RESEARCH ARTICLE

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Effectiveness of Southeast Missouri (SEMO) Agility Drill along with Ladder Drill Exercises versus Zig-Zag Drill along with Ladder Drill Exercises on Agility in Recreational Badminton Players: A Randomized Controlled Trial

Sayali Prashant Banole[1], P. Sathya[1*], Feba Roy[1] and Jibi Paul[2]

[1]College of Physiotherapy, School of Health Sciences, Dayananda Sagar University, Devarakaggalahalli, Harohalli, Kanakapura Road, Ramanagara District - 562112, Karnataka, India; drsathyagp@gmail.com
[2]Dr. M.G.R. Educational and Research Institute, Chennai - 600095, Tamil Nadu, India

Abstract

Background: Being agile is essential in badminton because it enables players to change directions quickly, respond effectively to opponents' shots and efficiently reach the shuttlecock. Better court coverage, quicker recovery times and accurate shot execution are made possible by this, which improves performance and lowers the chance of injury while eventually providing players with a competitive edge. Thus, the purpose of the study was to check the effectiveness of the Southeast Missouri (SEMO) Agility Drill along with Ladder Drill versus Zig-Zag Drill along with Ladder Drill Exercises and Conventional Drills on Agility among Recreational Badminton Players. **Method:** A total of 33 recreational badminton players participated in the study. It was a randomized controlled trial, single-blinded study. The players were randomized into three groups, by envelope method and alternate allocation, who underwent intervention for four weeks. The intervention included a SEMO Drill group along with ladder drill exercises, a Zig-Zag Drill group along with ladder drill exercises and a control group where players performed drills recommended by their coaches. The players' agility was assessed at pre- and post-intervention using the Badcamp Agility Test. **Result**: After 4 weeks of intervention,the Badcamp Agility Test showed significant improvement from pre-intervention (Mean = 19.1, S.D. = 1.9) to post-intervention (Mean = 17.2, S.D. = 1.7) irrespective of groups, as indicated by a paired t-test ($t = 6.76$, $p < 0.001$). The SEMO Agility Drill Group demonstrated the highest effectiveness in the Badcamp agility test (Mean = 3.4, S.D. = 1.5), significantly outperforming the Zig-Zag Drill Group (Mean = 1.9, S.D. = 0.7) and the Control Group (Mean = 0.4, S.D. = 1.0) based on a one-way ANOVA ($F = 19.98$, $p < 0.001$). **Conclusion**: The SEMO Agility Drill and Zig-Zag Agility Drills effectively enhance agility among recreational badminton players, with the SEMO drill showing superior results in improving agility. **Major Findings:** The study found that both the SEMO Agility Drill and Zig-Zag Drill significantly improved agility in recreational badminton players. However, the SEMO Agility Drill demonstrated superior results, outperforming the Zig-Zag Drill and control groups in the Badcamp Agility Test after a 4-week intervention.

Keywords: Agility, Badcamp Agility Test, Badminton, SEMO Drill, Zig-Zag Drill

1. Introduction

Sports have evolved from their traditional position as recreational activities to become an important component of health and well-being in today's society. The increasing number of boys and girls engaged in different sports is indicative of this shift. Such participation is a sign of the understanding that sports are essential for both

**Author for correspondence*

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therapeutic and preventive health measures, not merely a fad. People, especially teenagers, gain a lot of physical and emotional health benefits from playing sports. Engaging in athletic activities develops physical capabilities, improves physiological processes and promotes a mutually beneficial connection between the mind and body[1].

Badminton is a popular sport that involves quick, strong shots and flexible feet. Badminton is one of the world's fastest racket sports, with smashes reaching speeds of up to 30 meters per second[2]. Badminton requires rapid bursts of energy to make swift movements and changes of direction. As a result, agility is crucial to a successful player. Agility has traditionally been described as the rapidity with which one changes direction. However, it has lately been proposed that agility requires not only the ability to change direction quickly but also some perceptual skill. It may be regarded as an open motor skill that demands perceptual abilities and the capacity to react fast. Open motor skills are completed in a continually changing environment or in response to an unanticipated stimulus, requiring constant performer adaptability[3]. Sheppard and Young define agility as a quick whole-body movement with a change of velocity or direction in response to a sport's specific stimulus[4]. Agility has two main sub-components: rapidity in changing direction and cognitive factors[5]. Agility has been difficult to quantify. Distinct sports have distinct agility requirements in terms of turning speed and direction; badminton incorporates additional aspects such as shuttlecock handling and racket swinging. Many tests involve complicated motions; what is being measured may be unclear, and a high score may mask weaknesses in some areas of agility. It was also observed that sports scientists have yet to agree on a clear definition of agility[6].

