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The effect of dynamic warm-up exercise durations on different jump types in young male boxers

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Abstract

This study was conducted to determine the effects of various durations of dynamic warm-up exercise on different jump types in young male boxers. Fourteen young male athletes (mean age: 16.86±1.03 years, height: 172.57±11.34 cm, body weight: 65.21±16.42 kg) voluntarily participated in the study, which employed a pretest-posttest experimental research model, a quantitative method, without a control group. Our athlete group was selected from individuals with at least 3 years of sports history. The athletes were instructed to run for 5 minutes at an average heart rate of 120 beats/min, followed by dynamic stretching consisting of 10 different exercises for durations of 5, 10, and 15 minutes on different days. After each period of different dynamic exercises, the participants performed drop jump, countermovement jump, and squat jump tests. The SPSS package program was used to analyze the data obtained from the research. Repeated Measures ANOVA and the Bonferroni test, a post-hoc test, were applied to normally distributed data. Examining the drop jump test results, a significant difference was detected between the various dynamic warm-up times ($p < .05$), with the distance measured after the 10-minute exercise period higher than those following the 5- and 15-minute warm-up periods. There were no significant differences between the dynamic warm-up times ($p > .05$) for the countermovement jump and squat jump tests. As a result, dynamic warm-up exercises were determined to improve the drop jump performance of young male boxers, with the 10-minute exercise duration more positively affecting drop jump performance than either the 5- or 15-minute warm-up periods. According to the results of the study, dynamic warm-up exercises can be added to training to increase performance in young male boxers.

Keywords: Boxing, dynamic warm-up, jumping.

Genç Erkek Boksörlerde Dinamik Isınma Egzersiz Sürelerinin Farklı Sıçrama Türleri Üzerindeki Etkisi

Bu araştırma, genç erkek boksörlerde dinamik ısınma egzersiz sürelerinin farklı sıçrama türleri üzerindeki etkisini belirlemek amacıyla yapılmıştır. Araştırmaya 14 genç erkek sporcu (yaş: 16,86±1,03 yıl, boy: 172,57±11,34 cm, vücut ağırlığı: 65,21±16,42 kg) gönüllü olarak katılmıştır. Araştırmada nicel araştırma yöntemlerinden kontrol grupsuz ön test-son test deneysel araştırma modeli kullanılmıştır. Sporcu grubumuz en az 3 yıllık spor geçmişi olan bireylerden seçildi. Sporculara ortalama 120 atım/dk kalp atım hızında 5 dk koşu, sonrasında 10 farklı egzersizden oluşan dinamik germe egzersizleri farklı günlerde 5, 10 ve 15 dk süreyle uygulanmıştır. Her uygulama gününde farklı dinamik egzersiz sürelerinden sonra sporculara drop jump, counter movement jump ve squat jump sıçrama testleri uygulanmıştır.

Araştırmadan elde edilen verilerin analizinde SPSS paket programı kullanılmıştır. Normal dağılım gösteren verilere Repeated Measures ANOVA ve Post Hoc testlerden Benferroni testi uygulanmıştır. Araştırma bulgularında drop jump testi sonuçlarına bakıldığında dinamik ısınma süreleri arasında anlamlı bir fark tespit edilmiştir ($p<0,05$). Genç boksörlerde 10 dk dinamik ısınma egzersiz süresi sonrasında ölçülen drop jump sıçrama mesafesinin 5 dk ve 15 dk dinamik ısınma sürelerine göre daha yüksek olduğu belirlenmiştir. Counter movement jump ve squat jump testi sonuçlarına bakıldığında dinamik ısınma süreleri arasında anlamlı bir fark bulunmamıştır ($p>0,05$). Sonuç olarak genç erkek boksörlere uygulanan dinamik ısınma egzersizlerinin drop jump performansını arttırdığı, ayrıca 10 dk'lık dinamik egzersiz süresinin drop jump performansını 5 dk ve 15 dk ısınma sürelerine göre daha olumlu etkilediği belirlenmiştir. Çalışma sonuçlarımıza göre genç erkek boksörlerde performans artışı için antrenman programına dinamik ısınma egzersizleri eklenebilir.

Anahtar Kelimeler: Boks, dinamik ısınma, sıçrama.

