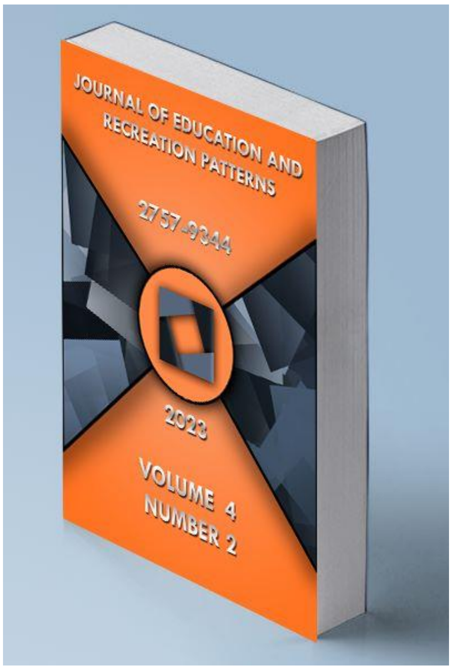

Journal of Education and Recreation Patterns (JERP)

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To cite this article:

Aslan, T.V. & Kahraman, M.Z. (2023). The effect of myofascial release technique applied with foam roller on jumping, flexibility, and short distance swimming performance in swimmers. *Journal of Education and Recreation Patterns (JERP), Vol 4* (2), 653-666. DOI: https://doi.org/10.53016/jerp.v4i2.193

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Journal of Education and Recreation Patterns (JERP)
Volume 4, Issue 2, Year 2023 ISSN: 2757-9344

The Effect of Myofascial Release Technique Applied with Foam Roller on Jumping, Flexibility and Short Distance Swimming Performance in Swimmers

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ARTICLE INFORMATION
Original Research Paper

Received 03.09. 2023
Accepted 18.10. 2023

https://jerpatterns.com

December, 2023

Volume: 4, No: 2

Pages: 653-666

ABSTRACT

Myofascial release techniques, particularly when applied using foam rollers, have gained prominence in sports science due to their potential benefits in enhancing athletic performance. This study delves into the impact of this technique on swimmers, a group where flexibility, jump capacity, and short-distance speed are paramount.The research engaged 12 male swimmers, all of whom had been active in the sport for a minimum of three years. Their average age stood at 19.58±.66 years, with an average height of 176.83±8.49 cm and body weight of 75.43±6.62 kg. Following a 5-minute low-intensity warm-up run, participants underwent 10 minutes of dynamic stretching exercises targeting major muscle groups involved in swimming. This was followed by a self-myofascial release (SMR) protocol using foam rollers, focusing on muscle areas most prone to tension and strain in swimmers. These protocols were applied consecutively at 48-hour intervals and at consistent times of the day to ensure uniformity.Post-protocol assessments revealed varying impacts on performance metrics. While the countermovement jump measurements remained statistically unchanged (p>0.05), significant improvements were observed in the 15 m swimming (t: 2,307, p: ,041), squat jump (t:,-2,541, p:,027), and flexibility (t:-2,491, p:,030) tests (p<0.05).These findings underscore the potential of integrating myofascial release techniques with foam rollers into swimmers' training regimens. Not only does this approach enhance specific performance parameters like squat jump and flexibility, but it also offers broader implications for the athletic community, emphasizing the importance of muscle relaxation and flexibility in achieving peak performance. Future research could delve deeper into the long-term impacts of such techniques and explore their efficacy across different athletic disciplines.

Keywords: Flexibility, Foam roller, Jumping, Myofascial Release, Swimming

INTRODUCTION

Swimming is one of the sports branches that is performed in water and provides the best development of physical capacity. While it is preferred by all age groups, it provides good cardiovascular endurance without the need for physical activities and weight training that cause stress on the skeletal-muscular system (Çelebi, 2008). However, the pressure in the water has an effect on breathing that makes breathing difficult, so the energy required to swim a distance is four times the energy required to run the same distance (Odabaş, 2003). In swimming, the arms and legs move by pushing against the passive resistance of the water. In swimming, the resistance of the water against the driving force and the difficulty of oxygen intake in the water environment cause more energy expenditure compared to other sports (Maglischo, 1993). In other words, the most important feature that distinguishes swimming from other sports is the energy spent to move horizontally in water. Since friction prevents movement, it is tried to be minimised. It is known that the energy required is much more than other sports due to the fact that water makes breathing difficult with the effect of pressure (Günay, 2008). At this point, recovery practices are very important for sportive performance.

