P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (RJIF): 5.38
IJPESH 2023; 10(2): 140-146

www.kheljournal.com
Received: 03-12-2022
Accepted: 05-01-2023

Muh Fitrah Mubarak
Depertment of Sport Science, Faculty of Sport Science, Yogyakarta State University, Indonesia

Sigit Nugroho
Depertment of Sport Science, Faculty of Sport Science, Yogyakarta State University, Indonesia

Corresponding Author:
Muh Fitrah Mubarak
Depertment of Sport Science, Faculty of Sport Science, Yogyakarta State University, Indonesia

Comparison of the Effectiveness of Hydrotherapy and sport massage on fatigue recovery

Muh Fitrah Mubarak and Sigit Nugroho

DOI: https://doi.org/10.22271/kheljournal.2023.v10.i2c.2845

Abstract
The purpose of this study was to compare the effectiveness of hydrotherapy and sports massage on fatigue recovery. The research design was two group pretest-posttest design. The number of samples amounted to 12 people. The sampling technique uses total quota sampling. The results of the tests carried out by the hydrotherapy group obtained values with an average (Mean) = 139.25 (pretest), 7.72 (posttest), and a Sig. = 0.000 < 0.05. For the sports massage group, the average value (Mean) = 139.91 (pretest), 7.87 (posttest), and Sig. = 0.000 < 0.05. Based on the results of significance <0.05, there is a significant difference in lactic acid levels. For effectiveness, the difference in values for the hydrotherapy group and the sports massage group, there is a difference in lactate difference of 0.50. It can be concluded that the effectiveness of the two methods does not really have a different impact.

Keywords: Recovery, hydrotherapy, sports massage

Introduction
Sports achievement is also an indicator that can be used directly to see the status or level of achievement and success in sports. Good performance is also supported by good performance, one of the causes of a person's declining performance can be caused by fatigue. As explained according to (Giriwijoyo & Zafar Sidik, 2010) [13] Fatigue is a decrease in the quality and quantity of work or exercise caused by doing work or sports. The higher the activity, the faster fatigue will arise.

The cause of fatigue in athletes is the result of the accumulation of lactic acid in the muscles, as stated by (Dinagsit, 2009) [7] Fatigue arises due to the buildup of lactic acid in the tissues. This is because the body's ability to neutralize the lactic acid pile is not proportional to the speed of lactic acid formed due to the severity of the exercise activity. If it lasts for a long time, this situation will greatly interfere with one's performance."(Ningrum & Rahayu, 2018) [27].

The state of fatigue includes physical and psychological aspects as well as subjective fatigue, which is characterized by decreased physical function, feeling tired, decreased motivation, and decreased work efficiency. Fatigue, both physical and psychological, is basically the body's protective mechanism to avoid further injury in order to recover after rest(Iwandana *et al*., 2022) [18].

Recovery is an important part that must be fulfilled. During training or competition, body tissues and energy systems are damaged causing fatigue, so the importance of the recovery phase is to stabilize the function of existing body tissues and strengthen these tissues, thereby improving athlete performance.(Anggriawan, 2015) [1]. Recovery is the process of returning metabolic functions in the body to their pre-activity state. This allows the body to return to optimal condition for the next activity (Fahmi & Ashadi, 2020) [11].

Exercising can accidentally damage the energy system and tissues, causing the body to become weak. Exercising more often weakens the body and increases the likelihood of tissue damage, so a balance between exercise and recovery is necessary to move on to the next phase of fitness. Recovery is one of the components of exercise that must be met, and exercise disrupts the energy system causing fatigue (Fahmi & Ashadi, 2020) [11].

In practice, not everyone involved in sport has a good understanding of the field of exercise physiology.

Thus, methods and efforts to deliver the application of the principles of exercise physiology to support maximum achievement can be realized and to develop new practitioners who understand the principles of exercise physiology.(Ashadi, 2014) [2]. In sports recovery or recovery, there are many methods or recovery strategies that can be used, such as using the 100 point weekly recovery checklist from Dr. Stephen Brid, PhD. With this method, it can be seen the number of points for each athlete while recovering, there are several types of recovery such as massage, contrast water (hot/cold), hydrotion status, Stretching, compression garments and adequate nutrition.(Fahmi & Ashadi, 2020) [11]. The points in each method of course have an effect, because it depends on how quickly the body functions again. If the pace is faster, the score will be higher, and the result of this score can tell how well the athlete is recovering.

