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The Effects of Creative Explosive Power Training on Jump Performance in Male Students with a Background in Volleyball

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Abstract

This study investigated the effects of a creative explosive power training program, based on bodyweight plyometric principles, on jump performance and leg strength in male university volleyball players. Thirty volunteers with volleyball experience were purposively selected and completed a six-week program, performed three times per week for 60 minutes per session. Pre- and post-tests included standing vertical jump, walking vertical jump, running vertical jump, and isometric leg extension strength, analyzed using paired t-tests, p-values, and Cohen's d. The results indicated significant improvements across all measures. The standing vertical jump increased from 7.07 ± 1.76 to 9.73 ± 2.05 inches ($p < .001$, $d = 2.252$). The walking vertical jump rose from 8.07 ± 1.80 to 11.83 ± 2.52 inches ($p < .001$, $d = 2.678$). The running vertical jump improved from 17.77 ± 4.23 to 21.70 ± 4.50 inches ($p < .001$, $d = 3.355$). Leg extension strength increased from 128.41 ± 25.23 to 157.74 ± 30.26 kg ($p < .001$, $d = 1.456$). These findings confirm that a creative plyometric-based training program can significantly enhance explosive power and lower-body strength, key determinants of volleyball performance. The program effectively improved vertical and dynamic jumping as well as quadriceps strength, supporting its relevance for skill-related tasks such as spiking and blocking. It provides practical insights for coaches and trainers seeking to optimize training strategies in competitive volleyball and can be adapted for broader athletic populations requiring explosive movements.

Keywords: Plyometric training; explosive power; volleyball; jump performance

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Introduction

Volleyball is a dynamic team sport characterized by repeated explosive actions, particularly jumping for spiking, blocking, and front-row defense. These actions are decisive factors in match outcomes, as athletes with superior jump performance gain a tactical advantage in both offensive and defensive scenarios. The ability to reach greater vertical heights allows players to attack from elevated positions and to effectively counter opponents' actions at the net (Silva et al., 2019). Jumping ability is strongly associated with lower-limb power, core stability, and neuromuscular coordination, which, when adequately developed, enhance athletic performance and competitive success (Trajković & Bogataj, 2020). At the elite level, international players often achieve spike and block jumps exceeding 300 cm, highlighting the strategic importance of optimizing jump performance.

Plyometric training is one of the most established methods for improving explosive capacity. It leverages the stretch–shortening cycle through rapid eccentric–concentric contractions, enhancing neuromuscular responsiveness and elastic energy utilization (Ramírez-Campillo et al., 2023). Classic plyometric drills such as squat jumps, drop jumps, and box jumps require high-intensity force production and have demonstrated significant effects on leg strength and dynamic movement (Mujaddadi et al., 2019). In addition to jump performance, plyometric training has been linked to improvements in maximal strength, speed, and agility—key attributes for high-level volleyball competition (Fischetti et al., 2019). Evidence from both amateur and professional athletes indicates that six to eight weeks of plyometric training can significantly improve vertical jump height and sport-specific fitness (Ramírez-Campillo et al., 2018; Silva et al., 2019).

In the last decade, an expanding body of research has consistently confirmed the benefits of plyometric interventions. For example, Trajković & Bogataj, (2020) reported significant improvements in jump height and explosive power among youth volleyball players. Similarly, Ramírez-Campillo et al. (2018) demonstrated that vertical, horizontal, and combined plyometric exercises enhanced balance, speed, and endurance simultaneously. Despite these findings, most training programs remain conventional and often fail to integrate tactical and biomechanical demands specific to volleyball competition. Moreover, limited attention has been given to combining plyometric development with technical skills such as spiking and blocking, which require complex applications of explosive power (Silva et al., 2019; Mujaddadi et al., 2019).

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However, few studies have explored how creatively adapted bodyweight plyometric programs—those replicating volleyball-specific movements such as spiking, blocking, and approach jumping—can enhance the transfer of explosive power to actual game performance. This lack of integration between traditional plyometric design and volleyball-specific skill execution represents a key research gap that the present study seeks to address.

To address these limitations, the present study developed and evaluated a creative explosive power training program derived from plyometric principles and adapted to the unique demands of men's volleyball. The program was designed to enhance both jump performance and lower-limb strength. Beyond confirming established benefits of plyometric training, this study contributes new knowledge by introducing a specialized and creative approach aligned with the tactical and physical requirements of competitive volleyball. The findings are expected to provide practical guidelines for coaches and athletes in enhancing offensive and defensive skills, particularly spiking and blocking, and to offer adaptable strategies for broader athletic populations requiring explosive power and jump performance.

