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Acute Effects of Hip Mobility Exercises in Addition to Dynamic Warm-up on Vertical Jump, Maximal and Isometric Strength Parameters

Barbaros DEMİRTAŞ[1A], Murat Can ÇEKEN[1B], Onur ÇAKIR[1C],
Malik BEYLEROĞLU[1D], Onat ÇETİN[1E]

[1] *Sakarya University of Applied Sciences, Spors Science Faculty, 54050, Sakarya-Turkey*

Address Correspondence to O ÇAKIR: e-mail: onurcakir@subu.edu.tr

Ethical Statement: It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.

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A: Orcid ID: 0000-0002-4720-7493 B: Orcid ID: 0000-0001-7625-5067 C: Orcid ID: 0000-0002-7230-771X
D: Orcid ID: 0000-0002-2223-0064 E: Orcid ID: 0000-0001-6841-5518

Abstract

This study aims to investigate the acute effects of hip mobility exercises applied before anaerobic activities on vertical jump, 1 repetition maximum (1RM), and isometric strength performances. For this purpose, 12 male athletes with a high level of training (age = 21 ± 1.2 years; height = 180 ± 0.05 m; body weight = 88.08 ± 9.17 kg) voluntarily participated in the study. Before starting the study, an approval report was obtained from the Sakarya University of Applied Sciences Ethics Committee and all athletes signed a voluntary consent form before the study. All participants were asked to perform a standard 15-minute dynamic warm-up procedure (dynamic stretching exercises related to cycling and tests) on the first measurement day. Then, in order to avoid fatigue in the athletes, 1 RM (1 Repetition Maximum) strength tests were applied. On the second measurement day, the subjects performed 8 different hip mobility exercises (2 sets x 20 seconds for each exercise) with the same 15-minute dynamic warm-up protocol and re-applied the tests applied on the first measurement day. When the findings were examined, it was found that there was no significant difference in the 1RM strength values of the deadlift exercise in the 1st and 2nd measurement sessions ($p = 0.596$). However, a significant difference was found between the 1RM strength, Isometric back-leg strength, Counter Movement Jump (CMJ), and Squat Jump (SJ) values of the squat exercise ($p = 0.003$, $p = 0.002$, $p = 0.002$, $p = 0.002$). In conclusion, this study shows that a dynamic warm-up protocol that includes hip mobility positively affects vertical jump, maximal, and isometric strength parameters.

Keywords: Hip mobility, Strength, Vertical jump, Warm-up.

Dinamik Isınmaya Ek Kalça Hareket Egzersizlerinin Dikey Sıçrama, Maksimal ve İzometrik Güç Parametreleri Üzerindeki Akut Etkileri

Bu çalışmanın amacı anaerobik aktiviteler öncesinde uygulanan kalça hareketliliği egzersizlerinin dikey sıçrama, 1 tekrar maksimum (1TM) ve izometrik kuvvet performansları üzerindeki akut etkilerini araştırmaktır. Bu amaç için 12 antrenman geçmişi düzeyi yüksek erkek sporcu (yaş = 21 ± 1.2 yıl; boy = 180 ± 0.05 m; vücut ağırlığı = 88.08 ± 9.17 kg) gönüllü olarak çalışmaya katılmıştır. Araştırmaya başlanılmadan önce Sakarya Uygulamalı Bilimler Üniversitesi Etik Kurulundan onay raporu alındı ve tüm sporculara çalışma öncesinde gönüllü onam formu imzalatılmıştır. Tüm katılımcılardan ilk ölçüm gününde 15 dakikalık standart bir dinamik ısınma prosedürü (bisiklet ve testler ile ilgili dinamik esneme egzersizleri) uygulamaları istenmiş ve daha sonra sporcularda yorgunluk meydana gelmemesi için sırasıyla dikey sıçrama, izometrik sırt bacak kuvveti ve alt ekstremiteye yönelik iki temel egzersizde 1TM (1 Tekrar Maksimum) kuvvet testleri uygulatılmıştır. İkinci ölçüm gününde ise denekler aynı 15 dakikalık dinamik ısınma protokolü ile 8 farklı kalça hareketliliği egzersizini (her egzersiz için 2 set x 20 saniye) gerçekleştirmişler ve ilk ölçüm gününde uygulanan testleri tekrar uygulamışlardır. Bulgular incelendiğinde 1. ve 2. ölçüm seanslarında deadlift egzersizinin 1TM kuvvet değerlerinde anlamlı bir fark olmadığı bulunmuştur ($p = 0.596$). Bununla birlikte squat egzersizinin 1TM kuvvet, İzometrik sırt-bacak kuvveti, Counter Movement Jump (CMJ) ve Squat Jump (SJ) değerleri arasında anlamlı bir fark olduğu bulunmuştur ($p = 0.003$, $p = 0.002$, $p = 0.002$, $p = 0.002$). Sonuç olarak, bu çalışma kalça hareketliliği içeren bir dinamik ısınma protokolünün dikey sıçrama, maksimal ve izometrik kuvvet parametreleri üzerinde olumlu bir etkiye sahip olduğunu göstermektedir.