Furthermore, badminton players must react to the shifting shuttlecock and change their body position quickly and consistently throughout the game. Agile footwork, or the ability to shift direction over short distances, is critical in both defending and attacking moves during badminton training and competition. Agility, defined as a quick whole-body movement with a change in velocity or direction in reaction to a stimulus, is a critical variable for remarkable performance in badminton contests[7].

A badminton match lasts at least 45 minutes, with brief, intensive spurts of exertion supported by aerobic endurance. Speed and agility are important, and lateral movements are used more frequently than in tennis[8].

The Southeast Missouri (SEMO) Agility Drill helps athletes become more adept at moving in different directions. It is often known that badminton players need to practice agility (e.g., running, jumping, leaping, lunging, changing direction quickly, and stopping and beginning suddenly). The Zig-Zag Drill is designed to enhance abrupt shifts in direction and corresponding movements. An agility drill called the zig-zag can strengthen the legs' quadriceps, hamstrings, gastrocnemius (calves), and soleus (shins) while also testing the cardiovascular system. These rapid motions increase heart rate, test balance, and coordination, and enhance athletic performance and speed. (https://www.verywellfit.com/) A study concluded that the acceleration sprint and combination zig-zag drill training have a substantial influence on speed and agility[9].

Ladder drills are a type of training that develops an athlete's SAQ (Speed, Agility, and Quickness) by using progressive prescription training to make them more adept at quicker, more accurate speeds. Exercises that improve speed, agility, and quickness help athletes respond to inputs more rapidly, initiate actions more quickly and efficiently, move successfully in a variety of directions, and halt or change course swiftly to do an activity quickly, smoothly, and repeatedly become a popular way to train athletes physical components, especially agility. This kind of training has been shown to enhance one's skills in a range of sports as demands grow[10]. This exercise makes use of an item known as a ladder, which is designed like a ladder and has ladder boxes, which will eventually be utilized as a footrest. Ladder training encourages coaches and players to be creative and can have a positive effect[11]. From a range of modest movements to quicker movements, this training progresses from general development to the development of complex talents. Explosive movements employed in development teaching and learning will be more successful because of the working concept of moving swiftly and at a slow pace[12].

As previously said, badminton is a racquet sport with open and quick movement. One of the players' goals during the game is to keep the shuttlecock out of reach of the opponent at various places on the court by utilizing, for example, high-speed strikes[13]. To be competitive in badminton, players need to be able to move fast in the direction of an appropriate position from where they may attack and intercept the shuttlecock at the same time. It depends on their quickness of movement and perceptual skills, which in turn depends on their ability to swiftly determine where to run. We contrasted expert

and nonexpert badminton players in a recent study using a reactive task that required them to point objects on a touchscreen as quickly and precisely as they could[14]. Badminton players performed the best in the Badcamp. They would have an advantage in the decision-making process during the Badcamp because the test is analogous to the demands of practice sessions and competitions. Based on the results of the investigation done by Luiz de França Bahia Loureiro Jr *et al* concluded that the Badcamp agility test, which was created to assess badminton players by simulating specific movements and conditions of uncertainty, is a specific agility test for badminton players given that the differences between badminton players and other groups of athletes occur only when these athletes agility is evaluated by the Badcamp agility test[15].

We hypothesize that Southeast Missouri (SEMO) Agility Drill along with Ladder Drill Exercises are more effective than Zig-Zag Drill Ladder Drill Exercises and Convectional drills in improving Agility in Recreational Badminton Players.

2. Materials and Methods

It was a single-blind randomized controlled experiment, with the data analyst blinded. The study comprised recreational badminton players, both male and female, aged 18 to 35 years. The study included people who had been trained in badminton for at least 2 to 3 years (more than 4 hours per week). The study included 33 players selected using a convenient sampling technique. Players who were pregnant or had a recent injury that required medical attention, as well as those with major musculoskeletal, neurological, ocular, vestibular, cardiorespiratory, or cognitive issues, were excluded. Additionally, participants who regularly participated in a sport other than badminton were excluded from the study.

