SPORMETRE
The Journal of Physical Education and Sport Sciences
Beden Eğitimi ve Spor Bilimleri Dergisi

DOI: 10.33689/spormetre.1257402

Geliş Tarihi (Received): 01.03.2023 Kabul Tarihi (Accepted): 02.09.2023 Online Yayın Tarihi (Published): 30.09.2023

ACUTE EFFECTS OF FOAM ROLLER ON PERFORMANCE IN ELITE VOLLEYBALL PLAYERS

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Abstract: The aim of this study is to examine the acute effects of foam roller on performance after static and dynamic stretching exercises in elite volleyball players. A total of 8 male athletes with age average of 19.3±0.39 participated in the study voluntarily. The participants' performance evaluations were carried out on two separate days, after stretching with stretching exercises and after foam roller exercise in addition to stretching with stretching exercises. 30 m sprint and agility performance of the participants were measured with a Smart Speed photocell. Flexibility measurements of the participants were performed with a standard sit-reach bench. A Smart Jump contact mat was used for active and multiple jump measurements of the participants. The data analysis was performed with SPSS 23.0 package program at 95% confidence interval ($p<0.05$). The assessment of the difference between different stretching protocols was evaluated with the Wilcoxon Signed-Rank test. **N**o statistically significant difference was found between Static-Dynamic stretching and Static-Dynamic stretching combined Foam Roller protocols in terms of sprint ($z=-0.702$, $p=0.48$), agility ($z=-1.4$, $p=0.16$), flexibility ($z=-0.422$, $p=0.67$), and anaerobic power ($z=-0.28$, $p=0.78$) parameters. **Conclusion:** It can be concluded that foam roller exercises in addition to static-dynamic stretching do not affect performance in elite volleyball players.

Key Words: Foam Roller, Dynamic Stretching, Static Stretching, Volleyball, Flexibility

FOAM ROLLER UYGULAMASININ ELİT VOLEYBOLCULARDA PERFORMANSA AKUT ETKİLERİ

Öz: Bu çalışmanın amacı, elit voleybolcularda statik ve dinamik germe egzersizleri sonrası köpük rulonun performans üzerindeki akut etkilerini incelemektir. Çalışmaya yaş ortalamaları 19,3±0,39 olan toplam 8 erkek sporcu gönüllü olarak katılmıştır. Katılımcıların performans değerlendirmeleri, germe egzersizleri ile ısınma sonrası ve germe egzersizleri ile ısınmaya ek foam roller uygulaması sonrası olarak iki ayrı gün gerçekleştirilmiştir. Katılımcıların 30 metre sürat ve çeviklik performansı Smart Speed fotosel ile ölçülmüştür. Katılımcıların esneklik ölçümleri standart otur-eriş sehpahası ile yapılmıştır. Katılımcıların aktif ve çoklu sıçrama ölçümlerinde Smart Jump kontakt mat kullanılmıştır. Verilerin analizi SPSS 23.0 paket programı ile %95 güven aralığında yapılmıştır ($p<0.05$). Farklı ısınma protokolleri arasındaki farkın değerlendirilmesi Wilcoxon Signed-Rank testi ile değerlendirilmiştir. Yapılan değerlendirmede, Statik-Dinamik ısınma ve Statik-Dinamik ısınma ile kombine Foam Roller protokolleri arasında sürat ($z=-0.702$, $p=0.48$), çeviklik ($z=-1.4$, $p=0.16$), esneklik ($z=-0.422$, $p=0.67$) ve anaerobik güç ($z=-0.28$, $p=0.78$) parametrelerinde istatiksel açıdan anlamlı bir farklılık bulunmamıştır. **Sonuç:** Statik-dinamik ısınmaya ek olarak uygulanan foam roller egzersizlerinin elit voleybolcularda fiziksel performansı etkilemediği söylenebilir.

Anahtar Kelimeler: Foam Roller, Dinamik Germe, Statik Germe, Voleybol, Esneklik

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INTRODUCTION

Atheletes commonly use static stretching and dynamic stretching as a warm-up or cool-down routine (Ebben et al., 2005). Static-dynamic streching increases body temperature, improves the coop-eration and coordination of the muscles, and has positive psy-chological effects such as enhanced readiness and mood for exercise (Bishop, 2003; Bishop, et al., 2013; Keskin et al., 2021). Also, stretching has been proven to prevent muscle stiffness, reduced the risk of injuries and improved performance (Behm et al., 2015; Kisner, et al., 2017). Moreover, it is discussed that various stretching methods may have different effects on athletes' performances (Birinci et al., 2022).

