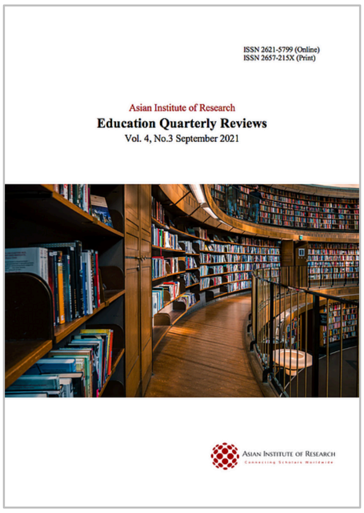


Education Quarterly Reviews

Arı, Yasemin, Tunçel, Asım, Sever, Ozan, and Arslangörür, Aslıhan. (2021), Acute Effects of Static and Dynamic Stretching on Jump Performance of Volleyball Players. In: *Education Quarterly Reviews*, Vol.4, No.3, 390-398.

ISSN 2621-5799

DOI: 10.31014/aior.1993.04.03.347

Published by:
The Asian Institute of Research

The Asian Institute of Research
Education Quarterly Reviews
Vol.4, No.3, 2021: 390-398
ISSN 2621-5799

DOI: 10.31014/aior.1993.04.03.347

Acute Effects of Static and Dynamic Stretching on Jump Performance of Volleyball Players

Yasemin Arı[1], Asım Tunçel[1], Ozan Sever[2], Aslıhan Arslangörür[3]

[1] School of Physical Education and Sports, Tekirdağ Namık Kemal University, Tekirdağ, Turkey
[2] Sports Science Faculty, Atatürk University, Erzurum, Turkey
[3] Institute of Health Sciences, Tekirdağ Namık Kemal University, Tekirdağ, Turkey

Correspondence: Yasemin Arı, School of Physical Education and Sports, Tekirdağ Namık Kemal University, Tekirdağ, Turkey, 59100, Tel: 0282 2503213. E-mail: yaseminari88@gmail.com

Abstract
The aim of this study is to examine the acute effects of different stretching methods on jump performance of volleyball players. 11 female volleyball players (age: 24.36 ± 5.10 years; height: 177.81 ± 7.30 cm; weight: 68.17 ± 11.69 kg; body mass index (BMI): 21.46 ± 2.56 kg.m^{-2}; sports age: 12.72 ± 5.31 years) have participated voluntarily in this study. The players have applied three different stretching protocols such as control (no stretching), static and dynamic stretching on non-consecutive days. The protocols have included 5 minutes general warm-up, 1 minute rest, 30-second stretch program for each muscle group (control group not included), 1 minute rest and countermovement jump (CMJ), squat jump (SJ) and standing long jump (SLJ) tests. Friedman analysis has been used for data analysis. Wilcoxon Signed Rank Test has been implemented in order to determine the difference among groups. At the end of the study, a significant difference has been found between control and dynamic stretching groups with regard to static stretching groups in view of CMJ and SJ performance findings ($p < 0.05$). It has been found that there is a statistically significant difference in the test averages of dynamic stretching group compared to static stretching group in view of SLJ performance findings ($p < 0.05$). This study shows that static stretching practices reduce the jumping performance of the players. As a result, it can be suggested that trainers should use dynamic stretching methods before the trainings on jumping properties containing explosive movements.

Keywords: Static Stretching, Dynamic Stretching, Jump, Volleyball

1. Introduction

Volleyball is an intermittent and non-contact game including periods of short loading and rest and requiring the players to change places during the match (Turnagöl, 1994). The maximum height of the player above the net is seen as the key determinant for successful offensive and blocking performance in volleyball (Ruffieux, Wälchli, Kim, & Taube, 2020). Therefore, a high vertical jumping skill in volleyball is a critical component of hitting and blocking (Dalrymple, Davis, Dwyer, & Moir, 2010). Jumping force is a skill that comes up with the combination of many factors such as explosiveness, flexibility, muscle strength and jumping technique (Şimşek, Tuncel, Ertan,

& Göktepe, 2005). Anthropometric features (body height and arm length) and vertical jumping skills are important factors for maximum achievable height for athletes. An athlete's jumping skill can be significantly improved through training while the anthropometric properties cannot be changed. Therefore, volleyball trainers look for the most effective and efficient exercises to improve their players' jumping skills (Ruffieux et al., 2020).

