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Comparing the Impact of Traditional Strength Training and Power Interval Training on Velocity Parameters During Loaded-Squat Jump Exercise

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Abstract

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The aim of this study is to investigate the effects of traditional strength and power interval training methods on the development of velocity parameters in the concentric phase of loaded-squat jump exercise and to determine which training method improves velocity parameters more. To achieve this goal, 30 male students who were studying at the School of Physical Education and Sports and did not regularly exercise participated voluntarily in this study. Participants were divided into three different groups using randomization: traditional strength training group, power interval training group, and control group. The participants performed a weighted squat jump exercise using external loads equivalent to 40% of their body weight in both pre-test and post-test measurements, and their mean velocity, mean propulsive velocity, and peak velocity values were obtained through an isoinertial velocity transducer. According to the analysis results, it was found that peak velocity significantly increased after traditional strength training. In addition, the power interval training method made a significant difference on the 1 RM pre-post test. The effect size of traditional strength training on peak velocity was determined as "small". In conclusion, it is thought that traditional strength training is a more prominent training method in improving movement velocity compared to power interval training.

Geleneksel Kuvvet ve Güç İnterval Antrenmanın Ağırlıklı Squat Sıçrama Hareketi Esnasındaki Hız Parametreleri Üzerindeki Etkisinin Karşılaştırılması

Özet

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Bu çalışmanın amacı geleneksel kuvvet ve güç interval antrenman yöntemlerinin, ağırlıklı squat sıçrama hareketinin konsantrik evresindeki hız parametrelerinin gelişimine etkilerini araştırmak ve hangi antrenman yönteminin hız parametrelerini daha fazla geliştirdiğini belirlemektir. Bu amaç doğrultusunda, Beden Eğitimi ve Spor Yüksekokulunda öğrenim gören ve düzenli olarak egzersiz yapmayan 30 erkek öğrenci bu çalışmaya gönüllü olarak katıldı. Katılımcılar rastgele yöntem kullanılarak geleneksel kuvvet antrenman grubu, güç interval antrenman grubu ve kontrol grubu olmak üzere üç farklı gruba ayrıldı. Katılımcıların ön-test ve son-test ölçümlerinde vücut ağırlıklarının %40 oranına denk gelen dış yükler kullanılarak ağırlıklı squat sıçrama egzersizi uygulandı ve isoinertial bir hız dönüştürücü yoluyla katılımcıların ortalama hız, ortalama itme hızı ve zirve hız değerleri elde edildi. Ayrıca, güç aralıkli antrenman yöntemi, 1 RM ön-son testinde önemli bir fark yarattı. Analiz sonuçlarına göre; geleneksel kuvvet antrenmanı sonrasında zirve hızının istatiksel olarak anlamlı düzeyde artığı tespit edilmiştir ve geleneksel kuvvet antrenmanın zirve hızı üzerindeki etki büyüklüğünün "küçük" olduğu belirlenmiştir. Sonuç olarak, power interval antrenmana göre geleneksel kuvvet antrenmanının hareket hızını geliştirmede daha ön plana çıkan bir antrenman yöntemi olduğu düşünülmektedir.

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Introduction

Athletes often use resistance training, also referred to as strength or weight training, to improve their fitness levels and rates of force development (RFD) (Fleck & Kraemer, 2004; Aristide et al., 2018).

Resistance training usually refers to the types of exercise that requires the muscular system to push against an opposing force using equipment (Sleivert & Taingahue, 2004). In recent years, resistance training protocols aimed at movement velocity have been used to increase muscular power and strength (Murray & Brown, 2006). The velocity of a movement can provides coaches or trainers with valuable information about the precision of an athlete's physical exertion while performing the movement. This technique, also known as velocity-based resistance training, can more accurately and consistently reveal the athlete's effort levels (Gonzales-Badillo & Sanchez Medina, 2010). Although movement velocity is a variable that needs more attention to observe the exercise intensity, only some researchers have emphasized the importance of movement velocity (Cormie et al., 2007; Gonzales-Badillo & Sanchez-Medina, 2010; Gonzales-Badillo et al., 2011; Sanchez-Medina & Gonzales-Badillo, 2011; Paraje-Blanco et al., 2014). Movement velocity, expressed as vectors, is the temporal rate of changes occurring in different positions of the movement (Zatsiorsky, 1998) and is a parameter used to digitize the intensity of the exercises in resistance training (Pereira & Gomes, 2002; Kawamori & Newton, 2006; Gonzales-Badillo & Sanchez-Medina, 2010; Cormie et al., 2011). For this reason, movement velocity is a very important criterion for regulating the responses during the training (Kraemer et al., 1988; Izquierdo et al., 2006; Gonzales-Badillo & Sanchez-Medina, 2010; Gonzales-Badillo et al., 2011; Sanchez-Medina et al., 2010, 2014; Sanchez-Medina & Gonzales-Badillo, 2011).