Self-myofascial release (SMR) is an intensive self-treatment with rigid foam rollers (FR) and other small hand tools based on the application of compressive force on soft tissue (Macdonald et al. 2014). Fascia acts as a support, stability and cushioning mechanism for bones and muscles and surrounds many different organs and muscles (Barnes, 1997). Muscle fascia has been found to aid muscle mobility, cellular circulation in the body and muscle flexibility and it is vital that the fascia is loose and malleable (Aboodarda et al., 2015). Injuries, inflammation, overuse (training, competition, etc.) cause disruption of the fascia structure and dehydration of the fascia. The deterioration in the structure of the fascia leads to decreased flexibility and loss of range of motion and performance (Cheatham, 2015).

Recently, myofascial release technique (MFR) has become an increasingly preferred technique, especially among sports scientists and trainers. MFR, a technique used in manual therapy, is used as an effective application to reduce pain and increase function by creating low load, long stretching in the myofascial complex and restoring optimal length (Ajimsha et al., 2015). MFR techniques provide soft tissue formation by relaxing the tense connective tissues (Prentice, 2003). In this technique, a cylinder is usually used in which a person puts his/her body on the FR (foam roller) and moves it back and forth to apply pressure to the fascia surrounding the muscles. This relaxes the fascia (Curran et al., 2008; Healey et al., 2014; Renan-Ordine et al., 2011). Self-myofascial release technique is a technique applied to restore the appropriate tension of tissues, increase their flexibility (Bradbury-Squires et al., 2015; Halperin et al., 2014; Macdonald et al., 2013; Mauntel et al., 2014), eliminate trigger points (Barnes, 1997; Schleip, 2003) and increase muscle recovery after exercise (Cheatham et al., 2015; MacDonald, et al., 2014; Weerapong et al., 2005).

The most important feature of the myofascial release technique, which is widely used among athletes before exercise, is the increase in flexibility without a decrease in anaerobic power performance (Renan-Ordine et al., 2011). Flexibility has an important place in sports in order to reach the desired motoric power and constitutes the basic element of training. Decreased flexibility prevents the movement from being fast and efficient. Many studies reveal that flexibility is one of the most important parameters affecting swimming performance and anaerobic muscle performance in swimming (Keleş, 2016; Shrier, 2004; Zakas et al., 2003). Flexibility can affect the reduction of foot strike time by enabling the swimmer to increase speed. This improvement is realised by increasing the applied force in terms of distance and level. To improve swimming performance, it is important to improve shoulder, spine, knee and ankle flexibility (Güler, 2000). Improving ankle flexibility in swimmers can also be effective in improving performance (Škarabot et al., 2015). Flexibility is also important to prevent injury.

The continuous repetition of movements in swimming creates tension in the muscles and these tensions can lead to injuries. For this reason, it is stated that it will be beneficial to include swimmers to perform static flexibility exercises after dynamic training before training while arranging the training programme (Geyik, 2019; Uçak, 2019).

In this direction, due to the relatively small number of studies on myofascial release technique applied with foam rollers and the lack of consensus in the studies, it is thought that our study will be useful in enlightening the mechanism of action of foam roller application in terms of its effects on sportive performance, and at the same time, it will be useful in terms of creating an infrastructure by shedding light on other scientific studies on fascia techniques within manipulative treatments. In the study, it was aimed to investigate the effect of myofascial relaxation technique applied with foam rollers on jumping, flexibility and short distance swimming performance in swimmers.