Warm-up routines, which include stretching exercises after light aerobic activity, are carried out to prevent sports injuries and to maximize motor performance capacity. Increasing physiological responses, blood flow and temperature are among the primary goals of warming up (Gelen, Meriç, and Yıldız, 2010). In addition to these objectives, stretching exercises are also applied to lengthen the connective tissue and muscle length (Amiri-Khorasani, Sahebozamani, Tabrizi, & Yusof, 2010).

The studies conducted have determined that the increase in flexibility in the musculoskeletal system occurs as a result of the interaction of neurological (Guissard, Duchateau, & Hainault, 2001) and mechanical (Kubo, Kanehisa, & Fukunaga, 2001) features in the muscle-tendon unit with static stretching exercises. However, ideas regarding the effectiveness of the static stretching practice before the competition have been questioned recently (Gelen, 2008). While there are studies showing that static stretching practices during warm-up do not have any effect on sports performance (Beydokhti & Haghshenas, 2014), there are studies arguing that when it is carried out in addition to the warming up, the range of motion increases the running performance to a higher level and that it positively affects sports performance (Samson, Button, Chaouachi, & Behm, 2012). Due to these disagreements, some researchers state that dynamic stretching should be used instead of static stretching before sportive performance (Kilit, Arslan, & Soylu, 2019).

Dynamic exercises have an important place in the formation of the basis of sportive movements. Current studies have shown that the stimulation of the nervous-muscular system before performing a sportive activity can be achieved by voluntary contraction movements from medium to high intensity such as dynamic stretches. In this direction, it is suggested that nerve-muscle activation will have a positive effect on sports performance (Gelen et al., 2010; Thompsen, Kackley, Palumbo, & Faigenbaum, 2007). McMillian, Moore, Hatler, and Taylor (2006) stated that horizontal jump performance of the athletes increased significantly after a series of dynamic stretches compared to static stretches. However, Unick, Kieffer, Cheesman, and Feeney (2005) reported that static and dynamic stretching does not affect the vertical jump performance of female athletes. Although many studies report that dynamic stretching protocols have a positive effect on athlete performance, inconsistencies are observed among the current research findings.

When the literature is examined, although there are studies that examine the effects of static and dynamic stretching exercises on performance parameters in volleyball (Kruse, Barr, Gilders, Kushnick, & Rana, 2013; Durukan & Göktepe, 2020), more precise studies are needed to determine the effects of different stretching protocols on sportive performance. Therefore, the aim of the study is to investigate the effects of branch-specific static and dynamic stretching methods conducted on female volleyball players on their jumping performance.

2. Method

2.1. Participant (subject) Characteristics

11 female volleyball players playing for Sivrihisarspor in the 2nd League (age: 24.36 ± 5.10 years; height: 177.81 ± 7.30 cm; weight: 68.17 ± 11.69 kg; body mass index (BMI): 21.46 ± 2.56 kg.m^{-2}; sports age: 12.72 ± 5.31 years) participated voluntarily in this study. The players were not involved in any training or competition during the study. According to the inclusion criteria, the participants should have no musculoskeletal injuries at least 6 months prior to the study, should actively attend the training or at least 4 days a week, and have regularly participated in trainings such as endurance, strength, sprint and the ones specific to volleyball. Written informed consent forms were obtained from the athletes after all players were informed about the research procedures, requirements, benefits and risks before the test.

2.2. Study Design

Anthropometric variables including height (cm) and body weight (kg) of each participant were measured. A portable stadiometer was used for height measurement and an electronic weighing machine was used for body weight measurement of volleyball players. The players were bare feet and wore shorts and T-shirts during measurement.

The present research protocol has been adapted from the studies of Chtourou et al. (2013). All volleyball players participated in three stretching methods: control (no stretch), static stretching, and dynamic stretching. The order of performance tests for the players was randomly selected with 48-hour rest intervals. The protocols included 5 minutes of general warm-up, 1 minute of rest, a 30-second stretch program for each muscle group (control group not included), 1 minute of rest and CMJ, SJ and SLT tests. Both static and dynamic stretching protocols were adapted from the study of Kruse, Barr, Gilders, Kushnick, and Rana (2015). The experimental procedure was summarized in Figure 1. All measurements were taken at the same time of the day (15.30-16.30) in the indoor sports hall. This part of the research should be carefully organized taking into account the principles of scientific research methods.

