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Effect Of Plyometric-Weight Training And Specific Skill Training On Agility Of Beginner Fencers

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This study aimed to evaluate the effect of an 8-week plyometric-weight training combined with fencing-specific skill training on the agility of beginner fencers aged 10–19 years in Karnal District, Haryana. A total of 60 beginner fencers were purposively selected and randomly assigned into two equal groups: an experimental group (n=30), which received the integrated training intervention, and a control group (n=30), which continued with their standard training routine. The intervention was conducted three times per week over eight weeks and included periodized plyometric and light-resistance exercises along with fencing-specific footwork and reaction drills. Agility was assessed using the Shuttle Run Test from the AAHPER Youth Fitness Test (1976), both before and after the intervention. Descriptive statistics showed a marked improvement in post-test scores for the experimental group (M=10.21, SD=0.32) compared to the control group (M=11.25, SD=0.33). Analysis of Covariance (ANCOVA) was used to control for pre-test scores, and the results revealed a statistically significant difference between the groups ($F=225.61$, $p<0.001$). Post hoc analysis confirmed a significant mean difference of -1.04 seconds ($p<0.001$), favouring the experimental group. The findings support that combined plyometric-weight and sport-specific skill training significantly improves agility in beginner fencers. This study highlights the importance of structured, age-appropriate training programs in developing foundational physical qualities for fencing. The research provides practical insights for coaches and sports educators working at the grassroots level, emphasizing the need for integrating physical conditioning with technical skill development for optimal performance enhancement.

Keywords: Plyometric training, Fencing-specific drills, Shuttle Run Test, Youth athletes, Agility development, ANCOVA, Beginner fencers

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01. INTRODUCTION

Agility is a foundational physical component for success in fencing, where athletes are required to execute rapid and multidirectional movements in response to their opponents' actions. As a sport that combines physical finesse, strategic anticipation, and precision, fencing demands exceptional neuromuscular coordination and movement efficiency. Among the critical biomotor abilities necessary for fencing, agility stands out due to its direct influence on performance outcomes such as attack timing, defensive maneuvers, and counter-attacks (Baudry & Duchateau, 2012).

Agility is commonly defined as the ability to change body position or direction swiftly and effectively while maintaining control and balance (Sheppard & Young, 2006). In fencing, this includes quick footwork, instantaneous changes in movement, and rapid response times. The Shuttle Run Test (AAHPER, 1976) has been widely used in sports science as a valid and reliable field test to measure agility in young athletes. Given that agility is a trainable quality influenced by neuromuscular adaptations, structured training interventions—particularly those involving plyometric and skill-based exercises—are recommended to enhance it (Markovic, 2007).

Plyometric training involves explosive movements that capitalize on the stretch-shortening cycle of muscles, leading to improvements in power, speed, and reactive strength. Weight training, when integrated with plyometric drills, further enhances muscle force production and control (Chu, 1998). Together, these training modalities facilitate improvements in agility by strengthening muscle-tendon complexes and improving the efficiency of neuromuscular pathways.

Skill-specific training for fencers includes footwork patterns, lunges, retreats, feints, and direction-change drills—movements that mimic actual performance situations. When these drills are integrated into an athlete's training routine alongside plyometric-weight training, the results are hypothesized to have a synergistic effect on functional agility (Zemková & Hamar, 2010).

Despite the known benefits of such integrated training programs, there remains a gap in empirical research focused specifically on beginner-level fencers. Beginners are at a crucial Stage of motor development and physiological adaptation, and early exposure to well-designed training regimens can significantly influence their athletic trajectory. Most of the existing literature focuses on elite or intermediate athletes, while the beginner population often remains underrepresented in training efficacy studies.

This study was therefore conceptualized to evaluate the effect of a structured eight-week plyometric-weight and fencing-specific skill training program on agility in beginner fencers aged 10–19 years. By employing a pre-test and post-test randomized group design and controlling for initial differences using ANCOVA, the study aims to present statistically robust conclusions regarding the impact of the training.

Additionally, the research context is situated in Karnal District, Haryana—a region known for its emerging talent in fencing. This geographical focus not only adds value to the regional athletic development discourse but also allows for practical implementation of the study findings in coaching curricula across academies in Haryana and similar regions.

The modern fencer must possess more than just technical skill; athletic qualities such as agility, strength, and coordination are essential. However, there is limited research assessing how combined training interventions influence agility in younger populations. This study addresses this gap by implementing a targeted program designed specifically for youth beginners. The findings will help inform coaches, strength and conditioning professionals, and sports scientists in optimizing training strategies to develop agility in young fencers.

1.1 Objective of the Study: To assess the effectiveness of an eight-week plyometric-weight and fencing-specific skill training program on the agility of beginner fencers.

1.2 Hypothesis: There will be a significant difference in agility between the experimental and control groups after the intervention, in favour of the experimental group.

