Yasemin Arı

EFFECTS OF DIFFERENT STRETCHING METHODS ON SPEED, JUMP, FLEXIBILITY AND UPPER EXTREMITY PERFORMANCE IN WRESTLERS

UČINKI RAZLIČNIH RAZTEGOVALNIH METOD NA HITROST, SKOK, GIBLJIVOST IN UČINKOVITOST ZGORNJIH OKONČIN PRI ROKOBORCIH

ABSTRACT

The aim of this study is to investigate the acute effects of different stretching methods on acceleration, vertical jump (CMJ), flexibility and upper extremity performance of young wrestlers. 8 young female wrestlers (15.37 ± 1.06 years; 162.46 ± 4.12 cm and 57.47 ± 6.41 kg) participated in the study voluntarily. Stretching methods were divided into five groups: control (no stretching), static, dynamic, static + dynamic and dynamic + static. The findings showed faster speed performance after control ($p = .012$; $\eta2 = 0.57$), dynamic stretching ($p = .050$; $\eta2 = 1.11$) and static + dynamic combined stretching ($p = .043$; $\eta2 = 0.96$) compared to static stretching; and there is a statistically significant positive difference according to the test averages after dynamic stretching ($p = .050$; $\eta2 = 0.91$) compared to dynamic + static combined stretching ($p<0.05$). Vertical jump performance, according to the control warming up, a statistically significant difference has been found according to the test averages after dynamic stretching ($p = 041$; $\eta2 = 1.17$) and static + dynamic combined stretching ($p = .043$; $\eta2 = 1.07$). No difference was found in flexibility and medicine ball throwing performances according to different stretching protocols ($p>0.05$). It was determined that the acute effect of static stretching had a negative effect on acceleration performances and dynamic stretching caused an increase in jump performance. This study suggests that dynamic and static + dynamic stretching can be used in young wrestlers to provide better performance in acceleration and jumping skills during warm-up sessions.

Keywords: wrestling, speed, vertical jump, throwing medicine ball, stretching exercises

Tekirdağ Namık Kemal University, School of Physical Education and Sports, Tekirdağ, Turkey

Corresponding author:*
Yasemin Arı, School of Physical Education and Sports, Tekirdağ Namık Kemal University, Tekirdağ, Turkey
E-mail: yari@nku.edu.tr

IZVLEČEK

Cilj pričujoče študije je bil raziskati akutne učinke različnih metod raztezanja na pospešek, navpičen skok (CMJ), prilagodljivost in zmogljivost zgornjih okončin mladih rokobork. V študijo smo vključili 8 mladih rokobork (15,37 ± 1,06 let; 162,46 ± 4,12 cm in 57,47 ± 6,41 kg), ki je v študiji sodelovalo prostovoljno. Metode raztezanja so bile razdeljene v pet skupin: nadzor (brez raztezanja), statično raztezanje, dinamično raztezanje, statično + dinamično raztezanje in dinamično + statično raztezanje. Rezultati so pokazali hitrejše hitrostne lastnosti po metodi nadzora ($p = .012$; $\eta2 = 0.57$), dinamičnega raztezanja ($p = .050$; $\eta2 = 1.11$) in kombiniranega statičnega + dinamičnega raztezanje ($p = .043$; $\eta2 = 0.96$) v primerjavi s statičnim raztezanjem. Ugotovili smo, da obstaja statistično značilna pozitivna razlika glede na testna povprečja po dinamičnem raztezanju ($p = .050$; $\eta2 =0,91$) v primerjavi z dinamičnim + statičnim kombiniranim raztezanjem ($p <0,05$). Ugotovili smo značilne razlika med kontrolnim in testnim navpičnim skokom po dinamičnem raztezanju ($p = 041$; $\eta2 = 1,17$) in statičnim + dinamičnim kombiniranim raztezanju ($p = .043$; $\eta2 = 1,07$). Značilna razlika je bila ugotovljena tudi v prilagodljivosti in uspešnosti metanja medicinske žoge glede na različno raztezanje protokolov ($p> 0,05$), kjer smo ugotovili, da akutni učinek statičnega raztezanja negativno vpliva na pospeševanje izvedbe testa ter dinamično raztezanje značilno poveča uspešnost skoka. Študija nakazuje, da lahko kombinirano statično + dinamično raztezanje uporabimo pri mladih rokoborcih, da bi s tem zagotovili boljše rezultate med ogrevalnimi sejami.