Static stretching exercises are performed by waiting a time at the point where the tension the joint (Bushman, 2011). On one hand, static stretching exercises can have a positive effect on flexibility performance. On the other hand, they cause a decrease in production in the muscle and therefore negatively affect performance in terms of muscle strength and endurance (Amiri and Kellis, 2013; Çakmak, 2021; Polat et al., 2019;).

Dynamic stretching exercises are performed by repeating a movement throughout the joint range of motion (Heyward & Gibson, 2014). Dynamic stretching exercises are thought to increase power production, unlike static stretching exercises (Harda et al., 2008). Moreover, dynamic stretching exercises can positively affect performance in parameters such as sprint and agility (Akkaya and Çolak, 2020; Kafkas et al., 2018; Polat et al., 2019). Static and dynamic stretching is one of the important strategies muscle strength and sprint performance (Rishal and Rishal, 2019).

The foam roller, which has become very popular in recent years, can be defined as self-massage (Saç et al., 2018). The foam roller is a cylindrical device in different sizes and degrees of hardness (Morey et al., 2014). Foam roller exercises are used to activate stretching methods, enhance performance, and accelerate recovery (Baumgart et al., 2019). Foam rolling exercises have positive effects on flexibility, sprinting, and agility performance. Foam rolling exercises are reported to have positive effects on flexibility, sprinting, and agility performance, but do not adversely affect muscle strength (Su et al., 2017; Yıldız et al., 2018). Studies show that foam rolling exercises contribute more positively to joint range of motion and peak maximal power output than static and dynamic stretching exercises (Behara and Jacobson, 2017; Su, 2017). Another study also states that foam rolling exercises in addition to dynamic stretching exercises provide more positive results in squat jump and countermovement jump test scores (Beyleroğlu, et al., 2021). In addition, foam rolling exercises are found to have the potential to contribute positively to sprint, agility, and strength performance test scores (MacDonald, 2013; Peacock, 2014).

In this context, the purpose of this study is to investigate the acute effects of Foam Roller in combination with dynamic stretching on the performance of elite volleyball players.

METHOD

The study consisted of two days with a 72-hour interval. The measurements were taken at 11:00 a.m. on the day that the athletes did not train, they were asked to have breakfast at least 90 minutes before the measurements, and then the athletes were included in the test. The study was approved by the Karabuk University Non-Interventional Ethics Committee with the date 07.11.2022 and the number 2022/1197. After the participants were given general information

about the study, their statements that they accepted to participate in the study on a voluntary basis were obtained with the "Informed Consent Form for Study for Research Purposes".

Study Group

A total of 8 male athletes with age average of 19.3±0.39 participated in the study voluntarily. The athletes participating in the study were informed about the aim and content of the study at the beginning of the study, and voluntary consent forms were obtained from the volunteer athletes.

Study Design

The study consisted of two days with a 72-hour interval. On the first day, the athletes were tested for flexibility, sprint, agility, and jumping, respectively, after performing static-dynamic stretching exercises, after 10 minutes of low-tempo jogging (5 km/s). On the second day, after 10 minutes of low-tempo jogging, the athletes performed static-dynamic stretching exercises combined with foam roller exercises, and then they were tested for flexibility, sprint, agility, and jumping, respectively. Measurements were taken 5 minutes after the warm-up protocol was completed.

Static and Dynamic Stretching Protocol

After 10 minutes of low-tempo jogging, as seen in figure 1, standing wall calf stretches, standing quadriceps stretches, standing hamstring stretches, and seated gluteus maximus static stretching exercises were performed respectively for 2x30 seconds with 10 seconds of passive rest between sets (Unick et al., 2005) (Figure 1). After static stretching exercises, as seen in figure 2, dynamic stretching movements of high knees, walking pigeon, butt kickers, skips, leg swings, and open hips were performed for 1x20 seconds for each leg (Beyleroğlu et al., 2021) (Figure 2).

Exercise	Set x Seconds (For each leg)
Standing Wall Calf Stretches	2x 30 sec
Standing Quadriceps Stretches	2x 30 sec
Standing Hamstring Stretches	2x 30 sec
Seated Gluteus Maximus Stretches	2x 30 sec

Figure 1: Static Stretching Exercises

Exercise	Set x Seconds (For each leg)
High Knees	1x 20 sec
Walking Pigeon	1x 20 sec
Butt Kickers	1x 20 sec
Skips	1x 20 sec
Leg Swings	1x20 sec
Open Hips	1x20 sec

Figure 2: Dynamic Stretching Exercises

Static, Dynamic and Foam Roller Stretching Protocol

As seen in figure 3, foam roller exercises were performed after static and dynamic stretching exercises. A 36-inch foam roller was applied to both sides of the hamstrings, quadriceps,

gluteus, and gastrocnemius muscles for 2 x 30 seconds with 10 seconds of passive rest. The athletes were given a 30-second rest period between the exercise sets (Sagiroglu, I., 2017).