Anahtar Kelimeler: Kalça hareketliliği, Kuvvet, Dikey sıçrama, Isınma

INTRODUCTION

The general aim of warm-up protocols applied before exercise is to maximize athletic performance (4). Athletes and trainers often apply stretching exercise protocols such as submaximal aerobic activity and static stretching (SG), dynamic stretching (DG), ballistic stretching (BG), and proprioceptive neuromuscular facilitation (PNF) before competitions and trainings to improve athletic performance (25, 16). Studies show that static stretching exercises can prevent the performance by reducing power and speed production instead of gaining athletes (12, 26, 21). However, dynamic stretching warm-up before training or physical competition improves neuromuscular performance, increases motor unit excitability, recruitment, and synchronization, reduces presynaptic inhibition, and improves motor neuron central activation (6). Dynamic stretching exercises, which have become popular in pre-training warm-up activities, are also called mobility exercises and include functional-based stretching exercise method that uses sport-specific movements to prepare the human body for activity (7). Especially in terms of performance, it is necessary to use dynamic form warm-up protocols to ensure a high level of strength and power production in the main part of the training (14). This warm-up method also improves hip mobility, which plays a very important role in the transfer of power from the lower to the upper extremity and for most athletes is one of the most important points for a good performance (5).

When we examine the literature in detail, no studies were found in which dynamic stretching exercises were applied in combination with regional mobility exercises. However, there are studies that examine the acute effects of various dynamic stretching exercise protocols on vertical jump (16) and maximal and isometric strength (27) parameters where the hip region is active. For example, in a study that examined the effects of acutely performed active, passive, and dynamic stretching exercises on vertical jump performance, a group of 16 young male tennis players who actively do sports were randomly assigned at different times by applying passive stretching, active stretching, and dynamic stretching exercises without stretching exercises. observed vertical jump performances applied in a way (6). It has been revealed that the measurements taken with DG have a more positive effect on vertical jump performance compared to other methods. In another study that compared the effects of dynamic stretching exercises and foam roller exercises, dynamic stretching exercises in the vertical and horizontal jump data, 37 meters sprint test data, and indirectly measured 1 RM (1 Repetition

Maximum) bench press data were observed higher performance (23). Ford et al. (13) reported that activation of the hip muscles during dynamic activity may be an important factor in the control of lower extremity movements.

According to this thought, adding exercises that improve the mobility and neuromuscular activation of the hip joint to the training programs can help improve the athletic characteristics of the athletes. In this context, the aim of our study is to investigate the acute effects of hip mobility exercises applied before anaerobic activities on vertical jump, 1 repetition maximum and isometric strength performances.