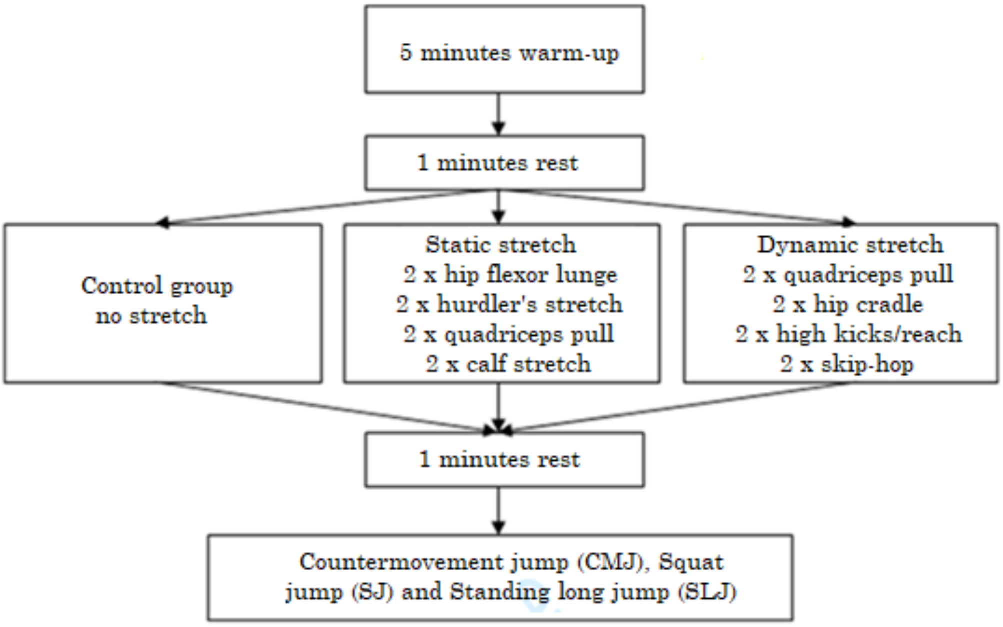


Figure 1: Experimental design

2.3. Warm Up and Stretching Protocols

The participants performed a general warm up by running at low and medium intensity in order to get prepared for the performance. All players were instructed to carry out stretching for 30 seconds for each of the lower extremity muscle groups during both static (hip flexor lunge, hurdler's stretch, quadriceps pull, calf stretch) and dynamic stretching (quadriceps pull, hip cradle, high kicks / reach, skip-hop). No resting period was given between the different stretching exercises. All warm-up exercises were implemented bilaterally with the help of a trainer. Dynamic stretches were performed slowly and continuously during the exercises. Total stretching time consisted of 2 sets for each muscle group of both legs. In the control group, the players rested after an 8-minute warm-up session.

2.4. Data Collection Tools

Jump test (SJ and CMJ): Two different techniques, countermovement jump and squat jump, were used to determine the acute effects of different stretch protocols on vertical jump performance. Participants are positioned within a specified area. A camera was placed right across the area to see the participant and the participant was asked to perform an active squat jump. The jump was considered invalid when the knees were bent, hip flexed with legs in air, and landed on or outside of the marked field lines. The athletes performed 3 jumps after sufficient rest and the best jump was recorded. The flight time of the participants was calculated using the Kinovea 0.8.15 program by looking at the transferred images. The jump heights of the participants whose flight times were determined were calculated with the formula (Markovic, Dizdar, Jukic, & Cardinale, 2004).

$$h = t_f^2 \cdot g^{-1} \cdot 8^{-1} \text{ (m)}$$

h = height g = 9.81 m·s^{-2} t = flight time

Standing long jump test (SLJ): Participants stood with their toes behind the long jump line and feet together. The participant jumped forward strongly by bending his knees, swinging his arms back and forth. He tried not to fall backwards after the jump. The distance between the starting line and the athlete's heel closest to this line was measured. The test was repeated twice and the best score was recorded (in cm), (Kamar, 2008).

2.5. Research Ethics

Ethical approval of this study was obtained with the decision of Atatürk University Faculty of Sport Sciences dated 22.03.2021 and numbered 70400699-000-E.2100083829.