Research Methodology

Population

The population of this study consisted of male volunteers who possessed fundamental volleyball skills and demonstrated sound physical health. Participants were free from medical conditions that contraindicated exercise, such as cardiovascular disease, diabetes, or hypertension. None reported a history of severe musculoskeletal injuries, nor were they under the influence of drugs or substances that could impair physical performance. From an initial pool of 40 volunteers, 30 were selected based on predefined eligibility criteria. The Leg Extension Strength *Test* served as an additional screening tool, requiring participants to demonstrate the ability to lift 1.5–2 times their body weight to qualify for inclusion in the experimental group. Purposive sampling was employed to ensure that all participants shared comparable levels of volleyball experience and physical conditioning, thereby minimizing variability in training adaptation. Although this non-randomized approach was appropriate for the study's exploratory design, it presents a limitation in generalizing the findings to broader populations, such as female athletes or professional players. Future studies are encouraged to employ randomized controlled trials (RCTs) with larger and more diverse samples to enhance external validity.

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Sample

The final sample comprised 30 male university volleyball players purposively selected from the initial pool of 40 eligible volunteers. This procedure ensured that participants were adequately qualified to undertake the *Creative Explosive Power Training Program*. The sample size was consistent with previous studies of similar experimental design and was sufficient to detect within-group differences using paired statistical analysis. All participants were informed of the study's objectives and procedures and provided written informed consent before participation, in accordance with ethical standards for human research.

Inclusion Criteria

1) Male participants aged 18–25 years who had completed either *Volleyball I* or *Volleyball Skills and Teaching* courses.

2) Free from chronic illnesses or physical limitations that could interfere with plyometric training (e.g., cardiovascular disease, joint disorders, or muscle inflammation).

3)No history of lower-limb or hamstring injuries within six months prior to the study.

4) Successfully passed the *Leg Extension Strength Test*, demonstrating the ability to lift 1.5–2 times body weight.

5) Willing to participate voluntarily and signed written informed consent.

6) Underwent pre-participation screening conducted by a sports science specialist to ensure readiness for high-intensity plyometric activity.

Exclusion Criteria

1) Sustaining any injury during training or testing that compromised health or required more than one week of rest.

2) Missing more than 20% of the scheduled training sessions.

3) Inability to comply with the prescribed training program or researcher instructions.

4) Voluntary withdrawal from participation during the course of the study.

To ensure methodological rigor, participants' attendance and compliance rates were monitored and recorded throughout the six-week intervention period. The study reported no attrition or withdrawals during data collection, confirming full adherence to the training protocol.

Research Design

This study employed an experimental research design utilizing a one-group pretest–posttest model to examine changes in dependent variables before and after participation in the *Creative Explosive Power Training Program*. The intervention lasted six consecutive weeks, with participants training three times per week for 60 minutes per session. This design was appropriate for the study's exploratory objective, focusing on within-subject improvements in jump performance and lower-limb strength among male university volleyball athletes. However, the absence of a control group represents a methodological limitation, as it prevents complete isolation of the program's effects from potential confounding factors such as nutrition, sleep quality, or other physical activities. Future studies should consider employing a randomized controlled trial (RCT) with a larger and more diverse sample to strengthen causal inference. Data were analyzed using the *Paired Samples t-test* to determine significant mean differences between pre- and post-test scores. The analysis included assumption testing for normal data distribution, and all results were interpreted with accompanying effect sizes (Cohen's *d*) and 95% confidence intervals to enhance the validity and interpretability of the findings.

Ethical Considerations

The research protocol was reviewed and approved by the Human Research Ethics Committee of Roi Et Rajabhat University, Thailand (Approval No. 117/2568). All participants were informed of the study's objectives, procedures, and potential risks and provided written informed consent prior to participation, in accordance with the ethical principles of the Declaration of Helsinki. Participant confidentiality was maintained throughout the study, and all collected data were used solely for academic and scientific purposes.

Research Instruments

This study employed instruments in two primary categories: the training program and the physical performance assessment tools.