INTRODUCTION

Boxing, a sport involving two opponents from the same weight group, is based on the principle of punching, whereby the athletes protect themselves and take positions with their feet within the predetermined rules of the game (10). The main goal in a boxing match is to protect oneself against the opponent, to punch the opponent without getting punched, and to score points accordingly with these hits (18). In a boxing match, athletes hit their opponents with the front side of the hand in a fist position, wearing boxing gloves rather than with their bare hands. As per the rules, striking the neck and below the waist is prohibited. In this sport, the main goal is to acquire points, which are awarded by five referees who determine the scores based on the accuracy and number of clear punches. In matches, the outcome is determined by good technique, tactics, and the fighting spirit of the athletes (7). Although the main goal in boxing is to strike the opponent above the belt as specified in the rules with good technique, to be successful in this sport it is also crucial to keep one's guard up against the opponent's attacks to avoid getting struck and thus surrendering points to him by employing effective defensive techniques (31, 40).

An indispensable component of competitions and competitions is the warm-up. Warm-up incorporates essential techniques to improve athletic performance, minimize injuries that may occur during competitions and training, and ensure that the athlete attains optimal physiological and psychological adaptation to the stresses he will be exposed to (27). With warm-up exercises, the organism shortens the transition time to exercise, and the body becomes primed for exercise with increased blood flow rate and warming muscles. The range of motion in connective tissue expands and consequently, the risk of musculoskeletal system injuries decreases. In addition, as the flexibility level of the joints increases, sports performance also improves (28). Athletes and coaches agree that stretching exercises, a component of the warm-up, contribute to enhanced athletic performance (38). Stretching exercises achieve this by optimizing the athletes' musculoskeletal efficiency levels prior to competition (33).

Body composition is one of the important factors for athletic success. Body composition represents a critical factor in producing the highest levels of athletic performance, involving essential components for athletic success such as strength, power, mobility, speed, endurance, and agility, known as basic motor characteristics (1, 29). Speed is also known as a skill that directly affects sporting success. In sports sciences, speed is defined as an athlete moving from one point to another in the shortest possible time. Viewed from a physiological perspective, this skill is dependent on the effective functioning of the central nervous system and skeletal muscles. (26,29). Employing a different definition, speed can be defined as reaching the distances to be covered earlier (5).

When considering the definition of jumping force, athletes can be said to possess the ability to jump horizontally far and vertically high. The lower extremity flexor and extensor muscles are very effective in jumping (35). In order to achieve optimal performance in sports, the ability to jump as fast and as high as possible is a critical factor (20). The vertical jump is a movement incorporating many joints in the body and requiring high levels of muscular strength in the hip, knee, and ankle joints. Proprioceptive exercises increase the strength of the flexor and extensor muscles in the foot and the muscles in the back of the thigh (15). A vertical jump is affected by the speed of the explosive force that occurs during the execution of the jump proceeding from eccentric muscle contraction to concentric muscle contraction. In view of this, proprioceptive training practices are effective in developing faster strength, increasing the frequency and rate of the motor units involved in the movement, and accordingly improving vertical jump execution and height. In addition, the mobility of the hip joint has a significant impact on vertical jump performance, thus determining the difference between submaximal and maximal vertical jumping ability (15).

Strength constitutes one of the basic motor skills of an organism, and with force, it is possible to move a mass (whether one's own body weight or the equipment used in a sport). Depending on the application of force, resistance is either overcome or opposed by the muscle mass (32). In their study, De Ste Croix et al. (8) found that with an increase in leg strength, anaerobic performance and strength levels increased in the thighs, calves, muscle mass of the leg, and legs with high mass but low fat levels. This observation can be explained by increased muscle mass in the legs and a high number of muscle fibers resulting in an increase in strength (30). When athletes with superior anaerobic performance were compared to their competitors, it was determined that their fast-twitch muscle fibers, called type II, were denser and that they possessed higher muscle volume (34).

The topic of the present study, which aimed to determine the effect of dynamic warm-up exercise periods on different types of jumps in young male boxers, has been little investigated in the literature. As such, the results of the present study may foster innovation in the training parameters of an important sport such as boxing in order to improve athletic performance, thus also representing an important contribution to the literature. Our study results show that the level of winning and success in book sports is very significant.

