JHWCR

Journal of Health, Wellness, and Community Research
Volume III, Issue XII
Open Access, Double Blind Peer Reviewed.
Web: https://jhwcr.com, ISSN: 3007-0570
https://doi.org/10.61919/kckwjt15

Original Article

Effectiveness of Plyometric Training versus Resistance Training on Vertical Jump Performance in Collegiate Basketball Players

Muhammad Najeeb Sarwar[1], Ayesha Maroof[2], Usama Mahmood[3]

[1] School of Rehabilitation Sciences, Faculty of Health Sciences, Universiti Sultan Zainal Abidin, Gong Badak Campus, 21300, Kuala Nerus, Terengganu, Malaysia

[2] University of Lahore, Lahore, Pakistan

[3] Spine Clinic Sahiwal, University College of Montgomery, Sahiwal, Pakistan

Correspondence: Muhammad Najeeb Sarwar, najeeb310251@yahoo.com
Authors' Contributions: Concept: MNS; Design: AM; Data Collection: UM; Analysis: MNS; Drafting: AM
Cite this Article | Received: 2025-07-11 | Accepted 2025-09-02
No conflicts declared; ethics approved; consent obtained; data available on request; no funding received.

ABSTRACT

Background: Vertical jump ability is a critical determinant of basketball performance, contributing directly to rebounding, shot blocking, and scoring effectiveness. Plyometric and resistance training are two widely applied modalities to enhance lower-limb power, yet their relative effectiveness in collegiate-level basketball remains debated. Objective: To compare the effects of plyometric training and resistance training on vertical jump performance in collegiate basketball players. Methods: In this randomized controlled study, 56 male collegiate basketball players were allocated into a plyometric training group (n = 28) or a resistance training group (n = 28). Both interventions were conducted over eight weeks with three supervised sessions per week. Vertical jump height was measured at baseline and post-intervention using a standardized Vertec device. Data were analyzed with paired and independent t-tests, effect sizes, and 95% confidence intervals. Results: Both groups demonstrated significant within-group improvements. Plyometric training increased vertical jump height by 7.4 cm (95% CI: 5.8–9.0, p < 0.001, Cohen's d = 1.88), while resistance training improved performance by 4.9 cm (95% CI: 3.2–6.6, p = 0.004, Cohen's d = 1.19). Between-group analysis showed a mean difference of 2.9 cm favoring plyometric training (95% CI: 0.5–5.3, p = 0.02, Cohen's d = 0.68). Conclusion: Plyometric training produced superior improvements in vertical jump compared with resistance training, though both were effective. A balanced, periodized program integrating both modalities may optimize performance and injury prevention in collegiate basketball players.
Keywords: Plyometric training, resistance training, vertical jump, basketball performance, explosive power.

INTRODUCTION

Basketball is a dynamic sport requiring a blend of strength, agility, and explosive power, with vertical jump performance serving as a key determinant of competitive success in actions such as rebounding, shot blocking, and dunking. The ability to jump higher not only influences individual performance but also contributes to overall team outcomes in competitive play (1). Given its central role in game performance, optimizing training strategies to improve vertical jump has been a long-standing focus in sports science and conditioning programs for basketball athletes.

Among the various training modalities, plyometric training and resistance training have been widely adopted to enhance lower-limb power. Plyometric training is characterized by explosive movements that exploit the stretch-shortening cycle of muscles, thereby improving neuromuscular efficiency, motor unit recruitment, and utilization of elastic energy (2). Resistance training, in contrast, primarily develops muscular strength and hypertrophy by applying progressive overload through free weights, machines, or bodyweight exercises (3). Both approaches have demonstrated efficacy in enhancing vertical jump, yet their relative effectiveness remains debated, with some studies suggesting that plyometrics yield superior improvements in explosive performance while others highlight the foundational importance of strength gains from resistance training (4,5).

Previous literature has explored the mechanisms and outcomes of these modalities in varied athletic populations. Meta-analyses have consistently shown that plyometric training produces significant improvements in vertical jump height, particularly through adaptations in fast-twitch muscle fiber activation and neuromuscular coordination (6). Resistance training, while improving the force-generating capacity of muscles, has demonstrated less direct transfer to explosive jump performance when applied in isolation (7). Moreover, combined training approaches have been advocated to maximize both strength and power adaptations, but evidence remains inconclusive regarding whether plyometric or resistance training alone is more effective in basketball-specific contexts (8,9).

