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Genç Erkek Basketbolcularda Dirençli Pliometrik Antrenman Kas Kuvvetini Arttırır

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Özet

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Amaç: Bu çalışmada genç basketbolculara uygulanan 12 haftalık dirençli ve dirençsiz pliometrik antrenmanın el, gövde ve bacak kas kuvveti üzerine etkisi incelenmiştir.
Yöntem: Çalışmaya, 15±0,8 yaşında 27 sporcu dahil edilmiştir. Sporcular, kontrol (K), pliometrik (P) ve ağırlık yeleği+pliometrik (A) olmak üzere 3 gruba ayrılmıştır. Her 3 grup 12 hafta boyunca rutin basketbol antrenmanı yapmıştır. Kontrol grubu rutin basketbol, pliometrik antrenman grubu vücut ağırlığı kullanarak pliometrik, ağırlık yeleği grubu ise ağırlık yeleği ile pliometrik antrenman uygulamıştır. Antrenman programının bitimini takiben tüm sporcuların el, sırt ve bacak kas kuvveti, dinamometre kullanılarak ölçülmüştür. Çalışmada elde edilen veriler ortalama±Ss olarak sunulmuş, ölçümler arası karşılaştırma t testi, gruplar arası karşılaştırma varyans analizi ile değerlendirilmiş, $p<0.05$ istatistiksel önem düzeyi olarak kabul edilmiştir.
Bulgular: Çalışmadan elde edilen sonuçlar, 12 haftalık antrenmanın pliometrik antrenman grubunda el ve sırt kuvvetini, ağırlık yeleği ile pliometrik antrenmanın ise bacak kuvvetini arttırdığını göstermiştir.
Sonuç: Sonuç olarak bu çalışma, genç basketbolcularda 3 ay boyunca uygulanan pliometrik ve dirençli pliometrik antrenmanın el, gövde ve bacak kuvvetinde artışa yol açtığını, ayrıca pliometrik antrenmana direnç eklenmesiyle, basketbolcularda son derece önemli olan alt ekstremite kuvvetinde belirgin artışın ortaya çıktığını çarpıcı biçimde ortaya koymuştur.

Resistant Plyometric Training Increases the Muscle Strength in Young Male Basketball Players

Abstract

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Exercise, Strength Training, Young Athlete, Weight Vest

Purpose: In this study, the effect of 12-week resisted, and non-resistive plyometric training applied to young male basketball players on hand, trunk and leg muscle strength was examined.
Method: 27 athletes aged 15+0.8 years old were included in the study. Athletes were divided into 3 groups: control (C), plyometric (P) and weight vest + plyometric (W), with 9 athletes each. All 3 groups performed routine basketball training for 12 weeks. Group C performed routine basketball, group P performed plyometric training using body weight, and group W performed plyometric training with a weight vest. Following the end of the training program, the hand, back and leg muscle strength of all athletes was measured using a dynamometer. The data obtained in the study were presented as mean + SD, comparison between measurements was evaluated with the t test, and $p<0.05$ was used as the significance level.
Results: This study revealed that plyometric and resistance plyometric training applied for 3 months in young basketball players led to an increase in hand, back and leg strength. The results of this study show coaches working in this field that adding resistance plyometric training to the standard basketball training program leads to more effective results in increasing physical performance.
Conclusion: In conclusion, this study strikingly revealed that plyometric and resistive plyometric training applied for 3 months in young basketball players led to an increase in hand, trunk and leg strength. Furthermore, with the addition of resistance to plyometric training, there was a significant increase in lower extremity strength, which is extremely important in basketball players.

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Introduction

Basketball is one of the sports followed with interest worldwide. Motoric abilities are important during the game in basketball. Features such as strength, speed, endurance and continuity in speed, which are especially important in basketball, contribute to the increase in performance (Savaş, 1992). Acquiring these features at an early age is important for basketball performance.