With the development of an increasingly modern and complex era, currently there are many methods of recovery in the development of sports, one of which is massage. It is known from some literature in the field of sports medicine that sports massage provides effective results in fatigue recovery. Massage is the pressure of a masseur on the surface of the body. Have a specific purpose as needed. The main purpose of applying pressure is to increase blood circulation in the body. Sport massage is a manipulation performed on an athlete with both hands in a passive and relaxed state with the aim of avoiding or reducing sports injuries(Subhan & Graha, 2019) [34]. Massage can also improve muscle tone and nerve function in addition to increasing circulation, absorption, and secretion(Roepajadi, 2012) [32]. The role of massage is to reduce fatigue and improve physical condition, allowing further activities to be carried out without experiencing fatigue.

Further studies have shown that sports massage is effective in reducing the degree of muscle fatigue(Taskin *et al*., 2018) [35]. In line with that, the research results obtained(Ayu Tri Widhiyanti *et al*., 2022) [4] state that"Passive recovery with local lower extremity massage increases leg muscle strength faster than passive recovery by sitting after a decrease in physical activity". The recovery sport massage method can reduce lactic acid levels(Fahmi & Ashadi, 2019) [10]. Conventional massage and recovery techniques are more effective in restoring heart rate (Hidayat & Ibrahim, 2021) [16].

In addition to sports massage, there is also another method, namely hydrotherapy. The term hydrotherapy is also known as hydromassage (MTA Kurniawan & Sifaq, 2018) [23]. This hydrotherapy uses water as a tool. With the treatment of the Hydrotherapy method, an athlete can avoid the accumulation of lactic acid. Of the several Hydrotherapy methods, one of which is Cold Water Immersion which according to various studies, the Cold Water Immersion method is considered more effective than other types of Hydrotherapy.(MTA Kurniawan & Sifaq, 2018) [23]. Cold Water Immersion (CWI) can improve recovery from high intensity cycling when compared to Hot Water Immersion (HWI) and Passive Recovery (PAS) (Vaile *et al*., 2008) [36]. Hydrotherapy at sufficiently low temperatures compared to very low temperatures can cause a relatively positive effect on muscle damage and the recovery phase after eccentric exercises on the arm.(Jo *et al*., 2021) [19].

From the explanation above, based on previous research, Sport Massage and Hydrotherapy were each found to be able to have an effect on fatigue recovery, but the effectiveness of these studies was not yet known if a comparison was made between the two. Therefore, the authors intend to further study conducting comparative research between the two methods to find out whether there is a comparison of the effectiveness between the Sport Massage and Hydrotherapy methods for the fatigue recovery process. Thus the results to be obtained can be a good reference for sportsmen, especially coaches and athletes, in choosing an effective recovery method after carrying out physical activities.

Materials and method

In this study, the type of research used is quantitative research with an experimental model, namely research that seeks to determine the effect of giving soccer game modifications to the gross motor skills of mentally retarded children. The research design used in this study was "One-group Pretest-Posttest Design" which is an experiment that uses pre-test and post-test to compare the conditions before being given treatment and after being given treatment. This study uses a design through a test before being given treatment (O1) and after being given treatment (O2) so that there is a comparison between O1 and O2 to determine the effectiveness of the treatment (X).

The research method used is a Pre-Experimental Design approach, with two sample groups or a Two Group Pretest Posttest design. It is said to be pre-experimental because this design is not yet a real experiment, because there are still external variables that also influence the formation of the dependent variable.

Two Group Pretest Posttest design is a pre-experimental design carried out on two different groups that received different treatments. Systematically, the research design can be seen in the following figure:

Image 1: Research design

The data collection procedures in this study are as follows:

a). Providing physical activity in the form of Circuit Training

In the first procedure, the sample performed a circuit exercise that had been prepared by the researcher. Circuit practice this time refers to JP O'Shea and ELFox quoted(Sajoto, 1995)states that there are a number of stations between 6 and 15 places.

b). Pre-Test

After the two sample groups did circuit training, the sample would be checked for pulse to determine whether the sample had reached 80% intensity exercise or not. After completing the pulse check, samples that have reached this intensity will be tested for lactic acid levels first, and lactic acid levels will be tested using Accutrend Lactacid.

c. Treatment

1) First Group Sample Treatment

The first group sample will receive treatment in the form of hydrotherapy cold water immersion (Cryotherapy) with the following SOP:

a) The temperature of the water used for immersion is 10°-15°C
b) The immersion duration used was 2.42 minutes with 5 repetitions.
c) The volume of water used is adjusted to the container or media used for immersion.

2) Second Group Sample Treatment

The second group sample will receive treatment in the form of a sports massage with the following SOP:

a) The techniques used in this sport massage are effleurage, petrissage, walken, shaking, effleurage.
b) Because the buildup of lactic acid will occur around the feet, the part of the body that is massaged is the lower body (thighs, calves and soles of the feet).
c) The duration used is the right leg for 6 minutes (thigh 2.5 minutes, calf 2.5 minutes, sole of the foot 1 minute)
d) Post-Test (Final Test)

The post-test was carried out after giving treatment, the tests carried out were counting the pulse and taking blood samples to determine the levels of lactic acid in the athlete's body.