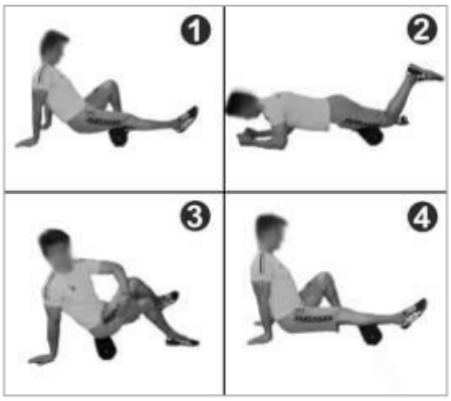

Figure 3: Foam Roller Stretching Exercises (Sagiroglu, I., 2017).

Data Collection Methods

Height (cm): A stadiometer with a sensitivity of 0.01 m. was used for the height measurements of the athletes. The athletes stood barefoot on the floor, knees were in full extension position, heels were placed together, and the body was in the upright position, and the degrees were recorded (cm).

Body Analysis: The body composition values of the athletes were measured with an InBody-270 device, a bioimpedance analyzer with a sensitivity of 0.01 kg. In a body composition analysis, besides measuring the fat for each part of the body separately by sending a slight electrical current to the body through the electrodes in contact with the hands and feet, bone ratio, body water, and muscle mass are also measured with great precision (Mor et al., 2019).

Sprint (s): The sprint performances of the athletes were measured with a Smart Speed Pro brand photocell installed between 0-30 m in the gym. The beginning was made 1 meter behind the photocell. Two measurements were made with an interval of 3 minutes and the best score was recorded (Bompa, T. O. & Haff, G. G., 2015)

Vertical Jump and Multiple Jump: Jumping performance measurements of the athletes were made with a Smart Speed Jump contact mat. In the active jump measurements, the athletes quickly got down from the knees and jumped vertically, with their hands on their waists, their knees fully extended and in an upright position. In the multiple jump measurements, the athletes tried to reach the maximal height for 15 seconds with their hands on their waists and knees at 90 degrees during the squat. 2 measurements were taken at 3-minute intervals and the best value was recorded.

Flexibility Test (cm): A sit-reach flexibility bench was used to measure the flexibility performance of the athletes. The athletes sat on the ground, stretched their legs, leaned their soles against the front of the bench, stretched their arms as far as possible on the meter on the upper surface of the bench, and waited for a few seconds at the last point where their fingertips touched. The last point of contact on the meter was determined and recorded in cm. If the participant's legs were bent before or during the waiting, the measurement was deemed invalid and repeated when the contact with the ground was lost.

Agility (s): A T-agility test parkour was used to measure the agility performance of the athletes. The duration of the parkour was measured with a Smart Speed Pro brand photocell. The start was made 1 meter behind the photocell. Two trials were made, and the best value was recorded.

Statistical Analysis: The statistical analysis of the data obtained in the study was made using the IBM SPSS 23 package program. The Wilcoxon Signed-Rank test was used to evaluate the difference between different stretching protocols. The significance level was interpreted as $p<0.05$.

FINDINGS

Table 1. The mean and standard deviation values of the descriptive characteristics of the participants (n=8)

Parameters	Mean±SD
Height (cm)	185.1±1.19
Body Weight (kg)	71.2±3.59
BMI (kg/m^2)	20.7±0.97
Body Fat Percentage (%)	10.4±2.07
Body Muscle Mass (kg)	35.9±1.33

Table 2. Comparison of sprint, agility, and flexibility means of the participants after different stretching protocols (n=8).

Parameters	Static-Dynamic Stretching	Static-Dynamic Stretching Foam Roller	z	p
	Mean±SD			
Sprint (sec)	4.55±0.13	4.58±0.12	-0.70	0.48
Agility (sec)	10.5±0.23	11±0.25	-1.40	0.16
Flexibility (cm)	39.2±2.23	39±2.51	-0.42	0.67

***p<0.05**

No statistically significant difference was observed in sprint, agility, and flexibility parameters between Static-Dynamic and Foam Roller stretching protocols ($p>0.05$).

