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High-Intensity Plyometric Training Improves Sprint Speed, Lower Limb Power, and Jump Distance in Male Athletes

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Abstract

Study purpose. This study examined the effects of an eight-week high-intensity plyometric training (HIPT) program on initial speed, lower limb power, and jump distance in male athletes.

Materials and methods. A quasi-experimental pre-test–post-test design was employed. Fifteen male athletes (age: 20.8 ± 1.4 years) from the athletics unit of Universitas Pattimura were recruited via convenience sampling from an existing athletics unit and participated in a structured HIPT program conducted three times per week for eight weeks. The program included depth jumps, obstacle jumps, single-leg jumps, and squat jumps with progressive intensity. Initial speed was measured via a 35-meter sprint test, lower limb power via the Sargent vertical jump test, and jump distance via the standing long jump. Data normality was confirmed using the Shapiro–Wilk test prior to analysis. Paired sample t-tests were applied to compare pre- and post-test values for each outcome variable; Cohen's d was calculated to quantify effect size, and one-way ANOVA was used to compare improvement magnitudes across variables ($\alpha = 0.05$). It should be noted that the small sample size ($n = 15$) and the absence of a randomized control group represent methodological limitations that qualify the interpretation of the findings

Results. Statistically significant improvements were observed in all variables ($p < 0.001$): initial speed improved by 6.33% (4.047 to 3.791 s), lower limb power increased by 25.07% (2.215 to 2.771 W), and jump distance increased by 25.03% (5.373 to 6.717 m). Large effect sizes were recorded for all variables ($d = -4.62$, 7.81, and 13.06, respectively), though these values should be interpreted cautiously given the small sample size and absence of a control group. ANOVA revealed significant differences in the magnitude of improvement across variables ($F = 2818.31$, $p < 0.001$, $\eta^2 = 0.993$).

Conclusions. HIPT appears to be an effective modality for improving explosive athletic performance over eight weeks. However, the magnitude of effects reported here warrants careful interpretation, and future research using larger, controlled samples is needed to confirm these findings.

Keywords: Plyometric Training, Initial Speed, Lower Limb Power, Jump Distance, Explosive Performance

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Introduction

Athletic performance in competitive sports is fundamentally shaped by a complex interaction of physical qualities, in which speed, explosive power, and jumping ability occupy central roles (Ramirez-Campillo et al., 2020; Xie et al., 2024). Initial speed is defined as the ability to accelerate rapidly from a stationary position over short distances and represents a critical determinant of success across various sports (Kahiji et al., 2024; Shuai et al., 2025). Lower limb power, defined as the capacity to generate maximal force in minimal time, underpins explosive movements such as jumping, sprinting, and rapid directional changes (Moran et al., 2021; Zheng et al., 2025). Jump distance, typically assessed through the standing long jump, serves as a reliable field-based indicator of lower extremity explosive strength (Söyler et al., 2024; Almunawar et al., 2026). Consequently, training methods capable of simultaneously enhancing these interrelated physical qualities have become a major focus in sport science.

Plyometric training (PT) has emerged as one of the most extensively researched neuromuscular training modalities for developing explosive power, speed, and jumping performance (Barrio et al., 2023; Nurtafajti et al., 2025). Plyometric exercises are characterized by a rapid eccentric muscle action immediately followed by an explosive concentric contraction, a sequence known as the stretch-shortening cycle (SSC) (Seiberl et al., 2021). The SSC enables muscles and tendons to store elastic energy during the eccentric phase and release it during the concentric phase, thereby enhancing force production and mechanical efficiency (Hasan, 2023). Evidence from systematic reviews and meta-analyses indicates that PT produces neuromuscular adaptations including increased motor unit recruitment, improved intermuscular coordination, enhanced rate of force development, and greater muscle-tendon stiffness (Sun et al., 2025). These adaptations contribute directly to sprint acceleration, explosive jumping, and rapid changes of direction direction (Deng et al., 2023; Sammoud et al., 2024).