Ključne besede: rokoborba, hitrost, vertikalni skok, metanje medicinske žoge, raztezne vaje

INTRODUCTION

Wrestling is one of the popular sports played at the Olympics (Arakawa et al., 2020). Wrestling is a sports discipline that places great demands on physical preparation for athletes with a total of 6 minutes (2 halves of 2 x 3 minutes) match time (Sterkowicz-Przybycień et al., 2011). In wrestling, strength, speed, technique and flexibility skills are required to pull, push, throw and lift the opponent, stop his/her attacks or establish superiority over the opponent (Polat et al., 2018). Therefore, the players must have high physiological and psychological characteristics in wrestling-specific performances such as aerobic-anaerobic performance, speed, flexibility, and strength of the upper-lower extremities (Mirzaei et al., 2009) in order to achieve the desired result in wrestling competitions (Baić et al., 2006; Ziyagil & Türkmen, 2017). Maximum effort is vital for success in the wrestling game as in many sports branches. For this reason, appropriate warm-up exercises are performed to prevent high-level performance and athletic injuries before sportive loads (Gelen et al., 2012).

Stretching exercises, which are used as part of warming up before physical effort are used to lengthen connective tissues and improve range of motion (ROM) (flexibility) around a joint (Amiri-Khorasani et al., 2010). Athletes use different warming methods such as static stretching, dynamic stretching, combined (static + dynamic or dynamic + static) stretching and proprioceptive neuromuscular facilitation (PNF) before physical activity (Polat et al., 2018; McMillian et al., 2006; Kilit et al., 2019; Amiri-Khorasani et al., 2016; Aydın et al., 2019). The target muscles or muscle groups are slowly extended to the stretch point and this position is held for a certain time during the static stretching exercise, which is one of the stretching exercise protocols (Costa et al., 2009). Static stretching performed at different periods before exercise and athletic performance is widely used in team and individual sports to increase the muscle performance of elite and amateur level athletes (Kilit et al., 2019). While in some studies, it has been reported that static stretching does not have a negative effect on performance (Behm & Chaouchi, 2011; Little & Williams, 2006; Samson et al., 2012), many studies have shown that static stretching method has caused a decrease in isometric (McHugh & Nesse, 2008) and isokinetic power output (Sekir et al., 2010) and it has also affected muscle performances such as sprint time (Amiri-Khorasani et al., 2016), jump height (Paradisis et al., 2014) and strength (Herda et al., 2008) adversely. Therefore, it was stated that dynamic stretching should be used instead of static stretching because of the performance decrease caused by static stretching (Amiri-Khorasani et al., 2016).

Dynamic exercises form the basis of sportive movements used in training or competitions. These exercises are based on plyometric movements for the lower and upper extremities, loaded resistance exercises or maximum voluntary contractions (Gelen et al., 2012). Faigenbaum et al. (2006) suggested that voluntary contractions from a low level to high intensity, such as dynamic warming, before performing an athletic activity will increase power generation and performance by activating nerve-muscle function. In some studies, it has been reported that dynamic stretching affects speed, agility (Amiri-Khorasani et al., 2016), vertical jump (Carvalho et al., 2012), medicine ball throwing (Herman & Smith, 2008) and other performances (McMillian et al., 2006) positively. It is recommended for the players to perform the static and dynamic stretching together for a better fit although the studies present the positive effects of dynamic stretching (Amiri-Khorasani et al., 2016). Additionally, it is observed that there are different outcomes when the effects of combined stretches on the performance of athletes are examined in different studies. (Amiri-Khorasani et al., 2010; Chaouachi et al., 2010; Amiri-Khorasani et al., 2016; Kilit et al., 2019).