Table 3. Comparison of vertical jump means of the participants after different stretching protocols (n=8).

Parameters	Static-Dynamic Stretching	Static-Dynamic Stretching Foam Roller	z	p
	Mean±SD			
Height (cm)	39.2±1.72	39.1±1.92	-0.14	0.89
Duration of Jumping (sec)	564.3±12.4	563.±13.7	-0.21	0.83
Maximum Power (kg)	3494.3±104.4	3487.6±115.8	-0.28	0.78
Maximum Power/Mass	49.9±2.51	49.9±1.89	-0.02	0.83

***p<0.05**

No statistically significant difference was observed in height, duration of jumping, maximum power, and maximum power/mass parameters between the Static-Dynamic and Foam Roller stretching protocols ($p>0.05$).

Table 4. Comparison of the multiple jumps means of the participants after different stretching protocols (n=8)

Parameters	Static+Dynamic Stretching	Static+Dynamic +Foam Roller		
	Mean±SD		z	p
Maximum Height (cm)	23.1±2.44	29.7±2.16	-1.26	0.21
Mean Height (cm)	19.6±2.74	24.6±1.98	-0.98	0.33
Mean Duration of Jumping (sec)	379.8±27.4	444.5±18.1	-1.26	0.21
Mean Ground Contact Time (sec)	208.7±23.9	206.8±10.1	-0.56	0.58
Maximum Power (kg)	2503.1±152	2924.1±126	-1,54	0,12
Maximum Power/Mass	36.1±3.31	45.9±4.96	-1,68	0.09
Number of Jumps (how many)	26±1.82	22.5±0.46	-1.70	0.16

***p<0.05**

No statistically significant difference was observed in maximum height, mean height, mean duration of jumping, mean ground contact time, maximum power, maximum power / mass, and number of jumps parameters between the Static-Dynamic and Foam Roller stretching protocols ($p>0.05$).

DISCUSSION

The aim of this study is to examine the acute effects of foam roller on performance after static and dynamic stretching exercises in elite volleyball players. When the results of the study were evaluated between the groups, no statistically significant difference was observed in sprint, agility, flexibility, vertical and multiple jump parameters ($p>0.05$).

When the relevant literature was examined, Yıldız et al. (2018) stated that in their study they conducted with 14 university students, foam roller exercise in addition to dynamic stretching did not affect sprint, agility, and jumping performance. Edis et al. (2021) stated in their study that they conducted with the participation of 10 amateur football players 19, foam roller exercise in addition to dynamic stretching did not affect jump performance. Bahara and Jacobson (2017) reported that foam roller exercises after dynamic stretching did not affect strength performance in elite football players. The findings of these studies show parallelism with our study. In all these studies, it was stated that in addition to static-dynamic stretching, foam roller made a statistically significant difference on flexibility values. Moreover, it was stated that static stretching exercises combined with foam roller on hamstring flexibility were more effective than static stretching exercises alone (Agre and Agrawal, 2019; Mohr and Long, 2014;).

Contrary to the findings of our study, Janot et al. (2013) stated that 30-minute foam roller exercises in addition to static stretching showed an increase in anaerobic power output in individuals aged 19-23, but this effect was not certain due to the limitations of the study. Peacock (2014), on the other hand, stated that foam roller exercises in addition to dynamic stretching provide a statistically significant increase in maximum anaerobic power, agility, and sprint parameters in male team sports players with an age average of 22 years. Moreover, it was stated that although there was no statistically significant increase in the agility, power, and sprint parameters of foam roller exercise in addition to dynamic stretching, it had the potential to affect positively (Beyleroğlu et al., 2021; MacDonald, 2013). The reason why the findings of all these studies are in the opposite direction of our study can be considered as the fact that the foam roller exercise program performed was more intense.

The main limitations of the present study included a relatively small sample size of elite volleyball players, a short training period, and the lack of external loading. Because of these,

our results may not generalise to players of different sex, level or age groups. Another limitation is the concrete floor, affecting the movement patterns and technical standards of players. Especially in the 30 m sprint and agility test.

In conclusion, acute responses to foam roller emerge in a very complex way, which makes it difficult to reach a clear conclusion about its effects. The reason why the results are so inconsistent may be the foam roller exercise time, intensity and age of the participants.

CONCLUSION

Our study showed that foam roller training did not increase acute performance in volleyball players. This study is limited to 8 elite volleyball players and the measurements of flexibility, sprinting, agility, and jumping performance tests performed on these athletes. It is anticipated that foam roller exercises with a larger number of participants and different intensities will contribute to the literature.

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