

# Effect of Plyometric with Basketball Training Program on Leg Performance and Under the Basket Shot of Male Basketball Players in Anhang University

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Article Info Received 9 December 2025 Revised 21 December 2025 Accepted 23 December 2025 Available online 27 December 2025
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## Abstract

The purpose of this research is to study and compare the effects of plyometric training with basketball training program on leg performance and under the basket shot of male basketball players in Anhang University. The informants consisted of 15 basketball players from Anhang University who were purposively selected and participated in training for 8 weeks, 3 days per week. Measurements of leg muscle strength, leg muscle power, and under the basket shot were performed. Data were statistically analyzed, using mean, standard deviation, and a one-way repeated measures ANOVA at a statistically significant level of 0.05.

The results of the study found that the athletes' leg muscle strength, leg muscle power, and under the basket shot before plyometric training with basketball training program, between 4th week, 6th week, and after the 8th week, there was a statistically significant difference at the .05 level. The research results concluded that plyometric with basketball training program can increase leg muscle strength and leg muscle power. This has led to an increase in the shooting ability of basketball players at Anhang University. However, further studies are needed to compare it with other forms of training.

**Keywords:** Plyometric Training, Basketball Training, Leg Performance, Under the Basket Shot.

## Introduction

In February 2020, the General Office of the General Administration of Sport of China issued a notice on further strengthening basic physical training to compensate for long-term deficiencies in athletes' physical conditioning. The document highlighted persistent weaknesses in general and sport-specific fitness, which significantly hindered China's performance in major international competitions such as the Tokyo Olympics (China Sports General Administration, 2020). This reflects the relatively late development of systematic physical-training research and practice in China, resulting in a clear performance gap between Chinese athletes and their international counterparts. In sports where physical qualities dominate competition outcomes, teams with superior strength, endurance, and power often prevail at decisive moments. Therefore, the physical condition of Chinese athletes plays a

crucial role in determining China's overall competitiveness in the Olympic Games and future world-class events. Since the release of this national directive, sports organizations across provinces and universities have increased their focus on physical training, implementing various "fitness monitoring" and "special physical ability enhancement" programs. Basketball, although a technology-driven sport, requires a strong physical foundation to fully support technical execution in high-intensity matches. Modern basketball is characterized by rapid transitions, explosive movement, and unpredictable tactical situations, all of which place heavy demands on athletes' strength and power. From the perspective of competitive sports, physical training must emphasize practicality meaning that improvements in physical capacity must directly transfer to sport-specific performance outcomes.

In basketball, lower-limb strength and power are vital not only for enhancing vertical jump height and acceleration but also for maintaining shooting stability and accuracy. A strong lower body provides a firm base during shooting, enabling better postural control, smoother force transfer, and more consistent shot mechanics, even under defensive pressure or during unstable movements such as pull-ups or fadeaways. Enhanced leg power also enables quicker take-offs and higher release points in under-basketball shots, reducing the likelihood of being blocked and increasing the probability of successful scoring. Research has consistently shown a strong positive relationship between lower-body explosive strength and shooting performance. Ziv and Lidor (2010), in their comprehensive review of basketball shooting mechanics, emphasized that athletes with superior explosive abilities transfer force more efficiently from the lower to the upper body, resulting in more fluid and consistent shot execution. The skill of under-basketball shooting requires both technical proficiency and sufficient leg muscular performance to stabilize the body and maintain proper shooting angles. Dong Yilin (2020) highlighted that specialized physical training must be aligned with the technical demands of the sport, ensuring a smooth bridge between athletic ability and technical execution.

Plyometric training derived from the Greek words "plythein" (increase) and "metric" (measure) is widely recognized as an effective method to develop explosive power by enhancing the Stretch-Shortening Cycle (SSC). The SSC mechanism allows muscles to store elastic energy during rapid eccentric contractions and release it during subsequent concentric actions, producing powerful and efficient movements. This is similar to compressing and releasing a spring to generate maximal output force in minimal time. Plyometric training closely resembles the dynamic movement patterns of basketball and is therefore considered a highly relevant method for developing sport-specific physical abilities (Cherni et al., 2019).