Results and Discussion

In this study the data obtained from the results of the recovery method research using the hydrotherapy method and sport massage to reduce lactic acid levels in Futsal players in Gowa Regency, amounting to 12 people who have been divided into two different groups. The results of calculating the profile of the research subjects carried out can be seen in the following table.

Table 1: Hydrotherapy Statistical Descriptive Analysis

Descriptive Statistics Hydrotherapy							
	N	Range	Minimum	Maximum	Sum	mean	Std. Deviation
DN After exercise	6	15.00	160.00	175.00	1000.00	166.6667	5.20256
DN after treatment	6	15.00	105.00	120.00	671.00	111.8333	5.30723
Pretest lactic acid levels	6	1.30	11.00	12.30	70.10	11.6833	.45789
Posttest lactic acid levels	6	1.40	2.95	4.35	22.55	3.7583	.51031
Valid N (listwise)	6						

When displayed in the form of a bar chart, the data is presented as follows:

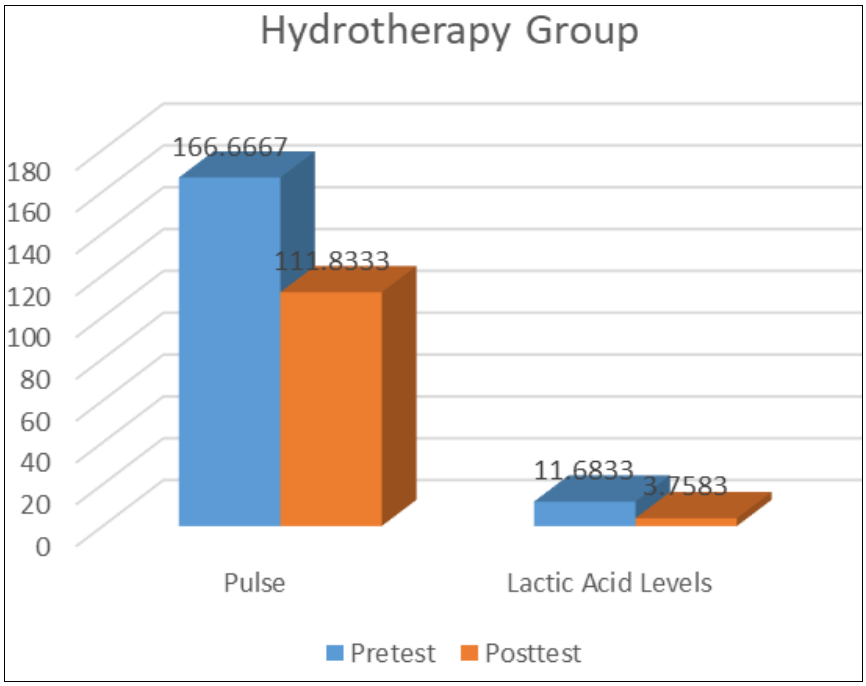

Fig 1. Bar chart of the pretest and posttest of the hydrotherapy group

From table 1. Above can be obtained an overview of the descriptive statistical results of hydrotherapy for the DN variable after exercise, the value range = 15.00; minimum value = 160.00; maximum value = 175.00; sum value = 1000.00; mean value = 166.66; SD value = 5.20. For the DN variable after treatment, the value range = 15.00; minimum value = 105.00; maximum value = 120.00; sum value = 671.00; mean value = 111.83; SD value = 5.30. For the pretest lactic acid level variable, the value range = 1.30; minimum value = 11.00; maximum value = 12.30; sum value = 70.10; mean value = 11.68; SD value = 0.40. For the posttest lactic acid level variable, the value range = 1.40; minimum value = 2.95; maximum value = 4.35; sum value = 22.55; mean value = 3.75; SD value = 0.51.

