# Effect of Plyometric Training on Agility, Explosive Power, and Sprint Performance among Young Athletes: A Comparative Study

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***Abstract*—Background: Sports performance depends on essential physical components such as agility, explosive power, and sprinting ability. Conventional training improves general fitness but may not adequately enhance sport-specific performance. Plyometric training utilizes the stretch–shortening cycle to improve neuromuscular efficiency and has demonstrated beneficial effects on athletic performance. However, short-term comparative evidence between plyometric and conventional training among young athletes remains limited.**

**Aim: To compare the effects of a four-week plyometric training program and conventional training on agility, explosive power, and sprint performance among young athletes.**

**Methodology: Thirty young athletes were randomly allocated into two groups: Plyometric Training Group (n=15) and Conventional Training Group (n=15). Agility was assessed using the T-Test Agility Run, explosive power using the Vertical Jump Test, and sprint performance using the 30-meter Sprint Test. Pre- and post-intervention data were analyzed using paired t-tests for within-group comparisons and independent t-tests for between-group comparisons. Statistical significance was established at $p< 0.05$.**

**Results: Both groups demonstrated statistically significant improvements following the intervention ($p = 0.001$). However, the plyometric training group exhibited greater improvements across all outcome measures. Agility performance improved from 10.88 s to 9.95 s ($t = −5.46$) in the plyometric group compared to 12.15 s to 11.17 s ($t = −3.37$) in the conventional group. Vertical jump height increased from 41.6 cm to 51.6 cm ($t = 8.25$) in the plyometric group and from 46.13 cm to 47.27 cm ($t = 2.16$) in the conventional group. Sprint performance improved from 4.84 s to 4.24 s ($t = −8.97$) following plyometric training, whereas the conventional group improved from 4.90 s to 4.63 s ($t = −6.16$). Inter-group analysis showed significant differences favoring plyometric training for agility ($t = −2.72$, $p = 0.001$), vertical jump ($t = 3.23$, $p = 0.001$), and sprint performance ($t = −2.52$, $p = 0.001$).**

**Conclusion: A four-week plyometric training program is significantly more effective than conventional training in improving agility, explosive power, and sprint performance among young athletes. Plyometric exercises can therefore be recommended as an effective short-term training strategy for enhancing sport-specific physical performance.**

***Index Terms*—Plyometric Training, Conventional Training, Agility, Explosive Power, Sprint Performance, Young Athletes.**

## I. INTRODUCTION

Agility, explosive power, and sprint performance are essential physical components that determine athletic success in many competitive sports. Agility refers to the ability to rapidly change body position or direction while maintaining balance, speed, and body control. Improved agility contributes to enhanced neuromuscular coordination, efficient movement patterns, and reduced risk of sports-related injuries.[1] Along with agility, sprinting speed and explosive muscular power are equally important for sports such as football, basketball, volleyball, badminton, athletics, and hockey, where athletes are frequently required to accelerate quickly, jump explosively, and perform rapid directional changes during competition.[2]

Traditional conditioning programs commonly used among young athletes include jogging, stretching,

endurance exercises, and general strengthening activities. Although these conventional training methods improve cardiovascular fitness and muscular endurance, they may not sufficiently enhance explosive athletic movements such as sprinting and vertical jumping.[3] In recent years, sports scientists and physiotherapists have increasingly emphasized the importance of plyometric training as a specialized exercise strategy for improving sport-specific performance.[4]

Plyometric training consists of explosive exercises such as hopping, bounding, jumping, and skipping that utilize the stretch–shortening cycle (SSC) of muscle action. During the SSC, muscles undergo a rapid eccentric contraction immediately followed by a powerful concentric contraction, thereby improving force production and neuromuscular efficiency.[5] This mechanism enhances muscle power, reaction time, and movement speed, which are critical determinants of athletic performance. Previous studies have demonstrated that plyometric exercises significantly improve vertical jump height, sprint acceleration, lower-limb strength, and agility among athletes.[6]

Several researchers have reported the effectiveness of plyometric training in enhancing sports performance. Miller et al. demonstrated significant improvements in agility following a structured plyometric program,[7] while Markovic and Mikulic reported enhanced neuromuscular adaptations and lower-limb explosive power after plyometric interventions.[8] Similarly, Ramirez-Campillo and colleagues observed improved sprint and explosive actions among young soccer players following short-term plyometric training.[9] These findings suggest that plyometric exercises may produce superior performance benefits compared with conventional training approaches.