MATERIAL AND METHOD

Participants

Twelve male athletes with a high level of training history (age = 21 ± 1.2 years; height = 180 ± 0.05 m; body weight = 88.08 ± 9.17 kg) voluntarily participated in this study. There were 4 wrestlers, 3 weightlifters, 2 powerlifters and 3 bodybuilders at the national and international level in the participant group. These athletes have been regularly trained at least five days a week and an average of 1.5 hours. All athletes were informed about the experimental aims, risks, and benefits of the study. All participants voluntarily signed the informed consent form. This research was conducted in accordance with the Declaration of Helsinki (1975) used for studies with human subjects. Before starting the study, an approval report was obtained from the Sakarya University of Applied Sciences Ethics Committee and all athletes signed a voluntary consent form before the study.

Experimental Design

All participants were asked to perform a standard 15-minute dynamic warm-up procedure (dynamic stretching exercises related to cycling and tests) on the first measurement day, and then, to avoid fatigue in the athletes, 1 RM (Repetition Maximum) strength tests were performed. On the second measurement day, the subjects performed 8 different hip mobility exercises (2 sets x 20 seconds for each exercise) with the same 15-minute dynamic warm-up protocol and re-applied the tests applied on the first measurement day. (Figure 1) After all dynamic warm-up and hip mobility procedures were performed, subjects performed 5 minutes of passive rest between tests. All measurements were made during the hours when the athletes were training in their daily routine.

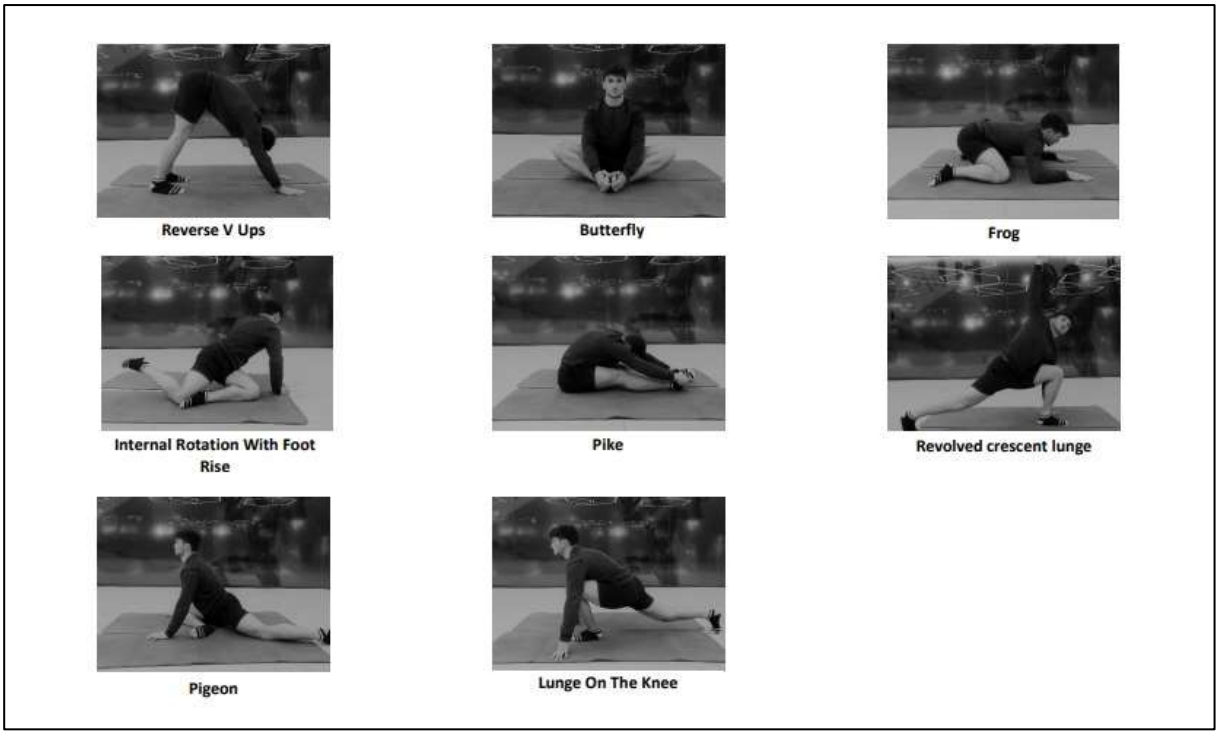

Figure 1. Hip mobility exercises performed in the study

Measurement Procedure

1RM Strength Test;

