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The effects of 10-week functional strength training and traditional strength training on strength and power of college basketball players

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Abstract
Introduction. **Functional strength training (FST) and traditional strength training (TST) are methods commonly used to improve athletic performance. However, their comparative effects on the strength and power of college basketball players remain underexplored.** Aim of Study. **The aim of the study was to evaluate the effects on strength and power in college basketball players participating in a 10-week FST vs. TST, both before and after the intervention.** Material and Methods. **The study involved 24 college basketball players (age ranged between 18 to 25 years) from two universities, divided into an experimental group (FST) and a comparison group (TST) with 12 participants in each. Both groups trained for 10 weeks, three times a week, for 90 minutes per session. Strength and power were assessed pre- and post-training using measures such as bench press 1RM, deep squat 1RM, 1-minute sit-up, two-handed chest pass with gravity ball, standing long jump, and vertical jump height. SPSS 27.0 software was used for paired and independent t-tests.** Results. **Both FST and TST significantly improved strength and power across all performance metrics ($p < 0.05$). Comparing the two groups, FST demonstrated significant advantages in deep squat 1RM, 1-minute sit-up, two-handed chest pass with gravity ball, and standing long jump ($p < 0.05$).** Conclusions. **Both FST and TST effectively enhance the strength and power of college basketball players. However, FST shows superior benefits in performance measures directly applicable to basketball-specific activities.**

KEYWORDS: strength, power, functional strength training, traditional strength training, college basketball players.

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Introduction

In competitive sports, a complete training system consists of physical fitness training, technical training, tactical training, and psychological training. Physical fitness is one of the most important factors in the overall structure of athletes' competitive ability and it is the foundation of the elements of competitive ability [1]. Basketball is a multi-interval sport of high-intensity and long duration time. In a 40-minute basketball game, players need to block their opponent or seize a favorable position in area that is 28 m long and 15 m wide by rushing to start, stopping, changing direction, jumping and competing fiercely for the ball in the air and on the ground. Frequent physical contact, collisions and high confrontation intensity require the athletes not only to have a strong body, but also good power, strength, endurance, flexibility and coordination [2]. It can be observed that good physical fitness enables athletes to execute techniques and tactics more effectively, which in turn increases the team's chances of winning.

All collegiate basketball players involved in this study were recruited from the Chinese University Basketball Association (CUBA), which plays an influential role in collegiate basketball in China. Although only a very small number of technically proficient players have obtained draft opportunities and entered the Chinese Basketball Association (CBA), relatively few are ultimately able to adapt to the professional league and develop into high-level players. This phenomenon is mainly attributable to the substantial differences between CUBA and CBA athletes in basic physical fitness and overall physical qualities, including height, weight, strength, and physical conditioning. These disparities place CUBA players at a clear disadvantage in the high-intensity and highly confrontational professional basketball environment, thereby limiting their long-term development at the CBA level [3]. The development of basketball players is limited by lack of physical strength, weak ability of physical confrontation and lack of basic skills. Especially in the final and decisive stages of a match, insufficient physical fitness can have a significant impact on game outcomes [4]. Therefore, a set of scientific physical training methods is very important for basketball players.

Traditional strength training (TST) typically involves more isolated exercises that target specific muscle groups, which can lead to increased muscle mass, improved muscle shape, and greater raw strength. These benefits are valuable for basketball players looking to enhance their physical presence and performance in strength-dependent movements such as jumping and rebounding. But TST may not fully translate to the functional demands of basketball, as it often focuses on fixed movements in controlled environments, potentially neglecting the balance, coordination, and agility required in actual game situations [5].

Functional physical training (FPT) is a means of conducting physical fitness training based on the actual condition of physical function and the specific characteristics of particular sports events. The action mode of functional training involves acceleration, deceleration, and stability of multiple joints and planes. It refers to the training of partial chains and connections in the human motion chain, including the completion of specific target actions, as well as the acceleration and deceleration of multidimensional movement trajectories, and stability training activities that meet specific target action characteristics [6]. Previous study found that a 20-week functional training could improve upper- and lower-body strength, flexibility, power and agility of professional basketball players [7], an 8-week functional training could improve flexibility, power, acceleration, agility, balance, and Functional Movement Screen (FMS) score of prepubertal tennis players was assessed to evaluate fundamental movement patterns [8], and an 8-week functional training could improve strength, power, agility, anaerobic capacity, speed, and power of amateur boxers [9].

