Comparison of cryotherapy and foam rolling on performance and lactate levels in futsal athletes

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Abstract

The use of Cryotherapy and Foam rolling methods is considered to speed up the post-exercise recovery process. However, so far there have been no studies comparing the two methods, thus the aim of this study was to compare the Cryotherapy and Foam rolling methods on performance and lactate levels in futsal athletes. This study uses an experimental method with a one-way crossover design pretest-posttest approach. The total subjects were 16 Amateur Futsal Players with an average age, 20.25 ± 1.23 years; height, 168.87 ± 2.02 cm; and weight, 54.61 ± 1.94 kg; BMI, 19.16 ± 1.01 kg/m-2. The results showed that foam rolling and cryotherapy had no effect on physical performance, but both methods could significantly reduce lactate levels. However, in this case the foam rolling method showed an improvement in the 20-meter sprint which was better than cryotherapy. Thus, the results of this study provide a recommendation for futsal athletes to use foam rolling in the post-exercise recovery process.

Keywords: *Cold water immersion, Recovery, Foam rolling*

INTRODUCTION

Futsal is a sport that demands high physical performance, the average duration of competitive matches ranges from 75 – 90 minutes (Barbieri et al. 2017) and the intensity of futsal players when competing has an average of 86-90% of the maximum heart rate (Rodrigues et al. 2011). Previous research revealed that futsal is an intermittent sport with a higher intensity than other intermittent sports such as football, basketball, *handball* and badminton (Niromlee Makaje et al. 2012). It is also proven that in a futsal match, players can cover an average distance of around 3000 – 4000 m (Oliveira et al. 2013), and the distance traveled by players can increase up to 5000 m for professional players and 4,500 m for amateur players (Makaje et al. 2012).

Rapid changes in direction such as *sprinting*, acceleration, deceleration, jumping, kicking, and *tackling* require the player to be able to maintain a high level of intensity as long as possible (Väkäkoitti 2017). In addition, a busy Futsal match schedule with short rest periods can affect the decrease in physical performance and fatigue in futsal players. Several studies have shown that after one match, futsal players experience a decrease in anaerobic performance (Moreira et al., 2015), lower body's muscle power, decreased running performance and neuromuscular

variables (Miloni et al., 2016), a decrease in average pulse, heart rate maximum pulse, and high-intensity running distance when the match began to appear in the second half (Milioni et al. 2016). It shows that futsal causes tiredness *(fatigue) and* indicating a decrease in physical performance.

Several studies have revealed that fatigue can be a problem for athletes because in addition to reducing performance, fatigue can also increase the risk of injury (Cheatham and Stull 2018; Lawrence 2011). Furthermore, previous literature implies that fatigue is a phenomenon of accumulation of lactic acid in muscle fibers, caused by high-intensity exercise (Finsterer 2012; Van Hall 2010). Thus, medical personnel and researchers in the field of sports should try to find appropriate and effective recovery methods to reduce lactic acid concentrations quickly, so that all athletes can recover and improve their performance (Pelana et al. 2021).

Some recovery methods such as *Cryotherapy* and *Foam rolling* (FR) has become a common practice in various types of sports, because both methods are considered to speed up the post-workout recovery process. (*Cryotherapy*) is cold water therapy with a temperature of 15 ° C which is carried out for 11 - 15 minutes as a recovery method which is believed to be able to minimize fatigue and accelerate recovery after exercise (Casanova et al. 2018; Versey, Halson, and Dawson 2013). While *Foam rolling* is a *self-myofascial release* (SMR) process, or self-massage by applying pressure to the soft tissues in the opposite direction using body weight as a burden (Cheatham et al. 2015; Cheatham and Stull 2018). According to (Healey et al. 2014) the method of foam *rolling* can improve muscle performance and flexibility and can reduce muscle fatigue and pain.

In recent years, the two methods are most often used in various types of sports, but so far there has been no study comparing the two to determine which is more effective in the process of physical recovery after exercise. Thus, the purpose of this study was to compare the recovery

methods for *Cryotherapy* and *Foam rolling* futsal players in terms of the *Vertical Jump*, 20M Sprint, and post-exercise lactate levels so that the results of this study can be used as a *reference* for coaches in choosing an effective recovery method for athletes.