In the research, 1RM strength measurements were made in squat and deadlift exercises. Before the 1RM strength tests, the athletes performed a standard 10-minute warm-up protocol on the bicycle ergometer. While performing 1RM strength measurements, 1 retest protocol recommended by the American College of Sports Medicine (ACSM) was applied. Firstly, 2 warm-up sets of light-medium were applied. After the first set was done with 5-10 repetitions, 1-minute rest was given. The second set was done with 2-5 repetitions and rested for 2 minutes. With the third set, 1 repetition was started and 2-4 minutes of rest was given. In the following sets, 5-10% load increase was continued for each successful lift and a rest period of 2-4 minutes was given. When an unsuccessful lifting occurred, the load was reduced by 2.5-5% and the lifting was performed again (1).

Vertical Jump Tests;

Counter Movement Jump and Squat Jump tests were used to determine the vertical jump performance of the participants. The My Jump 2 app (app) accessed from the iPhone Apple Store was used to determine vertical jump performance (ICC = 0.97-0.99) (15). The My Jump 2 application was developed to calculate the jump height from the airtime using the high-speed video recording feature on the iPhone 11 (2). Before testing, subjects were asked to try SJ and CMJ activities. Each participant performed 3 maximum SJs and CMJs, starting from a standing position and keeping their hands on their hips. The best of these three attempts was recorded.

Isometric Leg and Back Dynamometer Test;

Measurements were made using a (Takkei) brand dynamometer to determine isometric back and leg strength. After the participants completed the warm-up protocols, they positioned their feet on the dynamometer platform with their knees stretched. Then, with the arms tense, the back straight, and the body leaning slightly forward, they pulled the dynamometer bar they were grasping with their hands vertically upwards at maximum intensity. All participants performed 3 trials and the best score value was recorded in these trials (8,20).

Statistical analysis

Windows IBM SPSS Statistics program was used to analyze all data. The normality of the data was checked using the Shapiro-Wilk test. Since the data did not show normal distribution, the Wilcoxcon test, one of the nonparametric tests, was used to compare and analyze the differences between each trial and various performance parameters. Statistical significance was set at $p < 0.05$.

RESULTS

Table 1 shows the values obtained at two different data collection stages and the differences between them. When Table 1 was examined, it was found that there was no significant difference in the 1RM strength values of the deadlift exercise in the 1st and 2nd measurement sessions ($p = 0.596$). However, a significant difference was found between the 1RM strength, Isometric back-leg strength, CMJ and SJ values of the squat exercise ($p = 0.003$, $p = 0.002$, $p = 0.002$, $p = 0.002$).

Table1. Comparison of Athletes' 1st and 2nd Measurement Squat, Deadlift, Vertical Jump and Force measurements

Variables	Trials	Mean ± SD	p
Squat (kg)	1^{st} Trial	139.58±24.72	0.003*
	2^{nd} Trial	151.24±24.27	
Deadlift (kg)	1^{st} Trial	182.08±24.72	0.596
	2^{nd} Trial	182.71±25.62	
Countermovemnt jump (cm)	1^{st} Trial	41.39±7.11	0.002*
	2^{nd} Trial	43.39±6.49	
Squat Jump (cm)	1^{st} Trial	37.02±4.86	0.002*
	2^{nd} Trial	40.53±5.36	
Leg Dynamometer (kg)	1^{st} Trial	193.30±26.71	0.002*
	2^{nd} Trial	215.78±25.74	