Functional strength training (FST) and TST are two distinct approaches to enhancing physical performance, each with unique advantages and disadvantages. Therefore, this study aims to compare a 10-week FST and TST on strength and power of college basketball players.

Aim of Study

The aim of this study was to evaluate the effects on strength and power in college basketball players participating in a 10-week FST versus TST, both before and after the intervention.

Material and Methods

Participants

This study was a double-blind, randomized controlled trial (RCT). Twenty-four participants (aged 18-25) from two college basketball teams, were divided into two groups, the experimental group received specially designed FST (12 players), while the comparison group received TST (12 players) (Table 1). All participants were healthy and willing to participate. Before the study, subjects were informed of the purpose of the study, process, and preventive measures. All subjects signed informed consent forms. The study was approved by the Research Ethics Committee of Mahasarakham University (approval number: 053-601/2024, approval date: 31 January 2024).

Basketball players in both groups underwent training for 10 weeks, three times per week, with each session lasting 90 minutes. In weeks 0 and 11, pre-tests and post-tests were conducted to measure the strength and power indexes of the subjects in both groups, allowing for a comparison of changes in these indexes before and after the experiment.

Table 1. Baseline characteristics of basketball players participating in the research assigned to experimental (EG; n = 12) and comparison (CG; n = 12) groups

Groups	Age (years)		Height (cm)		Weight (kg)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
EG	21.00	1.54	186.17	7.30	85.38	11.71
CG	21.42	1.24	185.08	8.16	84.94	13.31

Note: $\bar{x}$ – arithmetic mean, SD – standard deviation

Following the pyramid model of functional physical training for competitive sports [1], this study developed a functional physical training plan for college basketball players, totaling 30 sessions over 10 weeks and it was divided into three stages – the first stage (weeks 1-3) was dedicated to the development of basic motor functions, the second stage (weeks 4-7) to general motor function development and the third stage (weeks 8-10) to specific motor function development.

Evaluation

Based on a literature review and expert evaluation [10-17], this study assessed the strength and power of college basketball players using specific indicators and testing instruments as shown in Table 2. Strength was measured through maximum upper-body strength (bench press 1RM), maximum lower-body strength (deep squat 1RM), and core strength (1-minute sit-ups). Power was assessed by evaluating upper-limb power (two-handed chest pass with gravity ball) and lower-limb power (standing long jump and vertical jump height with both feet).

Table 2. Test indexes of strength and power of college basketball players

First level indicators	Second level indicators	Measuring instrument
Max upper-limb strength	Bench press 1RM	Barbell set Yoga mat Stopwatch
Max lower-limb strength	Deep squat 1RM	
Core strength	1-minute sit-ups	
Power of upper limbs	Two-handed chest pass with gravity ball	Gravity ball Tape measure
Power of lower limbs	Standing long jump, vertical jump height with both feet	Height finder Tape measure

Note: 1RM – one-repetition maximum (the maximum amount of weight a person can lift for one repetition during an exercise)

Statistical analysis

All statistical analyses were carried out using SPSS version 27.0. All data were presented as mean ± standard deviation of the mean (SD). The data were checked for normal distribution using the Kolmogorov–Smirnov test, the achieved significance level was more than 0.05. An independent samples t-test was conducted for between-group pre-test data and post-test data, and a paired samples t-test was conducted for within-group pre-test and post-test data.

Results

The comparison of strength and power between the two groups is presented in Table 3. Prior to the commencement of the experiment, no statistically significant differences were observed between the groups ($p > 0.05$), indicating homogeneity in baseline performance. However, post-experiment analysis revealed significant differences across all assessed variables, including deep squat performance, 1-minute sit-up repetitions, two-handed chest pass with gravity ball, and standing long jump distance. These findings suggest that the training intervention had a measurable impact on strength and power development, with notable improvements observed in the experimental group.