Table 2: Descriptive Analysis of Sport Massage Statistics

Descriptive Statistics Sport Massage							
	N	**Range**	**Minimum**	**Maximum**	**Sum**	**mean**	**Std. Deviation**
DN After exercise	6	8.00	164.00	172.00	1006.00	167.6667	3.38625
DN after treatment	6	20.00	100.00	120.00	673.00	112.1667	7.88458
Pretest lactic acid levels	6	2.30	10.00	12.30	68.00	11.3333	.80104
Posttest lactic acid levels	6	2.60	3.35	5.95	26.55	4.4250	.91310
Valid N (listwise)	6						

When displayed in the form of a bar chart, the data is presented as follows:

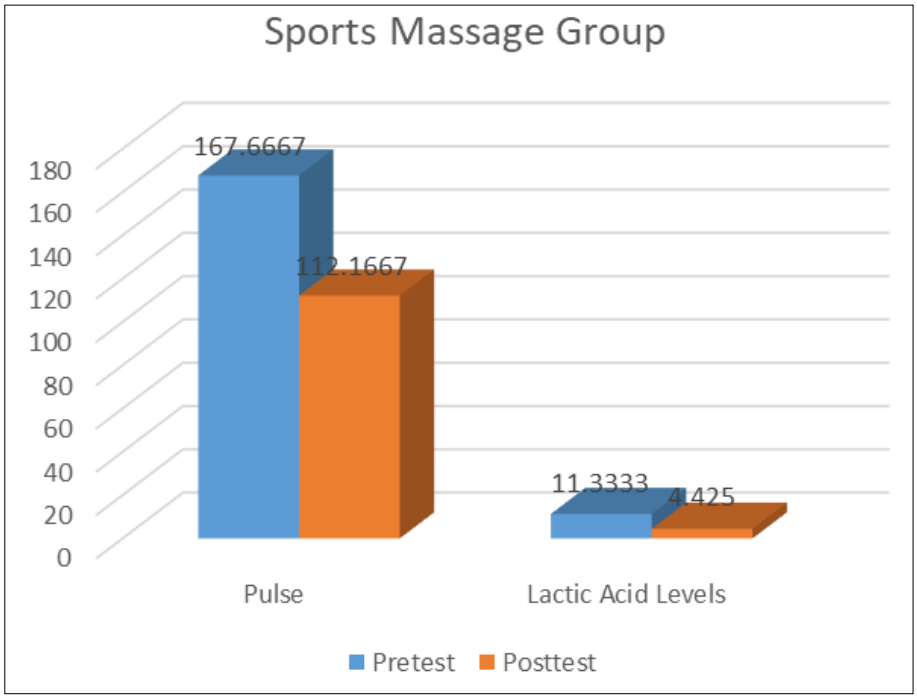

Fig 2. Bar diagram of the pretest and posttest of the sports massage group

From table 2. Above can be obtained an overview of the descriptive statistical results of sports massage for the DN variable after exercise, the value range = 8.00; minimum value = 164.00; maximum value = 172.00; sum value = 1006.00; mean value = 167.66; SD value = 3.38. For the DN variable after treatment, the value range = 20.00; minimum value = 100.00; maximum value = 120.00; sum value = 673.00; mean value = 112.16; SD value = 7.88. For the pretest lactic acid level variable, the value range = 2.30; minimum value = 10.00; maximum value = 12.30; sum value = 68.00; mean value = 11.33; SD value = 0.80. For the posttest lactic acid level variable, the value range = 2.60; minimum value = 3.35; maximum value = 5.95; sum value = 26.55; mean value = 4.42; SD value = 0.91.

Table 3; Hydrotherapy Normality Test

Tests of Normality Hydrotherapy						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	df	Sig.
DN After exercise	.218	6	.200*	.963	6	.844
DN after treatment	.302	6	.093	.911	6	.445
Pretest lactic acid levels	.101	6	.200*	.996	6	.999
Posttest lactic acid levels	.313	6	.067	.900	6	.375

From table 3 above, based on the number of samples used less than 50, it can be seen from the Shapiro-Wilk data, it is known that the hydrotherapy data for DN after exercise, DN after treatment, pretest lactic acid levels, posttest lactic acid levels obtained p> 0.05 then it can be concluded It is said that the data is normally distributed or follows a normal distribution.

Table 4: Sport Massage Normality Test

Tests of Normality Sports Massage						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
DN After exercise	.285	6	.140	.852	6	.163
DN after treatment	.307	6	.080	.877	6	.255
Pretest lactic acid levels	.175	6	.200*	.954	6	.776
Posttest lactic acid levels	.199	6	.200*	.944	6	.688

From table 4 above, based on the number of samples used less than 50, it can be seen from the Shapiro-Wilk data, it is known that sports massage data DN after exercise, DN after treatment, pretest lactic acid levels, posttest lactic acid levels obtained p> 0.05 then It can be said that the data are normally distributed or follow a normal distribution.