2.6. Data Analysis

All statistical analyzes were made using SPSS 18.0 version software. It was determined that all data did not show normal distribution. The effects of different stretching methods on CMJ, SJ and SLJ were determined using Friedman analysis. The Wilcoxon Signed Ranks test was used to find the difference between the groups. Effect dimensions (Cohen's d) were calculated for the significance of the comparisons. Thresholds for effect size statistics are as follows: <0.20 = trivial, 0.20-0.59 small, 0.6-1.19 = moderate, 1.2-1.99 = large, ≥ 2.0 very large (Hopkins, Marshall, Batterham & Hanin, 2009). Statistical significance level was determined as $p < 0.05$.

3. Results

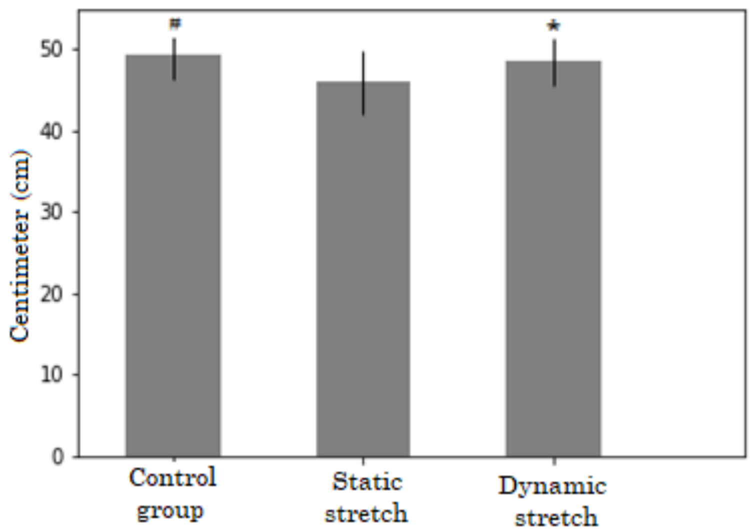
Table 1: Friedman Test Results of CMJ, SJ and SLJ Performance Values of Different Stretching Methods

Performance tests	Stretch protocol	Ort. ± S	Min.	Maks.	Chi-Square	p
	Control	49.36±.03	43.00	56.00		
CMJ	Static stretch	45.91±.04	40.00	53.00	11.64	.003*
	Dynamic stretch	48.45±.03	43.00	53.00		
	Control	48.73±.02	46.00	53.00		
SJ	Static stretch	45.18±.03	40.00	50.00	12.20	.002*
	Dynamic stretch	46.64±.03	43.00	53.00		
	Control	217.00±18.31	186.00	248.00		
SLJ	Static stretch	215.09±20.57	184.00	252.00	6.45	.040*
	Dynamic stretch	219.36±22.20	181.00	252.00		

*p<0.05

The average, minimum and maximum values of the CMJ, SJ and SLJ performances of the different stretching methods of the athletes participating in the study are given in Table 1. In the comparison of different stretching methods, a statistically significant difference was found in the performance values of CMJ, SJ and SLJ ($p < 0.05$) (Table 1).

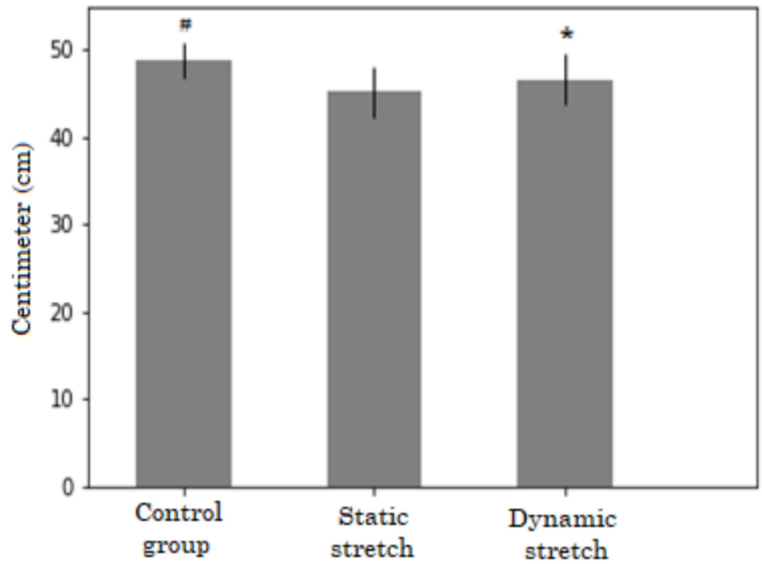
Figure 2: Wilcoxon Signed-Ranks Test Results of the CMJ Performance of Different Stretching Methods



#Control group - Static stretch; *Dynamic stretch - Static stretch

When the CMJ performance findings of different stretching methods in volleyball players were examined, a statistically significant difference was found in the test averages after the control (p = .011; η2 = 0.99) and dynamic stretching (p = .024; η2 = 0.99) groups ($p < 0.05$), compared to the static stretching group (Figure 2).