2.1 Study Procedure

By using the random allocation method (Envelope method), the 33 individuals were split into 3 groups: the SEMO Drill Group (n = 11), the Zig-Zag Drill Group (n = 11), and the Control Group (n = 11). The allocation ratio was 1:1:1. The entire investigation was carried out at Strings Academy of Badminton, Bangalore. Before the evaluation, the subjects gave their informed consent. Interviewing the subjects filled out the evaluation performa, and players who matched their BMI were chosen. The Badcamp Agility test was used to measure agility both before and after the event. A pre and post-assessment for agility was done using the Badcamp Agility test.

2.2 Intervention

2.2.1 SEMO Drill Group

After a 7–10-minute warm-up, there were 25–35 minutes of ladder drills exercises[11], after which the players engaged in Southeast Missouri (SEMO) agility drill. There was a total of 40–45 minutes spent on the intervention. For four weeks, three days a week. The principal investigator oversaw the implementation of the intervention.

2.2.2 Zig-Zag Drill Group

After a 7–10-minute warm-up, players engaged in a 25 to 35-minute ladder drill[16], followed by a Zig-Zag drill. There was a total of 40–45 minutes spent on the intervention. For four weeks, three days a week. The principal investigator oversaw the implementation of the intervention.

2.2.3 Control Group

Players performed the drills recommended by their coach.