Table 5: Hypothesis Testing with T-Test Hydrotherapy

Paired Sample Statistics					
		mean	N	Std. Deviation	Std. Error Mean
Pairs 1	X Hydrotherapy	139.2500	12	29.07084	8.39203
	Y Lactic Acid	7.7208	12	4.16443	1.20217

Paired Samples Correlations				
		N	Correlation	Sig.
Pairs 1	X Hydrotherapy & Y Lactic Acid	12	.993	.000

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pairs 1	X Hydrotherapy - Y Lactic Acid	131,52917	24.94055	7.19972	115.68270	147,37564	18,269	11	.000

Based on these data, the average value (Mean) of lactic acid was lower after being given hydrotherapy treatment of 7.72, compared to 139.25 before being given treatment. So it can be said that the administration of hydrotherapy can reduce lactic acid levels.

From the Paired Samples Correlations data obtained the value of Sig. 0.000 < 0.05, it can be said that the data has a significant correlation or relationship.

From the Paired Samples Test data obtained the value of Sig.(2-tailed) 0.000 < 0.05, it can be said that there is a significant difference in lactic acid levels between before being treated with hydrotherapy and after being given treatment.

Table 6: Hypothesis Testing with T-Test Sport Massage

Paired Sample Statistics					
		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pairs 1	X Sport Massage	139.9167	12	29.55567	8.53199
	Y Lactic Acid	7.8792	12	3.69954	1.06796

Paired Samples Correlations				
		N	Correlation	Sig.
Pairs 1	X Sport Massage & Y Lactic Acid	12	.984	.000

Paired Samples Test									
		Paired Differences					**t**	**df**	**Sig. (2-tailed)**
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
					Lower	**Upper**			
Pairs 1	X Sport Massage - Y Lactic Acid	132.03750	25.92228	7.48312	115.56727	148.50773	17,645	11	.000

Based on these data, the average value (Mean) of lactic acid was lower after being given a sport massage treatment of 7.87, compared to before being given treatment of 139.91. So it can be said that giving sports massage can reduce lactic acid levels.

From the Paired Samples Correlations data obtained the value of Sig. 0.000 < 0.05, it can be said that the data has a significant correlation or relationship.

From the Paired Samples Test data obtained the value of Sig. (2-tailed) 0.000 < 0.05, it can be said that there is a significant difference in lactic acid levels between before being given a sport massage treatment and after being given treatment.

So it can be concluded that there is a significant effect of giving the hydrotherapy method on recovery which can be seen from the decrease in lactic acid, it can be seen from the average value (Mean) of lactic acid is lower after being given hydrotherapy treatment of 7.72, compared to before being given treatment of 139.25, and the sport massage method can be seen from the average value (Mean) of lactic acid which is lower after being given a sport massage treatment of 7.87, compared to before being given treatment of 139.91.

However, for effectiveness, there is a difference in the mean value of 131.52 before and after being treated with the hydrotherapy method, and there is a difference in the mean value of 132.03 before and after being given the sport massage method, thus there is a difference in the difference between hydrotherapy to lactic acid and sport massage to lactic acid of 0.50. Thus, the effectiveness of the two methods does not really have a different impact, but with the results it can be said that the hydrotherapy method is slightly more effective than sports massage.

Factors causing fatigue are very complex, both physical and psychological conditions. Fatigue can be defined as a decrease in muscle performance that accompanies feelings of fatigue. Another definition of fatigue is the body's inability to maintain muscle power output (Muis *et al*., 2018) [24]. Muscle fatigue during exercise can occur for various reasons, including: depletion of energy stores from ATP, creatine phosphate, and glycogen; accumulation of lactate in the muscles; disturbances in homeostasis such as plasma osmolality, plasma volume, decreased pH of body fluids and decreased levels of electrolytes in body fluids; fatigue due to neuromuscular or central disorders; and fatigue due to environmental conditions, including temperature and humidity (Rashid & Agung, 2017) [30]. According to (Muis *et al*., 2018) [24] the phenomenon of fatigue can be caused by: 1) there is a problem with the supply of energy; ATP-PC and anaerobic glycolosis, 2) accumulation of products such as [H+] in the form of lactic acid, 3) failure of muscle mechanics to contract, and 4) changes in the nervous system.

Futsal matches are often played with no rest days for recovery. In international matches the gap between matches is only 0-2 days (Charlot *et al*., 2016) [5]. Fatigue for more than 4 days of tournaments in men's professional matches was found to result in a decrease in power (Countermovement jump) after the tournament (de Freitas, 2017) [6]. The accumulation of fatigue from each match and the short recovery time can lead to prolonged chronic fatigue in players if it persists (Nédélec *et al*., 2015) [26]. In addition, futsal has a relatively high risk of injury. Two-thirds of injuries to futsal players are due to contact with other players and one-third are due to non-contact. All non-contact injuries result from undue fatigue. The risk of injury is higher in players who experience fatigue, generally in the second half.(Engebretsen *et al*., 2010) [9].