Although there are few studies evaluating the acute effects of static and dynamic stretch on speed (Kilit et al., 2019), vertical jump (Carvalho et al., 2012), flexibility (Polat et al., 2018), and upper extremity performances (McMillian et al., 2006), to our knowledge, no research has been conducted on the acute effects of five different stretching exercise protocols (no stretching, SS, DS, CSD, CDS) on the speed, jump, flexibility and upper extremity performance of wrestling players. Based on some studies that reported a decrease in some performances after static stretching (Amiri-Khorasani et al., 2010; Amiri-Khorasani et al., 2016), it is assumed that there will be an acute decrease in performance responses and performing dynamic and combined stretching will increase the performance of athletes by performing static stretching exercises afterwards. Therefore, the purpose of this study is to compare the acute effects of different stretching methods on speed, jump, flexibility and upper extremity performances and to determine which of these stretching methods are more effective on the performance of young wrestlers.

METHODS

Participants

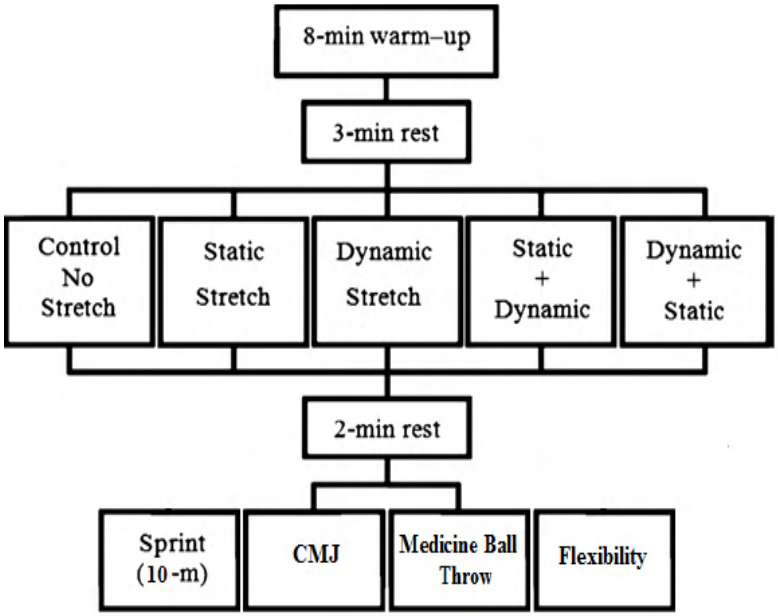
Eight women wrestlers (body height: 162.46 ± 4.12 cm; body mass: 57.47 ± 6.41 kg; age: 15.37 ± 1.06 years; BMI: 21.88 ± 2.66; body fat percentage: 21.42 ± 5.14; training experience: 4.62 ± 1.18 years) have participated voluntarily in this study. Data were collected during the pre-competitive season without any matches. The players have not been involved in any training or competition during the study. According to the inclusion criteria of the study, there should be no musculoskeletal injuries at least 6 months before the study, active participation in the trainings between 4 and 6 days a week and attendance in regular endurance, strength, sprint and wrestling special trainings for at least 2 years as training experience is required. All players and parents were briefed on the research procedures, requirements, benefits and risks before giving a written informed consent form before the test. The study was approved by the local university ethics committee (70400699 / 11.00-190066441).

Procedure

Anthropometric variables of each participant, including height (cm) and body weight (kg), were measured. Portable stadiometer (mesilife) was used for height measurement of wrestlers and electronic weighing machine (Tanita BC545N) was used for body weight measurement. The players were bare feet and wore shorts and T-shirts during measurement.

The current research protocol is adapted from studies conducted by Amiri-Khorasani et al (2016). All wrestlers participated in five stretching methods: control (no stretching), static stretching (SS), dynamic stretching (DS), static + dynamic (CSD), dynamic + static (CDS). The order of the performance tests for the players was randomly chosen with 48 hours of rest. The protocols are followed by each athlete's heart rate monitor (M400, Polar Electro Inc., Kempele, Finland), 8 minutes of general warm-up at a heart rate of 140 beats per minute, 3 minutes of rest, 30 seconds of stretching program for each muscle group (excluding stretch group), 2 minutes of rest followed by it consists of acceleration, vertical jump, flexibility and medicine ball throwing tests. Both static and dynamic stretching protocols have been adapted from the study of Herman & Smith (2008). The experimental procedure has been summarized in Figure 1. All measurements have been taken at the same time of the day (17.30-19.30) in the indoor sports hall.