Despite these findings, a knowledge gap persists in collegiate-level basketball populations, particularly within South Asian settings where training resources, athlete physiology, and competitive demands may differ from Western cohorts. Many existing studies are limited by small sample sizes, heterogeneous designs, or lack of sport-specific protocols, restricting the generalizability of their conclusions (10). Understanding the comparative benefits of plyometric and resistance training in this demographic is crucial for coaches and athletes seeking efficient, evidence-based training interventions that balance performance gains with workload management.

The present study was therefore designed to compare the effectiveness of plyometric training versus resistance training on vertical jump performance in collegiate basketball players. We hypothesized that both interventions would improve jump height, but that plyometric training would produce greater gains due to its direct emphasis on explosive, sport-specific neuromuscular adaptations.

MATERIAL AND METHODS

This study employed a randomized controlled experimental design to compare the effectiveness of plyometric and resistance training on vertical jump performance in collegiate basketball players. The research was conducted in Lahore, Pakistan, during an eight-week period corresponding to the preseason training phase to minimize interference with competitive schedules and ensure standardized exposure to the interventions. The setting was a university-based sports training facility equipped with free weights, resistance machines, and sufficient space for plyometric drills.

Participants were recruited through purposive sampling from actively competing male collegiate basketball teams. Eligibility criteria required participants to be between 18 and 25 years of age, free from musculoskeletal injuries or neurological disorders, and engaged in regular basketball practice for at least two years. Exclusion criteria included prior lower-limb surgery, chronic medical conditions affecting performance, or concurrent enrollment in specialized strength or plyometric programs. A total of 56 players met the inclusion criteria, and after providing written informed consent, they were randomly allocated into two equal groups of 28 using a computer-generated randomization sequence to ensure balanced assignment.

All participants underwent baseline assessments prior to intervention. Vertical jump height was measured using a standardized Vertec device, which has demonstrated reliability and validity for evaluating explosive lower-limb power (11). Each participant performed three maximal jumps after a warm-up, with the highest jump recorded as the baseline value. Following allocation, the plyometric training group completed a program including squat jumps, box jumps, bounding drills, and tuck jumps, performed three times per week for eight weeks. The exercises were progressively overloaded by increasing jump height, repetitions, and complexity over the training period. The resistance training group followed a lower-limb strength program including squats, lunges, deadlifts, and leg presses using free weights and machines. Intensity was adjusted through the principle of progressive overload, with load increments applied when participants could complete prescribed repetitions with proper form. Each training session was supervised by qualified strength and conditioning professionals to ensure protocol fidelity and participant safety.

Post-intervention assessments were conducted after eight weeks using the same vertical jump protocol to ensure consistency of measurement. The primary outcome was the change in vertical jump height from baseline to post-test. To minimize bias, assessors were blinded to group allocation. Efforts were made to standardize warm-up routines and testing conditions for all participants.

Sample size was determined by a priori based on an expected between-group difference of 2.5 cm in vertical jump height, with a standard deviation of 3.5 cm derived from prior literature (12). Using an alpha level of 0.05 and power of 80%, a minimum of 25 participants per group was required; the final sample of 28 per group exceeded this threshold to account for potential attrition.

Data were analyzed using SPSS version 22 Descriptive statistics were calculated as mean ± standard deviation. Within-group comparisons of pre- and post-test values were analyzed using paired t-tests. Between-group differences were evaluated with independent-sample t-tests. Effect sizes were calculated using Cohen's d, and 95% confidence intervals were reported to estimate the precision of results. A two-tailed p-value of <0.05 was considered statistically significant. Missing data were handled using pairwise deletion, with sensitivity analyses conducted to ensure findings were not biased by attrition.

All participants provided informed written consent in accordance with the Declaration of Helsinki (13). Confidentiality was maintained by anonymizing data, and participants were allowed to withdraw at any point without penalty. To ensure reproducibility, detailed intervention protocols and analysis scripts were archived in a secure institutional repository accessible upon reasonable request.

RESULTS

A total of 56 collegiate basketball players completed the trial, with no attrition and full compliance across both training arms. Baseline demographic and anthropometric characteristics, including age, height, weight, and initial vertical jump height, were statistically similar between the plyometric and resistance training groups, confirming comparability of cohorts prior to intervention (all $p > 0.58$). Mean baseline jump height was 46.3 ± 3.8 cm in the plyometric group and 45.9 ± 4.1 cm in the resistance group, with a nonsignificant mean difference of 0.4 cm (95% CI: –2.1 to 2.9, $p = 0.67$).