Despite growing evidence supporting plyometric exercises, limited research has directly compared the short-term effects of plyometric training and conventional training among young athletes. Furthermore, very few studies have evaluated whether a relatively brief four-week plyometric program can produce meaningful improvements in agility, explosive power, and sprint performance. Understanding the comparative effectiveness of these training methods is important for coaches, sports physiotherapists, and physical educators in designing scientifically effective and time-efficient conditioning programs.

Therefore, the present study was undertaken to compare the effects of a four-week plyometric training program with conventional training on agility, explosive power, and sprint performance among young athletes. The findings of this study may help identify an effective training strategy for improving athletic performance and optimizing sports conditioning programs in young athletes.

### Aim And Objectives

The aim of the present study was to compare the effects of a four-week plyometric training program and conventional training on agility, explosive power, and sprint performance among young athletes. The specific objectives were to evaluate the effects of plyometric training on agility, explosive power, and sprint performance; to assess the effects of conventional training on the same performance parameters; and to compare the effectiveness of both training methods in improving agility, explosive power, and sprint performance among young athletes.

## II. METHODOLOGY

### A. Study Design and Setting

The present study adopted a quasi-experimental pre-test and post-test control group design to compare the effects of plyometric training and conventional training on agility, explosive power, and sprint performance among young athletes. The study was conducted at the Department of Physical Education, Annamalai University, under standardized environmental conditions on the university sports ground.

### B. Study Population and Sampling

The study population consisted of young athletes aged between 17 and 20 years who were actively involved in regular sports participation. A total of 30 participants were recruited using a convenient sampling technique and randomly allocated into two groups through the lottery method: the experimental group undergoing plyometric training (n = 15) and the control group receiving conventional training (n = 15).

### C. Inclusion and Exclusion Criteria

Athletes aged between 17 and 20 years who regularly participated in organized sports activities at least three times per week, had no recent history of

musculoskeletal injury, and were willing to participate voluntarily were included in the study. Participants with a history of recent surgery or major lower-limb injury, neurological, cardiovascular, or orthopedic disorders affecting physical performance, or participation in any other structured training program during the study period were excluded from the study.

D. Materials and Outcome Measures

The materials used for the study included consent forms, assessment proforma sheets, a stopwatch, measuring tape, chalk, cones for agility testing, and recording sheets for data collection. Standardized and validated outcome measures commonly used in sports science research were employed for assessment. Agility was measured using the T-Test Agility Run (seconds), explosive power was assessed using the Vertical Jump Test (centimeters), and sprint performance was evaluated using the 30-Meter Sprint Test (seconds). Each test was performed twice, and the best value was recorded to ensure reliability.

E. Intervention Protocol

Participants in the experimental group underwent a structured four-week plyometric training program consisting of three sessions per week, totaling 12 sessions. Each session lasted approximately 45 minutes and included a 10-minute warm-up, 30 minutes of plyometric exercises, and a 5-minute cool-down period. The plyometric training program included squat jumps, tuck jumps, bounding drills, skater jumps, split squat jumps, lateral cone hops, depth jumps, hurdle hops, and broad jumps. Exercise intensity and complexity were progressively increased throughout the intervention period.

Participants in the control group underwent conventional conditioning exercises for the same duration and frequency. Each session consisted of 10 minutes of warm-up jogging, 10 minutes of static stretching, 20 minutes of strengthening exercises, and a 5-minute cool-down period. The conventional training program included squats, lunges, push-ups, sit-ups, jogging, and general conditioning exercises.

F. Procedure

Prior to commencement of the study, informed consent was obtained from all participants after explaining the purpose and procedures of the research. Eligible participants were screened according to the inclusion and exclusion criteria and randomly assigned to either the experimental or control group. Baseline pre-test assessments for agility, explosive power, and sprint performance were recorded before initiation of the intervention program. Participants subsequently underwent their respective training protocols for four weeks under investigator supervision to ensure participant safety, proper exercise technique, and adherence to the training program. Following completion of the intervention period, post-test assessments were conducted using the same outcome measures. All collected data were systematically recorded, coded, and tabulated for further analysis.

G. Ethical Considerations

Ethical approval was obtained prior to the commencement of the study. Participants were informed about the objectives, procedures, benefits, and potential risks associated with the study, and confidentiality of participant information was strictly maintained throughout the research process. Participants were also informed of their right to withdraw from the study at any stage without penalty.