The within-group comparison demonstrated that all assessed performance variables in the experimental (EG) and comparison (CG) groups exhibited significant improvements from pre-testing to post-testing ($p < 0.01$), as presented in Table 3. These findings indicate that the training intervention effectively enhanced strength and power within the group over the 10 weeks. Furthermore, when comparing each measurement variable before and

Table 3. Comparison of strength and power before (pre-test) and after 10 weeks of training (post-test) in experimental (EG; $n = 12$) and comparison (CG; $n = 12$) groups

Measurable indicators	Groups	Pre-test $\bar{x}$ (±SD)	Post-test $\bar{x}$ (±SD)	t	P
Bench press 1RM (kg)	EG	82.58(9.10)	92.08(8.11)*†	–12.775	0.0001**
	CG	82.92(7.22)	86.92(7.10)*†	–13.266	0.0001**
	p	0.922	0.111		
Deep squat 1RM (kg)	EG	123.33(9.85)	132.42(8.24)*†	–11.899	0.0001**
	CG	122.58(7.15)	125.58(7.61)*	–5.745	0.0001**
	p	0.833	0.046*		

1-minute sit-ups (times)	EG	49.75(8.55)	57.5 (6.68)*†	–10.333	0.0001**
	CG	48.25(6.298)	51.00(6.00)*	–11.000	0.0001**
	p	0.629	0.020*		
Two-handed chest pass with gravity ball (m)	EG	7.72(0.63)	8.70(0.50)*†	–18.917	0.0001**
	CG	7.79(0.65)	8.13(0.64)*	–13.146	0.0001**
	p	0.775	0.025*		
Standing long jump (cm)	EG	267.58(13.28)	278.33(13.54)*†	–15.654	0.0001**
	CG	264.33(10.00)	267.17(10.55)*	–8.805	0.0001**
	p	0.505	0.035*		
Vertical jump height with both feet (cm)	EG	69.50(7.57)	74.33(8.36)*†	–8.603	0.0001**
	CG	69.00(5.19)	70.92(5.71)*	–6.127	0.0001**
	p	0.852	0.255		

Note: CG – comparison group, EG – experimental group, $\overline{x}$ (±SD) – mean ± standard deviation
* $p \leq 0.05$ (between-study terms), **$p < 0.01$ (within-study groups)
† $p < 0.05$ (between-study groups)

after the experiment between the two groups, it was observed that all assessed variables showed a statistically significant difference in improvement. This suggests that both the FST and TST programs contributed to notable enhancements in strength and power, reinforcing the effectiveness of the respective training methodologies in improving athletic performance.

Discussion

The main finding of this study was that both FST and TST contributed to positive changes in the studied parameters – bench press, deep squat, 1-minute sit-ups, two-handed chest pass with gravity ball, standing long jump, and vertical jump height with both feet, indicating the overall effectiveness of both programs. However, when comparing the two training programs, FST had a greater effect on deep squat, 1-minute sit-ups, two-handed chest pass with gravity ball, and standing long jump. Both training programs produced similar improvements in bench press mobility and vertical jump height with both feet.

In basketball, strong maximum strength is a deciding factor when players from both teams engage in physical confrontation or compete for the ball as permitted by the rules [18]. After 10 weeks of training intervention, both functional and traditional trainings resulted in significant increases in upper-body maximum strength (bench press 1RM), lower-body maximum strength (deep squat 1RM), and core strength (1-minute sit-ups). These improvements can be attributed to several physiological mechanisms. Resistance training, regardless of the modality, stimulates muscle hypertrophy and increases neuromuscular efficiency [19]. The increase in muscle cross-sectional area and the recruitment of motor units contribute to enhanced force production capabilities [20]. However, the functional training group exhibited superior gains in deep squat 1RM and core strength. This can be explained by the emphasis on multi-joint, compound movements in functional training, which engage multiple muscle groups and promote greater overall strength development [21]. These results are very similar to a study by Lamberth et al. [22], who divided golfers into two groups for 6 weeks of FST and the original golf strength training program, and found that the original golf strength training program significantly improved the athletes' deep squat strength. However, there is no significant change in longitudinal jump and swing speed, while there is a significant increase in all data [22].