In order to perform effectively in basketball, scientific training methods must be applied (Sevim, 1991). Many training methods have been developed for the strength development of athletes in the older age category (Sevim, 1991). Plyometric training is one of the trainings consisting of hopping, skipping and jumps performed with the athletes' body weight (Foran, 2001). Plyometric training is generally used to strengthen the lower extremities. It provides improvement in many performance features such as jumping, running, and ability to resist gravity (Chu, 1992). It has also been observed that plyometric training increases the speed and strength abilities of athletes. Plyometric training is a method that improves jumping ability, which is an important parameter for basketball (Gambetta, 1989). In addition, there are plyometric training methods that add resistance to plyometric training to optimize jumping performance in basketball. For this purpose, there are various methods in the literature such as elastic bands (Shi et al. 2023) and resistance application devices (Pamuk et al. 2022). Another resistance application method is the weight vest application using free weights. A weight vest is a training method that is used with weights added to the athlete's own body weight, is inexpensive, and does not require expensive equipment (Macadam et al. 2017). It has been shown that training with weight vests increases athletes' sprint running performance and ground reaction forces. It has been shown that resistance training programs with weight vests allow athletes to develop many motor skills (Özbay et al. 2018).

There are very limited studies in the literature focusing on the effects of resistance training on muscular strength in young basketball players. However, it is important to clarify the issue in terms of determining the relationship between resistant and non-resistant plyometric training and adapting the training program according to the results. To our knowledge, in the literature, no study has been found investigating the effect of plyometric training using a weight vest, which is known to be very easy to use, cheap and effective, on the strength of different muscle groups in young basketball players. This study aimed to examine the effect of resistant plyometric training applied with a weight vest on muscle strength in young basketball players.

Material and Method

The study was carried out at Akdeniz University Faculty of Sports Sciences. The study was ethically approved by the Akdeniz University, Faculty of Medicine, Clinical Research Ethics Committee (24.07.2019/716).

Study Group

Twenty seven young male basketball athletes, aged 15-18, participated in the research. The athletes included in the study were those who have been playing basketball for at least 5 years, have no health problems, do not use medication regularly or take nutritional supplements. All athletes participated in the study voluntarily.

Procedure

Participating athletes were divided into 3 groups according to their training protocols: control (C), plyometric (P) and weight vest + plyometric (W) Groups were formed with 9 people in the whole group. All 3 groups trained for 12 weeks. Group C did routine basketball training, group P did plyometric jump training using body weight 3 days a week in addition to routine basketball training, group W did plyometric jump training with a weight vest 3 days a week in addition to routine basketball training.

In the research, bioelectric impedance device, hand dynamometer, back and leg dynamometer were used to measure muscle strength. Measurements obtained from the study were taken at the beginning and end of 12-week training**.**

Training Programs

In the training program to be applied in the study, the training groups performed standard basketball training for 12 weeks. In addition, group C was included in standard basketball training for 12 weeks (Turğut et al., 2017). In the study, group P performed plyometric training 3 days a week in addition to routine basketball training (Pamuk and Özkaya, 2017). In the study, W performed plyometric jumps by wearing weight vests 3 days a week, in addition to his routine basketball training (Khlifa et al., 2010).

Muscle Strength Measurement Parameters

Hand Grip Strength Test

Hand grip strength was measured with a Takai brand hand dynamometer. The athletes performed the test in a standing anatomical position without any support around them. Athletes were asked to squeeze the hand dynamometer with the highest force. This test was applied 3 times and the best value among the 3 scores was taken into the study. A 5-minute warm-up exercise was performed before testing (Kim et al., 2018).

Leg Strength Test (kg)

The leg strength of the athletes was measured with a Takai brand leg dynamometer. After the athletes place their feet on the dynamometer platform with their knees bent (130-140°), both arms are stretched, the back position is straight and the body is slightly tilted forward, after grasping the dynamometer bar with their hands, they use their legs vertically at maximum speed (in extension position).) measurement was carried out by pulling the bar up without using the back. This test was applied 3 times and the best value was taken into the study. A 5-minute warm-up exercise was performed before testing (Heyward, 2002; Özer, 2006).