H. Statistical Analysis

Statistical analysis was performed using SPSS version 25.0 (IBM Corporation, USA). Descriptive statistics including mean and standard deviation were calculated for all study variables. Paired t-tests were used to analyze differences between pre-test and post-test values within each group, while independent t-tests were employed to compare differences between the experimental and control groups. A p-value less than 0.05 was considered statistically significant.

## III. DATA ANALYSIS AND RESULTS

Statistical analysis was performed using SPSS version 25.0 (IBM Corporation, USA). Descriptive statistics including mean and standard deviation were calculated for all variables. Paired t-tests were used for intra-group comparisons, while independent t-tests were used for inter-group comparisons. Statistical significance was set at $p < 0.05$. Table 1 presents the descriptive statistics of the plyometric training group for agility, explosive power, and sprint performance.

Table 1: Descriptive Statistics of Plyometric Training Group

| Variables | Pre-Test Mean ± SD | Post-Test Mean ± SD |
|---|---|---|
| T-Test Agility Run (s) | 10.88 ± 0.78 | 9.95 ± 1.10 |
| Vertical Jump Test (cm) | 41.6 ± 6.72 | 51.6 ± 4.55 |
| 30-Meter Sprint Test (s) | 4.84 ± 0.39 | 4.24 ± 0.41 |

The mean T-Test Agility Run time decreased from 10.88 ± 0.78 seconds during the pre-test to 9.95 ± 1.10 seconds in the post-test, indicating improvement in agility performance. The mean Vertical Jump Test value increased from 41.6 ± 6.72 cm to 51.6 ± 4.55 cm, reflecting significant enhancement in explosive lower-limb power. Similarly, the mean 30-Meter Sprint Test time reduced from 4.84 ± 0.39 seconds to 4.24 ± 0.41 seconds, demonstrating improved sprint performance following plyometric training.

The plyometric training group demonstrated improvement in all performance variables following the four-week intervention. Agility and sprint test times decreased, while vertical jump performance increased in the post-test assessment.

The descriptive statistics of the conventional training group for agility, explosive power, and sprint performance was given in Table 2

Table 2: Descriptive Statistics of Conventional Training Group

| Variables | Pre-Test Mean ± SD | Post-Test Mean ± SD |
|---|---|---|
| T-Test Agility Run (s) | 12.15 ± 1.38 | 11.17 ± 1.36 |
| Vertical Jump Test (cm) | 46.13 ± 4.72 | 47.27 ± 4.10 |
| 30-Meter Sprint Test (s) | 4.90 ± 0.39 | 4.63 ± 0.44 |

The mean T-Test Agility Run time decreased from 12.15 ± 1.38 seconds during the pre-test to 11.17 ± 1.36 seconds in the post-test, indicating improvement in agility performance. The mean Vertical Jump Test value increased from 46.13 ± 4.72 cm to 47.27 ± 4.10 cm, reflecting enhancement in explosive lower-limb power. Similarly, the mean 30-Meter Sprint Test time reduced from 4.90 ± 0.39 seconds to 4.63 ± 0.44 seconds, demonstrating improved sprint performance following conventional training.

The conventional training group also showed improvement in agility, explosive power, and sprint performance following the intervention period.

The intra-group comparison of pre-test and post-test values using the paired t-test was given in Table 3.

Table 3: Intra-Group Comparison Using Paired t-Test

| Variables | Group | t-value | p-value |
|---|---|---|---|
| T-Test Agility Run | Plyometric | −5.46 | 0.001 |
| | Conventional | −3.37 | 0.001 |
| Vertical Jump Test | Plyometric | 8.25 | 0.001 |
| | Conventional | 2.16 | 0.001 |
| 30-Meter Sprint Test | Plyometric | −8.97 | 0.001 |
| | Conventional | −6.16 | 0.001 |

The results demonstrated statistically significant improvements in agility, vertical jump performance, and sprint performance in both the plyometric and conventional training groups ($p < 0.05$). Greater t-values were observed in the plyometric training group, indicating superior improvement compared to the conventional training group.

The inter-group comparison between the plyometric training group and the conventional training group using the independent t-test was given in Table 4.