Recovery is a key point of the training process. Apart from pure rest with passive recovery, several strategies and methods have been proposed for athletes to improve muscle function recovery after training or competition (Atranal & Sepriani, 2017) [3]. Recovery with the right method with a high level of fatigue can restore the body's metabolism to normal or even more optimally (Farhansyah, 2016) [12]. According to(Hing *et al*., 2008) [17] Recovery allows the body to replenish energy, decrease lactic acid, and reduce central nervous system fatigue. Therefore, based on the results of this study, hydrotherapy and sports massage can be used as a reference for good recovery methods.

The research results obtained in this study are also in line with the opinion of (Juliff *et al*., 2014) [20] who said that fatigue that occurs in athletes can be overcome one way is by therapy that uses water as a medium known as Hydrotherapy. Soaking the feet using water or commonly called hydrotherapy can reduce muscle tension, dilate blood vessels, lower blood pressure, relieve joint pain, kill germs, and can improve sleep quality. (Harnani & Axmalia, 2017) [14]. Hydrotherapy can recover a person from physical work, provide an increase in muscle ability and can reduce muscle pain (Elias *et al*., 2012) [8]. According to (Rifan, 2016) [31] the use of cold temperatures can provide a sense of relaxation in the muscles, a sense of

psychological relaxation, inhibit muscle damage, reduce edema and muscle pain.

One of the first effects of using cold water on the body system is the vasoconstriction it exerts on the area. This vasoconstriction can reduce cells to carry out metabolism. A decrease in the metabolic rate of the tissue will lower the temperature. The body's physiological response to cold temperatures in the form of a decrease in local metabolism is certainly very helpful in stopping the rate of metabolic waste in the form of lactic acid from accumulating more in the muscles. The decrease in metabolic waste can ultimately reduce muscle spasm. However, this vasoconstriction is temporary, exposure to cold water for a long period of time will cause a hunting response by the body. The hunting response is in the form of vasodilation. The occurrence of vasodilation will certainly facilitate blood flow and increase metabolism.(Wahid, nd) [37].

According to(Kovacs *et al*., 2014) [21], the less oxygen supply the greater the rate of formation of vasodilator substances that can cause vasodilation. Increased blood flow will also increase oxygen due to binding by hemoglobin in the blood. This process will also ensure the availability of oxygen, especially in the submerged parts of the body, thus the "cleaning" of lactic acid as a metabolic waste substance will be faster in the presence of oxygen.

In addition, the sports massage method in this study also gave significant results. According to(Perlman *et al*., 2019) [28] Massage can be useful for increasing blood flow in the body, smooth blood circulation can promote a good blood circulation system throughout the body's tissues. Sports massage itself is a series of special massage techniques / methods intended for the needs of an athlete or sportsman (AW Kurniawan & Kurniawan, 2021) [22] This is the most important aspect in improving the athlete's performance in recovery.

Fast recovery techniques will speed up the endurance process of athletes, allowing them to train optimally and achieve their goals. Massage treatments are also used in pre- and post-match preparation with a different technique, namely Swedish massage, with the aim of relieving pain and providing relaxation, and can also be used as a form of rehabilitation to help athletes recover quickly.(Purnomo, 2015) [29]. Almost identical to the study which found that passive recovery with local lower extremity massage increased leg muscle strength more quickly when compared to passive recovery by sitting after a decrease after physical activity.(Helaprahara *et al*., 2022) [15]. Besides that(Mulya *et al*., 2021) [25] states that sport massage or sports massage can help improve blood circulation while stretching focuses on increasing muscle elasticity and range of motion and recommends that athletes apply sports massage regularly to reduce the risk of muscle fatigue and even muscle injury.

Therefore, based on the results obtained from this study along with supporting references from previous studies, it can be said that hydrotherapy and sports massage can be used as alternative treatments for a fast recovery process, both for futsal and other sports that require high intensity.

Conclusion

From the results of the T test for the hydrotherapy group, the average value (Mean) = 139.25 (pretest), 7.72 (posttest), SD = 29.07 (pretest), 4.16 (posttest), and the value of Sig. = 0.000 < 0.05. So it can be said that hydrotherapy is able to reduce lactic acid levels, and based on the results of significance <0.05, there is a significant difference in lactic acid levels between before being treated with hydrotherapy and after being given treatment.

For the sports massage group, the average value (Mean) = 139.91 (pretest), 7.87 (posttest), SD = 29.55 (pretest), 3.69 (posttest), and the value of Sig. = 0.000 < 0.05. So it can be said that giving sport massage is able to reduce lactic acid levels, and based on the results of significance <0.05, there is a significant difference in lactic acid levels between before being given sport massage treatment and after being given treatment.

