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Effects of Plyometric Training on Agility and Speed in Female Re-Creational Badminton Players: A Pilot Study

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Abstract: Badminton is recognized as one of the fastest racket sports, with shuttlecock smash speeds reaching approximately 30 m/s. The sport requires players to react instantly to the fast-moving shuttlecock and continuously adapt their body position to perform efficient and accurate movements during play. Plyometric Training exercises such as jumping, skipping, and multidirectional hopping enhance neuromuscular function by promoting efficient muscle activation during eccentric contractions and improving the storing and reusing elastic energy during the concentric phase. These adaptations contribute to greater muscular power and overall athletic performance. This study was conducted to assess the effects of plyometric training on agility along with

speed among female re-creational badminton players. Twelve re-creational female badminton players between 18 and 25 years of age were tested before and after the test. Agility and speed were measured using the hexagon agility test and 10-meter sprint test. The collected data was assessed using summary statistics, the Shapiro–Wilk test for normality, along with paired sample t-tests, and IBM SPSS (Version 23). The statistical analysis demonstrated that the intervention significantly improved both speed and agility in badminton players. It shows that before and after the test, for the 10-meter sprint test ($t = 5.350$, $p < 0.001$) and hexagon agility test ($t = 5.685$, $p < 0.001$), clockwise ($t = 6.779$, $p < 0.001$) and anti-clockwise. The findings suggest that improvements in agility and speed play an important role in overall badminton performance. Future studies involving larger groups of participants are recommended to evaluate and strengthen the results of the present study.

Keywords: Athletic Performance, Badminton, Agility, Speed, Plyometric training

INTRODUCTION

Badminton is a widely popular sports enjoyed and competed by people globally [1]. Due to its fast-paced nature, badminton requires players to perform quick changes of direction, explosive sprints, and repeated jumps, relying on well-developed speed, agility, strength, and neuromuscular coordination to perform effectively [2].

Limited knowledge about differences between males and females, including maturity status, training and competition demands and injury rates may restrict their ability in young female athletes to achieve their full performance potential [3]. In the field of sports, optimizing athletic performance and preventing sports injuries are the core of physical fitness training [4].

One effective training strategy is plyometric training, which involves a quick lengthening of the muscle–tendon unit followed immediately by muscle shortening. This process, known as the stretch–shortening cycle, enhances explosive power and movement efficiency [5]. Furthermore, several studies have found that plyometric training enhances neuromuscular control and improves biomechanical movement's patterns during high-impact actions involving landing and change of direction, thus contributing to better athletic performance and reduced injury risk [6].

A badminton-specific meta-analysis demonstrated that plyometric training leads to gradual improvements in key performance measures, such as muscle strength, agility, speed, and balance [7]. Badminton players commonly incorporate various physical training methods, including plyometric training, core strengthening, interval training, resistance training, Pilates, and routine conditioning exercises. These training approaches are essential for enhancing the physical qualities required in badminton, such as agility, speed, power, endurance, and overall athletic performance [8].

Plyometric training, which is based on the stretch shortening cycle has been widely used to enhance the nerve and muscle function and improve lower-limb power, coordination, and agility in athletes [9]. Plyometric exercises are designed to improve muscular power, which is a key physiological component of speed. This can be improved the muscle's capacity to produce generate force quickly, these exercises enable players to develop greater explosive force during ground contact, resulting in faster acceleration and more efficient movement on the court [10]. Therefore, this pilot study were conducted to examine the effects of plyometric training on agility as well as speed among female re-creational badminton players.

RESEARCH METHODOLOGY

A pilot study using before and after test design was conducted to examine the effects of plyometric training on agility as well as speed among female re-creational badminton players.

Participants

This study included twelve female recreational badminton players aged 18–25 year voluntarily participated in this study. Participants were recruited using convenience sampling. Athletes who had been actively involved in badminton over the past three years, had not previously participated in a plyometric training program at the time of the study, and had a normal BMI were eligible for inclusion in the study. Individuals with recent musculoskeletal, neurological, visual, vestibular, cardiorespiratory, or cognitive disorders, a history of trauma or fractures in the upper and lower limbs, with major systemic diseases or those who had undergone ligament reconstruction surgery were excluded from the study. Each participants provide written informed consent before taking part in the study.

Study Design

Subjects were allocated to one group to perform plyometric training. Performance was assessed immediately before and after by the hexagon agility test and 10-meter sprint test.

Intervention

All participants throughout the three-week training period, the number of foot contacts ranged from 90 to 120 feet per session (foot contacts), as exercise load gradually increased progressively. This training program included hopping and standing jumps exercise in the plyometric sessions. Throughout the three weeks, the study group took part in plyometric exercises twice a week, with two days of rest between the sessions. Each plyometric sessions continued for about 35 minutes and consisted of 10 minute warm-up protocol with slow running exercise and dynamic stretching, followed by 20 minutes of plyometric exercises and 5 minute cool-down involving jogging exercises and static stretches.