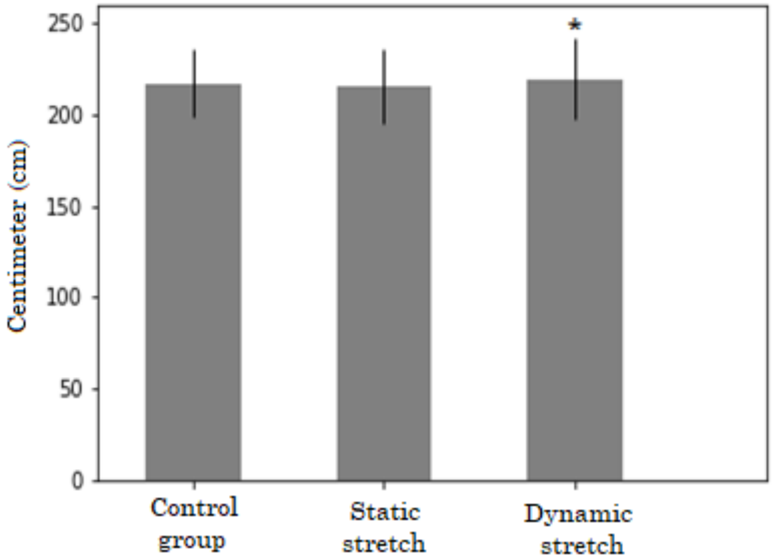
Figure 3: Wilcoxon Signed Ranks Test Results of The Squat Jump Performances of Different Stretching Methods



Control group - Static stretch; * Dynamic stretch - Static stretch

When the squat jump performance findings of different stretching methods were examined, it was found that there was a statistically significant difference in the test averages after the control (p = .011; η2 = 0.99) and dynamic stretching (p = .034; η2 = 0.99) groups compared to the static stretching group ($p < 0.05$), (Figure 3).

Figure 4: Wilcoxon Signed Ranks Test Results of The Standing Long Jump Performances of Different Stretching Methods



* Dynamic stretch - Static stretch

According to Figure 4, when the performance findings of different stretching methods with standing and long jump are examined, it was found that there is a statistically significant difference in the test averages after the dynamic stretching group ($p = .028$; $\eta2 = 0.09$) compared to the static stretching group ($p <0.05$), (Figure 4).

4. Discussion

This research was conducted to evaluate the acute effects of static and dynamic stretching on the jump performance of volleyball players. When the results of the study were evaluated, it was determined that the acute effect of static stretching had a negative effect on jumping performances and dynamic warming-up caused an increase in jumping performance. It was determined that there was no statistically significant difference between control and dynamic warm-up performances.

It is observed in the literature review that there are studies examining the effect of stretching protocols applied on performance outcomes. However, it has been determined that there are differences in the results of the stretching protocols applied in the current literature. When the studies conducted were examined, it is seen to be focused on the differences between static and dynamic stretching methods (Işıkdemir, Uzlaşır, & Köklü, 2020).