For effectiveness, there is a difference in the value for the hydrotherapy group with an average value (mean) of 131.52, and a difference in the value of the sports massage group with an average value (mean) of 132.03, thus there is a difference in the difference between hydrotherapy against lactic acid and sport massage against lactic acid. of 0.50. So it can be concluded that the effectiveness of the two methods does not have much different impact, or it can be said that they both have the same effectiveness for the recovery process.

Acknowledgements

1) The Chancellor of the State University of Yogyakarta who has provided support for his contribution so that this research is successfully carried out.
2) Dean of the Faculty of Sports Science (FIK) Yogyakarta State University for the time allowed.
3) Gowa District Futsal Management for their participation and approval to conduct this research.
4) Especially for all Futsal athletes of Gowa Regency who have been willing to be samples in this study.

References

1. Anggriawan N. Peran fisiologi olahraga dalam menunjang prestasi. Jorpres (Jurnal Olahraga Prestasi). 2015;11(2).
2. Ashadi K. Implementasi fisiologi olahraga pada olahraga prestasi. Pertemuan Ilmiah Ilmu Keolahragaan Nasional Univeritas Negeri Malang. Malang; c2014.
3. Atradinal A, Sepriani R. Pemulihan Kekuatan Otot Pada Atlet Sepakbola. Jurnal MensSana. 2017;*2*(2):99-105.
4. Ayu Tri Widhiyanti K, Rusitayanti NWA, Ariawati NW, Arisanti Dewi IAK, Indrawathi NLP, Sumerta IK. Pengaruh Massage Lokal Ekstremitas Bawah sebagai Pemulihan Pasif terhadap Kekuatan Otot Tungkai Atlet Sepakbola di SMP Negeri 3 Sukawati. Jurnal Pendidikan Kesehatan Rekreasi. 2022;8(1):186–195.
5. Charlot K, Zongo P, Leicht AS, Hue O, Galy O. Intensity, recovery kinetics and well-being indices are not altered during an official FIFA futsal tournament in Oceanian players. Journal of Sports Sciences. 2016;34(4):379–388.
6. de Freitas M. Multiaxial fatigue: From materials testing to life prediction. Theoretical and Applied Fracture Mechanics. 2017;92:360-372.
7. Dinagsit D. Perbedaan Pengaruh Metode Massage Air (Hydromassage) dan Metode Massage Manual terhadap Performa Setelah Kelelahan. Universitas Pendidikan Indonesia; c2009.
8. Elias GP, Varley MC, Wyckelsma VL, McKenna MJ, Minahan CL, Aughey RJ. Effects of water immersion on posttraining recovery in Australian footballers. International Journal of Sports Physiology and Performance. 2012;7(4):357-366.
9. Engebretsen L, Steffen K, Alonso JM, Aubry M, Dvorak J, Junge A, *et al*. Sports injuries and illnesses during the