METHOD

Participants

The study group consisted of 12 male swimmers who had been swimming for at least three years, had an average age of 19.58±.66 (years), height 176.83±8.49 (cm), and body weight 75.43±6.62 (kg) (Table 1). In order to be included in the study, swimming athletes must have the following characteristics: (a) have at least 3 years of experience in swimming; (b) not have any functional limitations that may affect test performance; (c) not have any medical condition that may affect the tests; (d) maintain regular physical activity during the study period. All athletes were informed about the requirements and risks of the study and signed an informed consent form stating that they voluntarily participated in the study. Participants were also asked to sleep for 7-8 hours before the tests. The study was initiated after the approval of Muş Alparslan University Scientific Research and Publication Ethics Committee (05.06.2023-95181) and was conducted in accordance with the Declaration of Helsinki. All tests and exercise practices were performed at the same time of the day (09.00-11.00).

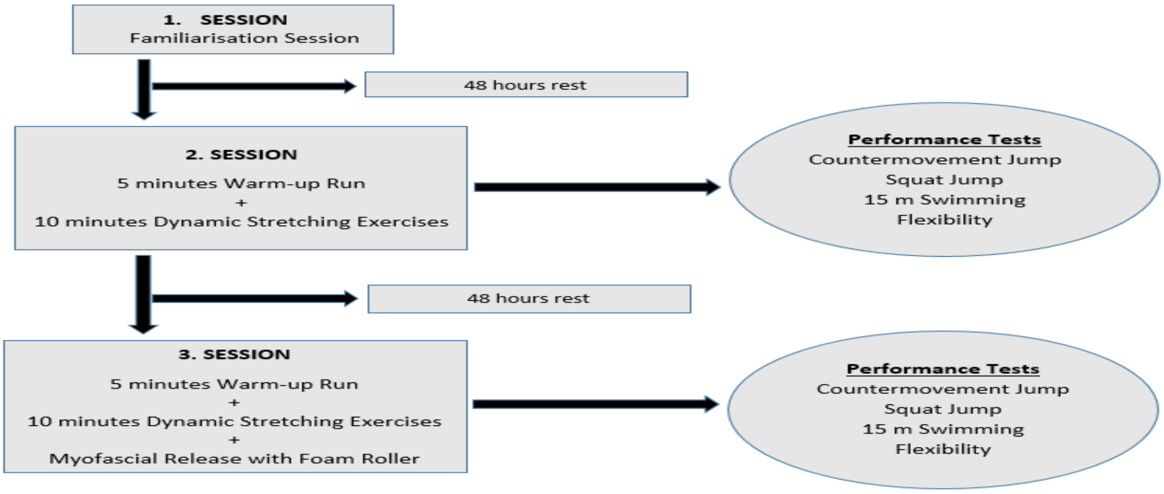
Table 1. Descriptive Statistics Table of Athletes Participating in the Study

Parameters	N	x̄±Sd.
Age (year)	12	19.58±.66
Height (cm)	12	176.83±8.49
Body Weight (kg)	12	75.43±6.62

Experimental Design of the Study

This study consists of a single group of twelve male swimming athletes and there is no control group. Prior to data collection, all swimmers were recruited to a familiarization phase session in which they practiced stretching exercises and a self-myofascial release technique and test parameters. This familiarization session was designed to minimize learning effects caused solely by the mechanics of performing the study protocols. In the second session of the study, participants performed a 5-minute low-intensity warm-up run at an average heart rate of 120 beats/min followed by 10 minutes of dynamic stretching (DS) exercises targeting the major muscle groups involved in swimming (Table 2). Then, jumping (Countermovement Jump (CMJ), Squat Jump (SJ)), 15 m swimming and flexibility performance tests were performed. In the third session, the athletes underwent the same protocol as in the second session plus self-myofascial release (SMR) with a foam roller focusing on the muscle areas most prone to tension and strain in swimmers. These protocols were applied consecutively at 48-hour intervals and at consistent times of the day (09.00-11.00) to ensure uniformity. The same tests were performed again after the last session and the measurement results were compared with each other after both applications (Figure 1).