Recent studies in Thailand further support the effectiveness of plyometric training in basketball performance. For example, Boonhan and Boonhan (2023) found that an eight-week plyometric program significantly improved jump-shot accuracy at various shooting distances among basketball players. Their study reinforces the importance of lower-limb power in enhancing shooting consistency and supports the theoretical foundation of the present research.

Beyond basketball, evidence from other sports also demonstrates the strong benefits of plyometric interventions. Rachote, Kumpuang, and Chimwong (2024) reported significant improvements in leg muscle power and blocking skills in volleyball athletes following a plyometric program combined with elastic resistance and sandbag loading. Although conducted in a different sport, the neuromuscular mechanisms involved particularly the enhancement of the SSC are consistent with the requirements of basketball movements such as jumping, accelerating, and rapid directional changes.

Additionally, strength training in general enhances joint stability, reduces injury risk, and prolongs athletic careers. However, observations of daily training among male basketball players at Ankang College revealed clear deficiencies in strength, endurance, and lower-body stability. These weaknesses not only reduce competitive performance but also increase injury risk. Currently, training in many university basketball programs still focuses mostly on technical and tactical drills, with insufficient emphasis on specialized physical training (Wang Daocheng, 2020).

Therefore, more in-depth research on basketball-specific physical training is urgently needed. Wang Liang (2018) emphasized the importance of improving athletes' performance through scientific and well-structured training systems. Incorporating lower-limb muscular development into basketball shooting training is not only essential for enhancing overall athletic performance but also critical for improving shooting effectiveness during competition.

## Objective

This study investigated the effect of plyometric training with basketball training on leg performance and under the basket shot of male basketball players at Ankang University.

## Literature Review

The theoretical basis of Plyometric training mainly comes from the neuromuscular mechanism of the stretch-shortening cycle (SSC). When the muscle undergoes a rapid eccentric contraction (eccentric phase) and quickly transitions to a concentric contraction (concentric phase), the elastic energy stored in the tendon and muscle belly tissue is released, significantly improving athletic performance (Komi, 2003). This mechanism is the core of explosive power generation and the key feature that distinguishes enhanced training from traditional strength training. The main goal of plyometric training is to effectively enhance the body's speed-strength capabilities. According to its training principles, Yan Zhe (2018) explains that plyometric training stimulates muscle strength primarily through the stretch-shortening cycle. The power generated in plyometric exercises mainly comes from the natural elasticity of muscles and tendons, as well as the stretch reflex factors that are key to supporting a wide range of athletic movements. Plyometric training, also known as enhanced training, helps strengthen this elastic response, thereby enhancing the muscle's elastic potential and improving overall muscular power. In parallel with this improvement, the capacity for speed-strength development is also increased. Speed-strength refers to the ability to exert maximum force at maximum speed under low load conditions and represents a synergy between "speed" and "strength." Moreover, enhanced training improves not only muscle strength and contraction capability but also neuromuscular control. It develops tension reflex responses, coordination between synergistic and antagonistic muscles, muscle relaxation mechanisms, and adaptability to external tension

The fundamentals of basketball are based on skills that use the strength of the leg and back muscles, such as jumping and shooting, taking off to grab rebounds, breaking through and stopping, defensive sliding and quick counterattacks all rely on the explosive power and neural control ability of the lower limbs (Mehmet Emin Demir et al., 2022; Cherni et al., 2019). In basketball games, actions such as taking off to grab rebounds, breaking through and stopping, defensive sliding and quick counterattacks all rely on the explosive power and neural control ability of the lower limbs. Studies have shown that Plyometric training can

significantly improve the vertical jump height, sprint speed and direction change ability of basketball players, and is an important means of special physical training (Mehmet Emin Demir et al., 2022; Cherni et al., 2019). By activating the SSC mechanism and recruiting fast muscle fibers, the training effect can be transformed from "strength improvement" to "special performance improvement", realizing a true "training-competition transformation".