Within the spectrum of PT, high-intensity plyometric training (HIPT) is characterized by exercises involving high ground reaction forces, short ground contact times, and maximal or near-maximal effort, such as depth jumps, single-leg bounding, and maximal horizontal jumps (Nobari et al., 2023; Oliver et al., 2024). A meta-analysis reported that high-intensity plyometric programs represent one of the most effective strategies for improving sprint performance (Ramirez-Campillo et al., 2023). More recently, El-Ashker et al. (2019) found that an eight week HIPT program significantly improved 10 meter, 30 meter, and 40 meter sprint times, as well as standing long jump and triple hop distance in elite youth soccer players. These findings suggest that the magnitude of neuromuscular stimulus provided by high intensity plyometric training may be superior to lower intensity alternatives in producing meaningful improvements in explosive athletic performance. Substantial evidence also supports the effectiveness of PT for improving lower limb power and jump performance across various athletic populations (Chen et al., 2024; Kons et al., 2023; Luo et al., 2025). The role of force vector orientation has been highlighted as an important factor, with horizontally oriented exercises showing greater transfer to sprint acceleration and horizontal jump performance, while vertically oriented exercises more effectively improve jump height (Moran et al., 2024; Morris et al., 2022).

The effects of plyometric training on lower limb power and jumping performance have been consistently documented across various athletic populations. Endab (2024) reported significant improvements in countermovement jump, squat jump, and standing long jump performance following plyometric training in soccer players. Fu et al. (2023) confirmed these findings through research examining the post activation performance enhancement effects of flywheel training on lower limb explosive power, observing that targeted training programs resulted in substantial improvements in jumping performance and overall lower limb power. Among adult athletes, Kons et al. (2023) synthesized evidence from randomized controlled trials and concluded that plyometric training significantly improves physical fitness outcomes including jumping, sprinting, and agility in individual sport athletes. In addition, Marin-Jimenez et al. (2024) established the criterion related validity of the standing long jump test as a field based measure of lower extremity explosive strength in adults. Collectively, these findings form a strong body of evidence supporting the role of plyometric training as an effective modality for improving both vertical and horizontal jumping performance, as well as broader measures of lower extremity explosive capacity.

Despite this growing evidence base, several gaps remain. Most existing studies have not isolated the specific effects of training intensity on performance outcomes (Clemente et al., 2022). Many investigations focus on a single performance variable rather than simultaneously evaluating the interconnected triad of initial speed, lower limb power, and jump distance within a single cohort (Aslam et al., 2025). Furthermore, relatively few studies have examined adult male athletes, who may respond differently to HIPT stimuli than adolescent populations due to more advanced neuromuscular development (Silva et al., 2022). The dose-response relationship of HIPT on these combined performance variables also remains insufficiently characterized (Villarreal et al., 2010). Therefore, this study aimed to examine the effects of an eight-week HIPT program on initial speed, lower limb power, and jump distance in adult male athletes. Specifically, this study addressed the identified gaps by (1) applying a high-intensity plyometric protocol rather than mixed-intensity designs, (2) simultaneously assessing three interrelated explosive performance variables within a single cohort, and (3) focusing exclusively on adult male university athletes, a population underrepresented in the existing plyometric training literature. It was hypothesized that HIPT would produce significant improvements across all three variables, and that the magnitude of improvement would differ across performance outcomes due to task-specific neuromuscular demands.

Materials and methods

Study participants

Fifteen male athletes (age: M = 20.8 years, SD = 1.4) from the athletics unit of Universitas Pattimura were recruited via convenience sampling, as the intervention was embedded within the unit's existing training program. While convenience sampling is a pragmatic approach in applied sport science settings, it introduces potential selection bias: participants fulfilling attendance and eligibility criteria may have been systematically more motivated or physically capable than the broader athlete population, which may limit the generalizability of the findings. Inclusion criteria required male sex, age 18–25 years, at least two years of organized sport participation, no acute lower limb injuries, and regular training attendance of at least three sessions per week. Exclusion criteria included lower limb surgery within the previous 12 months, current participation in plyometric training, or absence from more than two training sessions during the intervention. All participants provided written informed consent, and the study received ethical approval from the relevant institutional committee. Outcome measurements in this study included three main components, namely initial speed, lower limb power, and jump distance.