Figure 1. Experimental design



10 m speed: The athletes were positioned 0.5 m from the starting point and started the tests when they felt ready. Time was recorded using the Microgate Witty photocell device. The timer was automatically activated when experimental subjects passed through the first gate, and their time was recorded at 10 m after passing the end gate (Gorostiaga et al., 2004).

Countermovement jump (CMJ): Participants were positioned within a specified area. A camera was placed right across the area to see the participant and the participant was asked to make an active jump, hands free. Jump was considered invalid when the knees were bent, the legs flexed at the hip, and was landed on or out of the marked field lines. The athletes made 3 jumps after sufficient rest and the best jump was recorded. The images were then transferred to the computer environment via SD card. 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 by the formula (Markovic et al., 2004).

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

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

Throwing medicine ball: The maximum distance that the participant could throw the medicine ball from the head to the back was recorded in centimeters. The ball was held while the heels were located on the measuring line and the elbows in a straight position. Legs and the body were in flexion position then, medicine ball was thrown backwards with full force with

extension movements. While hip, legs and the body performs the extension movements during shooting, flexion movement occurs in the shoulder part. The distance between the point where the medicine ball fell on the ground and the heel of the foot was calculated in meters (Stockbrugger & Haennel, 2001).

Sit and reach test: A standard sit and reach box was placed on the floor. A centimeter scale was placed on the top surface of the box. The athletes were seated on the ground with legs fully extended and placed the soles of their feet flat towards the end of the flex board. Participants stretched the measuring scale as far forward as possible with their arms, palms facing down, without bending their knees and they waited for 3 seconds where their fingers reached the farthest point (López-Miñarro & Rodríguez-García, 2010).

Warm-up and stretching protocols: Participants performed general warm-up by running at low to medium intensity to prepare for performance. All players were instructed to stretch for 30 seconds for each of the upper-lower extremity muscle groups during both static (overhead arm pull, rear lunge and reach, hamstring stretch, quadriceps stretch, posterior hip stretch, trunk flexion / extension stretch) and dynamic stretching (bend and reach, rear lunge and reach, power jump, prone row, windmill, diagonal lunge and reach). There was no resting period between the different stretching exercises. All stretching exercises were carried out by both legs with the help of an instructor. Dynamic stretching was performed slowly and continuously during the exercises. The number of combined stretching exercise (CSD or CDS) sets was reduced from 2 sets to 1 set for each muscle group of both legs in order to equalize the total stretching time. In the control group, the players rested after an 8-minute warm-up session.

Statistical analysis

All statistical analyzes were made using SPSS 18.0 version software. It was determined that all data did not indicate normal distribution. The effect of different stretching methods on speed, jump, flexibility and medicine ball throw was determined using Friedman analysis. The Wilcoxon Signed Rank 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 et al., 2009). Statistical significance level was set at $p<0.05$.

RESULTS

The average, minimum, maximum and quarterly values of the speed, vertical jump, flexibility and medicine ball throwing performances of different stretching methods of the athletes participating in the study have been given in Table 1. In view of the comparison of different stretching methods, while statistical difference has been determined in speed and vertical jump performance values ($p<0.05$), no statistically significant difference has been found in flexibility and medicine ball throwing performance values ($p>0.05$), (Table 1).

Table1. Friedman test results of acceleration, vertical jump, flexibility and medicine ball throw performance values of different stretching methods