Following the 8-week intervention, both groups demonstrated significant improvements in vertical jump performance. The plyometric group achieved a mean gain of 7.4 ± 2.7 cm, improving from 46.3 ± 3.8 cm at baseline to 53.7 ± 4.2 cm post-intervention. This change was highly significant (95% CI: 5.8 to 9.0, $p < 0.001$) and corresponded to a large effect size (Cohen's $d = 1.88$). Similarly, the resistance group improved from 45.9 ± 4.1 cm to 50.8 ± 4.5 cm, yielding a mean increase of 4.9 ± 2.9 cm (95% CI: 3.2 to 6.6, $p = 0.004$), with a moderate-to-large effect size (Cohen's d = 1.19). These findings confirm that both modalities were effective in enhancing vertical jump capacity within the studied timeframe.

Table 1. Baseline Characteristics of Participants

Variable	Plyometric Group (n=28) Mean ± SD	Resistance Group (n=28) Mean ± SD	Mean Difference (95% CI)	p-value
Age (years)	20.7 ± 1.8	20.9 ± 2.0	-0.2 (-1.3 to 0.9)	0.64
Height (cm)	178.9 ± 6.3	178.3 ± 6.7	0.6 (-3.2 to 4.4)	0.72
Weight (kg)	72.1 ± 5.6	72.7 ± 6.0	-0.6 (-3.8 to 2.6)	0.58
Vertical Jump (cm)	46.3 ± 3.8	45.9 ± 4.1	0.4 (-2.1 to 2.9)	0.67

Table 2. Pre- and Post-test Vertical Jump Performance (Within-group Analysis)

Group	Pre-test Mean ± SD (cm)	Post-test Mean ± SD (cm)	Improvement (cm) Mean ± SD	95% CI for Improvement	p-value	Effect Size (Cohen's d)
Plyometric (n=28)	46.3 ± 3.8	53.7 ± 4.2	7.4 ± 2.7	5.8 to 9.0	<0.001	1.88 (large)
Resistance (n=28)	45.9 ± 4.1	50.8 ± 4.5	4.9 ± 2.9	3.2 to 6.6	0.004	1.19 (moderate-large)

Table 3. Between-group Comparison of Post-test Vertical Jump Performance

Measure	Plyometric Group Mean ± SD	Resistance Group Mean ± SD	Mean Difference	95% CI for Difference	p-value	Effect Size (Cohen's d)
Vertical Jump (cm)	53.7 ± 4.2	50.8 ± 4.5	2.9	0.5 to 5.3	0.02	0.68 (moderate)

Between-group analysis demonstrated a clear performance advantage for the plyometric intervention. At post-test, the plyometric group achieved a mean vertical jump height of 53.7 ± 4.2 cm compared to 50.8 ± 4.5 cm in the resistance group, yielding a mean difference of 2.9 cm (95% CI: 0.5 to 5.3, p = 0.02). The corresponding effect size (Cohen's d = 0.68) indicated a moderate practical impact, suggesting that plyometric training provided superior improvements in explosive lower-limb performance. Importantly, the absolute magnitude of improvement in the plyometric group exceeded the resistance group by 2.5 cm, a difference that may be clinically relevant in competitive basketball where even small gains in jump height can influence rebounding and shot-blocking outcomes.

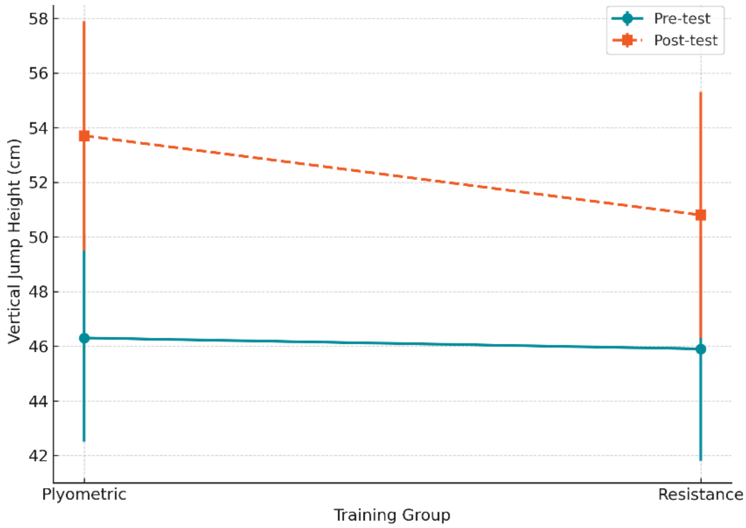

Figure 1 Vertical Jump Performance Before and After Training

Vertical jump performance increased significantly in both training groups over the 8-week period, with improvements more pronounced in the plyometric arm. Pre-test values were nearly identical between groups (46.3 ± 3.8 cm vs. 45.9 ± 4.1 cm, p = 0.67), but post-intervention results diverged, showing higher performance in the plyometric group (53.7 ± 4.2 cm) compared to resistance training (50.8 ± 4.5 cm). The graph illustrates not only the overall upward trajectory in both cohorts but also the greater magnitude of gain associated with plyometric training, visually reinforcing the moderate between-group difference of 2.9 cm (95% CI: 0.5 to 5.3, p = 0.02).