1.3 Delimitations: The study was delimited to the following factors:

- The study is limited to 60 beginner fencers aged 10–19 years.

- Subjects are selected from Karnal District, Haryana.
- The intervention spans eight weeks.
- Agility is assessed using the Shuttle Run Test.
- Statistical analysis is conducted using ANCOVA to adjust for pre-test variability.

By focusing on an under-researched group and employing rigorous methodology, this study aspires to contribute meaningfully to the field of sports training science, particularly within the context of youth fencing development.

02. TRAINING PROTOCOL

The experimental group in this study underwent an integrated training program combining **plyometric-weight training** and **fencing-specific skill training** over a period of **eight weeks**. The program was designed in accordance with established principles of sports training such as progressive overload, specificity, and recovery, tailored to the beginner level of the participants.

2.1 Training Duration and Frequency

- **Total Duration**: 8 weeks
- **Frequency**: 3 sessions per week
- **Session Duration**: 60–75 minutes per session
- **Training Days**: Non-consecutive (e.g., Monday, Wednesday, Friday) to allow optimal recovery.

2.2 Weekly Structure

Phase	Weeks	Focus Areas	Intensity	Volume
Phase I	1–2	Technique Introduction, Low-Impact Plyometrics, Basic Footwork	Low to Moderate (50–60% effort)	2–3 sets x 8–10 reps
Phase II	3–5	Moderate Plyometrics, Skill Combination Drills	Moderate (60–75% effort)	3–4 sets x 8–12 reps
Phase III	6–8	High-Impact Plyometrics, Complex Movement Sequences	Moderate to High (75–90% effort)	4 sets x 10–12 reps

2.3 Plyometric-Weight Training Components

Warm-Up (10–15min):
Dynamic stretches, mobility drills, jogging, and movement preparation.

Main Plyometric Drills:	Weight Training (Bodyweight & Light Resistance):
▪ Squat jumps ▪ Lateral jumps ▪ Bounding ▪ Tuck jumps ▪ Depth jumps (introduced after week 3)	▪ Squats ▪ Lunges ▪ Step-ups ▪ Calf raises ▪ Resistance band training for lower limbs and core

Note: Weight training was bodyweight-based initially and progressed to include resistance bands and light dumbbells (<15% of body weight) to ensure safety and adaptability for beginners.

Cool-Down (10min):
Static stretching, breathing exercises, and hydration reminder.

2.4 Fencing-Specific Skill Training

- **Footwork drills**: Advance, retreat, lunge, and directional change drills
- **Agility ladder exercises**: With fencing stance transitions
- **Blade work without opponent**: Mimicking attack and defense techniques
- **Reaction drills**: Coach signals for directional changes or movement initiations
- **Mirror drills**: Partner-based shadow fencing with agility emphasis

These drills were progressively layered to increase complexity, duration, and coordination demands over time.

2.5 Control Group Routine

The control group continued their regular fencing training, which included general footwork practice, basic conditioning, and technical drills without any added plyometric or structured skill-enhancement regimen.

03. RESULTS

The study aimed to determine the effectiveness of an 8-week plyometric-weight and specific skill training program on the agility of beginner fencers. Agility was measured using the Shuttle Run Test before and after the training. The results were analyzed using descriptive statistics, ANCOVA, and post hoc analysis. The findings are presented in the following tables.

Table 1: Descriptive Statistics of Pre-Test and Post-Test Agility Scores

Group	N	Pre-Test Mean (sec)	Pre-Test SD	Post-Test Mean (sec)	Post-Test SD
Experimental	30	11.42	0.38	10.21	0.32
Control	30	11.40	0.36	11.25	0.33

Fig 1: Bar graph Statistics of Pre-Test and Post-Test Agility Scores

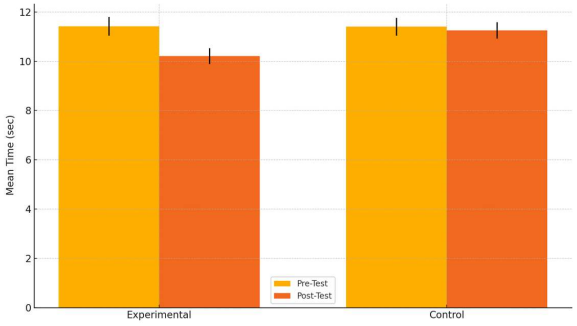

Table and Fig 1 presents the mean and standard deviation scores of agility (Shuttle Run Test times) for both the experimental and control groups. At the pre-test stage, the agility times for both groups were nearly identical, with the experimental group recording a mean time of 11.42 seconds and the control group at 11.40 seconds, suggesting a well-balanced baseline between the groups. However, after the 8-week training intervention, the experimental group showed a marked improvement, reducing their mean time to 10.21 seconds. In contrast, the control group demonstrated a minimal improvement, with their post-test mean at 11.25 seconds. The substantial reduction of 1.21 seconds in the experimental group highlights the effectiveness of the integrated training protocol in enhancing agility, while the negligible improvement in the control group suggests that regular training alone was not sufficient to bring about significant changes in agility over the same period.