Back Strength Test

The leg strength of the athletes was measured with a Takkei brand dynamometer. After the athletes placed their feet on the dynamometer platform in a rested state, the knees and arms were stretched, the back posture was straight and the body was slightly tilted forward, the hands grasped the dynamometer bar and then pulled the bar up to the maximum level with a vertical grip. This test was applied 3 times. The best value was recorded in the study. A 5-minute warm-up exercise was performed before testing (Heyward, 2002; Özer, 2006).

Analysis of Data

SPSS 22.0 statistical analysis program (IBM) was used in the analysis of the collected findings. Descriptive statistics were used to present the collected data. The data collected from the study were evaluated as arithmetic mean and standard deviation. Mean values of all parameters between pre-, and post-tests were compared with paired t test, and group differences were analyzed by using analysis of variance (ANOVA). The statistical significance level for the findings was set as p<0.05.

Results

The mean and the standard deviation values of the age, body weight height and body fat ratio of the three groups are shown in Table 1.

Table 1. Values of the physical characteristics of young basketball athletes participating in the research

Groups	Variables	x̄	SS
C (n=9)	Age (years)	15.70	0.82
	Body weight (kg)	60.70	7.88
	Height (cm)	168.68	7.82
	Fat (%)	15.90	7.87
P (n=9)	Age (years)	16.06	0.92
	Body weight (kg)	57.01	7.36
	Height (cm)	168.75	5.33
	Fat (%)	16.83	6.20
W (n=9)	Age (years)	15.93	0.68
	Body weight (kg)	58.39	7.10
	Height (cm)	168.37	4.61
	Fat (%)	11.86	2.12

The average age, body weight, height and fat percentage of C group athletes were found to be 15.70±0.82 years, 60.70±7.88 kg, 168.68±7.82 cm and 15.9±7.87 %, respectively. The average age, body weight, height and fat percentage of the P group athletes were found to be 16.06±0.92 years, 57.01±7.36 kg, 168.75±5.33 cm and 16.83±6.2%, respectively. In group W athletes, the average age, body weight, height and fat percentage were found to be 15.93±0.68 years, 58.39±7.10 kg, 168.37±4.61 cm and 11.86±2.12%, respectively. When the average values of age, body weight, body fat ratio and height are compared between the groups in Table 1, there is no statistical difference. The fact that the 3 groups have similar physical characteristics should be considered as an indication that the study groups were formed in an appropriate and comparable manner.

Table 2. Pre-, and post-test values in hand grip strength of all groups (kg)

Groups	Variables	x̄	SS	p
C	Pre-test	28,91	4,3	**0,039***
	Post-test	33,78	6,27	
P	Pre-test	28,97	3,35	**0,011***
	Post-test	32,21	3,27	
W	Pre-test	35,07	2,01	0,103
	Post-test	36,43	1,88	

Hand grip strength results of the groups are presented in Table 2. When we look at Table 2, when the C pre-post test results are compared, there is a significant difference in the pre- and post-test values (P<0.039). When P pre-post test results are compared, there is a significant difference in pre- and post-test values (P<0.011). This difference indicates that the post-test values are improved compared to the pre-test values. In W, no statistical difference was found in handgrip strength in pre-, or post-test measurements.

Table 3. Pre-, and post-test values in back strength of the study groups (kg)

Groups	Variables	x̄	SS	p
C	Pre-test	65,33	11,34	**0,004****
	Post-test	92,67	18,66	
P	Pre-test	61,33	25,62	**0,045***
	Post-test	92,22	19,08	
W	Pre-test	82,89	24,24	0,563
	Post-test	92,00	29,96	

Pre-, and post-test values in back strength of the groups are presented in Table 3. Accordingly, it was determined that back strength significantly increased in C (p<0.004), and P (p<0.045) groups. In W group, although the back strength increases, this difference was not statistically significant.