Previous studies were shown that velocity-specific adaptations for resistance training were caused by many factors, such as the specificity of movement, increased discharge in high-threshold motor units, increased stress on fast-twitch muscle fibers, and increased intramuscular and intermuscular coordination (Enoka, 1997; Tricoli et al., 2001; Cronin et al., 2002). Fast-twitch and slow-twitch muscle fibers have different contractile properties. Thus, an improvement in the activation of fast-twitch fibers due to training may lead to significant speed-specific adaptations (Tricoli et al., 2001). Behm and Sale (1993) found that motor unit activation engagement approaches were the primary stimuli for eliciting velocity-specific adaptations. These approaches involve moving a load explosively, regardless of the current speed of movement or load. Therefore, moving a load explosively and maintaining controlled movement speed are crucial stimuli for enhancing speed-specific neuromuscular performance characteristics and potentially inducing neural adaptations (Singh, 2016).

The two key factors for designing velocity-based resistance training are the percentage reduction in velocity and the mean concentric velocity of the fastest repetition (Gonzales-Badillo & Sanchez-Medina, 2010). The velocity of a movement varies depending on the exercise and is usually represented by the mean impulse velocity (MIV) or mean velocity (MV) during the concentric phase. Furthermore, the velocities attained during the exercise are influenced by the applied force (Pareja-Blanco et al., 2014). The assumption behind velocity-based resistance training is that athletes always complete their repetitions at maximal intentional velocity (Guerriero et al., 2018). According to Pareja et al. (2017) athletes experience unintentional strength and velocity declines when completing sets in resistance training. The decline in velocity between reps and sets of the same exercise can be used as an indicator to determine the level of fatigue (Sanchez-Medina & Gonzales-Badillo, 2011).

Resistance training design takes into account the type of training, the frequency of training, and the number of sets and reps (Juan et al., 2011). Movement velocity is a critical parameter in strength training, yet it often does not receive sufficient attention in training programs. As a result, studies on the effect of movement velocity on strength training have not produced a consensus (Marta & Paulo, 2003). Variations in movement velocity are caused by the number of reps and the load (Juan et al., 2011). Data associated with neural and muscular adjustments following high-intensity exercise suggest that workload-related fatigue occurs (Lattier et al., 2004). As a result, power performance decreases. For this reason, it is necessary to give sufficient intervals to meet the demand for optimal power performance. This is extremely important for achieving high movement speed. Billat (2001) reported that interspersing recovery periods between high-intensity loads, called interval loads, enables very intense exercises to be performed in strength applications. Within the framework of this approach, Buchheit and Laursen (2013) gathered interval training under six basic target combinations that affect metabolic and neuromuscular systems at different rates. One of these combinations was the part that caused high levels of neuromuscular tension and was referred to as type 6 (Laursen and Buchheit, 2018). These high-intensity noral and muscular applications performed under limited metabolic contribution can be expressed as power interval training method. Related studies have not reached a consensus on whether slow movement velocity or fast movement velocity is more effective in terms of athletic performance (Juan et al., 2011). This shows the different effects of different methods on targeted objectives in strength training. In recent years, many studies have been conducted to investigate the effects of different training protocols in addition to traditional methods in resistance training on strength and linear velocity (Jovanovic & Flanagan, 2014; Aristide et al., 2018).