Table 4: Inter-Group Comparison Using Independent t-Test

| Variables | Plyometric Group Mean ± SD | Conventional Group Mean ± SD | t-value | p-value |
|---|---|---|---|---|
| T-Test Agility Run (s) | 9.95 ± 1.10 | 11.17 ± 1.36 | −2.72 | 0.001 |
| Vertical Jump Test (cm) | 51.6 ± 4.55 | 47.27 ± 4.10 | 3.23 | 0.001 |
| 30-Meter Sprint Test (s) | 4.24 ± 0.41 | 4.63 ± 0.44 | −2.52 | 0.001 |

The post-test means values demonstrated significantly better performance in the plyometric training group compared to the conventional training group for agility, vertical jump performance, and sprint speed ($p < 0.05$). The plyometric training group showed lower agility and sprint test times and higher vertical jump performance. Both plyometric training and conventional training significantly improved agility, explosive power, and sprint performance among young athletes. However, the plyometric training group demonstrated superior improvements across all measured performance variables compared to the conventional training group.

## IV. DISCUSSION

The present study compared the effects of plyometric training and conventional training on agility, explosive power, and sprint performance among young athletes. The findings demonstrated significant improvements in all measured variables within both groups following the four-week intervention. However, the plyometric training group showed greater improvement in agility, vertical jump performance, and sprint speed when compared to the conventional training group.

The plyometric training group demonstrated a significant reduction in T-Test Agility Run time, indicating enhanced agility performance. These findings are consistent with previous studies by Miller et al. and Hammami et al., who reported that plyometric exercises improve neuromuscular coordination, stretch-shortening cycle efficiency, and change-of-direction ability.[7,10] The rapid eccentric-concentric muscle actions involved in plyometric drills may have contributed to improved movement efficiency and agility performance. A significant increase in vertical jump height was also observed in the plyometric training group. This finding supports earlier studies by Markovic and Mikulic, who concluded that plyometric training improves lower-limb explosive power through enhanced motor unit recruitment and muscle-tendon adaptations.[8] The repetitive jumping and bounding exercises performed during training likely improved muscular power generation and explosive force production.

Similarly, sprint performance improved significantly in the plyometric training group, as evidenced by the reduction in 30-meter sprint time. These findings agree with previous research demonstrating that plyometric exercises enhance acceleration and sprint ability by improving force production and reducing ground contact time during running.[9]

Although the conventional training group also demonstrated significant improvements in agility, explosive power, and sprint performance, the magnitude of improvement was comparatively smaller than that observed in the plyometric training group. Conventional conditioning exercises such as jogging, stretching, and strengthening drills may improve general fitness and muscular endurance; however, they may not effectively stimulate the neuromuscular adaptations required for explosive athletic movements.

Inter-group analysis further confirmed that plyometric training was significantly more effective than conventional training in improving all selected performance variables. The plyometric group demonstrated superior agility performance, greater vertical jump height, and faster sprint times compared to the conventional training group. These findings are consistent with previous literature suggesting that plyometric training produces greater sport-specific adaptations by enhancing stretch-shortening cycle efficiency, neuromuscular activation, and explosive muscular performance.

The overall findings of the study suggest that plyometric training is an effective short-term training strategy for improving agility, explosive power, and sprint performance among young athletes. The incorporation of structured plyometric exercises into athletic conditioning programs may therefore contribute to improved sports performance in activities requiring speed, rapid directional changes, and explosive lower-limb movements.

Despite the significant findings, certain limitations should be considered. The study involved a relatively small sample size and a short intervention duration of four weeks, which may limit the generalizability of the results. In addition, factors such as nutrition, lifestyle habits, and physical activity outside the training sessions were not controlled. Future studies are recommended with larger sample sizes, longer intervention periods, and additional performance variables to further validate the effectiveness of plyometric training.

Overall, the present study concludes that plyometric training is significantly more effective than conventional training in enhancing agility, explosive power, and sprint performance among young athletes.

## V. CONCLUSION

The present study demonstrated that both plyometric training and conventional training significantly improved agility, explosive power, and sprint performance among young athletes. However, the plyometric training group showed significantly greater improvement in all measured performance variables compared to the conventional training group. The superior outcomes observed following plyometric training may be attributed to improved neuromuscular coordination, enhanced stretch-shortening cycle

efficiency, and increased explosive muscle power. Therefore, plyometric training can be recommended as an effective short-term training method for enhancing sport-specific performance among young athletes.

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