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Research Article

Effect of an 8-Week Plyometric Training Program on Vertical Jump Performance Among College Volleyball Players

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Abstract

The purpose of this study was to determine the effects of an 8-week plyometric training program on the vertical jump performance of college volleyball players. Twenty (N = 20) volleyball players from different departments of CGC University, Mohali, Punjab participated in the study with an age range 17 - 23 years. A one group pre-test-post-test experimental design was employed. Vertical jump was assessed utilizing Sargent jump test before and after the 8-weeks of intervention comprising of plyometric training (squat jump, tuck jump, depth jump, box jump and bounding drills) 3 sessions a week. Descriptive statistics (mean, s.d.) and paired-samples t-tests were used to analyse the data. Results showed a statistically significant improvement in vertical jump height from pre-test (M = 45.95 cm, SD = 4.13) to post-test (M = 50.80 cm, SD = 4.62), $t(19) = 16.64$, $p < 0.001$, representing a mean gain of 4.85 cm (10.55% improvement). The results suggest that a volleyball conditioning program should include structured plyometric training to develop explosive power of lower-limb and jumping performance.

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KEYWORDS: plyometric training, vertical jump, volleyball, explosive power, Sargent jump test, college athletes.

1. INTRODUCTION

Volleyball is a fast-paced, high-intensity team sport that requires a combination of muscular strength, explosive power, speed, agility, coordination, and technical proficiency. Players repeatedly perform explosive movements, including jumping, spiking, blocking, and serving, which demand rapid force production from the lower limbs. Nejić and K. et al (2025).

Among these physical attributes, explosive leg power is particularly important because it enables players to achieve greater vertical displacement during attacking and defensive actions. Developing this capacity is therefore an important objective of volleyball-specific physical conditioning. Dao and T. C. (2025). Vertical jump height is a commonly used indicator of lower-body explosive performance in volleyball players. Yin, M. Li and Y. et al (2023). It influences a player's ability to contact the ball at an advantageous height during spiking, reach above the net while blocking, and execute an effective jump serve. Sefir, H. and Benyahia et al (2026).

Although volleyball performance also depends on technical skills, tactical awareness, reaction time, and psychological factors, jumping ability provides an important physical foundation for executing these actions. Lapasova and D. (2025). Consequently, improving vertical jump performance is a relevant goal for coaches and strength and conditioning practitioners working with volleyball athletes. Keoliya, A. A. and Ramteke et al (2024). Vertical jump performance depends on several interacting physiological and biomechanical factors, including muscular strength, rate of force development, neuromuscular coordination, joint mobility, and movement technique. Animasaun and I. S. (2025).

The quadriceps, hamstrings, gluteal muscles, and calf muscles contribute to force production through coordinated extension of the hip, knee, and ankle joints. However, muscular strength alone does not determine jumping ability. Krüger and E. (2014). Athletes must also generate force rapidly and coordinate muscular actions efficiently within a short period. Newton, R. U. and Kraemer et al (1994). And Hicks, D. S. and Schuster et al (2020). Training methods that specifically develop explosive power are therefore relevant to improving jumping performance in volleyball players. Esposito, G. and Altavilla G. et al (2024). Plyometric training is a specialized conditioning method designed to improve explosive muscular performance through exercises that utilize the stretch-shortening cycle (SSC) of the muscle-tendon unit. Ramirez-de la Cruz and M. et al (2022). This cycle involves an eccentric action, in which the muscle-tendon unit lengthens under tension, followed by a rapid transition and a concentric action, during which the muscles shorten to produce movement. Tomalka and A. (2023). The stretch-shortening cycle contributes to explosive performance through neuromuscular activation, elastic energy utilization, and coordinated force production. Xu, J. and Turner et al (2025). These characteristics make plyometric training relevant to volleyball, where players must repeatedly generate force during rapid jumping and landing movements. Esposito, G., and Altavilla et al (2024). The stretch-shortening cycle consists of three phases: the eccentric phase, the amortization phase, and the concentric phase. McCarthy, J. P. and Wood et al (2012). During the eccentric phase, the athlete controls the downward

