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The role of combined footwork training along with reaction time exercise on agility and reaction time in Badminton players

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Abstract
Badminton is a fast paced, high-intensity sport that requires quick movements, rapid changes of direction, and explosive acceleration. Agility and exercise on agility and reaction time in badminton players. A Single group experimental pre-post study was conducted with 20 male badminton players, aged 18-21 years were selected based on specific inclusion and exclusion criteria. The intervention lasted six months, with 60- minute sessions conducted three times a week for four weeks. Agility and reaction time were measured using the Illinois Agility Test and the Ruler Drop Test. Results showed significant improvements in agility (IAT: $p < 0.05$) and reaction time (RDT: $p < 0.05$) after the 4-week training program. This study suggests that a 4-week combined footwork training and reaction time exercise program can be an effective training strategy for improving agility and reaction time in badminton players.

Keywords: Agility, Badminton, combined training, footwork, reaction time, illinois agility test, ruler drop test

Introduction

Badminton is an energetic sport that requires a distinctive combination of physical skill and mental sharpness from its participants. Competitors must demonstrate outstanding agility, core strength, and quick reflexes to succeed in the game [1].

Badminton ranks among the most popular racquet sports globally and is the second most played sport in India, following cricket [2]. This sport necessitates that the athlete possesses a variety of physical attributes and intricate motor skills [3].

Badminton is recognized as the fastest racquet sport, with shuttlecock speeds exceeding 250 km/h during elite-level competitions [4]. The sport necessitates quick directional changes, explosive actions, and numerous reflexive movements [5]. In badminton, the capacity to strike and return shuttlecocks is essential, with proficiency in short serve techniques being a fundamental skill that every badminton player must possess [6]. Both elite and sub-elite athletes necessitate a specific type of agility known as footwork agility. This agility is a crucial physiological attribute that badminton players must have, alongside strength, recovery capacity, and anthropometric measurements [7]. A regulation badminton court is a sizable rectangle delineated by lines that are 40 mm in width. The court measures 13.4 meters (44 feet) in length and 6.1 meters (20 feet) in width [8]. The temporal framework of badminton matches indicates that the duration of a match typically ranges from 45 to 65 minutes. On average, each point lasts around nine seconds, and the number of strokes involved in each point is generally between 8 and 10 [9]. The six main directions of movement on the court consist of left and right in the forecourt, midcourt, and rear court [10].

Agility is an ability performed in a constantly changing environment [11]. In badminton, it allows players to change direction quickly, speed up and slow down, and maintain balance and stability during play [12]. Improved agility also includes improved body control during fast movements, i0-mproved intramuscular coordination and reduced risk of injury/reinjury [13]. Agility requires a Reaction to a stimulus that is usually generated from the opponent movements [14]. The capacity to employ diverse racquet techniques, along with physical and physiological elements, is essential for achieving peak performance in badminton. Furthermore, agility plays a significant role in enhancing overall success [15].

Reaction time is defined as the time between a given stimulus and the onset of movement [16]. Reaction time involves process of receiving stimulus from the receptor the transmission of information through nerves to the brain and from the brain to the muscle to perform movement [17]. Players who possess quicker reaction times enjoy a considerable competitive edge, enabling them to react more effectively to their opponent's actions and the dynamics of the shuttlecock [18]. RT is a key variable evaluated in psychomotor skills and serves as the primary factor in assessing psychomotor performance in racket sports [19].

The automation of sequential and cross-step movements is derived from the outcomes of footwork exercises. Footwork refers to the capacity of the feet to facilitate rapid movement of the body in various directions, enabling effective positioning for striking actions. An individual with proficient footwork can swiftly alter direction from different positions; however, there is often insufficient focus on footwork techniques during shadow training. Therefore, the training regimen should integrate exercises that utilize cross step, consecutive, or jump-step techniques [20].

A straightforward and less elaborate method for assessing reaction time, which can serve as an alternative to computer-based evaluations, is the conventional sovereign

drop test (RDT). While the RDT accounts for both reaction time and movement time, it remains a valid approach for measuring simple reaction time [21]. The Ruler Drop Test (RDT) serves as a simple technique for evaluating a person's reaction time. In its fundamental execution, an assistant positions a ruler vertically between the extended index finger and thumb of the participant's dominant hand, ensuring that the top of the participant's thumb is aligned with the zero-centimetre mark on the ruler. The assistant subsequently drops the ruler unexpectedly, prompting the participant to catch it as swiftly as possible. The distance at which the ruler is successfully caught reflects the participant's reaction time, with shorter distances signifying quicker responses [22]. The Illinois Agility Test serves as a method for assessing agility skills and has undergone validation and reliability testing. This assessment comprises a series of spins, slaloms, and a sprint around six cones arranged in a configuration resembling the letter "T." Prior to the initiation of the test, participants were allotted a 20-minute warm-up period. Each individual completed the test on two occasions, with the best recorded times being noted [23]. The activity consists of a 10-meter dash, manoeuvring around four cones, returning to the starting point, and concluding with an additional sprint. The dimensions of the course are 10 meters in length and 5 meters in width, with the cones spaced 3.3 meters

Reaction Time Exercise

apart. The objective is to navigate the course in the shortest time possible, beginning from a prone position and timing the run using a stopwatch.