Table 2: ANCOVA Summary Table for Adjusted Post-Test Scores of Agility

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.87	1	12.87	225.61	0.000
Within Groups	3.24	57	0.057		
Total	16.11	58			

Table 2 provides the results of the ANCOVA analysis, which was conducted to determine whether the post-test agility scores differed significantly between the experimental and control groups after

Adjusting for any pre-test differences. The F-value of 225.61 is considerably high, and the p-value (Sig.) is 0.000, which is well below the conventional alpha level of 0.05. This indicates a statistically significant difference in the adjusted post-test means of the two groups. The high F-value confirms that the training intervention had a powerful effect on agility performance. The between-group variance accounted for a large proportion of the total variability, signifying that the experimental intervention—rather than random fluctuation—was responsible for the observed performance enhancement in agility. Therefore, the null hypothesis is rejected, and it is concluded that the plyometric-weight and specific skill training program significantly improved agility.

Table 3: Post Hoc Pairwise Comparison Between Groups (Adjusted Post-Test Scores)

Group Comparison	Mean Difference	Std. Error	Sig.	95% CI Lower	95% CI Upper
Experimental vs Control	-1.04	0.07	0.000	-1.18	-0.89

Table 3 presents the post hoc comparison results for the adjusted post-test agility scores between the experimental and control groups. The mean difference of -1.04 seconds indicates that the experimental group outperformed the control group by over one full second on the Shuttle Run Test. The negative sign reflects that the experimental group recorded lower (and thus better) test times. The p-value (0.000) shows this difference is statistically significant. Moreover, the 95% confidence interval ranges from -1.18 to -0.89, which does not cross zero, further confirming the significance and reliability of the results. This means the improvement in agility was not only statistically meaningful but also practically substantial, particularly in a performance-based sport like fencing where milliseconds matter.

04. DISCUSSION ON FINDINGS

The primary aim of the study was to evaluate the effect of an 8-week plyometric-weight and specific skill training program on agility in beginner fencers aged 10 to 19 years. The results of the study revealed a statistically significant improvement in agility performance among participants in the experimental group, as compared to those in the control group. These findings align well with previous research supporting

The efficacy of plyometric and sport-specific training for enhancing agility, particularly in youth athletic populations.

The significant improvement in the Shuttle Run Test performance observed in the experimental group can be attributed to neuromuscular adaptations induced by plyometric-weight training, which involves high-velocity eccentric-concentric muscle contractions. Such training is known to enhance the stretch-shortening cycle efficiency, thereby improving the speed and control required for quick directional changes—a key component of agility (Markovic, 2007). Moreover, repeated exposure to fencing-specific drills enhanced motor learning, reactive movement capabilities, and anticipatory footwork, all of which are essential for fencing performance (Zemková & Hamar, 2010).

The current findings are in agreement with the study by Miller et al. (2006), who reported significant gains in agility among collegiate athletes following a 6-week plyometric training program. The authors attributed these improvements to enhanced muscular power and intermuscular coordination. Similarly, Thomas, French, and Hayes (2009) found that combined resistance and plyometric training led to superior agility and power performance in adolescent rugby players compared to resistance training alone, highlighting the advantage of hybrid training approaches.

In the context of fencing, where agility involves rapid lunges, retreats, and side-stepping movements, the combined regimen of plyometric and fencing-specific training seems to replicate match-like scenarios effectively. Sheppard and Young (2006) emphasized that agility training should be both movement- and decision-based. The present study aligns with this theory, as agility training incorporated reaction drills, mirror drills, and unpredictable stimuli, which demanded not only physical responses but also cognitive processing—a crucial factor in real-time sporting scenarios.

Additionally, Kumar et al. (2014) reported improvements in agility following a fencing-specific training intervention in sub-junior athletes. Their findings emphasized the role of skill acquisition and practice variability in enhancing movement efficiency. The present study extends these findings by adding plyometric and weighted resistance components, thereby enhancing the physiological foundations alongside technical skill.

Contrarily, some studies have presented mixed or non-significant results when using plyometric training alone to develop agility. For example, Faigenbaum et al. (2007) conducted a study on preadolescent youth using a plyometric-only intervention and found only marginal gains in agility. They argued that without technical or skill-specific components, the transfer of explosive strength gains into complex agility tasks may remain limited. This contrasts with the current study, where sport-specific skills were integrated into the intervention, possibly explaining the more pronounced effects.