The current research on the improvement of movement velocity, which has so far been neglected in resistance training but is considered to be a very important parameter, is expected to fill the gap in the literature on sports science as well as make important contributions to coaches, conditioners, and athletes engaged in strength training in designing training programs and improving their performance. This is because movement velocity is a variable that should be considered when designing resistance training programs in order to optimize neuromuscular force and power adaptations. Building on these considerations, the present study seeks to compare the effects of traditional strength training and power interval training on velocity parameters during the concentric phase of the loaded-squat jump exercise. The aim is to identify the training method that yields superior improvements in velocity parameters. The hypothesis of this study assumes that traditional strength training will improve movement velocity more than interval power training when compared.

Method

Participants

This study involved thirty male students who were not regularly engaged in exercise, and did not have any systemic diseases and were studying at the School of Physical Education and Sports (age: 20.8 ± 1.40 years; height: 176.0 ± 5.17 cm; weight: 69.6 ± 7.71 kg). The participants voluntarily enrolled in the study and were randomly assigned to one of three groups: traditional strength training group (TSTG) (n=10), power interval training group (PITG) (n=10), and control group (CG) (n=10). All participants received detailed information about the study's purpose, testing procedures, potential risks and benefits, and provided written consent. Table 1 presents descriptive information about the participants.

Table 1. Physical characteristics of participants

Variables	Groups	Number	X±SD
Age (year)	Power Interval	10	21.30 ± 1.41
	Traditional	10	20.80 ± 1.03
	Control	10	20.50 ± 1.71
Height (cm)	Power Interval	10	176.40 ± 4.69
	Traditional	10	173.70 ± 6.63
	Control	10	178.10 ± 3.03
Body Weight (kg)	Power Interval	10	70.43 ± 5.43
	Traditional	10	64.36 ± 5.80
	Control	10	74.25 ± 8.56

Procedures

Firstly, one repetitive maximal (1RM) strength values of participants were determined. And then, general strength training was applied to the participants three days (monday, wednesday and friday) a week for two weeks in order to gain a basic strength level to all participants in this study. In addition, theoretical and practical trainings were given on the implementation of the movements in the training, and measurements during this 2-week general preparation period. Following two weeks of general strength training, participants underwent pre-tests to determine their 1RM values during the full squat (SQFull) movement and velocity values in the concentric phase of the loaded-squat jump exercise (SJLoaded). Based on the pre-test results, the participants were divided into two homogeneous groups: the traditional strength training group (TSTG) and the power interval group (PIG). After the 6-week training period, post-tests were performed.

This study was approved by the Scientific Research and Publication Ethics Committee of Iğdır University (2022/22) and was conducted in accordance with the Declaration of Helsinki.

The data collection for this study was conducted in two stages: a pre-test and a post-test. During both stages, the participants' physical characteristics (height and body weight), 1RM values during a full squat, and velocity values during the loaded-squat jump exercise (SJLoaded) were measured. The measurements were taken at the performance laboratory of Gumushane University School of Physical Education and Sports by athletic performance experts, 48 hours before (pre-test) and after (post-test) the training protocols.

Measurements

The researchers took measurements of each participant's physical attributes, including height (measured in centimeters), body weight (measured in kilograms), body fat mass (measured as a percentage), and muscle mass (also measured as a percentage). They used a Seca 769 electronic measuring instrument from Seca Corporation in Hamburg, Germany, which had a precision of 0.001 meters for height and 0.01 kg for body weight. The researchers utilized a linear velocity transducer (T-Force Dynamic Measurement System; Ergotech Consulting S.L., Murcia, Spain) to calculate the velocity values (MV: mean velocity; MPV: mean propulsive velocity; PV: peak velocity) during the SJLoaded exercise (loaded-squat jump exercise). The SJLoaded exercise was conducted with external loads equivalent to 40% of the participants' body weights. During the SJLoaded exercise, the participants were instructed to flex their knees until their thighs were parallel to the ground. They were then given a start command to jump as quickly as possible while keeping their shoulders in contact with the bar. This movement was repeated three times as per the protocol by Loturco et al. (2015). If the requirements were not met, the participants were instructed to repeat the movement. This was important because the SJLoaded exercise involved moving both the external load and the participant's body weight, and parameters such as velocity and power depended on the participant's ability to accelerate the total mass (external load and body weight) as explained by Cormie et al. (2007). The participants were provided with verbal encouragement throughout all attempts to enhance their performance.