Study organization

This study employed a quasi-experimental design with pre-test and post-test measurements, without a randomized control group. The decision to forgo a control group was necessitated by the practical constraints of applied sport science research conducted within an existing athletics unit, where ethical considerations and institutional training schedules precluded random assignment of athletes to a non-training condition during the competitive preparation period (Jones & Ansdell, 2025). It is acknowledged that the absence of a control group limits the ability to rule out alternative explanations for observed improvements, such as maturation, learning effects, or concurrent training activities.

a. Initial Speed

Initial speed was measured using a 35-meter sprint test with electronic timing gates from Brower Timing Systems. Each participant performed two trials with sufficient rest between trials to minimize fatigue. The fastest time from the two trials was used for analysis. This measurement focused on acceleration ability during the initial phase of sprinting.

b. Lower Limb Power

Lower limb power was assessed using the Sargent test to determine vertical jump height. Participants first performed a maximal standing reach and then executed a maximal vertical jump assisted by arm swing. Lower limb power was estimated using the following formula: Power = (4.9 × body mass in kg) × √(reach distance in cm) / 100. Each participant performed two trials, and the maximum reach distance obtained was used for analysis.

c. Jump Distance

Jump distance was measured using the standing long jump test, which assessed the horizontal jump distance from the marked starting line to the nearest landing contact point. Participants were allowed to perform a countermovement according to their preference before jumping as far as possible. Two trials were conducted, and the longest jump distance was used for analysis. Data were analyzed using SPSS version 26.0 and R version 4.1.0 with a significance level of $\alpha = 0.05$. The Shapiro Wilk test was used to assess normality, and Levene's test was applied to examine the homogeneity of variance. Paired sample t tests were used to compare pretest and posttest measurements. Cohen's d was calculated to quantify effect size with thresholds of 0.2 for small, 0.5 for medium, and 0.8 for large effects. One way analysis of variance was used to compare difference scores across variables with effect size estimated using Eta squared with thresholds of 0.01 for small, 0.06 for medium, and 0.14 for large effects. The nonparametric Wilcoxon test was also conducted to verify the results obtained from the parametric analyses.

Statistical analysis

This study involved 15 male athletes (mean age 20.8 ± 1.4 years) from the athletics unit of Universitas Pattimura, recruited through convenience sampling within an ongoing training program, which may introduce selection bias and limit the generalizability of the findings. Participants met inclusion criteria such as being 18–25 years old, having at least two years of organized sport experience, being free from lower limb injuries, and maintaining regular training attendance, while exclusion criteria included recent surgery, participation in plyometric training, or excessive absence during the intervention. The study employed a quasi-experimental pre-test–post-test design without a control group due to practical and ethical constraints, acknowledging that alternative factors such as maturation or concurrent training could influence the results. Outcome measures included initial speed assessed a 35-meter sprint using electronic timing gates, lower limb power measured using the Sargent vertical jump test, and jump distance evaluated through the standing long jump; each test was performed twice with the best result recorded. Data were analyzed using SPSS version 26.0 and R version 4.1.0 at a significance level of 0.05, including Shapiro–Wilk tests for normality, Levene's test for homogeneity, paired sample t-tests, effect size calculations Cohen's d and Eta squared, and additional verification using the nonparametric Wilcoxon test.

Results

Preliminary Analysis

The Shapiro-Wilk test confirmed normal distribution of all variables at both time points (all $p > 0.05$), and Levene's test indicated homogeneity of variance. The assumptions underlying the paired sample t-test, namely, continuous outcome data, paired observations, approximately normally distributed difference scores, and absence of extreme outliers, were all satisfied. Parametric statistical procedures were therefore considered appropriate. As an additional verification, the non-parametric Wilcoxon signed-rank test yielded results consistent with those obtained from the paired t-tests, further confirming the robustness of the parametric analyses.