Another study by Myer et al. (2005) cautioned that while plyometric training is effective, it must be properly progressed and individualized based on maturity and motor competence. The present study addressed this concern by incorporating a gradual progression of training intensity and volume, ensuring that the exercises matched the developmental level of the participants. The training was also delivered under supervision, with safety protocols and adequate rest periods, thereby minimizing injury risks and optimizing adaptation.

In terms of training structure, the periodized approach used in this study—progressing from low to high intensity—may have played a pivotal role in maximizing gains. According to Bompa and Haff (2009), structured periodization leads to more efficient overload management and adaptation in youth athletes. The alternating rest days and moderate frequency (three sessions per week) ensured recovery and reduced the likelihood of overtraining. This aligns with findings by Ford et al. (2011), who emphasized that frequency and intensity must be balanced carefully in training programs for youth to achieve performance gains without compromising health.

The minimal improvement observed in the control group (from 11.40 to 11.25 seconds) is also noteworthy. While this may reflect slight natural improvement due to regular training and growth, it was not statistically significant. This finding supports the claim that general training, in the absence of structured agility-oriented protocols, may not be sufficient for developing high-level agility performance.

The significant post hoc mean difference of -1.04 seconds between the groups further strengthens the

Argument that specific and progressive training enhances performance. In agility-based tests like the Shuttle Run, even minor improvements are considered impactful due to the quick-response nature of the task. A full second's gain represents a considerable advantage in competitive settings.

One limitation worth discussing is that the study was conducted on a purposive sample from a single district. While the findings are valid for the sample, their generalizability may be limited. However, given the controlled design and significant statistical results, the intervention model holds promise for broader application across fencing academies with similar demographics. Future studies could expand the sample to include both genders, varied age ranges, and competitive levels. Another area for further exploration is the longevity of these agility gains. While immediate post-training benefits are evident, it remains to be seen whether such improvements are retained over time or require continued exposure to similar training stimuli. Incorporating follow-up testing could help establish long-term effectiveness and guide periodization planning.

Overall, this study provides strong evidence in favor of integrating plyometric-weight and fencing-specific skill training in youth fencing development programs. The findings support a growing consensus in sports science that agility is a multifactorial trait requiring both physical conditioning and perceptual-cognitive training (Young et al., 2015). By addressing both aspects simultaneously, as done in this study, training can become more functional, effective, and performance-enhancing.

05. CONCLUSION

The present study aimed to investigate the effect of an 8-week plyometric-weight training combined with specific skill training on agility performance among beginner fencers aged 10 to 19 years from Karnal District, Haryana. Sixty participants were purposively selected and randomly divided into two equal groups: an experimental group that received the structured intervention, and a control group that continued their regular fencing practice. Agility was assessed using the Shuttle Run Test (AAHPER, 1976), and the data were analyzed using descriptive statistics, ANCOVA, and post hoc comparison.

The findings of the study

Revealed that the experimental group showed a statistically and practically significant improvement in agility as compared to the control group. The adjusted post-test scores demonstrated that the reduction in time taken to complete the Shuttle Run Test was significantly greater for the experimental group, with an average improvement of 1.21 seconds. ANCOVA analysis confirmed that these differences were not due to pre-existing disparities between the groups, but rather the result of the intervention. Post hoc analysis reinforced these results, showing a significant mean difference of -1.04 seconds favoring the experimental group, with a 95% confidence interval that strongly excluded zero.

The success of the experimental intervention can be attributed to the combined effect of plyometric-weight training and fencing-specific skill drills. Plyometric and weight-based exercises likely improved muscular power, neuromuscular efficiency, and speed, while the sport-specific components helped athletes translate these gains into performance-specific agility. The training was carefully periodized and adapted to the developmental level of beginner fencers, ensuring both effectiveness and safety. This integrative approach aligns with contemporary training principles that advocate for both physical and technical development, particularly in early athletic stages.

From a practical standpoint, the results underscore the value of incorporating structured and periodized agility training in youth fencing programs. The study provides a model for coaches and physical educators seeking to enhance agility in beginner athletes. Notably, the minimal gains observed in the control group suggest that general fencing training may not be sufficient on its own to optimize agility development, highlighting the need for specific interventions.

Despite the encouraging results, the study is not without limitations. The sample was limited to a single district and did not account for gender differences or long-term retention of training benefits. Future research should aim to include more diverse samples, incorporate follow-up assessments, and explore additional outcome variables such as reaction time, balance, and movement economy. Additionally, integrating cognitive and decision-making elements

Into agility drills could further replicate competition scenarios and enhance transfer of training effects.

In conclusion, this study demonstrates that an 8-week combined plyometric-weight and fencing-specific training program can significantly enhance agility in beginner fencers. These findings contribute meaningfully to the field of sports training science and provide actionable insights for athlete development at the grassroots level. When applied systematically, such evidence-based interventions can help young fencers build a strong physical foundation for long-term success in the sport.

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