METHODS

An experimental method with an approach was *one-way crossover design pretest-posttest* used in this study. Where in one group will be treated using different recovery by being separated for 7 days as a *washout* from the first *treatment*. In the first recovery treatment, all subjects tried cold water bath (*Cryotherapy*), then after a 7-day gap, all subjects tried the method of *Foam rolling*. *Treatment* will begin after the subject simulates a futsal match with a time of 20 minutes x 2 rounds without any substitutions, and the parameters measured in this study include *vertical jump*, 20 meters-sprint, and blood lactate levels. These parameters will be measured after the match simulation and after running the recovery treatment.

Sixteen amateur futsal athletes with a mean (age, 20.25 ± 1.23 years; height, 168.87 ± 2.02 cm; and weight, 54.61 ± 1.94 kg; BMI, 19.16 ± 1.01 kg/m^{-2}.) volunteered to participate in this study (see table 1). Inclusion criteria that can participate in this study include, do not smoke, do not have a history of disease, a minimum of 2 years of practice experience, and a minimum of 2-3 times per week of exercise for the last 6 months. Prior to participation, subjects were given an explanation regarding the study procedures, and subjects were asked to read and sign the *informed consent*.

Measurements and Research Procedures

Anthropometric

Anthropometric data collection for athletes included age, weight, height, and BMI. For age data collection, it is done using a questionnaire that will be filled out independently by the subject, for height is measured

using a *stature* meter, while for weight and BMI using OMRON Karada Scan HBF-375.

Vertical jump

Vertical jump Height measurement is rated with *Vertec (Perform Better)*. *Vertec* is a measuring instrument for *vertical jump* in the form of a pole with a horizontal arrangement of iron such as a vane. The distance between the vanes is 1 inch. The lowest vane is adjusted to the height of the subject in a standing position with arms straight up. The jump height is calculated from the highest vane reach by hand that can be reached when the subject jumps.

Sprint test

Sprint test is carried out on a straight line with a length of 20 meters. Before doing the sprint, participants were instructed to run as fast as possible, measurements were taken using a *stopwatch* (Casio HS-80TW) supervised by 2 officers.

Lactate level

The lactate level check in this study is using *accutrend Plus Portable analyzer*. The measurement of lactate levels was carried out by taking a blood sample from the subject's fingertip with *a test strip* and immediately analyzed using the *accutrend Plus Portable analyzer* tool.

Cryotherapy

All participants tried to do a trial on some parts of the body by being immersed in cold water (*cold water immersion*). Immersion is carried out in cold water with a temperature of around 11-15°C for 11 minutes (Machado et al., 2016). Immersion is only done once, and the body part that is immersed is the lower limb, from the *Spina Iliaca Anterior Superior* (SIAS) to the soles of the feet (Zulkarnain 2014). Prior to immersion and to prevent *shock* due to sudden changes in temperature, the body part of the subject to be immersed is doused with plain water first. To keep the temperature between 11 - 15°C, it will be monitored every minute with a

water temperature thermometer (infrared thermometer). Immersion is carried out in a portable pool with a size of 2 x 3 meters.

Foam rolling

Foam rolling (FR) used measuring 14 × 33 cm (kettler). all participants did massage independently by rolling *Foam rolling* on the quadriceps, hamstrings, *adductor*, *gluteal*, and *gastrocnemius*, each done for 30 seconds.

The procedure in this study is, at the initial stage of the subject, anthropometric data was collected including Age, Height, Weight, and BMI. After that, all participants warmed up for 5-15 minutes and prepared to do a 20 minute x 2 round match simulation without substitutions. *Pre-test* data collection will be carried out post-simulation, where the *pre-test* in question is *posted* after conducting a match simulation which includes taking the lactate levels, vertical jumps, and 20 M sprints. While the *post-test* data collection will be carried out after all players have finished undergoing treatment/recovery in a predetermined time period which includes taking lactate levels, vertical jumps, and 20 M sprints. This is done to see the difference between the two methods of recovery, in order to determine which method is most effective in the recovery process of athletes.

Data Analysis

The data presentation will be displayed in the form of average and standard deviation. The analysis of the significance per group used *one-way one-way* ANOVA test. Meanwhile, to compare the two treatments, *two-way ANOVA was used.* All statistical analysis tests used SPSS version 25 with a significance level ($p < 0.01$ or $p < 0.05$).

RESULTS

The mean (±SD) of age, height, weight, FAT, and BMI of all players did not show any significant difference in the standard deviation (see table 1).