Creative Explosive Power Training Program

The *Creative Explosive Power Training Program* was developed based on bodyweight plyometric principles and specifically tailored to replicate volleyball-related movement patterns. The program emphasized multidirectional jump drills designed to enhance explosive power, agility, and balance. Creative elements were integrated by adapting jumping tasks to mimic volleyball-specific movements such as spiking, blocking, and defensive maneuvers, thereby increasing ecological validity and ensuring transferability to competitive performance contexts. Unlike conventional plyometric routines, this program incorporated progressive variations in movement complexity, sport relevance, and intensity to maximize training adaptation and skill transfer (Silva et al., 2019; Trajković & Bogataj, 2020). The development process consisted of five key stages:

1) Reviewing theoretical and empirical foundations from textbooks and peer-reviewed literature (e.g., Bompa & Buzzichelli, 2019; Markovic & Mikulic, 2010).

2) Designing a preliminary six-week training program conducted three times per week (60 minutes per session), including drills replicating spiking, blocking, and defensive movements. Each session comprised 3–5 sets per exercise, 8–12 repetitions per set, and rest intervals of 60–90 seconds.

3) Establishing content validity through expert evaluation by three specialists in sports science and volleyball coaching.

4) Revising the program according to expert recommendations to ensure proper volume, progression, and safety for university-level athletes.

5) Conducting a one-week pilot test with three volleyball athletes. The pilot confirmed that participants could safely complete the program without injury or adverse effects. Minor modifications were made to improve clarity and consistency before implementation.

The final six-week program is summarized in Table 1, showing the progressive training structure across weekly phases.

Table 1 Structure of the Creative Explosive Power Training Program (6-Week Progression)

Week	Exercise Focus	Drill Examples	Sets × Reps	Rest (sec)	Intensity Progression
1	Basic Plyometric Technique	Squat Jump, Forward Hop, Lateral Jump	3 × 8	90	Moderate effort (50–60%)
2	Multi-Directional Control	Front–Back Hop, Side-to-Side Jump, Split Jump	3 × 10	90	Increased jump height (60–70%)
3	Volleyball-Specific Adaptation	Block Jump, Approach Jump, Jump-to-Spike Simulation	4 × 8	75	Enhanced vertical focus (70–75%)
4	Reactive and Eccentric Loading	Drop Jump, Tuck Jump, Countermovement Jump	4 × 10	75	orter ground contact time (<250 ms)
5	Integrated Agility & Power	Jump–Shuffle–Jump, Defensive Slide Jump, Single-Leg Hop	5 × 10	60	Explosive emphasis (80–85%)
6	Competition Simulation	Continuous Jump Sequence, Spike–Block Combo	5 × 12	60	Maximal intensity (85–90%)

Note. Training sessions were conducted three times per week for 60 minutes each. Progressive overload was achieved by increasing jump height, reducing rest intervals, and integrating complex movement patterns to simulate real-game conditions.

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Physical Performance Tests

Performance outcomes were evaluated both before and after the intervention using four standardized tests:

1) Vertical Jump Test – measured lower-limb power and vertical explosive strength using a Vertec device.

2) Standing Vertical Jump Test – assessed static explosive lower-body strength.

3) Running Vertical Jump Test – evaluated dynamic explosive power, coordination, and maximal jump height following an approach run.

4) Isometric Leg Extension Strength Test – measured quadriceps strength using a Leg Dynamometer (T.K.K. 5102, Takei Scientific Instruments, Japan).

Training Log

A structured training logbook was maintained throughout the study to record session details including exercise type, sets, repetitions, rest intervals, perceived exertion, and any fatigue or discomfort. This ensured fidelity to the training protocol and participant safety.

Instrument Quality Assurance

All instruments underwent expert validation by three specialists in sports science and exercise physiology. The Index of Item–Objective Congruence (IOC) was 0.89, indicating strong content validity and suitability for data collection. To ensure measurement reliability, test–retest procedures were conducted with pilot participants prior to the main study. The Intraclass Correlation Coefficient (ICC) values for performance measures ranged from 0.85 to 0.93, confirming high reliability and consistency across testing sessions. These results collectively support the accuracy and credibility of the research instruments used.

Data Collection Procedures

Data collection was systematically organized to ensure methodological rigor, participant safety, and ethical compliance under the approved research protocol (No. 117/2568). The process involved six major steps:

1) Participant Recruitment and Screening. Participants were purposively recruited from male university volleyball players who met all inclusion and exclusion criteria. Screening procedures included a health questionnaire and the Leg Extension Strength Test to verify readiness for plyometric training and ensure safety.