METHOD

Study Participants

For this study, which employed a quantitative experimental research design, a pretest-posttest model with no control group was preferred. Athletes in the youth category from Ağrı province, Turkey were recruited for the study, with the research group consisting of 14 young male boxers who participated voluntarily. Our athlete group was selected from individuals with at least 3 years of sports history. According to our study, it may be possible to achieve higher performance in sports.

Ethics Approval

Prior to the start of this study, ethical approval was obtained from Muş Alparslan University Scientific Research and Publication Ethics Board on 5 October 2023 (meeting number 8, decision number 37).

Data Collection Tools

Study Design: Body and body weight measurements were taken before the study. In this study, composed of a single experimental group, the participants performed dynamic stretching exercise protocols of varying durations. The different protocols were comprised of 5 minutes of jogging + 5 minutes of dynamic stretching, 5 minutes of jogging + 10 minutes of dynamic stretching, and 5 minutes of jogging + 15 minutes of dynamic stretching. Following each period of dynamic stretching, the young male boxers completed three different jump tests (the drop jump, squat jump, and countermovement jump) in order to determine the effects of the various dynamic stretching exercise protocols.

Dynamic Stretching Exercise Protocols: After running for 5 minutes at an average heart rate of 120 beats/min, the participants performed dynamic stretching exercises lasting 5, 10, or 15 minutes. These consisted of 10 different exercises of medium to high intensity (walking knee to chest, butt kicks, carioca, leg swings, walking lunges, Frankenstein walk, high knee skip, high knee run, A skip, and B skip; Table 1). The testing protocols, all of which included 5 minutes of aerobic running, were carried out at 48-hour intervals. In order to prevent fatigue, a 3-minute rest period was allowed following completion of each set for the 10- and 15-minute dynamic stretching protocols.

Table 1: Dynamic Stretching Exercise Protocol

Dynamic Stretching Exercise	Explanation of Exercise	5 Min	10 Min	15 Min
Walking Knee to Chest	Walk taking normal walking steps, pulling hands and knees upwards	30 sec	2x30 sec	3x30 sec
Butt Kicks	Move forward with running steps, touching the buttocks with the heels	30 sec	2x30 sec	3x30 sec
Carioca	Run while the body is turned to the left or right, rotating the hips and with feet moving left or right	30 sec	2x30 sec	3x30 sec
Leg Swings	Legs swing forward and backward	30 sec	2x30 sec	3x30 sec
Walking Lunge	While walking forward with lunging steps, the knee of the hind foot touches the ground	30 sec	2x30 sec	3x30 sec
Frankenstein Walk	While walking, the arms are held parallel to the floor in front of the body and the tip of the toes touch the hands (performed without bending the knees)	30 sec	2x30 sec	3x30 sec
High Knee Skip	While running forward, the right knee is lifted in line with the left arm and the left knee with the right arm	30 sec	2x30 sec	3x30 sec
High Knee Run	While running, knees are pulled to the chest and arms swing	30 sec	2x30 sec	3x30 sec
A Skip	Proceed with hopping steps, pulling the knees to the chest	30 sec	2x30 sec	3x30 sec
B Skip	Proceed with hopping steps, with legs stiff and swinging upwards	30 sec	2x30 sec	3x30 sec

The following measurements and tests were performed for this study:

Height: Height was measured in cm with a tape measure, while the study participants were bare-footed.

Weight, Body Fat Percentage, and Muscle Mass: The body weights, fat percentages, and muscle masses of the athletes participating in the study were determined using the TANİTA MC 780 device.

Determination of Heart Rate: The heart rate of the athletes during jogging was monitored using a tablet with the IOS Polar Team application and Polar brand H10 (Polar Electro, Finland) model chest bands.

Drop Jump Test: The participants were tested on the jumping mat (Smart Jump; Fusion Sport, Australia). In this test athletes fall from 40 cm high crates onto the mat on the floor with both feet, keeping their hands on their waist and elbows bent outward (akimbo stance); as soon as their feet touch the mat, they jump as high as they can from a half squat position (23). Athletes perform 2 jumps with 30 seconds allowed between each attempt for recovery (4).