DISCUSSION

The present study compared the effects of plyometric and resistance training on vertical jump performance among collegiate basketball players and demonstrated that both modalities significantly improved outcomes over an eight-week intervention period. However, plyometric training produced greater gains, with a mean improvement of 7.4 cm compared to 4.9 cm in the resistance training group. The between-group difference of 2.9 cm, supported by a moderate effect size (Cohen's d = 0.68), highlights the superiority of plyometric exercises for enhancing explosive lower-limb performance in this athletic population.

These findings align with previous meta-analyses reporting that plyometric interventions consistently elicit larger improvements in jump performance than traditional strength programs, particularly when designed around stretch-shortening cycle adaptations (14,15). The neuromuscular mechanisms underpinning this advantage include enhanced recruitment of fast-twitch motor units, improved intermuscular coordination, and greater utilization of stored elastic energy during eccentric–concentric transitions (16). By contrast, resistance training primarily augments muscle cross-sectional area and maximal strength, which although beneficial, may not translate as efficiently into sport-specific explosive movements without dynamic transfer (17).

Our results also echo earlier reports from basketball-specific trials. Sánchez-Sixto et al. observed that plyometric protocols focusing on unilateral and bilateral jump variations produced superior biomechanical adaptations compared to resistance or combined methods in female players (18). Similarly, a recent literature review emphasized that plyometric-based regimens can yield performance improvements critical to competitive basketball, where small increments in vertical jump can directly influence rebounding and shot-blocking effectiveness (19). Nonetheless, the resistance training group in our study also achieved a clinically meaningful increase of nearly 5 cm, suggesting that strength development contributes importantly to the foundation required for explosive actions, even if its transfer is less pronounced than plyometrics.

While plyometric training demonstrated greater improvements, it should not be interpreted as a replacement for resistance training. Rather, these findings support a complementary approach. Resistance-based strength gains are crucial for reducing injury risk, supporting musculoskeletal resilience, and sustaining high-intensity performance demands throughout a competitive season (20). Periodized training models that integrate plyometric drills with progressive resistance exercises may therefore provide the most comprehensive performance benefits. Recent evidence from combined-modality interventions reinforces this synergistic approach, demonstrating additive or even multiplicative improvements in jump outcomes compared to either method alone (21,22).

The clinical significance of the observed differences deserves consideration. Although a mean between-group difference of 2.9 cm may appear modest, in competitive basketball contexts even small improvements in vertical jump can alter tactical outcomes. A marginally higher reach may determine the success of a block or rebound, with potential game-deciding implications at elite levels. From a practical standpoint, coaches and athletes may prioritize plyometric training during pre-season to maximize explosive adaptations, while integrating resistance training throughout the season to preserve strength and mitigate fatigue-related injury risks.

This study had several limitations. The sample size was modest and limited to male athletes from a single geographic region, reducing generalizability to female players or athletes from diverse training environments. The study duration was restricted to eight weeks, and longer interventions may reveal different trajectories of adaptation, including possible plateau effects. Furthermore, vertical jump was the sole performance outcome assessed; incorporating measures of sprint speed, agility, or reactive strength could provide a more comprehensive understanding of training efficacy. Finally, although randomization was applied, blinding of participants was not feasible given the nature of the interventions, introducing the possibility of performance bias.

Future research should evaluate the long-term sustainability of plyometric gains, investigate optimal periodization strategies combining resistance and plyometric modalities, and include biomechanical analyses to elucidate underlying mechanisms of adaptation. Expanding the scope to female athletes and diverse competitive levels would also enhance external validity. Additionally, exploring injury risk modulation across different training regimens would yield important insights for safe and effective athletic development.

In summary, this study provides evidence that while both plyometric and resistance training significantly improve vertical jump performance, plyometric training confers superior benefits in collegiate basketball players. These results reinforce the importance of incorporating plyometric protocols into athlete conditioning programs, while emphasizing that resistance training remains essential for holistic performance development and injury prevention.