Methodology

Purpose: The purpose of the study is to find the role of combined footwork training along with reaction time exercise on agility and reaction time in badminton players.

Selection of the subjects: A total of 20 players (males) ranging from 18-25 years were selected based on selection criteria using convenience sampling method**.**

Procedure: A total of 20 active badminton players were selected according to the selection criteria. The purpose and nature of the study were explained to all participants and an informed consent were obtained. The single group received footwork training along with reaction time exercise. The total study duration was 6 months and the training session for 4 weeks.

S.no	Variation	Exercise	Repitition	Sets	Rest between sets
1.	Reaction time exercise	Dribbling tennis ball	100	3	1-2 min
		Bouncing of the racket drills	30	3	1-2 min
		Wall rally drills	60	3	1-2 min
		Wall tennis ball drills	20	3	1-2 min

Ladder drills

S. No	Variation	Exercise	Repitition	Sets	Rest between sets
1.	Ladder drills	Lateral shuffle	2	2	1-2 min
		Lateral in and out	2	2	1-2 min
		Ali shuffle	2	2	1-2 min
		Skiers	2	2	1-2 min
		Ickey shuffle	2	2	1-2 min
		Figure of 8	10	3	1-2 min
		Backpedal sprint	10	3	1-2 min
		Squat jumps	10	3	1-2 min
		Single leg jump	10	3	1-2 min

Descriptive analysis of illinois agility and ruler drop test

Parameter	Test	Mean $\pm$ sd	Calculated "t" value	Tabulated "t" value
Illinois Agility Test	PRE-TEST	19.68±1.00	6.44	2.093
	POST TEST	18.88±0.96		
Ruler Drop Test (RDT)	PRE-TEST	15.72±1.98	10.29	2.093
	POST TEST	10.16±1.76		

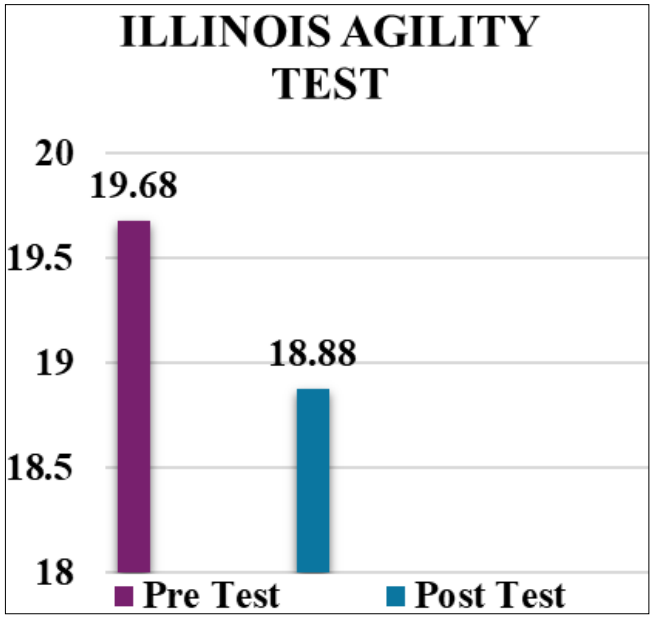

Fig 1: represents the post test values for illinois agility test

Result

The analysis of Illinois agility test. Using paired 't' test with 19 degrees of freedom and 0.05% as a level of significance, the calculated "t" value is 6.44, which was greater than the tabulated 't' value 2.093. The result shows that there was a marked difference between pretest and post-test values. The analysis of ruler drops test. using paired t test with 19 degrees of freedom and 0.05% as a level of significance, the calculated "t" value is 10.29, which was greater than the tabulated "t" value 2.093. the result shows that there was a marked difference between pretest and post-test. This suggest that the combined footwork training and reaction time exercise had a notable effect on improving agility and reaction time.