In this study, performance outcomes of the female volleyball players in view of CMJ, SJ and SLJ after static stretching have been found significantly lower compared to the values of the control group and dynamic warm-up group. This result shows that applying only static stretching exercises is not sufficient to prepare the athletes for activities that require high power production (such as jumping). Kruse et al. (2013) examined the acute effect of three different stretching protocols on female volleyball players and reported that they negatively affected the anaerobic power performances of the players after static stretching. In another study, it has been shown that static stretching practices have more negative effects on vertical jump performance than dynamic stretching (Werstein & Lund, 2012). Nevertheless, Paradisis et al. (2014) reported that static stretching after the acute effects of different stretching methods negatively affected the jumping performance of young girls. In addition to these studies, Yildiz et al. (2020) found that static stretching decreases the jumping performance of athletes. Moreover, Hough, Ross, and Howatson (2009) suggested that static stretching may cause some neurological disorders resulting in decreased muscle activation. Contrary to these findings, some existing studies reported that static stretching does not have a negative side effect on performance outcomes (Behm & Chaouchi, 2011; Little & Williams, 2006; Samson et al., 2012). Durukan and Göktepe (2020) found that there was no statistically significant difference in the jump performances of female volleyball players in view of different acutely practiced stretching exercises. In another study, it has been determined that static and dynamic stretching does not make a statistically significant difference between jumping performance of male athletes (Köse & Atan, 2015). Although there are studies in the literature reporting that static stretching does not negatively affect the jumping performance of athletes, many studies show performance disorders due to static stretching (Behm & Chaouchi, 2011; Yildiz et al., 2020). Researchers have suggested that static stretching can reduce the performance requiring power generation due to the muscle-tendon stiffness that inhibits the generation of force in the contractile component of the muscle (Holt and Lambourne, 2008).

In addition to the changes in the relationship between warming and force velocity, it has been stated that dynamic warming-up can increase power performance (McMillian et al., 2006). Many studies have shown that dynamic warming has positive effects on power generation and jump performance (Sekir, Arabaci, Akova, & Kadagan, 2010; Hough et al., 2009; Holt & Lambourne, 2008; Faigenbaum et al., 2006; Thompsen et al., 2007). Haghshenas, Beydokhti and Avandi (2014) examined the acute effect of different stretch protocols in volleyball players and reported a significant increase in anaerobic power in favor of dynamic stretching when dynamic and static stretching were compared. Faigenbaum et al. (2006) found that dynamic warm-up exercises increase vertical jump and long jump performance in female athletes. Kruse et al. (2015) examined the vertical jump performances of female volleyball players at different time intervals after static and dynamic warm-up practices and showed that there was a significant difference in the vertical jump performances of volleyball players 1 minute after the dynamic warm-up method according to static warm-up. The findings of this study show similarity with some studies which state that dynamic warming-up practices increase jumping performance. In addition, contrary to the current findings in the literature, some studies have reported that dynamic stretching does not improve short-term explosive performance (Bradley, Olsen, & Portas, 2007; Aydın et al., 2019; Balcı, Çelebi, Zergeroğlu, & Güner, 2020). Dalrymple et al. (2010) reported that there is no significant difference in vertical jump performance of female volleyball players after different warm-up practices. Unick et al. (2005) stated that there is no statistically significant difference on the vertical jump performance values of female participants carried out for different periods after static and dynamic warm-up exercises. It is thought that the inconsistencies in the findings of this study and some existing studies may be due to the age of the participants participating in this study, training status, stretching time, volume, density or other factors used in the current protocols.

Before the final results, the low sample size used in this study and the fact that the stretch protocols used did not analyze the chronic effect were determined as limitations of the study considering the population of female volleyball players. Another limitation is that the jump tests used for performance evaluation were evaluated by warming-up using static and dynamic stretching. However, a major strength of this study is that the short-term procedure was chosen to minimize performance changes that may come out over a longer period of time.

As a result, in this study, it was found that static stretching affects the jumping performance of female volleyball players negatively, while dynamic stretching has a positive effect on jumping performances of female volleyball players. According to the study findings, trainers and sports scientists should take notice of choosing stretching methods after the warm-up session. In future studies, studies on the physiological performance of athletes of different ages and performance levels with static, dynamic and combined (static + dynamic) stretches are recommended.

Acknowledgments

The authors thank the athletes and coaches who helped achieve these study results.

References

Amiri-Khorasani, M., Sahebozamani, M., Tabrizi, K. G., & Yusof, A. B. (2010). Acute effect of different stretching methods on illinois agility test in soccer players. *The Journal of Strength & Conditioning Research, 24*(10), 2698-2704. doi: 10.1519/JSC.0b013e3181bf049c

Aydın, Y., Kafkas, A., Çınarlı, F. S., Eken, Ö., Kurt, C., & Kafkas, M. E. (2019). Acute effects of different stretching exercise protocols on some anaerobic motoric tests. *Spor Hekimliği Dergisi*, *54*(2), 99-107. DOI: 10.5152/tjsm.2019.121

Balcı, A., Çelebi, M., Zergeroğlu, M., & Güner, R. (2020). The effects of static and dynamic stretching exercises on ankle muscle strength and balance. *Spor Bilimleri Araştırmaları Dergisi, 5*(1), 27-34. doi: 10.25307/jssr.673481

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. doi: 10.1007/s00421-011-1879-2

Beydokhti, I. T., & Haghshenas, R. (2014). Acute effect different stretching methods during warm ups on agility and power in amateur handball players. *WJSS, 9*(1), 7-12.