Applying Plyometric training to basketball is a novel attempt. To ensure the specificity and effectiveness of the training, this study scientifically selected the following representative exercises based on an extensive review of both domestic and international literature, as well as the technical requirements of basketball skills:

**Squat Jump:** Enhances vertical explosive power and simulates actions such as rebounding and jumping from a stationary position.

**Box Jump:** Improves joint stability and eccentric control.

**Single-Leg Hop:** Strengthens explosive power and muscular coordination in single-leg support situations.

**Lateral Bound:** Enhances change-of-direction ability and lateral defensive footwork.

**Depth Jump:** Activates the stretch-shortening cycle (SSC) mechanism to improve the efficiency of converting maximal strength into explosive power. (Voisin & Scohier, 2019; Cao et al. (2024)

Sirirat Hirunrat (2022) proposed the basic elements for establishing a training plan, which are as follows:

1. Training activities or programs must be consistent with training goals

The type of training activities or training depends on the training goals. The development of the training plan must according the training purpose. For example, the speed training plan must be a plan focused on improving speed, and the long jump training plan must be a plan that truly develops long jump ability.

2. Daily training duration (taking basketball as an example)

Athletes, especially basketball players, should train for 1-2 hours a day. However, it is important to consider the athlete's level of preparation. Training too long or too long can lead to a decline in physical function, causing muscle, tendon and joint injuries, and boredom during training. On the other hand, training that is suitable for the trainee can also improve training skills.

3. Weekly training cycle

Training time in a week Weekly training must include: the duration of daily training, the intensity and severity of the activities. Normally, the training time should be 3 days a week.

4. Activity intensity

When determining the intensity of an activity, one must consider the individual's muscle strength Training should follow the principle of going from easy to difficult, from light to heavy, and from local to whole body.

5. Duration of the entire training program

It is necessary to consider individual potential and respect the natural differences of individuals and their unique maximum ability limits. The coach should not force or rush the trainee to achieve better target results too quickly in a short period of time. Generally, a 4-6 week program of training 3 days a week will bring changes and development, including overall strength and explosive power.

6. Physical ability level

Before training is an important indicator for observing training effects Physical fitness assessment before training can clearly reflect physical changes after training. the training content should be adjusted accordingly. It is very important to test the athlete's physical ability

regularly throughout the training process. It can provide data support for the training plan, keep it synchronized with the athlete's physical fitness changes, and continuously optimize it, thereby promoting the athlete's continuous progress.

Based on the findings of this study, it can be concluded that the principles of training program development must be comprehensively studied and thoroughly understood. Coaches are required to carefully consider several key factors, including training objectives, duration, intensity, and the individual readiness of athletes taking into account aspects such as age, body weight, physical strength, and access to a safe and well-equipped training environment. It is essential that the training design aligns with the specific characteristics of the wrestling discipline and targets the appropriate muscle groups. This alignment ensures that the training program effectively meets the objectives of the study and can be further refined, developed, and applied to other related sports disciplines in a meaningful and evidence-based manner

## **Research Methodology**

### **Study design**

This quasi-experimental research design was conducted at Anhang University to explore plyometric with basketball training program on leg performance and under the basket shot of male basketball players. Before participation, individuals provided informed consent, having been fully briefed on the study's purpose and testing procedures. Participants were 15 male basketball players of Anhang University; they were purposefully sampled. They were doing plyometric with basketball training for 8 weeks.

### **Ethical consideration**

All procedures of this study were approved by the Ethics Committee of the Anhang University of China Ethics Committee with approval number AKU-ROAU-EC-2025-HR-003

### **Materials and methods**

A sample size was calculated following G\*Power software version 3.1 Following preliminary data, the number of participants was determined based on the calculated effect size  $f = 0.90$ ,  $\alpha = 0.05$  and power  $(1 - \beta) = 0.95$ . The following criteria were used inclusion criteria: 1) Male basketball players of Anhang University, aged between 18 and 25 2) Have at least 1 year of experience in basketball training and competition 3) In good health, with no history of serious sports injuries and exclusion criteria: 1) History of severe knee or ankle injury 2) Have a current illness or injury for which you are receiving rehabilitation treatment or medication 3) Those who are unable to attend training and testing arrangements regularly during the study period.

