lactic acid in muscles and extracellular fluid, irritating the sensory fibers' ends. The accumulation of lactic acid in the blood becomes a fundamental problem in physical performance because it can cause pain and fatigue, reducing performance [2]. Pain can be caused by an inflammatory process or caused by exercises that involve a lot of eccentric contractions of the muscles [3]. Besides, poorly programmed training can cause injury due to repeated training or overtraining. Uncontrolled exercise can lead to muscle damage, inflammation, and muscle pain [4].

The muscle damage during exercise is caused by mechanical trauma when the muscles contract. Pain due to damage to connective tissue can be relieved by stretching and recovery. To overcome muscle pain, it can be done by making light movements (gymnastics), an active recovery to increase the venous pump mechanism, or by resting the muscles experiencing muscle aches while doing massage [5].



The level of pain can be caused due to the training dose and intensity of the exercise given not following individual abilities or excessive muscle training or overtraining. If in someone who is not an athlete, the damage can be caused by muscle activity that exceeds the ability to do wrong activities and movements. Other factors are stiffness, speed of contraction, muscle fatigue, and position at the time of exercise [4].

Recovery should be made after each exercise that aims to eliminate lactic acid in muscles. Recovery immediately after training is a crucial factor for improving athlete performance. Recovery can reduce muscle soreness; this is due to eliminating lactic acid through increased microcirculation in muscles [6-7]. Research by Bakowski et al. (2008) on study subjects as many as 14 healthy men who had no history of upper arm injuries and no training experience. Each of the subject's arms performed concentric and eccentric exercises on the elbow flexors for eight sets. One lateral contra received no massage (recovery). The results showed that the component that received massage recovery experienced a decrease in pain by 10% -20%. [3]. Previous research stated that reducing lactic acid levels could be eliminated by administering antioxidants such as red dragon fruit [8]. This study aimed to determine the effect of stretching and recovery on DOMS (delayed onset muscle soreness) and lactic acid levels after exercise.

2. Methods

2.1 Ethical acceptance

Universitas Sumatera Utara (no.278/KEP/USU/2020) of the Committee on Ethics for the Implementation of Scientific Research in the Faculty of Medicine approved this work ethically.

2.2 Subjects

The subjects in this study were students of the Department of Sport Science, Medan State University, who assessed 16 people. The research subjects were randomly divided into 2 groups. Group P1, namely the physical exercise group without stretching and recovery; Group P2 in the physical exercise group with stretching and recovery. This research will be conducted at the Physiology Laboratory and Physiology Laboratory, Faculty of Sport Sciences, State University of Medan.

2.3 Exercise protocol

Perform exercise on treadmill on intensity 70-75% of maximum heart rate. Treadmill done for 3 days/week, for 4 weeks. The treadmill is done at Physical Laboratory Universitas Negeri Medan. Assessment the levels of lactic acid using the BM Strip Accutrend lactic acid

2.4 Statistic analysis

Lactic acid content data obtained were analyzed by t-test, using SPSS.

3. Results

The means of lactic acid levels on in group P1 increased significantly, while group P2 decreased significantly as shown in Table 1.

Table 1. Means Lactic acid levels on group

| Groups | Pre-test | Post-test | p |
|--------|-----------|-----------|-------|
| | Mean±sd | Mean±sd | |
| P1 | 3.59±0.88 | 5.19±0.56 | 0.00* |
| P2 | 3.58±0.88 | 3.00±0.55 | 0.18* |

Note : group P1= control ; group P2= treatment; sd= standard deviation; *=significant

Table 2. Difference in lactic acid level on group

| Group | Mean | sd | p |
|-------|------|------|--------|
| P1 | 5.19 | 0.56 | 0.000* |
| P2 | 3.00 | 0.55 | |

Note : group P1= control ; group P2= treatment; sd= standard deviation;

*=significant

The lactic acid levels in group P2 was lower than in group P1 as shown in Table 2. Group P1 and Group P2 difference significantly in Lactic acid levels ($p < 0.05$).

4. Discussion

Lactic acid levels in the exercise group who received recovery and stretching decreased significantly ($p < 0.05$) compared to the exercise group who received no recovery. This is because recovery and stretching is a healing process that can increase the elimination of lactic acid from muscles. Active recovery is a low-intensity or light-intensity exercise that refers to recovery from low-intensity exercise to recover. Active recovery helps rid the muscles of lactic acid, which causes pain and fatigue. Can be done by jogging. Active recovery can help muscle soreness go away more quickly and help muscles repair damaged tissue [9].

Doing stretching exercises regularly has been proven to be very effective in reducing the chance of injury, such as tension in muscles (spasms) and muscle pain. The tension in the muscles can also limit and inhibit the range of motion in the joints. Stretching training programs can help prevent tension in muscle groups, maintain joint flexibility, and help warm up before doing core exercises [10].

In a hypoxic state, glycogen will be converted into glucose, then glucose will be converted to lactic acid. Lactic acid through the bloodstream enters the liver. In the liver, lactic acid will be converted into glucose through the process of gluconeogenesis. Glucose back into the blood which will then be used in the muscles. In the strengths, glucose is converted back into glycogen. This is known as the lactic acid cycle or the Cori cycle [11]. Lactic acid levels in the blood can also be used as a parameter of the athlete's fitness degree. Through the Conconi test, an anaerobic threshold of 4 mmol that is tolerated by pulse can be used to determine the dose of aerobic exercise and anaerobic exercise [12].

Lactic acid production is very dependent on the intensity of physical activity. Production of lactic acid in untrained people is the same as in trained people, the difference is the process of elimination from lactic acid. In trained people the elimination process is faster than in untrained people. In addition, trained people will experience an increase in the anaerobic threshold correlated with pulse rate, at a higher pulse rate, and less pain than untrained people (Willmore & Costill 2008) [13].

Elimination of lactic acid in the organs of the body through the kidneys and heart. The heart and kidneys can use lactic acid as an energy source. The liver can use lactic acid as a raw material for gluconeogenesis for the formation of glucose. In addition to the ability of the body's organs to eliminate lactate, it can also be done by restoring it. Recovery will increase blood flow so that areas that have improved lactic acid will have flowed to another place in the body that has enough oxygen so that lactic acid elimination can be increased [13].

5. Conclusion

The formation of lactic acid levels due to exercise and causing pain, often called DOMS (Delayed Onset Muscle Soreness), can decrease if given active recovery and combination stretching.

6. References

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