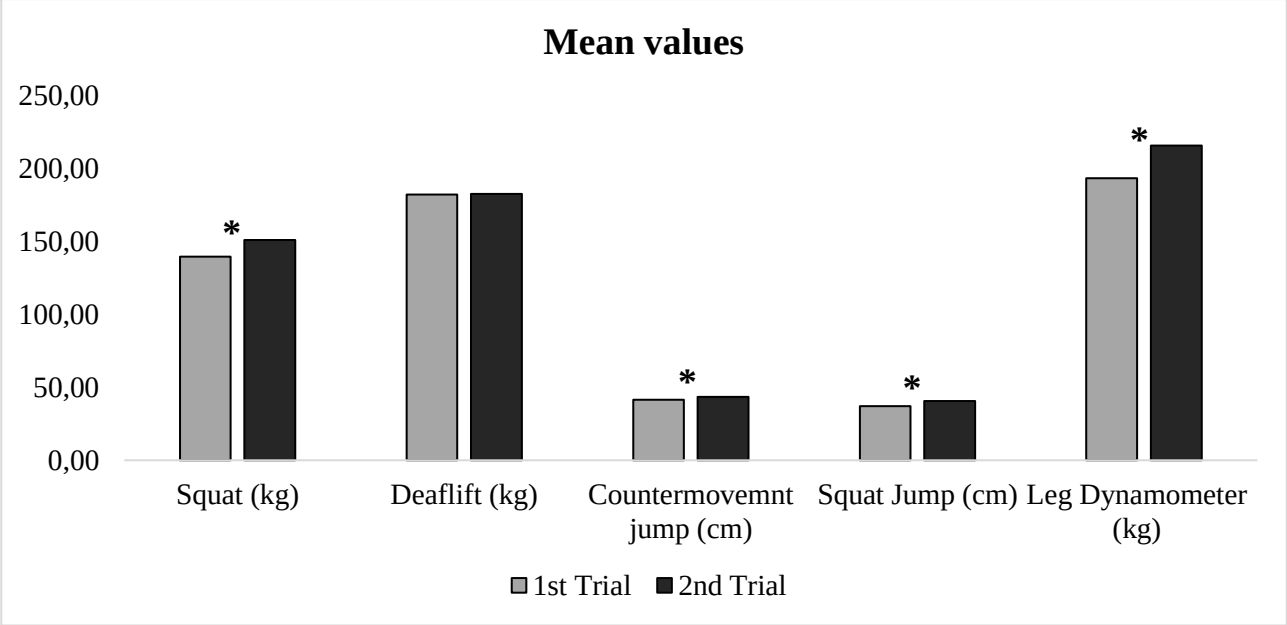

Figure 2. Average values of 1st and 2nd measurement squat, deadlift, countermovement jump, squat Jump and leg dynamometer of the athletes

* Indicates the significant difference between the 1st and 2nd measurements.

DISCUSSION

This study aimed to examine the acute effects of a dynamic warm-up including hip mobility exercises on vertical jump, 1RM, and Isometric strength performance. The results of the study showed that specific hip mobility exercises added to dynamic warm-up caused a significant increase in squat exercise 1RM strength, Isometric strength and vertical jump performance ($p < 0.05$), but deadlift exercise did not significantly increase 1RM strength values ($p > 0.05$).

When the previous studies are examined, it is seen that the dynamic warm-up protocols applied before the training reveal different results on performance. (6,4,14,22) stated that, as in our study, dynamic warming has positive effects on vertical jump performance. However, (19,11) stated in their study that dynamic warming did not reveal any positive effect on vertical jump performance. In addition to these studies (23,18), their studies show that applying dynamic mobility exercises in addition to dynamic warm-up results in more positive results than the dynamic warm-up protocol applied alone. The different results in the studies related to the subject in the literature may be due to many different factors. The training history and training level of the participant group, method differences in the applied dynamic warm-up protocols, intensity and amount of the content of the protocols, total duration, and rest intervals can be given as examples of these factors. (9).