### **Research Instruments**

1. Plyometric with basketball training program developed by researchers for 8 weeks of training.

2. Leg dynamometer tester model: BCS-400 to test the strength of the leg muscles

3. Standing vertical jump to test the power of the leg muscles

4. Under the basket shot, according to the evaluation manual of the Chinese basketball association.

### **The Research Instruments**

To ensure the validity and reliability of the tools and procedures used in this study, the following steps were taken:

1. A Plyometric with basketball training program was presented to five experts in the fields of sports science and physical education. The 5 experts agreed that the program was appropriate and practical, obtained a consistency index from experts equal to 0.88,

and suggested improvements based on the experts' suggestions. The final version of the training program was adjusted and finalized before being put into practice. After that revised program was piloted with a group of 15 people with similar characteristics to the sample group to determine the suitability and feasibility of the program. After that introduced into the experiment.

2. Leg dynamometer tester model: BCS-400

3. Standing Vertical jump

4. Under the basket shot, according to the evaluation manual of the Chinese basketball association found the reliability is equal to 0.83.

### **Data Collection**

Data collection in this research was conducted by the researcher himself. The steps are as follows:

1. Contact the school of physical education of Ankang University in China to request cooperation in the research and provide convenience for the sample group. Explain the details of the training and experiment for understanding.

2. The researcher proceeded to request a certificate from the Research Ethics Committee to conduct research on humans

3. The researcher conducted a test on the sample group to enter the research process by dividing them into an experimental group to train for 8 weeks.

4. Perform 8 weeks of training as planned. The experimental group trained 3 days a week, Monday, Wednesday, and Friday, from 5:30 to 6:30 pm. Physical fitness tests of muscle strength and muscle power of both groups of subjects were conducted at week 4, week 6, and week 8.

5. The results of statistical analysis were summarized, the research results were discussed, and recommendations were made from this study.

### **Data Preparation and Analysis**

In this study, the researcher used the SPSS statistical software program to analyze the test data. The procedures were as follows:

1. Calculate the mean and standard deviation of leg muscle performance and basketball shooting ability before and after training in weeks 4, 6, and 8

2. Use repeated measures one-way ANOVA to compare the differences in the mean values of physical fitness before training, after the 4th week, after the 6th week, and after the 8th week of training. If there are significant differences in the mean values of physical fitness across these time points, adjustment for multiple comparisons: Bonferroni. The statistical significance level was set at 0.05.

### **Research Finding**

The results of the effect of plyometric with basketball training program on leg performance and under the basket shot of male basketball players at Ankang University. As follows.

**Table 1** Mean values and standard deviations of the leg muscle strength, leg muscle power, and under the basket shot were analyzed at five stages: before training, after 4 weeks, after 6 weeks, and after 8 weeks of plyometric with basketball training program. (n=15)

Outcome	Leg muscle strength	Leg muscle power	Under the basket shot
	(mean±SD)	(mean±SD)	(mean±SD)
Before the test	136 ± 10.17	63 ± 5.90	9 ± 1.11
After training 4	142±8.45	67±5.11	11±1.17
After training 6	142±8.54	68±5.52	11±1.34
After training 8	144±8.02	70±5.69	12±1.17

From Table 1, it is found the beginning of the experiment, the average score of leg muscle strength ( $\bar{X}$ =136, S.D.=10.17). the fourth week, the average score had increased ( $\bar{X}$ =142, S.D.=8.45). the sixth week, the average score was ( $\bar{X}$ =142, S.D.=8.54). The last week, the average score had increased ( $\bar{X}$  =144, S.D.=8.02).

The first week was average score of leg muscle power ( $\bar{X}$ =63, S.D.=5.90). the fourth week, the average score had increased ( $\bar{X}$ =67, S.D.=5.11). the sixth week, the average score had increased ( $\bar{X}$ =68, S.D.=5.52). The last week, the average score had increased ( $\bar{X}$ =70, S.D.=5.69).