Figure 1: Drop Jump Test

Countermovement Jump Test: The participants performed this test on the jumping mat (Smart Jump; Fusion Sport, Australia). In our study, arm swing was not allowed during the test so that the focus would remain on lower extremity explosive strength. Each athlete started the test in a standing position on the platform with hands on the waist and elbows bent outwards (akimbo stance). As soon as they descended into a squat position, they then jumped as high as possible (6).

Figure 2: Countermovement Jump Test

Squat Jump Test: As with the countermovement jump test, arm swing was not allowed while performing the squat jump test. Each athlete started the test in a standing position on the platform, waiting for 3 seconds at an average knee flexion of 90-100° before jumping as high as possible. Reviewing the literature, the most common waiting time for knee flexion for this test was found to be 3 seconds (6, 9).

Statistical analysis

The SPSS package program was employed in the statistical analysis of the data obtained from this study. The normality level of the data was determined using the Shapiro-Wilk test. Repeated measures ANOVA (analysis of variance), a parametric test, and the Bonferroni test, a post-hoc test, were applied to normally distributed data. In the study, a value of $p < .05$ was accepted as statistically significant.

FINDINGS

Descriptive statistics of the demographic features of the young boxers participating in this study are given in Table 1.

Table 1. Descriptive statistics of the athletes' demographic characteristics

Demographic Variable	n	Mean	Std. Dev.
Age (years)	14	16.86	1.03
Height (cm)	14	172.57	11.34
Weight (kg)	14	65.21	16.42

Table 2. Drop jump repeated measures ANOVA test results

Test	Duration	n	Mean	Std. Dev.	f	p	Variance
Drop Jump	5 min.1	14	27.82	6.35	5.683	0.011*	2>1
	10 min.2	14	31.00	6.31			2>3
	15 min.3	14	28.56	5.27			

*p < .05

According to the drop jump test results of the young male boxers shown in Table 2, a significant difference was detected based on the dynamic warm-up times ($p < .05$). The jump distances of the participants following the 10-minute dynamic warm-up exercise were higher than those obtained after the 5-minute and 15-minute warm-up periods.

Table 3. Counter movement jump repeated measures ANOVA test results

Test	Duration	n	Mean	Std. Dev.	f	p	Variance
Counter Movement Jump	5 min.	14	30.39	4.06	0.443	0.635	p > .05
	10 min.	14	30.44	5.52			
	15 min.	14	30.99	5.29			

As can be seen from the results presented in Table 3, no significant difference was observed between the countermovement jump test results of the participants with respect to the various dynamic warm-up times (p > .05).

Table 4. Squat jump repeated measures ANOVA test results

Test	Duration	n	Mean	Std. Dev.	f	p	Variance
Squat Jump	5 min.	14	28.44	5.64	0.463	0.587	p > .05
	10 min.	14	28.86	5.91			
	15 min.	14	28.92	5.52			

According to the data shown in Table 4, there was no significant difference between the squat jump test results based on the different warm-up times (p > .05).

DISCUSSION AND CONCLUSION

In the present study, the effect of different dynamic warm-up exercise periods on various jump types performed by young male boxers was examined. According to our findings, upon examining the results of the drop jump, countermovement jump, and squat jump tests performed following the protocols incorporating 5, 10, and 15 minutes of jogging and dynamic stretching exercises, a significant difference was detected only for the drop jump distances. The mean drop jump distance of the young boxers following the 10-minute dynamic warm-up exercise period was higher than those following the 5-minute and 15-minute warm-up periods. No statistically significant differences were observed between the countermovement jump and squat jump test results with respect to the various warm-up periods, but the jump distances for the 15-minute warm-up times were greater than those for the 10-minute warm-up times, which exceeded those associated with the 5-minute warm-up periods.

Dynamic warm-up movements with a high warm-up time have been observed to contribute more to vertical jump height than those with a shorter warm-up time. A review of the literature reveals numerous studies in support of our findings. Examining the acute effects of different warm-up protocols on jumping performance, Gelen (17) concluded that static warm-up protocols resulted in a decrease in vertical jump performance, but found that dynamic warm-up protocols had positive effects on vertical jump performance. Faigenbaum et al. (12) examined the acute effects of different warm-up methods on the anaerobic performance levels of athletes, determining that dynamic warm-up protocols positively impacted vertical jump performance. In their study on post-activation model warm-up incorporating squat and 10-repetition multiple jump tests, Harmancı et al. (22) showed that dynamic warm-up exercises caused a significant increase in jump heights, whereas static warm-ups resulted in a significant decrease. Atan (3) examined the effects of different warm-up protocols on joint range of motion, jumping, and sprint performance, concluding that a jogging + dynamic stretching protocol had a more positive effect on vertical jump performance than jogging + static stretching. Wright et al. (39) investigated the effects of static stretching, dynamic stretching, and warm-up on vertical jumping in their study involving 36 athletes between the ages of 18-30 and found that dynamic stretching warm-up exercises improved vertical jump performance. Conversely, static stretching exercises have been shown to negatively affect vertical jump performance.