Training Protocols

Table 2, Table 3, and Table 4 provide detailed information on the training protocols and daily training for the study. To determine the exercise intensity of the traditional strength training protocol, the 1RM strength value of each exercise was calculated. On the other hand, the maximal times of each exercise were determined using an electronic photocell in the power interval training protocol, and the movements were performed at the maximal speed. Only the intensity of the tendo band squat movement was detected using the training mode of the T-Force dynamic measurement system. All training sessions were performed at the gym and fitness center of Gumushane University School of Physical Education and Sports. The training sessions were held between 16:00 and 18:00. The training sessions consisted of three phases: a 15-minute warm-up phase, a 40- to 50-minute training phase, and a 10-minute cooling-down phase. The control group consisted of physical education students who were not included in any training program.

Table 2. Traditional strength training daily training movements

	TRADITIONAL STRENGTH TRAINING																	
	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5			WEEK 6		
Movements	**Mondey**	**Wednesday**	**Friday**	**Monday**	**Wednesday**	**Friday**	**Monday**	**Wednesday**	**Friday**	**Monday**	**Wednesday**	**Friday**	**Monday**	**Wednesday**	**Friday**	**Monday**	**Wednesday**	**Friday**
Squat	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Leg Press	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Leg Flexion	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Leg Extension	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Barbell Side Lunge	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 3. Power interval training daily training movements

	TRADITIONAL STRENGTH TRAINING																	
	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5			WEEK 6		
Movements	**Mondey**	**Wednesday**	**Friday**	**Monday**	**Wednesday**	**Friday**	**Monday**	**Wednesday**	**Friday**	**Monday**	**Wednesday**	**Friday**	**Monday**	**Wednesday**	**Friday**	**Monday**	**Wednesday**	**Friday**
Lateral Plyos Split Squat	x		x		x		x		x		x		x		x		x	
Lateral Bound to Sprint	x		x		x		x		x		x		x		x		x	
Single Lag Lateral Bounds		x		x		x		x		x		x		x		x		x
Lateral Tuck Jumps to Sprint		x		x		x		x		x		x		x		x		x
10 yd Shuttle to 10 yd Sprint	x	x	x	x	x	x		x		x		x		x		x		x
Parachute Drill							x		x		x		x		x		x	
Agility Drill	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Tendo Band Squat	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Table 4. Traditional Strength and Power Interval Training Protocol

Traditional Strength Training	**Power Interval Training**
Squat Leg Press Flexion Extension Barbell Side Lunge	Lateral Plyos Split Squat Lateral Bound to Sprint Single Lag Lateral Bounds Lateral Tuck Jumps to Sprint 10 yd Shuttle to 10 yd Sprint Parachute Drill Agility Drill Tendo Band Squat

	Traditional Strength Training				Power Interval Training				
Week	Intensity	Set/ Repetition	Rest Between Sets	Rest Between Movements	Intensity	Set/ Repetition	Rest Between Repetitions	Rest Between Sets	Rest Between Movements
1	20%	6x12	1 min	3 min	$\geq V_{max}$ 90%	2x4	30 sec	1 min	3 min
2		8x12				2x4			
3	30%	6x12				2x5			
4		8x12				2x5			
5	40%	6x12				2x5		45 sec	
6		8x12				2x5			

Statistical Analysis

The collected data were entered into the SPSS (18.0) program for analysis. To determine if the data showed normal distribution, the Shapiro-Wilk test was performed. The results indicated that the data was suitable for normal distribution. One-Way ANOVA was conducted to compare the pre-test values of the groups for 1RM and velocity (mean velocity, mean propulsive velocity, and peak velocity). Paired t-Test was used to compare the pre-test and post-test results. For variables that showed a statistically significant difference, the effect size of the training program was calculated. To determine the effect size of the training program, the values developed by Rhea (2004) and recommended for recreationally active individuals were utilized (<0.35 insignificant, 0.35-0.80 small, 0.80-1.50 medium, >1.5 large). The significance level was set at $p < 0.05$.