The first week was average score of under the basket shot ( $\bar{X}$  = 9, S.D.=1.11). the fourth week, the average score was ( $\bar{X}$ =11, S.D.=1.17). the sixth week, the average score was ( $\bar{X}$ =11, S.D.=1.34). The last week, the average score had increased ( $\bar{X}$ =12, S.D.=1.17).

**Table 2** One-way analysis of variance (ANOVA) was performed on leg muscle strength, leg muscle power, and under the basket shot before training, after 4 weeks, after 6 weeks, and after 8 weeks. (n = 15)

Outcomes	Source of Variation	SS	Df	MS	F	p
Leg muscle strength	Training Duration	679.920	4	169.980	43.649	.000
	Error	218.080	56			
Leg muscle power	Training Duration	398.000	4	99.500	34.142	.000
	Error	163.200	56	2.914		
Under basketball shooting	Training Duration	71.333	4	17.833	22.160	.000
	Error	45.067	56	.805		

\* $P \leq 0.05$

According to Table 2, the comparison of leg performance and under the basket shot shows that the difference is statistically significant at the .05 level. The results of the correlation analysis between the duration of plyometric with basketball training program on leg performance and under the basket shot of male basketball players found that the training duration has a positive statistically significant correlation at the .05 level with leg performance, which is leg muscle strength, leg muscle power and under the basket shot.

## Discussion/Conclusion

The findings of this study demonstrate that an eight-week integrated plyometric and basketball training program can substantially enhance leg muscle strength, leg muscle power, and under the basket shot accuracy among collegiate male basketball players. The progressive improvements observed across all testing intervals support the idea that structured neuromuscular training is essential for optimizing basketball performance.

First, the significant increase in leg muscle strength indicates improved motor-unit recruitment, neuromuscular coordination, and enhanced ability to generate maximal force under functional movements. This pattern aligns with Hammami et al. (2021), who reported similar gains in strength and reactive power among university athletes following combined plyometric–strength conditioning programs. The gradual improvement observed in each testing stage suggests that the volume and intensity of training were appropriate and allowed sufficient adaptation without causing excessive fatigue.

Second, the development of leg power, evidenced by the increase in standing vertical jump height, supports the effectiveness of the stretch-shortening cycle (SSC). Plyometric exercises enhance elastic energy storage and release, neuromuscular activation, and fast-twitch muscle fiber recruitment, producing more powerful lower-limb propulsion. These results are consistent with the findings of Ramirez-Campillo et al. (2022), who demonstrated that structured plyometric training significantly improves jump height, sprint performance, and overall explosiveness among young basketball and soccer athletes.

Third, the improvement in under the basket shot accuracy reflects successful transfer from physical conditioning to technical basketball performance. Enhanced leg performance, postural control, and proximal-to-distal energy transfer likely improved shooting mechanics, particularly in maintaining rhythm and accuracy during ground-up force production. Cao et al. (2024) similarly found that lower-limb stability and power meaningfully influence the consistency of shooting performance in university-level basketball players. concluded that plyometric with basketball training program can increase leg muscle strength and leg muscle power. This has led to an increase in the shooting ability of basketball players at Ankaang University. However, further studies are needed to compare it with other forms of training.

This study concludes that plyometric with basketball training program is an effective and practical approach for enhancing athletic performance in male collegiate basketball players. Over eight weeks, the participants demonstrated consistent and statistically significant improvements in leg muscle strength, leg muscle power, and under the basket shot accuracy. These outcomes confirm that plyometric-based conditioning stimulates neuromuscular adaptations that directly support technical skill execution. The integrated model developed in this study provides an evidence-based approach that collegiate coaches can adopt to improve players' explosive capability and shooting efficiency. Furthermore, the results align with contemporary performance - enhancement theories emphasizing functional transfer between physical conditioning and basketball-specific skills.

## Suggestion

1. Limited measurement variables: only leg muscle strength, leg muscle power, and shooting accuracy were examined. Future studies should include agility, sprint speed, balance, and biomechanical analysis (e.g., EMG, motion capture).
2. The study should expand the participant group to include female athletes and various age groups, and compare plyometric basketball training with strength training, balance training, or a combination of strength training methods.

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