The results of this study show that regional hip mobility exercises performed in addition to dynamic warm-up have a positive effect on maximal and isometric strength parameters. When studies on the subject are examined, (10) stated that static stretching protocols performed before exercise impair maximal force production. (24,17), on the other hand, supports the results of our research and states that dynamic warming protocols are more beneficial in improving strength, peak power generation and explosive power characteristics than static warming. Furthermore, (27) revealed that the regional mobility-improving warm-up protocol was more effective in increasing muscle strength than static and dynamic warm-ups. For this reason, it is thought that specific hip mobility exercises added to dynamic warm-up have a positive effect on the participants' maximal and isometric strength performance. It has been found that static, dynamic, ballistic, and PNF stretching procedures had detrimental effects on maximal dynamic force performance, which is

contrary to the findings of our research (3). This distinction may be based on the participants' training age and level as well as the length, volume, and intensity of the protocols used.

In conclusion, the findings of this study show that a dynamic warm-up protocol including hip mobility has a positive effect on vertical jump, maximal and isometric strength parameters. Exercises that increase hip mobility can be incorporated into warm-up routines to enhance the hip joint's range of motion. However, the hip joint, which is one of the central regions of the body, plays an important role in maximizing performance in vertical jump, maximal and isometric strength parameters. For this reason, wider joint angle may result in higher performance. In addition to these results, there is a need for more studies investigating the effects of mobility exercises applied to the same region or different regions.

REFERENCES

1. American College of Sports Medicine (Ed.). (2013). ACSM's health-related physical fitness assessment manual. Lippincott Williams & Wilkins.

2. Balsalobre-Fernández, C., Glaister, M., & Lockey, R. A. (2015). The validity and reliability of an iPhone app for measuring vertical jump performance. Journal of sports sciences, 33(15), 1574-1579.

3. Barroso, R., Tricoli, V., dos Santos Gil, S., Ugrinowitsch, C., & Roschel, H. (2012). Maximal strength, number of repetitions, and total volume are differently affected by static-ballistic-, and proprioceptive neuromuscular facilitation stretching. The Journal of Strength & Conditioning Research, 26(9), 2432-2437.

4. Behm, D. G., & Chaouachi, A. (2011). A review of the acute effects of static and dynamic stretching on performance. European journal of applied physiology, 111(11), 2633-2651.

5. Boyle, M. (2016). New functional training for sports. Human Kinetics.

6. Carvalho, F. L., Carvalho, M. C., Simão, R., Gomes, T. M., Costa, P. B., Neto, L. B., ... & Dantas, E. H. (2012). Acute effects of a warm-up including active, passive, and dynamic stretching on vertical jump performance. The Journal of Strength & Conditioning Research, 26(9), 2447-2452.

7. Cetin, O., Işık, Ö., & Yaşar, M. N. (2020). The acute effects of a dynamic warm-up including hip mobility exercises on sprint, agility and vertical jump performance. European Journal of Human Movement.

8. Chandra, A. M., Ghosh, S., İkbal, R., & Sadhu, N. (2007). Farklı Mesleklerin İşçi Statik MuskuloskeletalFitness Üzerine Etkilerinin Karşılaştırmalı Olarak Değerlendirilmesi. Uluslararası İş Güvenliği ve Ergonomi Dergisi, 13(3), 271-278.

9. Chaouachi, A., Castagna, C., Chtara, M., Brughelli, M., Turki, O., Galy, O., Chamari, K., & Behm, D. G. (2010). Effect of warm-ups involving static or dynamic stretching on agility, sprinting, and jumping performance in trained individuals. The Journal of Strength & Conditioning Research, 24(8), 2001-2011

10. Cramer, J. T., Housh, T. J., Johnson, G. O., Miller, J. M., Coburn, J. W., & Beck, T. W. (2004). Acute effects of static stretching on peak torque in women. The Journal of Strength & Conditioning Research, 18(2), 236-241.

11. Edis, Ç., Uçan, İ. & Vural, F. (2021). Farklı Isınma Protokollerinin Squat Kuvvet Değerlerine Akut Etkisi: Miyofasiyal Gevşeme Yöntemi ile Kuvvet Temelli Isınma Yöntemlerinin Karşılaştırılması. Beden Eğitimi ve Spor Bilimleri Dergisi, 23 (1), 14-28.