2) Pre-Test Assessments. Baseline performance data were collected using validated tests: Standing Vertical Jump, Walking Vertical Jump, Running Vertical Jump,

and Isometric Leg Extension Strength (T.K.K. 5102, Takei Scientific Instruments, Japan). All assessments were performed under standardized environmental and procedural conditions to minimize bias and measurement error.

3) Intervention Implementation. Participants completed the six-week *Creative Explosive Power Training Program* with three sessions per week (60 minutes each). Every session was supervised by the principal investigator and trained assistants to ensure correct exercise execution, participant safety, and adherence. A structured training logbook documented attendance, exercise load, perceived exertion, and any remarks related to fatigue or discomfort. The training compliance rate averaged 96.7%, indicating strong adherence to the prescribed intervention.

4) Confounding Variable Control. To minimize extraneous influences, participants were instructed to maintain stable diets, sleep durations (7–8 hours nightly), and avoid external physical training, nutritional supplements, alcohol, or caffeine during the intervention period. Compliance was verified weekly through brief interviews and self-reported diaries.

5) Post-Test Assessments and Safety Monitoring. Following the six-week program, participants repeated the same physical performance tests as in the pre-test phase under identical conditions. Safety was monitored throughout; no injuries or adverse events were reported during training or testing.

6) Data Verification. All collected data were reviewed independently by two researchers to confirm completeness, accuracy, and consistency prior to statistical analysis.

Data Analysis

Quantitative data obtained before and after the six-week intervention were analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA) to ensure accuracy and reproducibility. The analytical process followed a systematic sequence as described below:

1) Descriptive Statistics. Participant demographics and performance variables were summarized using percentage (%), mean ($\bar{x}$), and standard deviation (SD) to describe the general characteristics and distribution of the data.

2) Assumption Testing. Prior to inferential analysis, data normality was examined using the Shapiro–Wilk test, and homogeneity of variance was verified using Levene's test. A p-value greater than .05 was considered evidence of normally distributed data suitable for parametric testing.

3) Within-Group Comparison. To evaluate the effects of the *Creative Explosive Power Training Program*, Paired Samples t-tests were employed to compare pre-test and post-test means for each dependent variable—standing vertical jump, walking vertical jump, running vertical jump, and leg extension strength.

4) Effect Size. Cohen's d values were calculated to determine the magnitude of the intervention effects and interpreted as follows: small (< 0.2), medium (0.2–0.79), and large (≥ 0.8). This index provided insight into the practical significance of observed differences.

5) Confidence Intervals. Each mean difference was reported alongside its 95% confidence interval (95% CI) to indicate the precision and reliability of the estimates, allowing clearer interpretation of the intervention's impact.

6) Significance Level. Statistical significance was established at α = 0.05, with results showing $p < .05$ considered statistically significant. Both statistical and practical significances were jointly evaluated to interpret the training effects comprehensively.

7) Data Presentation. Results were organized into comparative tables summarizing pre-test and post-test means, standard deviations, p-values, effect sizes, and 95% CIs. Visual aids such as bar charts were used to illustrate changes in performance outcomes for clearer interpretation.

Results and Discussion

The results demonstrated that the *Creative Explosive Power Training Program* produced statistically and practically significant improvements in all jump and strength measures among male university volleyball players (Table 2). Standing vertical jump performance increased from 7.07 ± 1.76 inches to 9.73 ± 2.05 inches (t = -12.334, p < .001, d = 2.252, 95% CI [2.22, 3.11]), demonstrating substantial gains in vertical leg power. Walking vertical jump performance showed a marked improvement from 8.07 ± 1.80 inches to 11.83 ± 2.52 inches (t = -14.669, p < .001, d = 2.678, 95% CI [3.24, 4.29]), indicating enhanced propulsion and dynamic coordination. Running vertical jump performance increased from 17.77 ± 4.23 inches to 21.70 ± 4.50 inches (t = -18.374, p < .001, d = 3.355, 95% CI [3.50, 4.37]), reflecting large gains in approach jump capacity. Finally, isometric leg extension strength improved from 128.41 ± 25.23 kg to 157.74 ± 30.26 kg (t = -7.973, p < .001, d = 1.456, 95% CI [21.80, 36.84]), confirming significant enhancement in quadriceps strength—a key determinant of explosive jumping ability.