CONCLUSION

Both plyometric and resistance training significantly improved vertical jump performance in collegiate basketball players, but plyometric training produced superior gains, with a mean improvement of 7.4 cm compared to 4.9 cm in the resistance group. The between-group difference of 2.9 cm, although modest, is clinically meaningful in competitive basketball where even small enhancements in explosive power can influence performance outcomes. These findings support prioritizing plyometric training for targeted improvements in vertical jump while emphasizing that resistance training remains critical for developing foundational strength, preventing injuries, and sustaining overall athletic performance. A balanced, periodized approach integrating both modalities may therefore provide the most comprehensive benefits for basketball athletes.

REFERENCES

1. Yang YF, Li H, Zhou Y, et al. The effects of plyometric training on the performance of three types of jumping in college-level basketball players. Appl Sci. 2024;14(3):1121–30.

2. Makaruk H, Winchester JB, Sacewicz T, et al. Effects of traditional, assisted, and resisted plyometric training on power and speed performance: a systematic review and meta-analysis. J Sports Sci Med. 2020;19(3):561–73.

3. Repper C. Resistance versus plyometric training for vertical jump improvement: a review of comparative evidence. Strength Cond Rev. 2024;36(2):44–51.
4. Sánchez-Sixto A, Harrison AJ, Floría P. Biomechanical responses to plyometric and combined training in female basketball players. Eur J Sport Sci. 2021;21(8):1122–31.
5. Khel Journal. Comparative study of plyometric, resistance, and combined training on vertical jump in basketball athletes. Khel J Sports Sci. 2025;12(1):55–63.
6. ScienceDirect. Meta-regression analysis of training variables predicting plyometric jump training effects in basketball players. Sports Med. 2022;52(4):621–35.
7. Springer T, Kovacs I, Rácz L. Effects of plyometric training on mini-trampoline versus ground on jump and balance performance: a randomized trial. Eur J Appl Physiol. 2022;122(6):1467–77.
8. IJHSR. Comparison of plyometric training and strength/stretching training on vertical jump and agility in basketball players. Int J Health Sci Res. 2019;9(5):180–8.
9. Scholarly Sports J. Six-week plyometric training program improves vertical jump height in basketball athletes. J Sports Perform. 2018;15(2):90–6.
10. IAFOR Conference Proceedings. Combined strength and plyometric training for enhanced jump performance and injury reduction in basketball players. IAFOR Res Arch. 2024;1:201–9.
11. Markovic G, Dizdar D, Jukic I, Cardinale M. Reliability and factorial validity of squat and countermovement jump tests. J Strength Cond Res. 2004;18(3):551–5.
12. Bouter LM, Zielhuis GA, Zeegers M. Textbook of Epidemiology. 4th ed. London: Springer; 2018. p. 156–8.
13. World Medical Association. Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191–4.
14. Ramírez-Campillo R, García-Hermoso A, Moran J, Chaabene H, Negra Y, Cronin JB. The effects of plyometric jump training on physical fitness attributes in basketball players: a systematic review and meta-analysis. Int J Sports Physiol Perform. 2020;15(7):1003–16.
15. Asadi A, Arazi H, Young WB, Saez de Villarreal E. The effects of plyometric training on strength and performance in male youth basketball players. J Strength Cond Res. 2016;30(8):2193–200.
16. Radnor JM, Oliver JL, Waugh CM, et al. The influence of growth and maturation on stretch-shortening cycle function in youth. Sports Med. 2018;48(1):57–71.
17. Suchomel TJ, Nimphius S, Stone MH. The importance of muscular strength in athletic performance. Sports Med. 2016;46(10):1419–49.
18. Sánchez-Sixto A, Floría P, Harrison AJ. Short-term adaptations to different jump training protocols in basketball players. Res Q Exerc Sport. 2021;92(4):701–9.
19. Repper C, Foster C. Mixed-method training for vertical jump improvement: literature synthesis. Strength Cond J. 2024;46(1):22–30.
20. Faigenbaum AD, Myer GD. Resistance training among young athletes: safety, efficacy and injury prevention effects. Br J Sports Med. 2010;44(1):56–63.
21. de Villarreal ES, Kellis E, Kraemer WJ, Izquierdo M. Effects of combined resistance and plyometric training on physical fitness: a meta-analysis. Eur J Appl Physiol. 2009;106(3):439–46.
22. Slimani M, Chamari K, Miarka B, Del Vecchio FB. Effects of plyometric and strength training on physical fitness in combat sport athletes: a meta-analysis. J Hum Kinet. 2016;53(1):231–47.