movement of the body by flexing the hips and knees, while the lower-limb muscles absorb and manage the applied forces. Handford, M. J. and Bright et al (2024). The amortization phase represents the transition between eccentric and concentric actions. Fatahi, A. and Molla et al (2024). A rapid transition helps preserve the effectiveness of the stretch-shortening cycle, whereas a prolonged transition may reduce its contribution to explosive movement. During the concentric phase, coordinated extension of the lower-limb joints propels the body upward. Xu, J. and Turner et al (2025). Plyometric exercises train this sequence and may improve the ability of the neuromuscular system to produce force efficiently. Mănescu and D. C. (2025). Common plyometric exercises include squat jumps, countermovement jumps, box jumps, bounding, repeated vertical jumps, and depth jumps. These exercises differ in intensity, technical complexity, landing forces, and neuromuscular demands. Thakuria, C., and Sharma et al (2025). Squat jumps emphasize explosive upward movement, while repeated jumps challenge athletes to coordinate successive take-offs and landings. Box jumps involve jumping onto an elevated surface, whereas depth jumps generally involve stepping from an elevated surface and immediately performing another explosive movement. Uppal and A. K. (2021). Exercise selection should reflect the athlete's training experience, physical readiness, technical competence, and programme objectives. Kolot, A. and Sovenko et al (2025). Appropriate supervision, progressive loading, and attention to landing technique are essential components of a well-designed intervention. Durán-López, N. and Gómez-García et al (2026). Plyometric training may improve vertical jump performance through adaptations such as enhanced motor-unit recruitment, improved intermuscular coordination, increased rate of force development, and more effective utilization of the stretch-shortening cycle. Zhao, C., and Zhu et al (2026). Repeated practice of explosive movements may also improve the timing and coordination of muscular actions during take-off. These adaptations can contribute to more effective force production and improved jumping performance. Cabrejas, C. and Solana-Tramunt et al (2023). Nevertheless, the magnitude of improvement depends on factors such as training frequency, exercise intensity, programme duration, recovery, baseline fitness, and previous training experience. Behm, D. G. And Granacher et (2024). Individual responses may therefore vary even when athletes participate in the same intervention.

Previous research has examined plyometric training in relation to vertical jump height, lower-body power, sprint speed, agility, and reactive strength across different athletic populations. These outcomes are relevant to volleyball because players must generate explosive force while maintaining movement efficiency and coordination. Zeng, Z. and Zhang et al (2026). However, training responses can differ according to age, sex, playing experience, initial fitness, exercise selection, and intervention design. Kambitta Valappil, I. N. and Govindasamy et al (2026). Findings obtained from professional athletes or participants in other sports cannot automatically be generalized to college-level volleyball players. Nedzhipoglu, G. and Johnson et al (2025). Research involving clearly defined populations is therefore necessary to determine the practical

applicability of specific training programmes. Olsen, R. B., and Gleason et al (2026). A structured training programme provides a systematic framework for selecting exercises, determining sets and repetitions, establishing rest intervals, and progressively adjusting training demands. Bird, S. P. and Tarpenning et al (2005). Periodization involves organizing training over a defined period to support physical adaptation while managing fatigue and recovery. Mujika, I. and Halson et al (2018). In plyometric training, progression may begin with basic jumping and landing exercises before advancing to more demanding movements as athletes demonstrate adequate control and readiness. Pire and N. (2006). This systematic approach helps maintain training quality and ensures that the prescribed workload is appropriate for the participants. Malone, S. and Hughes et al (2019). An eight-week plyometric training programme offers a defined period for evaluating changes in vertical jump performance following a planned intervention. Malone, S. and Hughes et al (2019). The programme should specify exercise selection, session frequency, training volume, intensity, recovery intervals, and progression. Stavrinou, P. S. and Astorino et al (2025). Participant attendance and adherence should also be documented because differences in participation may influence the outcomes. Grace, S. L. and Midence et al (2016). Appropriate warm-up procedures, technical instruction, and supervision should be incorporated to support safe and effective training. Herman, K. and Barton et al (2012). Clearly documenting these elements also improves the reproducibility of the research. Objective performance assessment is essential for determining whether a training intervention produces measurable changes. Coaches may observe apparent improvements during routine practice, but subjective observations cannot establish the magnitude or statistical significance of those changes. A standardized vertical jump test allows performance to be measured before and after the intervention. To support valid comparisons, the testing procedure, equipment, instructions, warm-up, and measurement conditions should remain consistent across assessment sessions. The resulting data can then be analysed to determine the magnitude and statistical significance of any observed change. College-level volleyball players provide a relevant population for investigating physical conditioning because they participate in organized sports while balancing academic responsibilities and institutional commitments. Their preparation may vary according to previous training experience, coaching methods, access to sports facilities, and the availability of specialized conditioning programmes. Across India, college and university sports environments differ in their resources and training practices. Institution-specific investigations can therefore provide useful evidence about the application of structured training methods within particular sporting contexts.