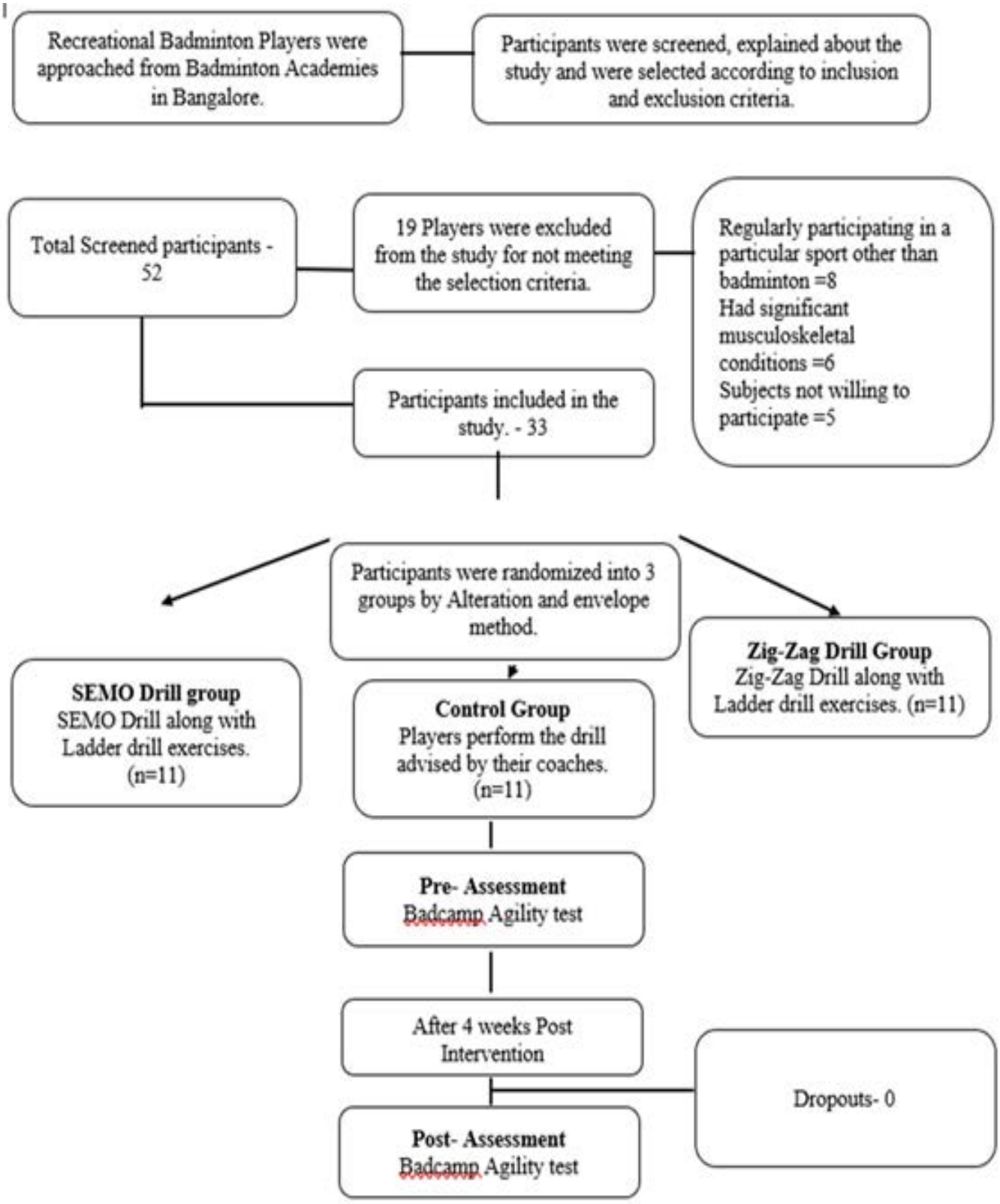
2.3 Outcome Measure

The Badcamp Agility test was administered at the start (pre-intervention) and completion of the 4-week training program (post-intervention). Badminton players delivered the top performances at Bandcamp. They would have an advantage in the decision-making process during the Badcamp because the test is analogous to the demands of practice sessions and competitions.

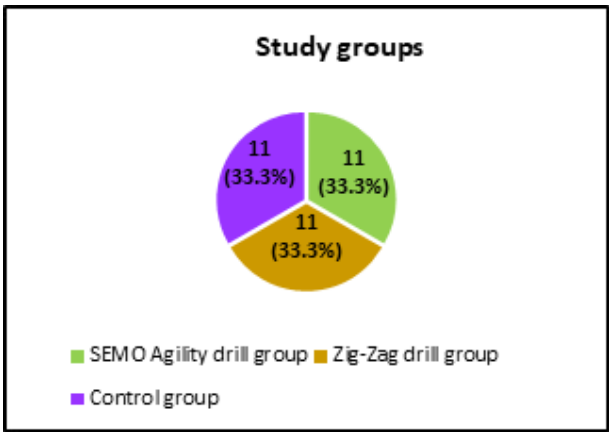
3. Statistical Analysis

The collected data were summarized by using Descriptive Statistics: frequency, percentage; mean, and S.D.

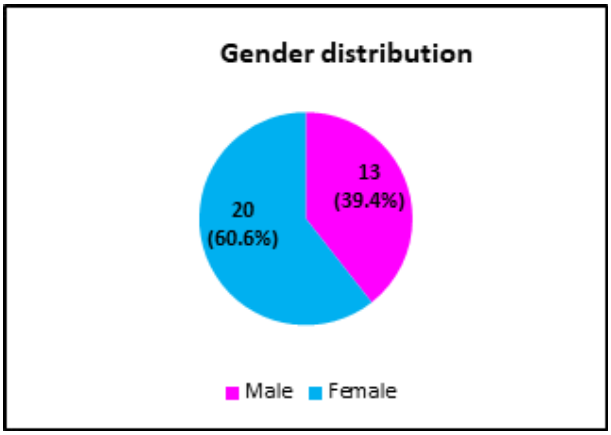
The Independent sample "t" test was used to compare age, height, weight, BMI, and Badcamp agility test between males and females, and the Paired "t" test was used to compare the Badcamp agility test from pre-intervention to post-intervention irrespective of groups as well as within the groups. One-way ANOVA was used to compare age, height, weight, BMI, and Badcamp agility test according to groups. In the Post hoc analysis, the



Flow chart of Study



Graph 1. Study groups.



Graph 2. Gender distribution.

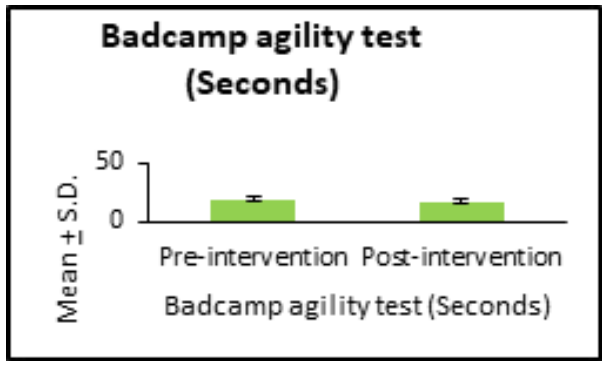
Table 1. Descriptive statistics for age, height, weight, and BMI