Descriptive Statistics

Table 1. Descriptive Statistics (n = 15)

Variable	Pre-test M	Pre-test SD	Post-test M	Post-test SD	Mean Diff	% Change
Initial Speed (s)	4.047	0.014	3.791	0.077	−0.256***	−6.33%
Lower Limb Power (W)	2.215	0.063	2.771	0.078	+0.555***	+25.07%
Jump Distance (m)	5.373	0.091	6.717	0.114	+1.345***	+25.03%

**** $p < 0.001$*

Descriptive statistics for all outcome variables are presented in Table 1. Visual inspection of the data revealed substantial improvements in all three performance measures following the eight-week high-intensity plyometric training intervention. Initial speed, assessed using the 35-meter sprint time, decreased from a pretest mean of 4.047 seconds (SD = 0.014) to a posttest mean of 3.791 seconds (SD = 0.077), representing an average reduction of 0.256 seconds and a 6.33 percent improvement in sprint performance. Lower-limb power increased from a pretest mean of 2.215 W (SD = 0.063) to a posttest mean of 2.771 W (SD = 0.078), reflecting an absolute increase of 0.555 W and a relative improvement of 25.07 percent. Similarly, jump distance increased from 5.373 m (SD = 0.091) at pretest to 6.717 m (SD = 0.114) at posttest, corresponding to an improvement of 1.345 m and a 25.03 percent increase in horizontal jump performance.

Paired t test Results

A paired-samples t test was conducted to evaluate the statistical significance of changes from pretest to posttest for each outcome variable, with the results presented in Table 2. All three performance measures showed statistically significant improvements following the eight-week intervention (all $p < 0.001$).

Table 2. Paired t test Results

Variable	t-value	p-value	95% CI	Cohen's d	Effect Size
Initial Speed	15.18	<0.001***	[-0.291,-0.221]	-4.62	Very Large
Lower Limb Power	-138.56	<0.001***	[0.546, 0.564]	7.81	Very Large
Jump Distance	-223.91	<0.001***	[1.335, 1.354]	13.06	Very Large

Note. *Effect sizes are classified as "very large" based on conventional Cohen's d thresholds; however, values of this magnitude are exceptionally high and likely reflect statistical artifacts associated with the small sample size (n = 15), minimal pre-test variability, and the absence of a control group. These values should be interpreted with caution.*

For initial speed, the paired t-test revealed a statistically significant reduction in 35-meter sprint time, t (14) = 15.18, p < 0.001, 95% CI [-0.291, -0.221]. The magnitude of the effect was classified as very large (Cohen's d = -4.62), indicating that the observed improvement in sprint performance was not only statistically significant but also practically meaningful. The negative direction of the effect size reflects the desirable decrease in sprint time, indicating that participants demonstrated substantially improved acceleration capacity following the high-intensity plyometric training intervention.

Lower limb power showed a highly significant increase from pretest to posttest, t (14) = -138.56, p < 0.001, 95% CI [0.546, 0.564]. The effect size for this variable was very large (Cohen's d = 7.81), representing one of the most pronounced training effects observed in the study. These findings indicate that the high intensity plyometric training protocol produced marked improvements in the participants' capacity to generate explosive force during vertical jumping, as assessed through the Sargent test protocol. Jump distance demonstrated the largest effect size among the three outcome variables, t (14) = -223.91, p < 0.001, 95% CI [1.335, 1.354], Cohen's d = 13.06. This extremely large effect size indicates that horizontal jump performance, as assessed using the standing long jump test, was highly responsive to the high intensity plyometric training stimulus. Participants exhibited substantial improvements in their ability to project the body horizontally through coordinated explosive lower limb actions.

ANOVA Results

To determine whether the magnitude of training-induced improvements differed across the three performance variables, a one-way analysis of variance was conducted comparing the change scores across all outcome measures Table 3.

Table 3. Variance Analysis (One Way ANOVA)

Statistic	Value
F-statistic	2818.31
p-value	< 0.001
Eta-squared (η^2)	0.993
Effect Size Classification	Large

The results revealed a highly significant difference in the magnitude of change across the three performance variables, F (2, 42) = 2818.31, p < 0.001. The effect size was extremely large ($\eta^2 = 0.993$), indicating that approximately 99.3 percent of the variance in change scores could be attributed to the type of outcome measure assessed. These findings suggest that although high-intensity plyometric training produced significant improvements across all three performance dimensions, the absolute magnitude of improvement varied substantially depending on the specific physical quality measured. The differential responsiveness of initial speed, lower limb power, and jump distance to the training intervention reflects differences in measurement scales, neuromuscular demands, and biomechanical characteristics associated with each performance task.