Table 1. Anthropometric data

Variables	Experimental(N=16)		
	Mean (SD)	Min	Max
Age	20.25 ± 1.23	18	22
Height (cm)	168.87 ± 2.02	165	173
Weight (kg)	54.61 ± 1.94	51	57.3
BMI (kg/m^{-2})	19.16 ± 1.01	17.44	20.54

BMI = body mass index

Table 2.Physiology characteristics

Variable	*Cryotherapy* (N = 16)		*Foam rolling* (N = 16)		*P*
	Value-Post-S-P	Post	Post-S-P	Post	
V. Jump	17:24 35.52 ±	34.26 ± 19.67	35.53± 12:40	34.82 ± 0.98	0065
Sprint 20M	3:51 ± 0.23	3.43 ± 0.23	3.47 ± 0.20	3.35 ± 0.15	0.064
Lactate Level	7.98 ± 0.62	2.20 ± 0.48**	8.06 ± 0.45	2.11 ± 0.25**	0.001**

Post-S = Post Simulation, Post-P = Post recovery
*significance $p < 0.05$
**significance $p < 0.001$

The results in table 2 show that the average vertical jump in the two treatments did not show a significant difference (p= 0.065). Furthermore, in the 20 meter sprint variable for the two recovery methods there was also no significant difference (p= 0.819), but the recovery group *foam rolling* experienced a higher increase in sprints when compared to the recovery group *cryotherapy,* respectively (*cryotherapy* -2%, and *foam rolling* -3%). As for the lactate level variable, the two groups showed a significant difference, where after conducting a recovery trial, both groups experienced a significant decrease in lactate levels (p= 0.001).

DISCUSSION

The purpose of this study was to compare the benefits of the two recovery methods, namely *foam rolling* and *cryotherapy* immediately after exercise. This study is the first to compare the two recovery methods for futsal players with the hope that coaches can choose the right method for

their athletes to speed up the post-competition recovery process. The findings in this study provide evidence that *foam rolling* and *cryotherapy* did not improve performance on tests of 20-meter *sprints* and *vertical jumps* in futsal players. However, the recovery method *foam rolling* recovers sprint performance faster when compared to *Cryotherapy*. Furthermore, *foam rolling* can lower the blood lactate concentration better than *Cryotherapy*.

The results of this study support several previous studies (Pelana et al. 2021; Radkin, Azryn, and Moliga 2010; Wiewelhove et al. 2019), which stated that FR had no significant effect on performance improvements such as *Vertical jumps* and 20 Meter sprints immediately after exercise, but FR will see the benefits after 24-48 hours later. Given this phenomenon, we might speculate that FR has no physiological effect on muscle. On the other hand, according to (Phillips et al. 2021) reported that the performance of the pro-agility *test slightly* increased after 1 minute of release *self-myofascial* continuous with *foam roller* in both male and female activities. The study they have done may be different from the result of this research and this is because the protocol in using *foam rolling* in each study is different. The different types of massages *roller*, duration, activity history in the sample, and varying activity levels make for a difference.

Furthermore, the recovery method *cryotherapy* also did not improve immediate post-exercise recovery as measured by 20-Meter jump and sprint performance. This was also conveyed by (Radkin et al. 2010), who stated that there was no significant difference in long-distance running performance after 12 minutes of immersion in cold water at 14 °C. the decrease in the performance of the 20 meter jump and sprint is caused by the water temperature being too cold and the immersion duration being too long so that the athlete feels uncomfortable due to the decreased body temperature, this can make the athlete unable to perform the test *anaerobic* optimally (Cochrane 2004).

An important finding of this study is that both *cryotherapy* recovery method and *foam rolling* method can reduce blood lactate concentrations equally. This study specifically demonstrated that both methods were effective in reducing lactate concentrations after exercise-induced muscle fatigue. Several previous studies revealed that the use of *foam rolling* and *cryotherapy* can induce structural, metabolic, or neural changes that lead to changes in muscle soreness or *delayed onset muscle soreness* (DOMS), decreased edema, increased blood lactate elimination, and better tissue healing, especially due to increased blood flow to the muscles (Casanova et al. 2018; Pearcey et al. 2015).

CONCLUSION

The results of this study show evidence that immediately after exercise, the use of *foam rolling* and *cryotherapy* methods has no effect on physical performance such as jumps and sprints of 20 meters post-exercise, but for foam rolling, the recovery is faster process at 20 meters spins. In addition, both methods can also reduce lactate levels significantly. Thus, we suggest that coaches and sports scientists should recommend *foam rolling* compared to *cryotherapy* to their athletes after training sessions or matches in futsal.

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