Week	Training volume (foot contacts)	Plyometric drill	Sets*Reps	Training intensity
1	90	Side-to-side ankle hops	2*15	Low
		Standing jump and reach	2*15	Low
		Front cone hops	5*6	Low
2	120	Side to side ankle hops	2*15	Low
		Standing long jump	5*6	Low
		Lateral jump over barrier	2*15	Medium

		Double leg hops	5*6	Medium
3	120	Side to side ankle hops	2*12	Low
		Standing long jump	4*6	Low
		Lateral jump over barrier	2*12	Medium
		Double leg hops	3*8	Medium
		Lateral cone hops	2*12	Medium

Outcome Measure

Performance was measured in seconds using the best achieved from three attempts. The same assessment protocol was used for both the pre and post-test evaluations to maintain consistency throughout data collection.

Statistical Analysis

Continuous variables were summarized using mean ± standard deviation, whereas categorical variables were reported as frequencies and percentages. The normality of the data was assessed using the Shapiro–Wilk test before statistical analysis. As the data followed a normal distribution, differences between pre- and post-intervention measurements were evaluated using a paired-samples t-test. All statistical analyses were performed using IBM SPSS Statistics Version 23, and a p-value of < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1: Distribution of Age and Anthropometric Characteristics Among Badminton Players

		Frequency	Percent
Age	20-22 years	8	66.7
	23- 25 years	4	33.3
	Minimum	Maximum	Mean ± SD
Height	1.58	1.70	1.642 ± 0.037
Weight	47.00	67.00	56.667± 5.836

BMI	18.80	23.30	20.992± 1.641

The age distribution of the badminton players showed that 66.7% (n = 8) were between 20 and 22 years, while 33.3% (n = 4) were between 23 and 25 years. The overall mean age of the participants was 21.750 ± 1.658 years.

The mean height of the players was 1.642 ± 0.037 m, with values ranging from 1.58 m to 1.70 m. The mean weight was 56.667 ± 5.836 kg, ranging from 47.00 kg to 67.00 kg. The mean body mass index was 20.992 ± 1.641 kg/m², with values ranging from 18.80 to 23.30 kg/m².

Table 2: Comparison of 10 m Sprint Test Performance Before and After Intervention Among Badminton Players

		Mean	Std. Deviation	Decrement	t value	p value
10m sprint test	Pre	2.080	0.438	0.446	5.331	P<0.001*
	Post	1.634	0.257			

The mean 10 m sprint test time significantly decreased from 2.080 ± 0.438 seconds in the pre-test to 1.634 ± 0.257 seconds in the post-test, with a decrement of 0.446 seconds. The paired t-test showed that significant improvement was noted (t = 5.331, p < 0.001). These findings indicate that the intervention significantly improved sprint speed among badminton players.

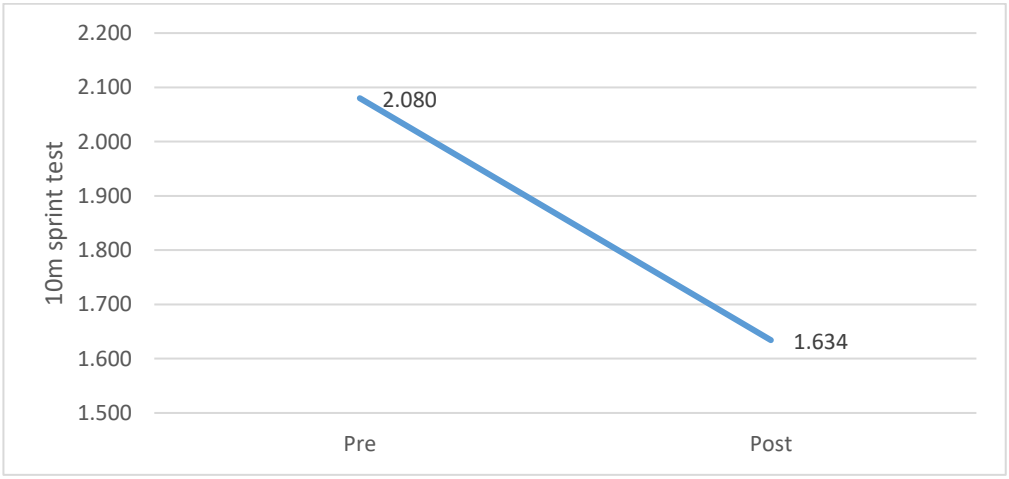

Figure 1: Representation of Pre and Post 10 m Sprint Test Performance Among Badminton Players

Table 3: Comparison of Hexagon Agility Test (Clockwise) Before and After Intervention Among Badminton Players

		Mean	Std. Deviation	Decrement	t value	p value
Hexagon {clock}	Pre	7.562	1.366	1.508	4.624	0.001*
	Post	6.053	0.588			

The mean time for the Hexagon agility test (clockwise) significantly decreased from 7.562 ± 1.366 seconds in the pre-test to 6.053 ± 0.588 seconds in the post-test, with a decrement of 1.508 seconds. The paired t-test showed that significant improvement was noted (t = 4.624, p = 0.001). These findings indicate that the intervention significantly enhanced clockwise agility performance among badminton players.