In study by Faigenbaum et al. (13) examined the effects of warm-up protocols applied after static and dynamic warm-up on the physical conditions of young athletes and their acute effects on the athletes, and found that vertical jump performance was significantly reduced after static warm-up compared to dynamic warm-up. In another study comparing dynamic and static warm-up methods, Thompsen et al. (36) found that dynamic warm-up exercises more positively impacted vertical jump performance than static methods. Güler (19), in his study examining how active jumping performance following different neuromuscular warm-up protocols affected biomechanical parameters in young football players, observed a significant difference in the body surface temperature and vertical jump heights of 24 football players who employed dynamic and FIFA 11+ warm-up protocols, compared to a static warm-up protocol. Mohammadtaghı et al. (25) examined the acute effect of static and dynamic stretching on hip range of motion during step kicks in 18 professional football players, finding that warm-ups incorporating dynamic stretching movements improved performance. In his study investigating the effects of different warm-up protocols on flexibility and jumping performance involving 20 male basketball players aged 13-14, Andrejic (2) employed dynamic warm-up and static warm-up protocols; significant differences were detected in the vertical jump results of the dynamic warm-up group. Esmer et al. (11) examined the effects of static warm-up and dynamic warm-up protocols on the motor characteristics of adolescent basketball players, observing statistically significant differences in the vertical jump heights of the participants. Fattahi et al. (14) researching the effects of dynamic and static warm-up exercises on the vertical jump heights of 57 male volleyball players, concluded that the vertical jump performance of the dynamic warm-up group was superior to the static warm-up group. According to their findings, dynamic warm-up exercises were more suited to exercises requiring explosive power. In his research examining the effects of static and dynamic warm-up exercises on the vertical jump and sprint performances of 20 basketball players, Galazoulas (16) found that dynamic warm-up exercises had a positive effect on vertical jump heights compared to static warm-up exercises. In their study on 32 female volleyball players, Haghshenas et al. (21) investigated the acute effects of different warm-up methods and observed that dynamic warm-up exercises resulted in a significant increase in anaerobic power compared to static warm-up exercises.

Although a review of the literature uncovered many studies supporting our results, nonetheless, some studies have obtained results that are not consistent with our findings. Kahraman et al. (23) examined the acute effects of different warm-up protocols on speed, vertical jump, balance, and leg strength in young male futsal players and found that the static warm-up group was more successful in vertical jump performance than the group employing dynamic warm-up practices. The reason for this discrepancy may be due to differences in the actual content of the warm-up protocols and/or the different branches of sport involved. In their study, Torres et al. (37) reported that neither the static nor the dynamic warm-up protocol produced any effect on the development of leg strength. The fact that this study's results did not coincide with our findings may be explained by the higher mean age of their study participants compared to ours and/or the different branch of sport involved.

In conclusion, the present study determined that dynamic warm-up exercises improved the drop jump performance of young male boxers, and that the 10-minute dynamic exercise duration affected this performance more positively than either the 5- or 15-minute warm-up periods. For young boxers, employing dynamic warm-ups of a duration that will increase muscle elasticity by reaching a sufficient temperature, without the warm-up period being too short or too long, can increase vertical jump heights.

RECOMMENDATIONS

According to the results of our study conducted to determine the effect of dynamic warm-up exercise periods on different jump types in young male boxers, the following recommendations can be made:

• Applying dynamic warm-up protocols for a sufficient period of time (10 minutes) before competitions and training can increase the performance of athletes.

• Studies should be conducted on warm-up times for different warm-up protocols.

• Coaches and athletes should be provided with more information regarding dynamic warm-up exercises.

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