This study examined the effects of an eight-week high-intensity plyometric training intervention on initial speed, lower limb power, and jump distance in male athletes. The findings demonstrated statistically significant improvements across all three performance variables, with very large effect sizes (Cohen's d = -4.62 for initial speed, 7.81 for lower limb power, and 13.06 for jump distance). These results support the hypothesis that a structured high-intensity plyometric training program produces substantial improvements in explosive athletic performance.

Discussions

Effects of High Intensity Plyometric Training on Initial Speed

The significant reduction in 35-meter sprint time (a 6.33 percent improvement, from 4.047 to 3.791 seconds) following the eight-week high-intensity plyometric training intervention indicates that this training modality effectively enhances initial speed and acceleration capacity in male athletes. The very large effect size (Cohen's d = -4.62) observed in this study exceeds the findings reported in recent meta-analyses examining the effects of plyometric training on sprint performance. Liu et al. (2024) conducted a systematic review and meta-analysis on the effects of combined strength, plyometric, and sprint training on repeated sprint ability, reporting Hedges' g values ranging from −0.46 to −1.39. The directional finding of the present study aligns with these benchmarks; however, the Cohen’s d of −4.62 observed here substantially exceeds values typically reported in the literature and is most likely inflated by the very small within-group variability at pre-test (SD = 0.014 s) combined with the small sample size. This statistical artifact occurs because Cohen’s d is computed as the mean difference divided by the pooled standard deviation: when standard deviations are extremely small relative to the mean change, even a modest absolute improvement produces a disproportionately large d value. The appropriate interpretation, therefore, rests on the 6.33% improvement in sprint time, which falls within the range of 3–10% improvements in sprint performance commonly reported in plyometric training interventions of comparable duration. The statistical artifact does not diminish the practical meaningfulness of the sprint improvement but does underscore the importance of reporting percentage change alongside Cohen’s d in studies with small samples.

The biomechanical plausibility of sprint improvements following HIPT is well established. Exercises involving depth jumps and obstacle jumps generate high ground reaction forces and short contact times that closely replicate the demands of sprint acceleration (Ma et al. (2025). The specific physiological mechanisms underlying these sprint improvements involve several well-documented neuromuscular adaptations. Repeated high-intensity plyometric loading enhances motor unit recruitment by stimulating greater activation of fast-twitch (Type II) muscle fibers, thereby increasing peak force output. Concurrently, adaptations in neural drive and muscle architecture improve the rate of force development, enabling greater force production within the brief ground contact windows of sprint acceleration. Increased tendon stiffness from repeated stretch-shortening cycle loading also facilitates more efficient elastic energy storage and release during each foot contact (Pechlivanos et al., 2024). These combined adaptations directly address the specific mechanical demands of sprint acceleration, in which athletes must produce substantial horizontal propulsive force within minimal ground contact time , a physiological requirement that is progressively overloaded through the high-intensity depth jump and obstacle jump exercises incorporated in this study.