Figure 1. *Experimental Design Diagram*



Dynamic Stretching Exercise Protocol

In the second session of the study, participants performed a 5-minute low-intensity warm-up run at an average heart rate of 120 beats/min followed by 10 minutes of dynamic stretching (DS) exercises targeting the major muscle groups involved in swimming (Table 2). The heart rate (HR) values of the athletes during the 5-minute warm-up run were monitored using Polar brand H10 (Polar Electro, Finland) model chest bands and IOS Polar Team application using a tablet. In dynamic stretching exercises consisting of 10 different movements performed between two 15 m lines, 1 movement lasted 1 minute. At the beginning of the 15 m line, the movement was started, the movement was continued for 20 seconds (s), the end of the line was reached and after resting on the line for 10 (s), the same movement was repeated. When returning to the starting line, after resting for 10 seconds, the second movement was started and 10 different movements were applied in this way (Çolak & Çetin 2010).

Table 2. Dynamic Stretching (DS) Exercises

DS Exercises	Description	10 min
High Knee Run	Knees are pulled to the chest and arms are waved while running.	1 min
Butt Kick	The heels touch the hips and run with running steps.	1 min
Power Skip	One leg is jumped with running steps and the knee is pulled up. Arms join the movement rhythmically.	1 min
Straight Leg Kick	With walking steps, the hands are kept parallel to the front and the toes of the feet touch the hands without bending the knees.	1 min
Carioca	With running steps, the right foot is taken diagonally in front of the left foot. Then the left foot takes a step, and the opposite of the same movement is done and the movement is continued in this way.	1 min
A- Skip	Knees are pulled to the chest with running steps. Arms are rhythmically folded and progress with light jumps.	1 min
B- Skip	In addition to the A-skip, the legs are swung straight forward after the knees are pulled to the chest.	1 min
Walking Lunge	Step forward with walking steps and move forward with the knee of the back leg touching the floor.	1 min
Rapid high knees	Fast knee is pulled to the abdomen with running steps.	1 min
High knees pull	When walking, one knee is pulled up while the arms are moved down.	1 min

Foam Roller Protocol

Myofascial relaxation technique with foam roller was applied to hamstring, quadriceps, gluteal and gastrocnemius muscles by the participants themselves (Grid Foam Roller). For each selected muscle group, the athlete was asked to move from the starting point to the end point of that muscle region by applying pressure with their own body weight. The protocol was applied for 30 seconds (s) for each muscle group and once for each region. There was a 15 s transition time between the two exercise applications. Each technique was performed bilaterally with no rest period when changing limbs.

Data Collection Tools

Height Measurement: The height of the participants was measured with SECA brand height meter with bare feet.

Body Weight Measurement: The body weights of the individuals participating in the study were measured with Tanita BC 730 Body Analysis Scale with bare feet, wearing only shorts and t-shirt.

Countermovement Jump Test (CMJ): The athlete was informed that he/she should stand on the jumping mat and keep his/her hands on his/her waist during the jump. While the athlete was standing in an upright position with hands on waist, he/she first squatted 90 degrees to the squat position and suddenly made a vertical jump at any time. The CMJ of the athletes was measured with an electronic jump mat (Smart Jump; Fusion Sport, Australia). Each athlete was given enough rest time (3 minutes) between repetitions and two trials were performed; the higher performance was recorded (Gezer, 2020).

Squat Jump Test (SJ): When performing the SJ test, arm swing will not be allowed as in the countermovement (CMJ) test. The athlete made a squat jump at a time of his/her choice while waiting with his/her hands on the waist and knee bent 90 degrees. Each athlete was given enough rest time (3 minutes) between repetitions and two attempts were made and the higher performance was recorded. SJ measurements of the athletes were measured with an electronic jump mat (Smart Jump; Fusion Sport, Australia) (Gezer, 2020).

Flexibility Test: A sit and reach bench measuring 35 cm long, 45 cm wide, by 32 cm high was employed in the sit and reach test to measure the flexibility of the hamstring and back muscles. The athletes stood with the soles of their feet on the bench and reached forward as far as they could reach without bending their knees; the distance reached was recorded in centimeters. The test was repeated, and the better result was accepted as the flexibility value (Hopkins, 2000).