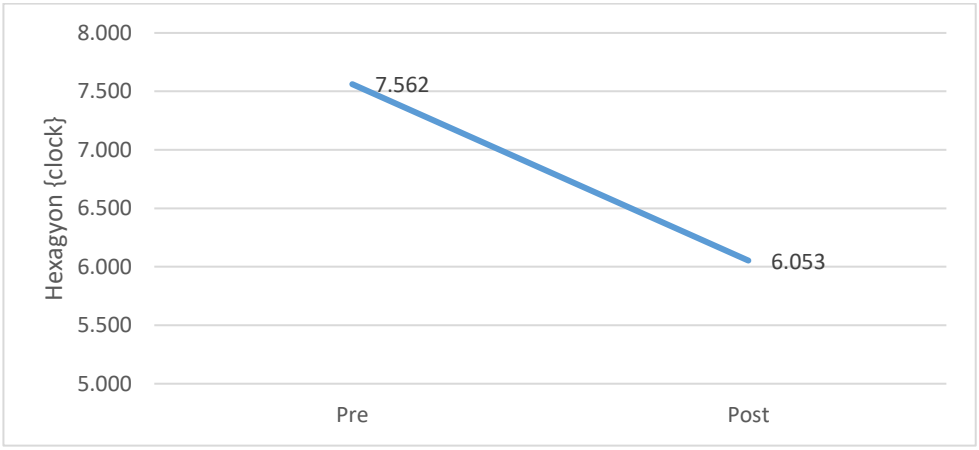

Figure 2: Representation of Pre and Post Hexagon Agility Test (Clockwise) Performance Among Badminton Players

Table 4: Comparison of Hexagon Agility Test (Anti-Clockwise) Before and After Intervention Among Badminton Players

		Mean	Std. Deviation	Decrement	t value	p value
Hexagon {anti}	Pre	7.134	0.889	1.357	8.257	p<0.001 *
	Post	5.778	0.609			

The mean time for the Hexagon agility test (anti-clockwise) significantly decreased from 7.134 ± 0.889 seconds in the pre-test to 5.778 ± 0.609 seconds in the post-test, with a decrement of 1.357 seconds. The paired t-test showed that significant improvement was noted ($t = 8.257$, $p < 0.001$). These findings indicate that the intervention significantly enhanced anti-clockwise agility performance among badminton players.

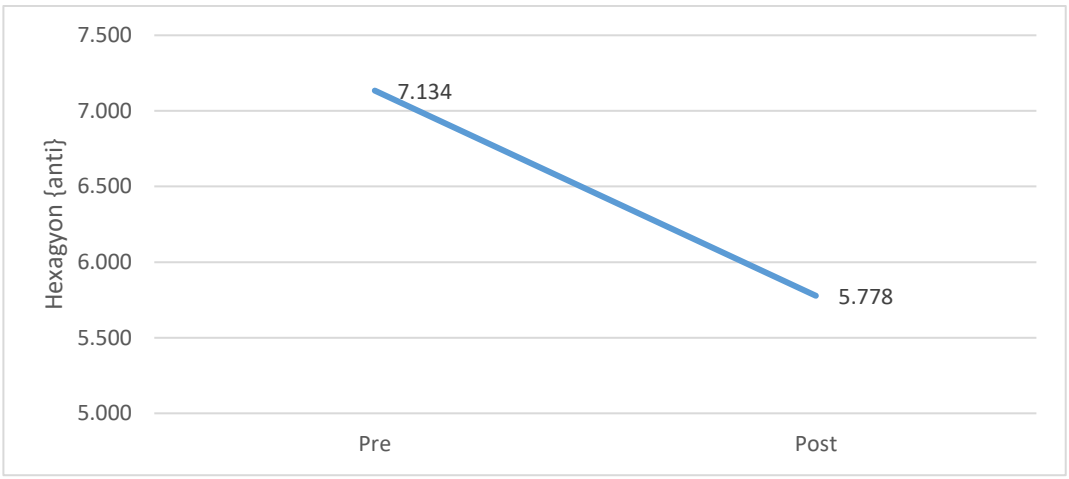

Figure 3: Representation of Pre and Post Hexagon Agility Test (Anti-Clockwise) Performance Among Badminton Players

DISCUSSION

The present pilot study evaluated the effects of plyometric training on agility along with speed among female re-creational badminton players. Overall, the findings in this study indicate that both agility and speed have a positive effect on immediate performance in badminton players. However, the hexagon agility test demonstrated significantly greater improvement than the 10 m sprint test in pre-post plyometric training.