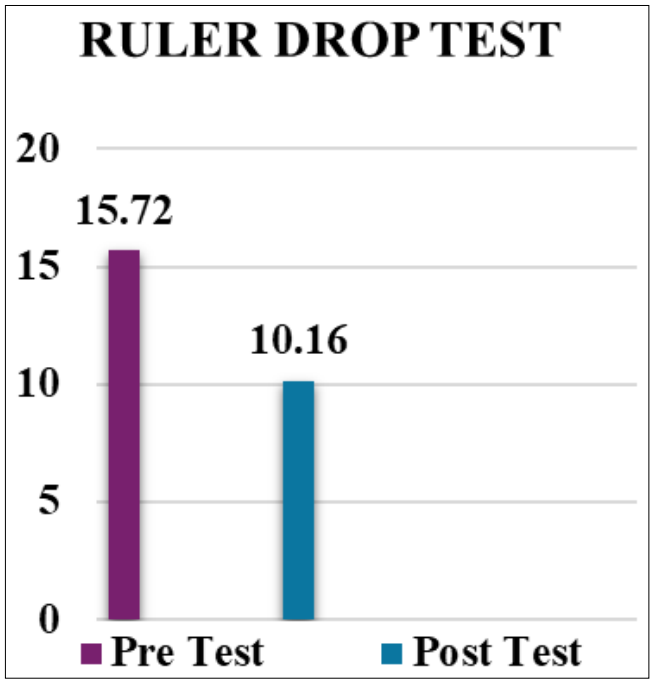

Fig 2: represents the post- test values for ruler drop test

Discussion

Muhammad Arnando et al., proposed that footwork is a fundamental skill that badminton performance on the court. It involves the strategic movement of feet to position the body effectively for executing various strokes. Proficient footwork enables players to return shots with greater ease and efficiency, thereby improving their ability to anticipate and react swiftly to their opponent's moves. Biomechanical changes occur within the body as athletes develop their footwork techniques. Efficient footwork relies on a combination of lower limb muscle activation, joint mobility, and neuromuscular coordination. The rapid and repetitive movements required in badminton lead to adaptations in muscle strength, endurance, and flexibility. These biomechanical adaptations contribute to improved explosive movements, allowing players to accelerate, decelerate, and change direction swiftly without losing balance. Footwork training is an effective method for improving movement skills in badminton. Through structured training, athletes can refine their ability to move to repetitive patterns of agility steps performed by the athlete. These agility steps significantly aid in transitioning between different locations on the court and changing directions efficiently. This form of training not only enhances a player's speed and movement precision but also ensures better energy conservation during a match, allowing players to sustain their performance over extended rallies. Biomechanically, footwork training enhances proprioception, which is the body's ability to sense its position and movement in space. This is achieved through repeated drills that condition the nervous system to coordinate muscle contractions and joint movements more effectively. As a result, players experience improved reaction times, reduced risk of injury, and enhanced agility. Additionally, the interaction between kinetic chain movements, such as the alignment of the ankles, knees, and hips, plays a crucial role in optimizing footwork performance. Wang Q et al., proposed that Exercises aimed at enhancing reaction time are specifically structured to boost an athlete's capacity to react promptly and accurately to various stimuli. Consistent practice of these exercises can lead to significant improvements in reaction time, facilitating quicker responses to external cues. Enhanced reaction times are particularly beneficial in sports that demand rapid responses, such as badminton, basketball, and tennis. Additionally, improved reaction times can help mitigate the risk of injuries by allowing athletes to react more swiftly to potential dangers. Engaging in reaction time exercises leads to various biomechanical adaptations that significantly improve overall athletic performance. These adaptations encompass neuromuscular coordination, refined muscle activation patterns, enhanced proprioception and joint stability, improved reflex responses, and optimized energy efficiency. Neuromuscular coordination is enhanced as reaction time exercises improve the efficiency of neural pathways responsible for muscle activation. This refinement facilitates quicker muscle contractions, augmenting an athlete's ability to respond rapidly to stimuli. Additionally, consistent training focused on reaction time alters muscle activation sequences, ensuring that contractions occur with optimal timing and strength, enabling athletes to execute explosive movements more effectively in high-intensity sports. T. Malwanage et al., proposed that the application of biomechanics and appropriate methods is crucial for optimum performance. Biomechanical changes for footwork training enhance agility, that is incorporating footwork

training improves on on-court footwork performance. Also, it optimises lower limb biomechanics. Kuei-Pin Kuo et al., proposed that Biomechanical changes for reaction time exercise enhances faster cognitive motor response and optimized neuro muscular coordination. Regular reaction time drills can lead to more efficient motor patterns, reducing unnecessary movements and conserving energy during matches. This study has primarily examined agility and reaction time independently, without exploring a comparative analysis or an integrated training approach for both aspects in badminton players. In this context, the present study introduced a training regimen that combines footwork drills with reaction time exercises, demonstrating a significant enhancement in both agility and reaction speed when trained together. While both methods proved to be highly effective individually and, their combined implementation resulted in substantial improvements in both agility and reaction time among badminton players.

Conclusion

The aim of this study was to investigate the impact of combining footwork training along with reaction time exercises on agility and reaction time in badminton players. A clear explanation of the study was provided to each player, and those who Agreed to participate were selected, with consent obtained from all. Players who met the inclusion and exclusion criteria were selected. The single group experimental study with 20 badminton players received footwork training along with reaction time exercise. The pretest and post-test evaluation were done using the Illinois agility test and the ruler drop test. Statistical The analysis revealed a significant difference between the pre-test and post-test. results of both the Illinois Agility Test and the Ruler Drop Test. Based on the data analysis, the null hypothesis was rejected, and the alternative hypothesis was accepted. Therefore, the study concluded that combining footwork drills with reaction time exercises is effective in enhancing both agility and reaction time in badminton players.

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