12. Faigenbaum, A. D., Bellucci, M., Bernieri, A., Bakker, B., & Hoorens, K. (2005). Acute effects of different warm-up protocols on fitness performance in children. The Journal of Strength & Conditioning Research, 19(2), 376-381.

13. Ford, K. R., Nguyen, A. D., Dischiavi, S. L., Hegedus, E. J., Zuk, E. F., & Taylor, J. B. (2015). An evidence-based review of hip-focused neuromuscular exercise interventions to address dynamic lower extremity valgus. Open access journal of sports medicine, 6, 291.

14. Frantz, T. L., & Ruiz, M. D. (2011). Effects of dynamic warm-up on lower body explosiveness among collegiate baseball players. The Journal of Strength & Conditioning Research, 25(11), 2985-2990.

15. Gallardo-Fuentes, F., Gallardo-Fuentes, J., Ramírez-Campillo, R., Balsalobre-Fernández, C., Martínez, C., Caniuqueo, A., & Izquierdo, M. (2016). Intersession and intrasession reliability and validity of the My Jump app for measuring different jump actions in trained male and female athletes. Journal of strength and conditioning research, 30(7), 2049-2056.

16. Gelen, E. (2010). Acute effects of different warm-up methods on sprint, slalom dribbling, and penalty kick performance in soccer players. The Journal of Strength & Conditioning Research, 24(4), 950-956.

17. Herda, T. J., Cramer, J. T., Ryan, E. D., McHugh, M. P., & Stout, J. R. (2008). Acute effects of static versus dynamic stretching on isometric peak torque, electromyography, and mechanomyography of the biceps femoris muscle. The Journal of Strength & Conditioning Research, 22(3), 809-817.

18.Holt, B. W., & Lambourne, K. (2008). The impact of different warm-up protocols on vertical jump performance in male collegiate athletes. The Journal of Strength & Conditioning Research, 22(1), 226-229.

19. Jones, A., Brown, L. E., Coburn, J. W., & Noffal, G. J. (2015). Effects of foam rolling on vertical jump performance. International Journal of Kinesiology and Sports Science, 3(3), 38-42.

20. Karakoc, O. (2016). Muscle Strength and Flexibility without and with Visual Impairments Judoka's. International Education Studies, 9(5), 12-17.

21.Kistler, B. M., Walsh, M. S., Horn, T. S., & Cox, R. H. (2010). The acute effects of static stretching on the sprint performance of collegiate men in the 60-and 100-m dash after a dynamic warm-up. The Journal of Strength & Conditioning Research, 24(9), 2280-2284.

22. Pagaduan, J. C., Pojskić, H., Užičanin, E., & Babajić, F. (2012). Effect of various warm-up protocols on jump performance in college football players. Journal of human kinetics, 35, 127.

23. Peacock, C. A., Krein, D. D., Silver, T. A., Sanders, G. J., & Von Carlowitz, K. P. A. (2014). An acute bout of self-myofascial release in the form of foam rolling improves performance testing. International journal of exercise science, 7(3), 202.

24. Peck, E., Chomko, G., Gaz, D. V., & Farrell, A. M. (2014). The effects of stretching on performance. Current sports medicine reports, 13(3), 179-185.

25. Sağiroğlu, İ., Kurt, C., Pekünlü, E., & Özsu, İ. (2017). Residual effects of static stretching and self-myofascial-release exercises on flexibility and lower body explosive strength in well-trained combat athletes. Isokinetics and Exercise Science, 25(2), 135-141.

26. Sim, A. Y., Dawson, B. T., Guelfi, K. J., Wallman, K. E., & Young, W. B. (2009). Effects of static stretching in warm-up on repeated sprint performance. The Journal of Strength & Conditioning Research, 23(7), 2155-2162.

27. Su, H., Chang, N. J., Wu, W. L., Guo, L. Y., & Chu, I. H. (2017). Acute effects of foam rolling, static stretching, and dynamic stretching during warm-ups on muscular flexibility and strength in young adults. Journal of sport rehabilitation, 26(6), 469-477.