Table 4. Pre-, and post-test values in leg strength of the study groups (kg)

Groups	Variables	x̄	SS	p
C	Pre-test	89,67	21,23	0,081
	Post-test	96	26,7	
P	Pre-test	92,11	21,46	0,413
	Post-test	97,00	22,15	
W	Pre-test	118,56	34,11	**0,001****
	Post-test	132,67	29,32	

When we look at Table 4, we found a statistically significant difference only in the pre- and post-test values of the leg strength of the W group (P<0.001). It was revealed that the resistant plyometric training performed by W group showed more effective results than the other groups.

Discussion and Conclusion

In this study, the effect of resistant plyometric training using a weight vest on muscle strength in young male athletes was examined. We found that plyometric training applied for 12 weeks improved hand and back strength, and plyometric training applied with a weight vest significantly improved leg strength. The results of our study revealed that combined resistance and plyometric training are more effective than plyometric training alone, especially in increasing lower extremity muscle strength.

In the literature, there are various training methods applied to increase muscle strength in athletes. It has been shown that combined training on inclined surfaces increases the 100 m sprint running performance by increasing lower extremity muscle strength (Çetin 2018, Çetin et al., 2018). Pamuk et al. (2022) revealed that the plyometric and resistance plyometric training they applied for 12 weeks did not affect the vertical jump performance of young basketball players, but increased the lower extremity isokinetic muscle strength. De Villarreal et al., in their meta-analysis examining the effects of plyometric training performed using the lower extremities on muscle strength, found that the increase in muscular strength increased more significantly with resistive plyometric training than with plyometric training alone, so it would be beneficial for coaches to review their training programs accordingly.

In the literature, it has been shown that combined training by adding resistance to plyometric training on athletes increases the vertical jump, CMJ, drop jump, sprint running and balance (Ramirez et al., 2022). It has been known for a long time that plyometric training, which is frequently applied to increase athletic performance, affects the stretching-shortening cycle in the muscles, leading to an increase in the force reaching the muscle from the muscle-tendon area, thus improving features such as jumping, agility and changing direction in athletes. It is known that plyometric training combined with resistance affects and increases physiological and biomechanical functions such as stretch reflex, elastic force, motor unit recruitment, and pushing force in the legs, especially in the pre-jumping period, and this leads to a more effective jump, which is very important in branches such as volleyball, badminton and basketball (Sanchez-Sixto et al.,2021, Topal and Ozkaya,2022; Voelzke et al.,2012). Sanchez-Sixto et al. (2021) showed that low-resistance and low-volume squat exercises added to plyometric training in female basketball players increased jumping performance in athletes more than plyometric training alone. Sheikh and Hassan (2021) applied plyometric training to 18-22 years old volleyball players using a weight vest for 12 weeks, and showed that there was a greater increase in speed and agility performance compared to plyometric training alone. According to the researchers we mentioned above, there are significant differences in the methodology we used, and also the characteristics of the athletes. First of all, the resistance levels we applied in addition to plyometric training in the present study were higher than other researchers. In addition, our study has originality due to this type of training protocol applied to young basketball players.

In this study, it was determined that plyometric training increased hand grip and back strength, while resistant plyometric training using a weight vest increased leg strength. In their study where they conducted biomechanical analysis of body parts during training using a weight vest, Silder et al., (2015) showed that the body adopts a posture that tends to contract more in order to adapt during the use of a weight vest, and this leads to an increase in leg stiffness. In this study, we did not aim to measure lower extremity stiffness or angular changes of body parts. However, we found that there was a very significant increase in lower extremity muscular strength. We believe that this finding provides important clues that plyometric training using a weight vest will contribute to increased performance in young basketball players. Whether the study findings will be obtained in female athletes of similar ages, or the mechanisms underlying this change can be clarified in future studies.

In conclusion, in this study it was concluded that plyometric training applied for 12 weeks in young basketball players increased hand and back strength, while plyometric training applied with a weight vest increased leg strength. We believe that our study will guide sports scientists working in this field and practitioners who prepare training programs in the field.

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