Results

The tables below (Table 5 for 1RM, Table 6 for mean velocity, Table 7 for mean propulsive velocity, and Table 8 for peak velocity) illustrate the comparison of the pre- and post-test results for each variable obtained during the loaded-squat jump movement, which was conducted using free weights with an external load equivalent to 40% of the participants' body mass.

Table 5. Comparison of the pre- and post-test results in terms of 1RM mean values

Groups		**1 RM**				
		n	**X± SD**	**t**	**MD**	**p**
Power Interval	Pre-test	10	124.00±8.43	2.449	4.0	**.037***
	Post-test	10	120.00±10.0			
Traditional	Pre-test	10	117.50±13.59	.000	.00	1.00
	Post-test	10	117.50±11.84			
Control	Pre-test	10	114.50±8.64	-1.309	-2.0	.223
	Post-test	10	116.50±9.44			

*p<0.05

Based on the results presented in Table 5, a statistically significant difference was observed between the pre- and post-test 1RM mean values in the power interval training group [$t_{(9)}$= 2.449, p=.037, effect size=0.77]. However, there were no statistically significant differences found in the other groups (p>0.05).

Table 6. Comparison of the pre- and post-test results in terms of mean velocity

Groups		Mean Velocity				
		n	X± SD	t	MD	p
Power Interval	Pre-test	10	1.43±.14	.24	.00	.958
	Post-test	10	1.43±.10			
Traditional	Pre-test	10	1.42±.12	-2.182	-.06	.057
	Post-test	10	1.49±.07			
Control	Pre-test	10	1.37±.07	-.165	-.00	.872
	Post-test	10	1.37±.07			

(p>0.05).

As indicated in Table 6, both power interval and traditional strength training did not have a statistically significant effect on mean velocity (p>0.05).

Table 7. Comparison of the pre- and post-test results in terms of mean propulsive velocity

Groups		Mean Propulsive Velocity				
		n	X± SD	t	MD	p
Power Interval	Pre-test	10	1.58±.19	.66	.00	.948
	Post-test	10	1.58±.14			
Traditional	Pre-test	10	1.59±.18	-1.954	-0.7	.082
	Post-test	10	1.66±.13			
Control	Pre-test	10	1.50±.10	.032	-0.0	.975
	Post-test	10	1.50±.10			

(p>0.05).

According to Table 7, no statistical difference was observed in the comparison of the mean propulsive velocity values of the three groups after the training program (p>0.05).

Table 8. Comparison of the pre- and post-test results in terms of peak velocity

Groups		Peak Velocity				
		n	X± SD	t	MD	p
Power Interval	Pre-test	10	2.48±.27	-194	-.01	.851
	Post-test	10	2.49±.25			
Traditional	Pre-test	10	2.42±.17	-2.484	-.14	**.035***
	Post-test	10	2.56±.14			
Control	Pre-test	10	2.39±.18	-.419	-.01	.685
	Post-test	10	2.41±.11			

*p<0.05

Based on the data presented in Table 8, traditional strength training resulted in a statistically significant increase in peak velocity values [$t_{(9)}$= 2.484, p=.035, effect size=0.78]. While there were also improvements in mean velocity and mean impulse velocity values, these improvements were not statistically significant (p>0.05).

Discussion

The primary objective of this study was to examine the impact of power interval training and traditional strength training on velocity parameters during the concentric phase of loaded-squat jump exercise. The participants undertook either power interval training or traditional strength training for a duration of six weeks. External loads equivalent to 40% of each participant's body weight were used. The study aimed to identify the superior training method for improving the velocity parameters, which included mean velocity, mean propulsive velocity, and peak velocity. The analysis results showed that the traditional strength training group demonstrated improvement in the mean velocity, mean propulsive velocity, and peak velocity parameters during the loaded-squat jump exercise. However, the statistically significant difference between the two groups was only observed in the peak velocity parameter (p<0.05). In contrast, no statistically significant improvement was observed in the velocity parameters of the power interval training group. This development was found to be "small" when evaluated according to the effect size values developed by Rhea (2004).