(n = 33)	Range	Mean	S.D.
Age (Years)	18 to 26	20.9	2.7
Height (Cm)	153 to 168	158.2	3.9
Weight (Kg)	45 to 79	60.5	10.8
BMI (Kg/M^2)	18.7 to 30.1	24.1	3.5

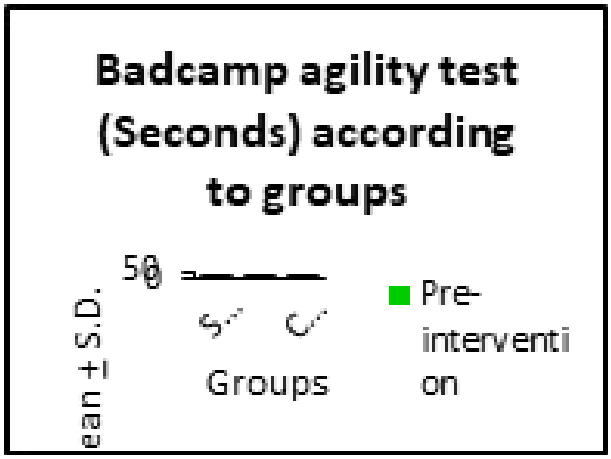
Tukey test was used for the multiple comparisons. To find the relation between age, height, weight, BMI, and the Badcamp agility test; The Pearson correlation coefficient ("r") was used. The p-value < 0.05 was considered as significant. Data were analyzed by using the SPSS software (SPSS Inc.; Chicago, IL) version 29.0.10.

4. Results

Table 1 presents the descriptive statistics for a sample of 33 individuals, including their age, height, weight, and BMI. The ages range from 18 to 26 years, with a mean of 20.9 years and a standard deviation (S.D.) of 2.7 years. Heights vary between 153 to 168 cm, averaging 158.2 cm with a S.D. of 3.9 cm. Weights span from 45 to 79 kg, with a mean of 60.5 kg and a S.D. of 10.8 kg. BMI values range from 18.7 to 30.1 kg/m^2, with an average of 24.1 kg/m^2 and a S.D. of 3.5 kg/m^2.



Graph 3. Comparison of Badcamp agility test within groups.



Graph 4. Comparison of Badcamp pre-intervention and post-intervention.

The Paired "t" test was used to compare the Badcamp agility test within the groups. There was a difference ($p < 0.05$) in the Badcamp agility test among the SEMO Agility drill group and the Zig-Zag drill group.

The One-way ANOVA was used to compare the Badcamp agility test between the groups. There was a difference ($p < 0.05$) in the Badcamp agility test between the groups during pre-intervention as well as post-intervention.

Table 2. Comparison of Badcamp agility test within the groups

		Mean	S.D.	"t"	p-value
SEMO Agility drill group	Pre-intervention	19.6	2.1	7.66	< 0.001*
	Post-intervention	16.3	1.7		
Zig-Zag drill group	Pre-intervention	20.0	1.8	9.33	< 0.001*
	Post-intervention	18.2	2.0		
Control group	Pre-intervention	17.7	1.0	1.45	0.177
	Post-intervention	17.2	0.8		

("t" = Paired "t" test; * Significant)

Table 3. Comparison of Badcamp agility test between groups

Badcamp agility test (Seconds)		Mean	S.D.	"F"	p-value
Pre-intervention	SEMO Agility drill group	19.6	2.1	6.14	0.006*
	Zig-Zag drill group	20.0	1.8		
	Control group	17.7	1.0		
Post-intervention	SEMO Agility drill group	16.3	1.7	3.91	0.031*
	Zig-Zag drill group	18.2	2.0		
	Control group	17.2	0.8		

("F" = One way ANOVA; * Significant)

5. Discussion

The current study aimed to compare the effectiveness of two agility drills, the Southeast Missouri (SEMO) Agility Drill and the Zig-Zag Drill, in improving agility among recreational badminton players. The study revealed significant improvements in the Badcamp agility test within both the SEMO Agility Drill group and the Zig-Zag Drill group, but there was a notable difference in performance between the groups at both pre- and post-intervention.