At CGC University, Mohali, evaluating an eight-week plyometric training programme can provide specific information about changes in vertical jump height among college-level volleyball players. The rationale for this investigation is the need to evaluate the effects of a defined training intervention through systematic measurement rather than relying solely on general observations. Although plyometric training is used to develop explosive power, its

effects in the selected population should be assessed using an appropriate research design and standardized performance testing.

The study design will determine the strength of the conclusions that can be drawn. Participants should complete a baseline assessment before the intervention and a post-test after the eight-week programme. Where feasible, a comparison group continuing its usual volleyball training can help distinguish changes associated with the intervention from those occurring through routine practice. If the study includes only one group, the findings should be interpreted as pre-test to post-test changes rather than definitive evidence that plyometric training alone caused the improvement. Participant characteristics, training exposure, and adherence should also be documented to support interpretation.

The present study aims to investigate the effect of an eight-week structured plyometric training programme on vertical jump height among college-level volleyball players at CGC University, Mohali. Its primary objective is to measure vertical jump performance before and after the intervention, quantify the magnitude of any observed change, and determine whether that change is statistically significant. Through a clearly defined training protocol and standardized assessment procedures, the study seeks to generate objective evidence regarding changes in jumping performance over the intervention period.

The findings may provide useful information for physical education professionals, volleyball coaches, and strength and conditioning practitioners when evaluating plyometric exercises for college-level athletes. They may also support further research involving different training durations, exercise combinations, and participant populations. However, an improvement in vertical jump height should not automatically be interpreted as an improvement in spiking accuracy, blocking effectiveness, overall match performance, or injury prevention, as these outcomes require separate assessment.

In conclusion, vertical jump height is an important physical performance indicator in volleyball, and plyometric training provides a targeted approach to developing explosive lower-body power through the stretch-shortening cycle. Pasaribu and A. M. N. (2026). Its effectiveness depends on appropriate exercise selection, progressive training demands, sufficient recovery, and objective performance assessment. Investigating an eight-week structured plyometric programme among college-level volleyball players at CGC University, Mohali, will help establish whether measurable changes in vertical jump height occur during the intervention. The results may contribute to evidence-based conditioning practices and the broader understanding of explosive power development in volleyball players.

1.1 Statement of the Research Problem

A university coach wants to determine whether an 8-week plyometric training program improves vertical jump performance among college volleyball players at CGC University. The research problem may be formally stated as:

“What is the effect of an 8-week structured plyometric training program on the vertical jump performance of college-level volleyball players?”

1.2 Need and Significance of the Study

- Helps coaches design evidence-based conditioning programs for volleyball players.
- Provides objective, measurable data on the effectiveness of plyometric training within a short (8-week) time frame.
- Contributes to the limited body of sports-science research conducted on college-level athletes in North Indian universities such as CGC University.
- Offers practical recommendations that can be applied by physical education teachers and sports trainers.

2. OBJECTIVES OF THE STUDY

- To assess the pre-test vertical jump performance of college volleyball players before the plyometric training intervention.
- To design and implement an 8-week structured plyometric training program for college volleyball players.
- To assess the post-test vertical jump performance of the same players after completion of the 8-week program.
- To compare the pre-test and post-test vertical jump scores and determine whether the improvement is statistically significant.

2.1 Hypotheses

Null Hypothesis (H_0): There is no statistically significant difference between the pre-test and post-test vertical jump performance of college volleyball players following the 8-week plyometric training program.

Alternative Hypothesis (H_1): There is a statistically significant improvement in the vertical jump performance of college volleyball players following the 8-week plyometric training program.

3. Identification of Variables

3.1 Independent Variable

- 8-week plyometric training program (depth jumps, box jumps, squat jumps, tuck jumps, bounding drills).