Effects of High Intensity Plyometric Training on Lower Limb Power

The 25.07% increase in Sargent-derived lower limb power is a meaningful finding; however, the associated effect size (Cohen's d = 7.81) is exceptionally large and requires critical examination. The power estimation formula used (Power = 4.9 × body mass × √reach distance / 100) is a field-based approximation with acknowledged measurement error. The small pre-test standard deviation (SD = 0.063 W), combined with the modest but consistent absolute gains, produced a disproportionately large d value. For context, comparative literature consistently reports effect sizes in the moderate-to-large range for plyometric interventions on vertical jump-derived power: Arntz et al. (2022) reported pooled effect sizes of g = 0.40–0.89 for jump-derived power outcomes in plyometric training meta-analyses, while Luo et al. (2025) reported Hedges' g values of 0.5–1.2 for vertical jump height improvements following plyometric training in female adolescents. The Cohen's d of 7.81 observed in the present study is an order of magnitude larger than these benchmarks, clearly indicating that this value reflects statistical inflation rather than a genuinely superior training effect. The true population-level effect of HIPT on lower limb power is likely in the moderate-to-large range consistent with the broader literature (Luo et al. 2025; Arntz et al., 2022) and the present findings should be interpreted in that context rather than at face value. Mechanistically, the improvement in lower limb power can be attributed to a cascade of specific physiological adaptations associated with HIPT. Enhanced stretch-shortening cycle efficiency results from increased tendon stiffness and improved coupling between the eccentric loading and concentric propulsion phases of vertical jumping (Seiberl et al., 2021). Increased muscle spindle sensitivity following repeated high-velocity loading enhances the magnitude and speed of the myotatic reflex, thereby augmenting the reflex-driven contribution to concentric force production. Improved intermuscular coordination between the quadriceps, hamstrings, gluteus maximus, and plantar flexors also contributes to more effective force transfer during the vertical jump. Together, these adaptations increase the rate at which mechanical work can be performed against gravity (Arntz et al., 2022). The progressive overload structure of the training program advancing in jump height and volume across weeks likely optimized these adaptations over the intervention period.

Effects of High Intensity Plyometric Training on Jump Distance

The 25.03% increase in standing long jump distance (Cohen's d = 13.06) represents the most pronounced finding in this study and warrants particularly careful interpretation. An improvement of 1.345 m (from 5.373 m to 6.717 m) is noteworthy in absolute terms and consistent with the principle of training specificity, given that the HIPT protocol emphasized horizontal force application through single-leg jumps and bounding movements. Physiologically, improvements in horizontal jump performance following HIPT are mediated by coordinated adaptations in multiple muscle groups. Enhanced activation of the gluteus maximus and hip extensor complex, which are primary contributors to horizontal propulsion during the push-off phase, enables greater horizontal impulse generation. Increased quadriceps strength and improved knee extension velocity contribute to a more powerful concentric push at take-off. Simultaneously, improved eccentric loading capacity in the plantar flexors allows more effective storage and release of elastic energy at the ankle, amplifying horizontal projection distance. Kryeziu et al. (2023) reported significant improvements in standing long jump following a twelve-week plyometric program in adolescents, corroborating the directional consistency of the present findings. For comparative reference, Kryeziu et al. (2023) reported effect sizes in the range of d = 0.7–1.4 for standing long jump improvements following plyometric programs in adolescents, while broader meta-analytic evidence suggests that plyometric interventions typically yield effect sizes of g = 0.5–1.0 for horizontal jump performance. The Cohen's d of 13.06 observed in the present study far exceeds these reference values and is almost certainly a product of statistical conditions specific to this sample, namely, the very homogeneous pre-test performance (SD = 0.091 m) and the small sample size (n = 15). These conditions create an extremely narrow denominator in the d calculation, inflating the coefficient independently of the true training effect. The absolute improvement of 1.345 m and the 25.03% relative change are more appropriate benchmarks for evaluating the practical significance of this finding. Future research should report percentage change and 95% confidence intervals alongside Cohen's d, and should replicate these findings in larger, controlled samples to establish more reliable population-level effect estimates.

Differential Responsiveness of Performance Variables

The one-way ANOVA revealed significant differences in the magnitude of training-induced improvements across the three performance variables ($F = 2818.31$, $p < 0.001$, $\eta^2 = 0.993$), indicating that although high-intensity plyometric training improved all measures of explosive performance, the absolute magnitude of improvement varied considerably. This differential responsiveness reflects differences in measurement scales, neuromuscular demands, and biomechanical characteristics associated with each performance task. Standing long jump demonstrated the largest absolute improvement, followed by lower limb power and initial speed. This pattern may be explained by the principle of force vector specificity in plyometric training. Asencio et al. (2024) reported that horizontally oriented plyometric exercises produce greater improvements in horizontal performance measures, whereas vertically oriented exercises preferentially enhance vertical performance. The high intensity plyometric protocol used in this study incorporated both horizontal and vertical exercises, with the horizontal components likely contributing more substantially to the observed improvements in horizontal jumping performance.