15- meter Swimming Test: The 15 m swimming test measurements of the athletes were performed in a semi-Olympic indoor swimming pool with a water temperature of 27 ^{o}C, pool dimensions of 25 × 12.50 m and an ambient temperature of 30 ^{o}C. The participants were asked to complete the 15 m distance as soon as possible after the exit command using the freestyle swimming method. A 'Seiko' brand stopwatch was used in the measurements of the participants in the 15 m swimming performance and their degrees were taken.

Statistical Analysis

SPSS 22.0 package programme was used for statistical analysis of the data. Normality levels of the data were determined by Shapiro-Wilk test. Parametric tests were preferred in the analysis of normally distributed data. Paired Sample T Test was used in the evaluation of in-group changes before and after the application, and the significance level was accepted as 0.05 in statistical comparisons. Effect sizes (ES) of mean differences were determined using Cohen's d-test and effect sizes were categorized according to Hopkins scale: 0.0-0.2 = insignificant; 0.2-0.6 = small; 0.6-1.2 moderate; 1.2-2.0 = large; > 2.0 = very large (Hopkins et al., 2009).

FINDINGS

In this part of the study, the findings of the research examining the effect of myofascial relaxation technique applied with foam rollers on jumping, flexibility and short distance swimming performance are presented.

Table 3. Paired Sample t-Test Results Regarding the Performance Abilities of the Study Group

Parameters	Group	n	x̄± Sd.	t	p	ES
15- m Swimming (sec)	DS	12	7.87±1.13	2.307	**.041***	0.29
	DS+SMR	12	7.54±1.09			
Countermovement Jump (CMJ) (cm)	DS	12	33.49±3.80	-.306	.765	-
	DS+SMR	12	33.71±3.91			
Squat Jump (SJ) (cm)	DS	12	31.39±2.85	-2.541	**.027***	0.34
	DS+SMR	12	32.35±2.72			
Flexibility (cm)	DS	12	27.37±5.61	-2.491	**.030***	0.28
	DS+SMR	12	28.83±4.62			

*P<0,05, DS: Dynamic Stretching, SMR:Self-Myofascial Release, sec: second, cm:centimetres ES: Effect Size

Performance values of different protocols are presented in Table 3. When Table 3 is analyzed, it is seen that there is no statistical difference between the countermovement jump measurement values of the group in which myofascial release technique was applied in addition to dynamic exercises (p>0.05), while there is a statistically significant difference between the 15 m swimming (t: 2.307, p: .041), squat jump (t: -2.541, p: .027) and flexibility (t: -2.491, p: .030) measurement values (p<0.05). 15 metre swim (Cohen's d=0.29), Squat jump (Cohen's d=0.34) and Flexibility (Cohen's d=0.28) values, the significant difference effect size was found to be at a small level.

DISCUSSION

This study was conducted to determine the effect of myofascial release technique applied with foam rollers on swimmers' jumping, flexibility and short distance swimming performance parameters. Myofascial release is a form of manual soft tissue therapy used to treat somatic dysfunction leading to pain and limitation of movement. The self-myofascial release (SMR) technique uses a stick (Mikesky et al., 2002), foam roller (Macdonald et al., 2013) or roller massager (Sullivan et al., 2013) to massage one's own muscles. To demonstrate the effect of SMR, studies have focussed on how foam rolling affects range of motion (ROM), muscle soreness and lower limb biomechanical performance. Thus, the first effect is associated with recovery, while the second effect is associated with performance (Laffaye, 2019).

When the research findings were analysed, it was determined that there was no statistical difference between the countermovement jump measurement values with myofascial release technique, but there was a statistically significant difference between the 15 m swimming, squat jump and flexibility measurement values. According to these findings, it was determined that myofascial release technique using foam rollers in combination with dynamic stretching improved 15 m swimming performance and increased squat jump and flexibility values.