Winter Olympic Games 2010. British Journal of Sports Medicine. 2010;44(11):772-780.
10. Fahmi H, Ashadi K. The Comparation of Sport Massage and Hydrotherapy Cold Water to Physiological Recovery. JUARA: Jurnal Olahraga. 2019;4(2):196–209.
11. Fahmi H, Ashadi K. Erratum: Perbandingan Sport Massage dan Hydrotherapy Cold Water Terhadap Physiological Recovery. JUARA: Jurnal Olahraga. 2020;5(1):122.
12. Farhansyah J. Percepatan Pemulihan Olahraga Dengan Aktive Recovery; c2016.
13. Giriwijoyo S, Zafar Sidik D. Konsep Dan Cara Penilaian Kebugaran Jasmani Menurut Sudut Pandang Ilmu Faal Olahraga. Jurnal Kepelatihan Olahraga. 2010;2(1):1-9.
14. Harnani Y, Axmalia A. Terapi Rendam Kaki Menggunakan Air Hangat Efektif Menurunkan Tekanan Darah Pada Lanjut. Journal of Community Health. 2017;3(5):129–132.
15. Helaprahara D, Fepriyanto A, Rasyid AR, Azis AA. Pengaruh Massase Olahraga Sebagai Pemulihan Pasif Terhadap Peningkatan Vo2max Atlet Bolavoli. PENJAGA: Pendidikan Jasmani & Olahraga. 2022;2(2):42–48.
16. Hidayat RR, Ibrahim I. Pemulihan Suhu Tubuh Dan Denyut Jantung Dengan Metode Sport Massage Dan Stretching Statis Setelah Berenang. Sport Science and Education Journal. 2021;2(1).
17. Hing WA, White SG, Bouaaphone A, Lee P. Contrast therapy—A systematic review. Physical Therapy in Sport. 2008;9(3):148–161.
18. Iwandana DT, Falaahudin A, Romadhoni M. Koordinasi Kegiatan Menjaga Kebugaran Melalui Massage Bagi Atlit KONI Bantul Yogyakarta. SNHRP, 2022, 1426–1429.
19. Jo H, Kim C, Kim M, Jo H, Kim C, Kim M. Effects of Hydrotherapy on Muscle Damage and Recovery Profile After Eccentric Exercise in Arm. Exercise Science. 2021;30(3):336–345.
20. Juliff LE, Halson SL, Bonetti DL, Versey NG, Driller MW, Peiffer JJ. Influence of contrast shower and water immersion on recovery in elite netballers. The Journal of Strength & Conditioning Research. 2014;28(8):2353–2358.
21. Kovacs G, Avian A, Pienn M, Naeije R, Olschewski H. Reading pulmonary vascular pressure tracings. How to handle the problems of zero leveling and respiratory swings. American Journal of Respiratory and Critical Care Medicine. 2014;190(3):252–257.
22. Kurniawan AW, Kurniawan MTA. Sport Massage Pijat Kebugaran Olahraga. Tulungagung: Akademia Pustaka; c2021.
23. Kurniawan MTA, Sifaq A. Perbandingan metode hydrotherapy cold water immersion (cryotherapy) dengan sport massage terhadap penurunan kadar asam laktat pasca circuit training. Jurnal Prestasi Olahraga. 2018;1(4).
24. Muis MR, Nasution MI, Azhar ME, Radiman R. Pengaruh kepemimpinan dan self efficacy terhadap kelelahan emosional serta dampaknya terhadap kepuasan kerja dosen. Jurnal Riset Sains Manajemen. 2018;*2*(3):131-142.
25. Mulya DY, Suwondo A, Setyaningsih Y. Kajian pustaka pemberian sport massage dan stretching terhadap pemulihan kelelahan otot dan kadar asam laktat pada atlet. Jurnal Kesehatan Masyarakat (Undip). 2021;9(1):79-86.
26. Nédélec M, Halson S, Abaidia AE, Ahmaidi S, Dupont G. Stress, sleep and recovery in elite soccer: a critical review of the literature. Sports Medicine. 2015;45(10):1387–1400.
27. Ningrum DA, Rahayu NI. Perbandingan Metode Hydrotherapy Massage dan Massage Manual terhadap Pemulihan Kelelahan Anaerobic Lactacid Pasca Olahraga. JTIKOR (Jurnal Terapan Ilmu Keolahragaan). 2018;3(1):30-33.
28. Perlman A, Fogerite SG, Glass O, Bechard E, Ali A, Njike VY, *et al*. Efficacy and safety of massage for osteoarthritis of the knee: a randomized clinical trial. Journal of General Internal Medicine. 2019;34(3):379–386.
29. Purnomo NT. Perubahan kadar laktat darah akibat manipulasi sport massage pada latihan anaerob. Jurnal Ilmiah Penjas (Penelitian, Pendidikan Dan Pengajaran). 2015;1(2).
30. Rasyid A, Agung N. Pengaruh Pemulihan Aktif Jogging Terhadap Penurunan Asam Laktat Pada Olahraga Bulutangkis. Journal Sport Area. 2017;2(2):10-18.
31. Rifan M. Efek Cryotherapy (water immersion) Terhadap Pemulihan Kelelahan Atlet Sepakbola; c2016.
32. Roepajadi J. Masase Sebagai Sarana Enterpreneurship Mencetak Tenaga Ahli Profesional. Surabaya; c2012.
33. Sajoto M. Peningkatan & pembinaan kekuatan kondisi fisik dalam olah raga. Dahara Prize; c1995.
34. Subhan A, Graha S. Efektifitas Massage Terapi Cedera Olahraga Terhadap Nyeri Tumit Dan Nyeri Otot Tibialis Pada Atlet Futsal Sma Negeri 1 Ciamis. 2019, XVIII.
35. Taskin M, Budak H, Taskin M, Bozoglu MS, TAskin H. The effect of massage and kinesiotape applications on maximal squat strength. Ovidius University Annals, Series Physical Education and Sport/Science, Movement and Health. 2018;18(2):160–166.
36. Vaile J, Halson S, Gill N, Dawson B. Effect of hydrotherapy on recovery from fatigue. International Journal of Sports Medicine. 2008;29(7):539–544.
37. Wahid W.M. (n.d.). Perbandingan pengaruh cold bath dan contrast bath terhadap penurunan kadar asam laktat. *Sains Olahraga:* Jurnal Ilmiah Ilmu Keolahragaan. 2008;6(1):1-10.