Conclusions

This study found statistically significant improvements in initial speed (−6.33%), lower limb power (+25.07%), and jump distance (+25.03%) following an eight-week HIPT intervention in adult male athletes. These findings support the utility of structured HIPT as a training modality for enhancing explosive athletic performance. However, several important caveats must be acknowledged. The extremely large effect sizes reported (Cohen's d = −4.62 to 13.06) are likely inflated by the small sample size and narrow pre-test variability, and should not be interpreted as representing true population-level effects of comparable magnitude. The absence of a control group further limits causal attribution of the observed improvements to the HIPT intervention. The findings should therefore be regarded as preliminary and hypothesis-generating rather than conclusive. Future research employing larger, randomized controlled designs is necessary to determine the true magnitude of HIPT effects on these performance outcomes. Specifically, future studies should: (1) examine the dose-response relationship between HIPT volume, frequency, and intensity and performance outcomes across a range of athlete populations; (2) investigate whether the observed benefits of HIPT transfer to sport-specific performance tasks beyond laboratory measures of speed, power, and jump distance; (3) compare the relative effectiveness of HIPT against moderate-intensity plyometric training and combined strength-plyometric programs in adult athletes; and (4) include follow-up assessments to evaluate the retention of training-induced adaptations following the cessation of the intervention. From a practical perspective, the directional findings of this study carry meaningful implications for coaches and strength-and-conditioning practitioners. An eight-week HIPT block structured around depth jumps, obstacle jumps, single-leg jumps, and squat jumps, performed three times per week with progressive overload, appears capable of producing meaningful improvements in sprint acceleration, lower limb power, and horizontal jumping ability in adult male athletes. Practitioners should prioritize progressive intensity management: beginning with sub-maximal drop heights and manageable bounding volumes during the first two to three weeks before advancing to near-maximal effort. The observed differential responsiveness across performance variables further suggests that exercise selection should be tailored to specific athletic goals: horizontal plyometric exercises (e.g., single-leg bounds, standing long jumps for distance) should be prioritized when horizontal force production is the primary training target, whereas vertical exercises (e.g., squat jumps, countermovement jumps) may be emphasized when vertical power is the primary objective.

Practical Implication

Despite the methodological limitations described, the directional findings of this study offer several practical insights. Coaches and practitioners may consider incorporating depth jumps, obstacle jumps, single-leg jumps, and squat jumps into eight-week training blocks to target improvements in sprint acceleration, lower limb power, and horizontal jumping ability. Progressive overload should be implemented systematically, beginning with lower-intensity exercises before advancing to higher-intensity stimuli to minimize injury risk. The differential responsiveness across performance variables further suggests that exercise selection should be tailored to specific performance goals, with horizontal plyometric exercises prioritized when horizontal force production is the primary objective.

Limitation

Several limitations of this study should be explicitly acknowledged. First, the quasi-experimental design without a randomized control group prevents definitive causal attribution of performance improvements to the HIPT intervention; contributions from learning effects, seasonal training cycles, or unmonitored concurrent physical activities cannot be excluded. Second, the small sample size (n = 15) substantially reduces statistical power for detecting interactions and subgroup effects, and critically contributes to the inflation of Cohen's d values by reducing within-group variance estimates. Third, all participants were drawn from a single institution, limiting the generalizability of findings to other populations, performance levels, or cultural and training contexts. Fourth, no follow-up assessment was conducted to evaluate the retention or decay of training-induced gains after the intervention concluded. Fifth, the power estimation formula employed in the Sargent test is a field-based approximation, and future studies should consider laboratory-based force plate assessments to obtain more precise measurements of lower limb power. Sixth, the comparison of raw change scores across variables measured in different units (seconds, watts, meters) in the ANOVA limits the validity of cross-variable comparisons. Future studies should employ larger, randomized controlled designs, include follow-up assessments, and use standardized or percentage-change metrics for cross-variable comparisons to address these limitations.

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Conflict of interest

The authors have no conflicts of interest to declare.

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