Flexibility can be defined as the ability of body tissues to reach full range of motion (ROM) without any injury to joints or groups. Range of motion is regulated by the proper extension of all soft tissues surrounding the joints (Heyward, & Gibson, 2014; Thacker et al., 2004). The main role of flexibility is to reduce the risk of injury. Appropriate muscle flexibility increases the ability to move joints through the highest possible range of motion. Furthermore, flexibility exercises or techniques used before a main training activity can improve physical performance, especially muscle strength. This is achieved by increasing the utilisation of elastic strain energy during the performance of movements (Shivalingaiah et al., 2016). One technique whose aim is to increase the flexibility of soft tissues is myofascial release (MFR). Myofascial release is based on manual therapy and helps to reduce restrictions or adhesions within the fascial tissue layers (Barnes, 1997). Laffaye et al. (2019) examined the effect of self-myofascial release with foam rolling on recovery after high-intensity intermittent exercise and found that self-myofascial release reduced delayed onset muscle soreness (DOMS) by 50%, increased hip range of motion by approximately 4.2%, and may be useful for reducing DOMS after high-intensity interval training. Le Gal et al. (2016) examined the effects of self-myofascial release in adolescent tennis players and found that self-myofascial release of the infraspinatus and pectoralis muscles 3 times a week for 5 weeks improved the dominant glenohumeral internal rotation range of motion in tennis players and can be used as a strategy to maintain the mobility of this joint. Pożarowszczyk et al. (2018) found that the use of foam rollers (8-10 repetitions to the back group leg, back and neck muscles, total 15 min) acutely increased trunk flexibility (fingertip contact distance test-metric measurement) in 12 swimmers aged 14 years but did not change muscle tone and stiffness in the muscles where the application was performed. Škarabot et al. (2015) examined the effects of static stretching and foam roller exercise models on ankle range of motion in 11 trained adolescent swimmers. The researchers found that each combination of static stretching, foam roller and foam roller static stretching applied to plantar flexor muscle groups (30 seconds x 3 sets of 10 seconds rest between sets) was effective in the acute increase of passive ankle dorsiflexion range of motion. Mazzei (2019) reported that the use of vibrating and non-vibrating foam rollers (30sec x 3set to calf muscles, 15sec rest between sets, metronome 30bpm, dominant leg) increased the flexibility of plantar flexor muscle groups in female university swimmers (18-23 years).When literature studies are examined, there are many studies similar to our research findings showing that myofascial release technique acutely increases flexibility (MacDonald et al, 2013; Sullivan et al, 2013, Roylance et al, 2013, Jay et al, 2014, Halperin et al, 2014, Bradbury-Squires et al, 2015, Peacock et al, 2014 , Grieve et al, 2015). In this context, in our study, it was observed that the group in which myofascial relaxation was applied showed more improvement in flexibility values compared to the group that was not applied. The results obtained are consistent with the aforementioned research and point to the positive effect of the technique on muscle flexibility.

When the 15 m swimming performances of the participants were examined, it was determined that the 15 m swimming degrees of the group with myofascial application were better than the group without myofascial application. In studies investigating the effects of myofascial relaxation method on the vascular system, it was found that the amount of nitric oxide in the blood increased after the application of pressure by the baroreceptors in the vessel through the central nervous system, and as a result of this increase, the vessel wall allows 256 times more blood flow to pass through the vessels based on Poiseuille's law (Hall et al., 2011; Okamoto et al., 2014). In one of the studies supporting our study, it was reported that ankle internal rotation range of motion (ROM) was highly correlated with maximal performance in frog swimming style (Kippenhan, 2002). In the other study, the combination of knee external rotation and ankle supination flexibility improved 100 m breaststroke results by 24.4% (Jagomägi & Jürimäe, 2005). In the study of Ekmekci (2020), which examined the effect of foam roller application on flexibility and swimming performance values in swimming branch, it was stated that myofascial relaxation method made significant positive contributions to the performances of swimmers compared to dynamic warm-up from classical warm-up methods. Between the pre-test and post-test values of the experimental group, 3,88% in 50 m freestyle, 7,3% in 50 m backstroke, 14,81% in 50 m frog style, 8,90% in 50 m butterfly style and 17,36% in sit - lie flexibility test were found to improve positively. Our results coincide with the findings in the literature. It is thought that with the positive increase in flexibility values, the range of motion of the joints improves positively and this contributes to the swimmers' better reaching and better application of branch-specific techniques. As a matter of fact, this difference arising from myofascial release technique contributed to the 15 m swimming degrees of the myofascial application group to be at better levels compared to the non-myofascial application group. Therefore, it can be said that myofascial release method improved the performance of the swimmers.