Bradley, P. S., Olsen, P. D., & Portas, M. D. (2007) The effect of static, ballistic, and proprioceptive neuromuscular facilitation stretching on vertical jump performance. *Journal of Strength and Conditioning Research, 21*(1), 223–226.

Chtourou, H., Aloui, A., Hammouda, O., Chaouachi, A., Chamari, K., & Souissi, N. (2013). Effect of static and dynamic stretching on the diurnal variations of jump performance in soccer players. *PloS One*, *8*(8), e70534. https://doi.org/10.1371/journal.pone.0070534

Dalrymple, K. J., Davis, S. E., Dwyer, G. B., & Moir, G. L. (2010). Effect of static and dynamic stretching on vertical jump performance in collegiate women volleyball players. *The Journal of Strength & Conditioning Research*, *24*(1), 149-155. doi: 10.1519/JSC.0b013e3181b29614

Durukan, E., & Göktepe, M. (2020). Kadın voleybolcularda dikey sıçrama performansına, akut uygulanan farklı germe egzersizlerinin etkisi. *Atatürk Üniversitesi Beden Eğitimi ve Spor Bilimleri Dergisi,* 22(4), 148-157.

Faigenbaum, A. D., Kang, J., McFarland, J., Bloom, J. M., Magnatta, J., Ratamess, N. A., & Hoffman, J. (2006). Acute effects of different warm-up protocols on anaerobic performance in teenage athletes, *Pediatric Exercise Sciences, 18*(1): 64-75. https://doi.org/10.1123/pes.18.1.64

Gelen, E. (2008). Farklı ısınma protokollerinin sıçrama performansına akut etkileri. *Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi*, VI(4), 207-212.

Gelen, E., Meriç, B., & Yıldız, S. (2010). Farklı ısınma protokollerinin sürat performansına akut etkisi. *Spor Klinikleri Spor Bilimleri*, *2*(1), 19-25.

Guissard, N., Duchateau, J., & Hainault, K. (2001). Mechanisms of decreased motoneuron excitation during passive muscle stretching. *Experimental Brain Research*, *137*(2), 163-169. doi: 10.1007/s002210000648

Haghshenas, R., Beydokhti, İ. T., & Avandi, S. M. (2014). Acute effect of different warm-up stretch protocols on vertical jump performance in volleyball players. *International Journal of Sport Studies*, *4*(8), 907-913.

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. doi: 10.1519/JSC.0b013e31815f9d6a

Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. *Medicine & Science in Sports & Exercise*, *41*(1), 3. doi: 10.1249/MSS.0b013e31818cb278

Hough, P. A., Ross, E. Z., & Howatson, G. (2009). Effects of dynamic and static stretching on vertical jump performance and electromyographic activity. *The Journal of Strength & Conditioning Research, 23*(2), 507–512. doi: 10.1519/JSC.0b013e31818cc65d

Işıkdemir, E., Uzlaşır, S., & Köklü, Y. (2020). Genç erkek basketbolcularda yapılan farklı ısınma yöntemlerinin bazı performans parametreleri üzerine akut etkisi. *Spor Bilimleri Dergisi*, *31*(3), 96-105. https://doi.org/10.17644/sbd.688295

Kamar, A. (2008). *Sporda yetenek beceri ve performans testleri.* Ankara: Nobel Yayınları.

Kilit, B., Arslan, E., & Soylu, Y. (2019). Effects of different stretching methods on speed and agility performance in young tennis players. *Science & Sports*, *34*(5), 313-320. https://doi.org/10.1016/j.scispo.2018.10.016

Köse, B., & Atan, T. (2015). Effect of different warm-up methods on flexibility jumping and balance. *Journal of Physical Education & Sports Science/Beden Egitimi ve Spor Bilimleri Dergisi*, *9*(1).