Plyometric training significantly improved agility performance in our meta-analysis. This improvement is likely attributable to enhanced stretch-shortening cycle efficiency, resulting in superior neuromuscular function and change-of-direction ability [5]. Future research should examine how sand-based plyometric training, plyometric training on hard surfaces, and a combination of both surfaces on improving agility in badminton players [7].

A gradually progressed plyometric training program may be incorporated for coaches and trainers to enhance lower-limb muscle strength, thereby improving agility in badminton players. However, agility is a multifaceted physical attribute that involves rapid whole-body movements performed in response to specific stimuli, as described by Sheppard and Young.

Therefore, while plyometric training contributes to agility development, sport-specific drills and reactive training may also be necessary to optimize on-court performance [1,8].

Plyometric exercises involve explosive lower-limb movements in which the muscles rapidly transition from an eccentric (deceleration) contraction to a concentric (acceleration) contraction. This sequence, commonly referred to as the stretch–shortening cycle, activates the stretch reflex, enabling the muscles to produce greater force during the concentric phase. A faster eccentric stretch results in increased force production, leading to more powerful and efficient movements. In addition, plyometric training promotes both peripheral and central neural adaptations, enhancing joint proprioception, kinesthetic awareness, and overall neuromuscular control.

The findings of this study are comparable to those reported in earlier research, which has shown plyometric training increase neuromuscular performance through the stretch–shortening cycle. This training method improves motor unit recruitment, optimizes elastic energy storage and reuse, and enhances intermuscular coordination, thereby contributing to better explosive performance and overall athletic ability [10]. Tarik Ozmen et al. reported that a six-week plyometric training program was associated with enhanced agility and vertical jumping ability among young badminton players [11,12].

Given the greater demands of badminton for rapid multidirectional movements, the incorporation of plyometric training into regular conditioning programs may substantially improve on-court performance in female recreational badminton players.

There are some limitations to this study that are important to consider when interpreting the results. This study includes a limited number of participants, as this present study was undertaken as a pilot study, which may limit how widely the findings can be applied. Furthermore, the effect of core muscle strength on players' performance was not assessed; electromyographic analysis and muscle activation studies were not performed. Future studies involving larger and more diverse samples, a longer duration period, incorporating female athletes and players of elite levels, along with PT, used alongside other forms of training to evaluate their impact on overall athletic ability, and additionally, incorporating electromyographic analysis.

CONCLUSION

This pilot study compared the effects of plyometric training on agility as well as speed among female re-creational badminton players. Among 12 collegiate athletes included in the present study, the pre-post comparison was considered statistically significant improvement in badminton performance immediately following intervention. The mean 10 m sprint and Hexagon agility test time significantly improved after plyometric training intervention.

This study's findings suggest that plyometric training can produce favourable outcomes influences badminton performance by enhancing explosive leg power, agility, and dynamic balance, all of which are essential for rapid on-court movements. It optimises the stretch-shortening cycle in muscles, allowing players to execute higher jump smashes, faster lunges, and quicker directional changes.

These results highlight the important effect of plyometric training on improving athletic ability in sports involving rapid acceleration, deceleration, and changes in direction. In addition, these beneficial effects may be achieved within three weeks of training, which could be particularly valuable over the past preparation phase of the competitive season for badminton players. The study conducted with a limited sample size, further research involving larger participant groups and a wider range of athletic populations is needed to confirm these findings and develop evidence-based recommendations.

DECLARATIONS

Study Limitations

This pilot study was conducted on a small sample of collegiate athletes, which may restrict the applicability of the findings to broader populations. Furthermore, the influence in core muscle strength on athletic performance was not assessed; electromyographic analysis and muscle activation studies were not performed. Further studies should involve larger and more heterogeneous samples, a longer duration period, incorporating female athletes and players of elite levels, along with PT, used alongside other forms of training to evaluate their change in overall athletic ability, additionally, incorporating electromyographic analysis.

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Funding Source

No external funding was obtained for completing this study.

Competing Interests

The researcher confirm no competing interests relevant.

Ethical Approval

The study was approved by the Institutional Ethics Committee, A. J. Institute of Medical Sciences & Research Centre, Mangaluru, Karnataka, India. Ethical approval was granted under Reference No. AJEC/REV/209/2025 on 27 June 2025. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Informed Consent

All participants gave their written informed consent prior enrolling in the study**.** Participation was entirely voluntary, and the aim of the study was explained to all participants and its procedures before providing written consent.

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