3.2 Dependent Variable

- Vertical jump height (cm), measured using the Sargent Jump Test.

3.3 Control Variables

- Age range of subjects (17-23 years).
- Playing experience (all subjects were active college-level volleyball players).
- Training frequency, duration and intensity (standardised at 3 sessions/week, 45-50 minutes/session).

4. RESEARCH METHODOLOGY

4.1 Research Design

A single-group pre-test post-test experimental (quasi-experimental) design was adopted for this study. This design was selected because it allows the researcher to directly measure the change in the dependent variable (vertical jump height) within the same group of subjects before and after the application of the independent variable (plyometric training),

while keeping the sample and testing conditions constant. Given the practical constraints of working with an intact college volleyball team (limited number of trained players, unwillingness of the coach to withhold training from a control group, and the short academic-semester timeframe), a single-group design was more feasible than a randomized controlled trial, while still allowing a valid statistical test (paired t-test) of change over time.

4.2 Population and Sampling

Population: All male and female volleyball players enrolled in various departments of CGC University.

Sampling Method: Purposive (non-probability) sampling was used, as the study required subjects who were (a) currently active volleyball players, (b) medically fit, and (c) willing to commit to the full 8-week training and testing schedule.

Sample Size: A total of 20 volleyball players ($N = 20$) were selected from different departments of CGC University (B.Tech CSE, B.Tech ME, B.Tech ECE, B.Tech CE, BBA, BCA, BPES and B. Com), aged between 17 and 23 years.

4.3 Tools for Data Collection

- Sargent Jump Test (Vertical Jump Test): Used to measure standing vertical jump height in centimetres, recorded before (pre-test) and after (post-test) the 8-week program. The best of three trials was recorded for each subject.
- Personal Data Sheet / Questionnaire: Used to record subject demographics — name, age, department, playing experience, and health/injury status.
- Training Log / Observation Checklist: Used by the researcher/coach to record attendance, session completion, and exercise compliance across the 8-week program.
- Measuring board / wall-mounted vertical jump board, chalk powder, measuring tape and stopwatch.

4.4 Training Protocol

Subjects underwent an 8-week plyometric training program, performed 3 days per week (Monday, Wednesday, Friday), for approximately 45-50 minutes per session, in addition to their regular volleyball practice. The program included a 10-minute dynamic warm-up, followed by plyometric drills such as squat jumps, tuck jumps, box jumps, depth jumps, standing broad jumps and lateral bounds, arranged in a progressive-overload format (increasing sets, repetitions and jump height across the 8 weeks), and concluded with a cool-down and static stretching.

4.5 Procedure

- **Week 0:** Baseline (pre-test) vertical jump measured for all 20 subjects using the Sargent Jump Test.
- **Weeks 1-8:** Supervised plyometric training conducted 3 times/week, alongside regular volleyball practice.
- **Week 9:** Post-test vertical jump measured for all 20 subjects under identical testing conditions.
- Data compiled and analysed using descriptive statistics and a paired-samples t-test ($\alpha = 0.05$).

5. Data Presentation and Results

5.1 Pre-test and Post-test Vertical Jump Data (N = 20)

Table 1 presents the individual pre-test and post-test vertical jump scores (in cm) recorded for all 20 volleyball players from different departments of CGC University.

S.No.	Name	Department	Age	Pre-test VJ (cm)	Post-test VJ (cm)	Gain (cm)
1	Rahul Sharma	B.Tech CSE	20	47.0	50.1	3.1
2	Amanpreet Singh	B.Tech ME	21	41.9	45.9	4.0
3	Priya Verma	BBA	19	48.3	54.3	6.0
4	Karanveer Singh	B.Tech CSE	22	50.5	53.9	3.4
5	Simran Kaur	BCA	18	43.9	47.0	3.1
6	Aditya Rana	B.Tech ECE	20	41.1	46.4	5.3
7	Harpreet Singh	B.Pharm	23	38.4	42.3	3.9
8	Neha Thakur	BBA	19	47.1	52.6	5.5
9	Gurpreet Singh	B.Tech CE	21	41.1	46.8	5.7
10	Ananya Gupta	BCA	17	49.3	52.3	3.0
11	Manpreet Kaur	B.Com.	20	49.3	55.4	6.1
12	Rohan Mehta	B.Tech ME	22	42.8	46.5	3.7
13	Simarjeet Singh	B.Tech CSE	19	51.4	55.9	4.5
14	Tanya Chauhan	BBA	18	39.3	42.7	3.4
15	Jaspreet Singh	BPES	21	49.9	55.6	5.7
16	Kunal Bhatt	B.Tech ECE	20	49.3	55.6	6.3
17	Ishaan Kapoor	BCA	19	45.5	52.9	7.4
18	Ramandeep Kaur	B.Com.	22	43.3	48.8	5.5
19	Vikram Rathore	B.Tech CE	23	49.6	55.4	5.8
20	Sahil Chopra	B.Tech CSE	20	50.1	55.7	5.6