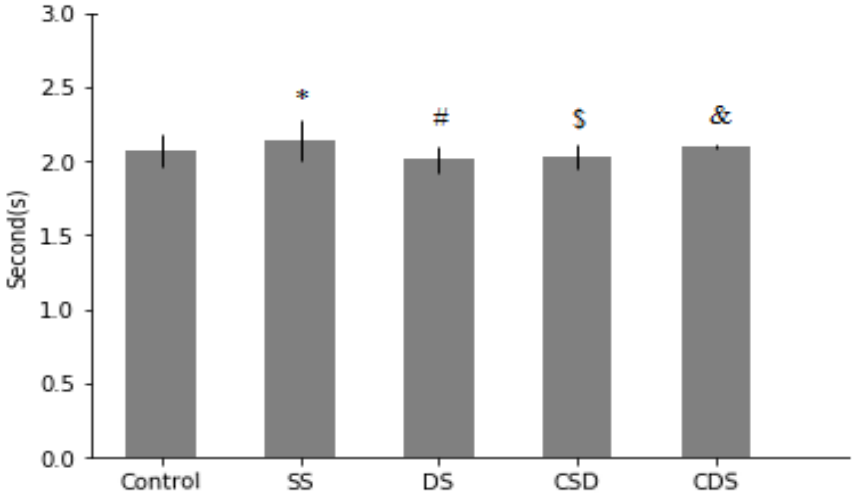
Performance Tests	Stretch Protocol	X±SS	Min.	Maks.	Percentiles			Chi-Square	p
					25th	50th (Median)	75th		
Acceleration	Control (No Stretch)	2.07±.11	1.89	2.28	2.00	2.06	2.14	12.51	.014*
	Static Stretching	2.14±.14	1.92	2.40	2.08	2.11	2.23		
	Dynamic Stretching	2.01±.09	1.84	2.12	1.93	2.04	2.08		
	Static+ Dynamic	2.03±.08	1.92	2.16	1.96	2.01	2.13		
	Dynamic+ Static	2.10±.01	2.00	2.29	2.00	2.07	2.19		
CMJ	Control (No Stretch)	25.13±.02	23.00	31.00	23.00	24.50	26.00	10.63	.031*
	Static Stretching	26.88±.03	23.00	34.00	23.75	26.00	29.75		
	Dynamic Stretching	28.13±.03	23.00	31.00	26.00	28.50	31.00		
	Static+ Dynamic	27.88±.03	23.00	34.00	26.00	26.00	31.00		
	Dynamic+ Static	26.25±.03	23.00	34.00	23.75	26.00	26.00		
Medicine ball throw	Control (No Stretch)	7.18±.91	5.78	8.98	6.65	7.19	7.53	9.30	.054
	Static Stretching	6.66±.84	5.48	7.85	5.80	6.80	7.35		
	Dynamic Stretching	6.46±.61	5.39	7.23	6.03	6.46	7.05		
	Static+ Dynamic	7.01±.95	5.61	8.54	6.21	6.89	7.77		
	Dynamic+ Static	7.01±.89	5.77	8.94	6.54	7.00	7.09		
Flexibility	Control (No Stretch)	32.11±6.89	23.00	40.90	24.97	32.90	38.32	9.34	.053
	Static Stretching	31.57±7.39	19.80	40.30	25.05	31.85	39.05		
	Dynamic Stretching	30.63±6.49	20.40	39.60	25.00	31.45	36.05		

Static+ Dynamic	32.53±6.89	23.30	40.90	25.07	33.40	39.15
Dynamic+ Static	30.88±6.92	21.80	39.50	23.37	32.50	37.22

*p<0.05

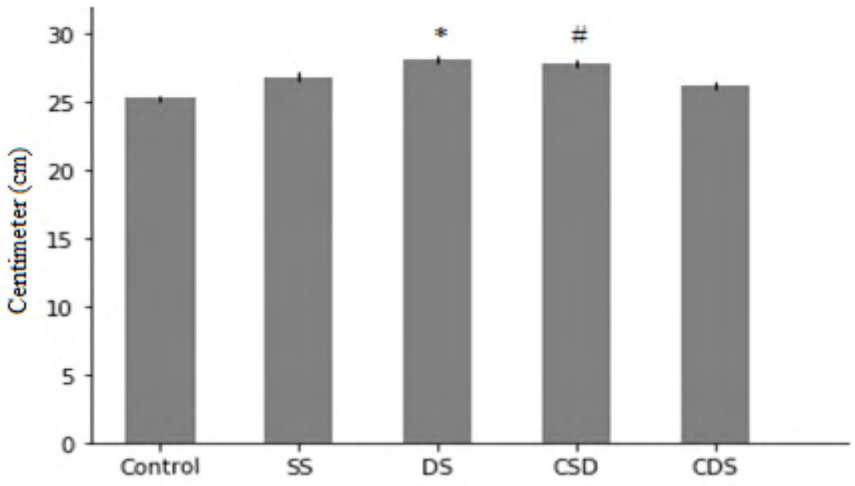
Considering the findings of the speed performance of different stretching methods in wrestlers, it has been determined that there is a faster speed performance after control (p = .012; η2 = 0.57, ‘‘small’’), dynamic stretching (p = .050; η2 = 1.11, ‘‘moderate’’) and static + dynamic combined stretching (p = .043; η2 = 0.96, ‘‘moderate’’) compared to static stretching; and there is a statistically significant difference according to the test averages after dynamic stretching (p = .050; η2 = 0.91, ‘‘moderate’’) compared to dynamic + static combined stretching (Figure 2), (p<0.05).