Kruse, N. T., Barr, M. W., Gilders, R. M., Kushnick, M. R., & Rana, S. R. (2013). Using a practical approach for determining the most effective stretching strategy in female college division I volleyball players. *The Journal of Strength & Conditioning Research*, *27*(11), 3060-3067. doi: 10.1519/JSC.0b013e31828bf2b6

Kruse, N. T., Barr, M. W., Gilders, R. M., Kushnick, M. R., & Rana, S. R. (2015). Effect of different stretching strategies on the kinetics of vertical jumping in female volleyball athletes. *Journal of Sport and Health Science*, *4*(4), 364-370. https://doi.org/10.1016/j.jshs.2014.06.003

Kubo, K., Kanehisa, H., & Fukunaga, T. (2001). Is passive stiffness in human muscles related to the elasticity of tendon structures? *European Journal of Applied Physiology, 85*(3), 226-232. Doi:10.1007/s004210100463

Little, T., & Williams, A. G. (2006). Effects of differential stretching protocols during warm-ups on high speed motor capacities in professional soccer players. *Journal of Strength and Conditioning Research*, *20*(1), 203-207. https://doi.org/10.1519/R-16944.1

McMillian, D. J., Moore, J. H., Hatler, B. S., & Taylor, D. C. (2006). Dynamic vs. static-stretching warm up: the effect on power and agility performance. *The Journal of Strength & Conditioning Research*, *20*(3), 492-499.

Markovic, G., Dizdar, D., Jukic, I., & Cardinale, M. (2004). Reliability and factorial validity of squat and countermovement jump tests. *The Journal of Strength & Conditioning Research*, *18*(3), 551-555.

Paradisis, G. P., Pappas, P. T., Theodorou, A. S., Zacharogiannis, E. G., Skordilis, E. K., & Smirniotou, A. S. (2014). Effects of static and dynamic stretching on sprint and jump performance in boys and girls. *The Journal of Strength & Conditioning Research*, *28*(1), 154-160. doi: 10.1519/JSC.0b013e318295d2fb

Ruffieux, J., Wälchli, M., Kim, K. M., & Taube, W. (2020). Countermovement jump training is more effective than drop jump training in enhancing jump height in non-professional female volleyball players. *Frontiers in Physiology*, *11*. doi: 10.3389/fphys.2020.00231

Samson, M., Button, D. C., Chaouachi, A., & Behm, D. G. (2012). Effects of dynamic and static stretching within general and activity specific warm-up protocols. *Journal of Sports Science & Medicine*, *11*(2), 279-285. PMCID: PMC3737866

Sekir, U., Arabaci, R., Akova, B., & Kadagan, S. M. (2010). Acute effects of static and dynamic stretching on leg flexor and extensor isokinetic strength in elite women athletes. *Scandinavian Journal of Medicine & Science in Sports*, *20*(2), 268-281. https://doi.org/10.1111/j.1600-0838.2009.00923.x

Şimşek, B., Tuncel, F., Ertan, H., & Göktepe, S. (2005). Farklı lig kategorilerindeki bayan voleybol oyuncularının seçilmiş fiziksel uygunluk parametrelerinin değerlendirilmesi. *Gazi Beden Eğitimi ve Spor Bilimleri Dergisi*, *10*(3), 29-38.

Thompsen, A. G., Kackley, T., Palumbo, M. A., & Faigenbaum, A.D. (2007). Acute effects of different warm-up protocols with and without a weighted vest on jumping performance in athletic women. *Journal of Strength and Conditioning Research, 21*(1), 52-56. doi:10.1519/00124278-200702000-00010

Turnagöl, H. (1994). Voleybolda enerji sistemleri. *Hacettepe Üniversitesi Voleybol Bilim ve Teknoloji Dergisi, 2*, 34-37.

Unick, J., Kieffer, H. S., Cheesman, W., & Feeney, A. (2005). The acute effects of static and ballistic stretching on vertical jump performance in trained women. *Journal of Strength and Conditioning Research*, *19*(1), 206-212. doi:10.1519/00124278-200502000-00035

Werstein, K. M., & Lund, R. J. (2012). The effects of two stretching protocols on the reactive strength index in female soccer and rugby players. *The Journal of Strength & Conditioning Research*, *26*(6), 1564-1567. doi: 10.1519/JSC.0b013e318231ac09

Yildiz, S., Gelen, E., Çilli, M., Karaca, H., Kayihan, G., Ozkan, A., & Sayaca, C. (2020). Acute effects of static stretching and massage on flexibility and jumping performance. *Journal of Musculoskeletal & Neuronal Interactions*, *20*(4), 498-504. PMCID: PMC7716682