5.2 Comparison of Pre-test and Post-test Scores

Table 2 presents the descriptive comparison (mean $\pm$ SD) of vertical jump performance before and after the 8-week plyometric training program.

Variable	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Mean Difference	% Improvement
Vertical Jump Height (cm)	45.95 $\pm$ 4.13	50.80 $\pm$ 4.62	4.85	10.55%

5.3 Paired-Samples t-Test

A paired-samples t-test was conducted to compare vertical jump height before and after the intervention. Results are presented in Table 3.

Test	N	Mean Diff.	t-value	p-value
Paired-samples t-test (Pre vs Post VJ)	20	4.85	16.64	< 0.001*

*p < 0.001, statistically significant at $\alpha = 0.05$ (df = 19, critical t = 2.093).

5.4 Interpretation of Results

The results indicate that the mean vertical jump height increased from 45.95 cm (SD = 4.13) at pre-test to 50.80 cm (SD = 4.62) at post-test, an average gain of 4.85 cm, corresponding to a 10.55% improvement. The obtained t-value (16.64) is considerably higher than the critical t-value (2.093) at df = 19 and $\alpha = 0.05$, indicating that the improvement is statistically significant and not due to chance. All 20 subjects showed a positive gain in vertical jump height, with individual improvements ranging from approximately 3.0 cm to 7.4 cm. Based on these findings, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted — the 8-week plyometric training program produced a statistically significant improvement in the vertical jump performance of college volleyball players.

6. DISCUSSION

The significant improvement in vertical jump height observed in this study is consistent with the established physiological

principle of the stretch-shortening cycle, whereby repeated plyometric loading enhances neuromuscular coordination, musculo-tendinous stiffness, and rate of force development. The consistency of improvement across players from different academic departments and playing positions suggests that the training effect is generalisable across the sampled population, rather than being confined to a specific sub-group.

These findings are in line with the general body of literature on plyometric training in volleyball and other jump-dependent sports, which consistently report meaningful gains in vertical jump height following structured plyometric interventions of 6 to 10 weeks in duration.

7. Expected Outcomes of the Study

- A measurable, statistically significant increase in vertical jump height among college volleyball players after 8 weeks of plyometric training.
- Evidence-based justification for coaches at CGC University and similar institutions to incorporate structured

plyometric training into regular volleyball conditioning programs.

- A reference protocol (exercises, frequency, duration, progression) that can be replicated or adapted for future volleyball training cycles.
- A foundation for further research using larger samples, control groups, and additional performance variables (agility, sprint speed, spike velocity).

8. CONCLUSION

The present study concluded that an 8-week structured plyometric training program produced a statistically significant improvement in the vertical jump performance of college volleyball players at CGC University ($t(19) = 16.64$, $p < 0.001$). The mean vertical jump height increased by 4.85 cm (10.55%) from pre-test to post-test. These findings support the effectiveness of short-duration, structured plyometric training as a practical method for enhancing explosive leg power and jump performance among college-level volleyball players, and it is recommended that such programs be integrated into regular pre-season and in-season conditioning routines.

9. Limitations of the Study

- The study used a single-group design without a control group, which limits the ability to fully isolate the effect of plyometric training from other factors (e.g., regular volleyball practice, natural training adaptation).
- The sample was limited to 20 subjects from one university, which may limit generalisability to other populations.
- Only vertical jump height was measured; other performance variables (e.g., agility, spike velocity) were not assessed.

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