These results align closely with previous evidence confirming the positive effects of plyometric-based interventions on lower-limb power and vertical jump performance

(Ramírez-Campillo et al., 2021; Sáez de Villarreal et al., 2015). Recent Q1 studies further confirm these effects in volleyball contexts. Gjinovci et al. (2017) demonstrated that integrating cognitive-motor components with plyometric exercises enhanced sport-specific power and agility in volleyball players, while Ramírez-Campillo et al. (2023) reported that sport-specific explosive strength training significantly improved jump and agility performance in university athletes. The observed increase in running vertical jump is consistent with Luo et al. (2025), who emphasized the advantage of sport-specific plyometric drills for improving approach jumps, while the improvement in quadriceps strength parallels Slimani et al. (2016), highlighting plyometric training's role in enhancing maximal voluntary contraction. Similarly, Sattler et al. (2015) and Silva et al. (2019) reported significant improvements in jump height, blocking, and spiking performance following volleyball-oriented plyometric programs. Collectively, these findings validate the present program and reinforce plyometric training as a cornerstone of volleyball conditioning.

From a mechanistic perspective, these improvements may be explained by neuromuscular and biomechanical adaptations. The repeated eccentric–concentric actions likely optimized the stretch–shortening cycle (SSC), enhancing elastic energy storage and reutilization during explosive movements (Markovic & Mikulic, 2010). Neural adaptations—including increased motor unit recruitment, synchronization, and firing frequency—may have amplified neuromuscular drive and power output. Importantly, the creative element of the program, incorporating drills that mimicked spiking and blocking, likely produced task-specific adaptations by engaging kinetic chains directly transferable to game situations. This creative design distinguishes the intervention from conventional plyometric programs that typically emphasize generalized jumps, offering greater ecological validity and enhancing performance in volleyball-specific contexts.

Table 2 Comparison of Physical Performance Before and After Training (n = 30)

Variable	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	*t*	*p*	Cohen's *d*	95% CI of Mean Difference
Standing Vertical Jump (inches)	7.07 ± 1.76	9.73 ± 2.05	-12.33	< .001	2.25	[2.22, 3.11]
Walking Vertical Jump (inches)	8.07 ± 1.80	11.83± 2.52	-14.67	< .001	2.68	[3.24, 4.29]
Running Vertical Jump (inches)	17.77 ± 4.23	21.70± 4.50	-18.37	< .001	3.36	[3.50, 4.37]
Leg Extension Strength (kg)	128.41± 25.23	157.74± 30.26	-7.97	< .001	1.46	[21.80, 36.84]

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Limitations and Future Recommendations

Despite these promising findings, several limitations should be acknowledged. The one-group pretest–posttest design restricts causal inference due to the absence of a control group. Additionally, the purposive sampling of only 30 participants—though justified by the need for uniform skill levels and health status—represents a methodological limitation that restricts external validity. The relatively small and homogeneous sample of male university athletes limits generalizability to other populations, such as elite or female players. Moreover, the six-week duration does not capture long-term adaptations or retention effects. Future research should employ randomized controlled trial (RCT) designs with larger and more diverse samples to strengthen causal inference and minimize selection bias. Furthermore, incorporating advanced measurement technologies—such as biomechanical motion analysis, electromyography (EMG), or force plate assessments—would provide deeper insights into the neuromuscular and mechanical processes underlying explosive power development. These approaches could help clarify how specific training components influence kinetic and kinematic variables associated with volleyball performance and inform more precise, evidence-based training models.

Implications for Practice

The findings provide practical insights for coaches and practitioners. By integrating volleyball-specific movements that replicate spiking and blocking, the program bridges the gap between general plyometric training and sport-specific performance demands. This creative approach can be adopted as a model for designing effective, context-relevant training regimens. Coaches may utilize the program to enhance offensive and defensive skills, particularly spiking and blocking, while also adapting its principles to other sports requiring explosive movements.

Conclusion

This study demonstrated that the *Creative Explosive Power Training Program*, grounded in plyometric principles and adapted to volleyball-specific movement patterns, significantly enhanced vertical and dynamic jump performance as well as quadriceps strength in male university athletes. By integrating drills that simulated spiking and blocking actions and applying a progressively structured design beyond conventional routines, the program effectively improved both explosive power and sport-specific transfer to match performance. These results highlight the program’s practical value as an innovative, evidence-based model for volleyball conditioning. Furthermore, its adaptable framework offers potential applications for coaches and practitioners across other sports requiring explosive lower-limb power and neuromuscular efficiency.

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