One of the best physical performance indicators is the vertical jump, which directly corresponds to strength and power (Maulder & Cronin, 2005; Morin & Samozino, 2018). Also, Civan, Karhan & Civan (2022), athletes' parameters like vertical jump, anaerobic power, and explosive strength can benefit from an 8-week plyometric training program that is regularly planned and structured. These parameters are reliable predictors of performance in many sports. Richman et al. (2019) showed that there was an improvement in squat jump (SJ) performance parameters after myofascial release application. Peacock et al. (2014) examined the effects of self-myofascial relaxation techniques on performance and found that the programme combined with myofascial relaxation techniques improved jump performance compared to dynamic warm-up. Dynamic stretching + vibrating foam roller application (28 Hz, 20 s × 1 set on bilateral rotator cuff, quadriceps femoris, hamstrings, gastrocnemius, and back muscles) significantly increased active vertical jump height, agility, and knee extension ROM and decreased quadriceps muscle stiffness in university badminton athletes (Lin et al., 2020). In another study, it was reported that foam roller exercises significantly increased depth jumps and hip strength in college volleyball players (Tsai et al., 2021). In another study in which myofascial relaxation techniques were examined, it was stated that foam roller application increased jumping and flexibility performances (Sağıroglu, 2017). In a study similar to our research results conducted by Yıldız et al. (2018), it was determined that flexibility values increased significantly more after vibrating foam roller application (26.40±4.38cm vs. 23.00±3.91 cm, $p < 0.05$). The results of the literature and our research findings support each other. When the literature studies and our study were compared, it was determined that there were similar results as well as results that were not similar to our study. MacDonald et al. (2014) investigated the effect of foam rolling of the thigh and hip muscles on vertical jump after 0, 24, 48 and 72 hours and found that vertical jump did not acutely increase after FR intervention. It can be stated that the reason for these differences may be due to variables such as the content of the exercise model applied with foam roller (frequency, duration, vibration speed, muscles to be applied and hardness/softness of the materials to be used). However, the lack of an optimal protocol for foam roller exercise models and the selection of participants (students, recreationally active adults, elite athletes, and child athletes) may be another important factor in the differences between the results of the studies. At the same time, it is possible that the expected performance improvement in range of motion and performance kinematic components may not have been achieved due to the inability to apply sufficient and equal pressure on the muscle during foam roller exercises and the difficulty in standardizing the pressure during the application.

Conclusion

In conclusion, acute warm-up with myofascial release in addition to dynamic exercises improved squat jump, flexibility and swimming performance test results compared to acute dynamic warm-up without myofascial release. These findings underscore potential of integrating myofascial release techniques with foam rollers into swimmers' training regimens. Not only does this approach enhance specific performance parameters like squat jump and flexibility, but it also offers broader implications for the athletic community, emphasizing the importance of muscle release and flexibility in achieving peak performance. Therefore, incorporating foam rolling into dynamic warm-up may be a useful method to improve physical performance and can be considered when implementing efficient training routines.

Limitations

Future studies that will determine the effects of different myofascial relaxation types and durations on different sports performance parameters of different sports types will provide important contributions to sports performance. At the same time, future research may investigate the long-term effects of such techniques in more depth and explore their effectiveness in different athletic disciplines.

Recommendations

The fact that male swimmers participated in this study can be considered as a limitation. Therefore, future studies should include evaluations that allow comparison of the effect of myofascial release technique on the performance of different groups. In addition, since our research was designed to reveal acute effects, it cannot be generalized for chronic effects. With this approach, the chronic effects of foam roller protocols on land and water performance can be examined in future studies with research models covering a long period of time.

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Author(s)' statements on ethics and conflict of interest

Ethics statement: We hereby declare that research/publication ethics and citing principles have been considered in all the stages of the study. We take full responsibility for the content of the paper in case of dispute.

Conflicts of Interest: There are no conflicts of interest declared by the authors.

Funding: None