In addition, functional training often incorporates unstable surfaces and dynamic movements, which enhance core stability and proprioception, important for maintaining balance and control during basketball-specific actions [23].

In basketball games, power is more reflected in the physical quality and special technical characteristics of players, including ball holding and changing direction without the ball to avoid defense, rebound grabbing, shot-blocking, and defense. Therefore, good power is one of the key factors to win basketball games [24].

When examining power, both training modalities improved performance in measures such as two-handed chest pass with gravity ball, standing long jump, and vertical jump height with both feet. The between-group comparisons showed that while there were no significant differences in bench press 1RM and vertical jump height with both feet post-training, functional training showed greater improvements in deep squat 1RM, 1-minute sit-up performance, two-handed chest pass with gravity ball, and standing long jump. This indicates that functional training may be more effective in developing specific athletic qualities that are crucial for basketball performance. The emphasis on dynamic movements and core stability in functional training likely contributes to these enhanced outcomes [21, 23], which in turn significantly improve athletes' jump performance and 1RM [25].

This result is consistent with the results of Agron Kasa's study. By conducting functional training and TST on two groups of young people aged 19 to 21, Agron Kasa found that when compared with the comparison group, the core muscle group in the experimental group could be activated better, and the contribution ratio in the motor chain was higher. Therefore, the body balance ability, movement stability, and power of the experimental group were significantly better than those of the comparison group [26].

Power is important in basketball for actions such as jumping for rebounds, sprinting down the court, and executing quick directional changes [27]. The physiological basis for these improvements lies in the rate of force development (RFD), which is the ability to exert force quickly. Functional training enhances RFD by focusing on explosive movements that require quick muscle contractions [28]. The integration of plyometric exercises and sport-specific instructions in functional training probably contributed to the enhanced power observed in this study. These exercises improve the stretch-shortening cycle, allowing athletes to generate more force in a shorter time frame, which is essential for basketball performance [21].

The 10-week training program resulted in improvements in both strength and explosive power, which are critical elements of athletic performance in basketball. The improvements in strength contribute to better overall physicality on the court, allowing players to hold their ground against competition and perform more effectively [29]. Enhanced explosive power translates directly to improved jumping ability, acceleration, and flexibility, all of which are important for success in basketball [30].

Moreover, the functional training approach improves physical capabilities and also encourages better movement patterns and coordination, which can reduce the risk of injury [27]. By training in a manner that almost resembles the demands of the sport, athletes are better prepared for the specific challenges they face during competition.

In summary, this study focuses on the importance of selecting appropriate training modalities according to the specific demands of the sport. While both FST and TST can enhance athletic performance, FST appears to provide additional benefits in developing the strength and power necessary for basketball. Coaches and athletes should consider integrating functional training elements into their programs to optimize performance and reduce injury risk.

Conclusions

This study demonstrates that both FST and TST improve strength and power in college basketball players, both training methods have distinct characteristics and benefits. TST focuses on isolated exercises that increase muscle mass and raw strength – essential for powerful jumps and rebounds. The structured progression in TST allows for clear measurement of strength gains, providing a solid foundation for players' physical development. FST has shown superiority in enhancing players' functional abilities. It improves their dynamic movements, balance, and coordination on the court, which are crucial for actual game performance. The multi-joint and multi-planar movements of FST better simulate real basketball activities, making it effective for improving agility and reducing injury risks. A combination of both methods is recommended for comprehensive training programs, allowing coaches and athletes to leverage the advantages of each approach to optimize strength and power development in college basketball players.

Limitations include a short intervention duration, small sample size, and lack of position-specific analysis. Future research should address these limitations, increase the sample size and duration of intervention, and conduct long-term follow-up, as well as explore the effects of FST and TST on participants with diverse training backgrounds, explore long-term effects to inform tailored training programs that enhance sports performance and reduce injury risk.

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Conflict of Interest

The authors declare no conflict of interest.

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