Figure 2. Wilcoxon Signed-Ranks Test results of the acceleration performance of different stretching methods. *No stretching - Static stretching; #Static stretching - Dynamic stretching; $Static stretching - CSD stretching; &Dynamic stretching - CDS stretching.



Considering the CMJ performance findings of different stretching methods, according to the control warming up, a statistically significant difference has been found according to the test averages after dynamic stretching (p = 041; η2 = 1.17, ‘‘moderate’’) and static + dynamic combined stretching (p = .043; η2 = 1.07, ‘‘moderate’’), (Figure 3), (p<0.05).

Figure 3. Wilcoxon Signed-Ranks Test Results of CMJ performances of different stretching methods. *No stretching - Dynamic stretching; #No stretching - CSD stretching.



DISCUSSION

As far as we know, the acute effect of the stretching method applied in this study on the performances of different sports players has been examined (Amiri-Khorasani et al., 2016; Aydın et al., 2019; Kilit et al., 2019), but this is the first study to examine the acute effects on the acceleration, flexibility, lower and upper extremity performances. Therefore, the aim of the study is to examine the acute effects of different stretching methods on acceleration, jumping, flexibility and upper extremity performances. It was determined in the research findings that the acute effect of static stretching had a negative effect on speed performance and dynamic stretching caused an increase in jump performance. On the other hand, there was no significant difference in performance between other protocols.

Wrestling is a sport with many performance dynamics. It is important to apply these dynamics at the maximum level and to be successful in training and competitions (Polat et al., 2008). Many studies have investigated the acute effect of dynamic or combined stretching, which are the recommended stretching methods to increase athletic performance responses (Little and Williams, 2006; Faigenbaum et al., 2006; Turki et al., 2012; Amiri-Khorasani et al., 2016; Kilit et al., 2019). In addition to these studies, in the study on wrestlers is consistent with most studies reporting that dynamic or combined stretching improves performance during sprint time (Turki et al., 2012; Amiri-Khorasani et al., 2016; Kilit et al., 2019). For example, Amiri-Khorasani et al. (2016) have shown that different stretching exercise protocols applied before exercise

performed better than the static and non-stretch protocols after dynamic and combined stretching. Little & Williams (2006) have stated that acute dynamic stretching improves the acceleration test performance of football players. However, there are also studies in the literature reporting that dynamic stretching has no effect on speed performance (Chaouachi et al., 2010). Polat et al. (2018) have found that acute applied ballistic warm-up does not show any difference in the speed performance of wrestlers. In addition, Schilling & Stone (2000) attributes that static stretching does not have a positive effect on linear running performance to the changes in the muscle-tendon unit as a result of static stretching. In this study, it can be said that the increase in muscle tension with static stretching decreases the performance values. As a result of the research, we can say that the hypothesis that the dynamic and combined dynamic stretching exercise protocol will positively affect the speed performance has been confirmed.