Achieving improvements in an individual's functional neuromuscular strength and power adaptations requires knowing the accurate type of load or correct way of lifting the load (Harris et al., 2007). Until recently, the intensity of exercise and the degree of effort spent during different exercises have been defined as the percentage of one-repetition maximal that contributes to calculating the relative load in different reps and sets (Gonzales-Badillo & Sanchez-Medina, 2010). However, especially when it comes to improving the athletic performance, the creation of a load/velocity profile and determination of intensity based on velocity measurement during the concentric phase of major strength exercises has started to be used as an alternative method (Guerriero et al., 2018). Although a pronounced emphasis should be placed upon velocity during any exercise; many studies have failed to attach necessary importance to this parameter (Pereire & Gomez, 2003; Harris et al., 2007; Gonzales-Badillo & Sanchez-Medina, 2010; Sanchez-Medina et al., 2011). According to Behm and Sale (1993), optimal improvement in strength and power ability through specific resistance training can be achieved by performing the training at an exact or close to optimal training velocity. In addition, optimal training velocity is thought to affect both nerves and muscles and maximize functional strength and power performance. Caiozzo et al., (1981) suggested that the contribution would be less if this optimal velocity level is not used. According to Guerriero et al. (2018), resistance training loads that result in a movement velocity of ≤ 1.00 $m.sn^{-1}$ are the most effective for enhancing mean impulse velocity values.

Our comprehensive literature review uncovered a discrepancy between our findings and those of Bayrakdaroğlu (2018), who observed a statistically significant difference in MV, MPV, and PV values during the loaded-squat jump exercise between plyometric, complex, and resistance training groups after 8 weeks of training ($p<0.05$). Specifically, the plyometric, weight, and complex training groups exhibited higher mean MV values compared to the control group, whereas the weight and complex training groups demonstrated higher mean MPV values compared to the control group. On the other hand, the author found that plyometric and weight training groups showed significantly higher mean PV values than the control group. The study found no statistically significant difference between the other groups ($p> .05$). Prior to the training protocol, the MV values were 1.24 m/sec for the plyometric training group (PTG), 1.27 m/sec for the weight training group (WTG), 1.2 m/sec for the complex training group (CTG), and 1.17 m/sec for the control group (CG). After 8 weeks of training, the MV values were 1.37 m/sec for the PTG, 1.40 m/sec for the WTG, 1.40 m/sec for the CTG, and 1.20 m/sec for the CG. The PV values obtained in the pre-test were 2.34 m/sec for the PTG, 2.34 m/sec for the WTG, 2.34 m/sec for CTG, and 2.22 m/sec for the CG, while the PV values obtained in the post-test were 2.58 m/sec for the PTG, 2.61 m/sec for the WTG, 2.58 m/sec for the CTG, and 2.28 m/sec for the CG. The MIV values obtained in the pre-test were 1.34 m/sec for the PTG, 1.38 m/sec for the WTG, 1.28 m/sec for the CTG, and 1.29 m/sec for the CG, while the MPV values obtained in the post-test were 1.53 m/sec for the PTG, 1.57 m/sec for the WTG, 1.56 m/sec for the CTG, and 1.32 m/sec for the CG. The statistically significant difference between groups could be attributed to the fact that all participants were licensed athletes engaged in combat sports such as kickboxing, taekwondo, wrestling, boxing, Muay Thai, and Wushu.

In a study conducted with female volleyball players by Newton et al. (2006), it was found that significant increases (8.8%) in peak velocity occurred after 4 weeks of unloaded squat jump training. Loturco et al., (2015) randomized their participants into two groups as increasing and decreasing bar velocity and after a 6-week training protocol, they found that both groups improved their mean impulse velocity values during unloaded and lightly-loaded (with loads corresponding to 40% of body weights) squat jump exercise. The findings of our study are similar to the results of the above-mentioned study.

To optimize neuromuscular strength and power adaptations in resistance training programs, it is important to consider movement velocity as a key variable. The loaded-squat jump exercise improved mean velocity, mean propulsive velocity, and peak velocity parameters in the traditional strength training group, with statistically significant differences observed only in the peak velocity parameter between groups. The power interval training group did not show statistically significant improvements in velocity parameters. For this reason, it can be argued that the use of traditional strength training to improve movement velocity, which is an overlooked but very important parameter in resistance trainings, may lead to further improvement. In addition, it is thought that this will contribute to trainers, conditioners, and especially athletes who are engaged in strength sports in terms of preparing training programs and improving athletic performance.

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