It has been stated that dynamic warming can increase power performance in addition to the changes in the relationship between warming and force velocity (McMillian et al., 2006). Many studies have shown that dynamic or combined stretching has a positive effect on power (Sekir et al., 2010) and jump (Carvalho et al., 2012) performances. Haghshenas et al. (2014) examined the acute effect of different stretching protocols on volleyball players and reported a significant increase in anaerobic power in favor of dynamic stretching when dynamic stretching and static stretching were compared. Behm & Chaouachi (2011) have concluded that dynamic stretching routines are the preferred method to improve explosive muscle contractions. Contrary to the current findings, some studies have reported that dynamic stretching does not improve short-term explosive performance (Jaggers et al., 2008; Samuel et al., 2008). Aydın et al. (2019) applied the same protocol with the different stretching exercises in this study and stated that there was no statistically significant difference in vertical jump performance values after the study. In addition, although some existing studies have not shown any side effects of static stretching (Samuel et al., 2008), others have stated that static stretching may adversely affect short-term maximum performance (Paradisis et al., 2014). It is thought that the inconsistencies in the findings of some existing studies with this study may be due to the age of the participants, training status, stretching time, volume, density or other factors used in current protocols.

The ability to generate or transfer explosive muscle power is a key element for the success of many athletic activities (Stockbrugger & Haennel, 2001). To the author's knowledge, only a few studies have examined the acute effects of different warm-up methods on upper extremity strength performance (Knudson et al., 2004; McMillian et al., 2006; Torres et al., 2008). In this study, it was determined that there was no statistically significant difference in medicine ball

throwing performance of different stretching exercises applied to wrestlers. Torres et al. (2008) examined the effect of upper body static stretching and dynamic stretching on upper body muscle performance in athletes and stated that there was no significant change in medicine ball throwing performance in athletes. In contrast to these studies, Mcmillian et al. (2006) have stated that there is a positive difference in the performance of throwing medicine balls in dynamic stretching exercises compared to static stretching. Herman & Smith (2008) applied a four-week dynamic and static warm-up program to wrestlers and reported an improvement in medicine ball throwing performance (4%) in favor of dynamic exercise at the end of four weeks. It is difficult to make a definitive judgment as to whether different stretching exercises affect performance with so few studies focusing on the upper body. Also, Torres et al. (2008) have stated that almost all studies in the literature focus on the effects of yawning on lower body neuromuscular performance.

Flexibility is included in athletes' training program as an important part of the warm-up procedure. However, it is not correct to limit performance only to flexibility (Polat et al., 2018). According to the current literature studies, it has been seen that different stretching protocols can affect the flexibility performance of athletes in different ways. For example, Tsolakis et al. (2010) have found no significant difference in flexibility performance after static or ballistic stretching of the lower extremities in international fencers. In addition, it was stated in another study similar to our study findings that there was no difference in sit and reach performance between static and dynamic exercises (Perrier et al., 2011). Contrary to the current findings, Polat et al. (2018) have found that ballistic warming applied to wrestlers increases their flexibility. Kumar & Chakrabarty (2010) have found that ballistic exercise significantly increases the flexibility of athletes' hamstring muscles compared to static exercise. In addition, there are a number of other studies reporting the superiority of static stretching for increasing static ROM in addition to the positive effects of dynamic stretching (Covert et al., 2010). Samson et al. (2012) reported that static stretching increased 2.8% in sitting and reaching range of motion (ROM) compared to dynamic stretching.

Although this is the first study to examine the acute effects of different stretching methods on acceleration, jump, flexibility and upper limb performances in young wrestlers, some limitations should be carefully noted before final conclusions are drawn. Firstly, it is small sample size given that they are young female wrestling players. Another limitation is that it did not analyze the chronic influence of wrestlers on their performance. However, an important

strength of this study is, short-term procedure was chosen to minimize any performance changes that could occur over a longer time period.

CONCLUSION

In conclusion, the acute effects of different stretching methods on acceleration, jumping, flexibility and upper extremity performances of young wrestlers were examined in this study. These research findings show that dynamic and combined (static + dynamic) stretching can increase speed and jump performance in young wrestlers. According to the study findings, coaches and sports scientists should consider choosing the stretching type after the warm-up session. In addition, dynamic and combined (static + dynamic) stretching should be done to increase the speed and jump performance of their players. Researches on athletic performance and sports branch performances of different stretching methods, athletes of different ages and performance levels are recommended in future studies.

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Conflicts of Interest

The author declare no conflict of interest.

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