5.1 Results Interpretation

5.1.1 Pre-Intervention Results

As shown in Table 3, the SEMO Agility Drill group and the Zig-Zag Drill group had relatively similar performance before the intervention (19.6 and 20.0 seconds, respectively). In contrast, the control group showed a better baseline performance (17.7 seconds), possibly due to individual variability or prior experience in agility drills. These baseline differences were statistically significant, as evidenced by the One-Way ANOVA (p = 0.006), highlighting the influence of pre-existing factors on agility performance.

5.1.2 Post-Intervention Results

Both the SEMO Agility Drill and Zig-Zag Drill groups showed a statistically significant improvement in agility, with their post-intervention times decreasing to 16.3 and 18.2 seconds, respectively (p = 0.031 for SEMO, p = 0.031 for Zig-Zag drill group). This finding suggests that both drills were effective in improving agility. However, the SEMO Agility Drill group demonstrated a greater improvement compared to the Zig-Zag Drill group, which may be attributed to the drill's specific emphasis on dynamic and explosive movements, which are key to badminton performance.

Interestingly, the control group did not show significant improvements (pre-intervention 17.7, post-intervention 17.2), as the paired t-test results (p = 0.177) indicated no change. This underscores the importance of structured training programs, such as the SEMO Agility Drill and Zig-Zag Drill, in enhancing physical performance, as compared to no intervention.

These results align with similar studies on agility training in sports. For example, Kovacikova *et al.* found that agility training significantly improved athletic performance.[16] Similarly, Afonso *et al.*[17] demonstrated that both agility drills improved performance in recreational athletes, although the type of drill (linear vs. multidirectional) had a distinct impact on performance enhancement. Fletcher *et al.*[15] further supported this, emphasizing that agility-focused training enhances both movement efficiency and reaction time, which are crucial for high-speed sports like badminton.

5.2 Mechanisms of Improvement

The observed improvements could be due to various factors, including increased neuromuscular coordination, faster reaction times, and enhanced muscular strength from repeated exposure to agility tasks. The SEMO Agility Drill likely contributed to greater improvements because it involves continuous change of direction and dynamic acceleration, which are critical for badminton movements, such as lunges and quick direction changes.

As noted by Ali *et al.*,[18] multidirectional agility drills improve reaction times and enhance cognitive and motor functions, both of which are vital for sports like badminton. The dynamic nature of the Zig-Zag Drill also contributes to improved agility, though it may not engage the athlete's full range of motor skills as effectively as the SEMO Agility Drill. Additionally, Kim *et al.*,[19] found that agility training positively influences proprioception and joint stability, reducing the risk of injuries while enhancing movement precision.

Several studies have demonstrated the positive effects of agility training on athletic performance. Jung *et al.*,[20] conducted a randomized controlled trial to compare linear and multidirectional agility drills, finding that multidirectional drills provided superior improvements in overall agility. Lee *et al.*[21] also reported that agility training enhances muscle strength, flexibility, and coordination, thereby improving sports performance, including badminton.

Morris *et al.*,[22] highlighted that agility exercises targeting quick direction changes lead to better control over body movements, which is essential for badminton players. This research reinforces the significance of incorporating specific, sports-related drills into training regimens to optimize player performance.

5.3 Gender Distribution

While the study included both male and female participants, Graph 2 shows that the gender distribution was relatively balanced, which is crucial for ensuring the generalizability of the results across both genders. Gender-specific analysis might yield interesting insights, as previous studies have indicated that agility improvement could vary slightly based on gender due to physiological differences such as muscle mass, coordination, and flexibility.

5.4 Practical Implications

The significant improvement in agility in the SEMO drill group and Zig-Zag drill group suggests that incorporating these drills into regular training regimens could be highly beneficial for badminton players. Coaches and trainers should consider integrating such drills to enhance their players' agility. Practically, this means that training programs should include exercises that mimic the specific movements and demands of badminton. Training programs can be designed to progressively increase in intensity and complexity, ensuring that players continuously challenge their neuromuscular systems and avoid performance plateaus.

5.5 Limitations of the Study

- The sample size was relatively small.
- The intervention period was limited to four weeks.
- Additionally, the study focused solely on recreational badminton players, so the findings may not be generalizable to elite or professional athletes.

6. Conclusion

The study demonstrated that both the SEMO Agility Drill and the Zig-Zag Drill, alongside Ladder Drill Exercises, significantly enhanced agility in recreational badminton players. The SEMO Drill was notably more effective, likely due to its varied movement patterns. These results underscore the importance of incorporating structured agility drills into badminton training to enhance athletic performance.

7. Ethical Approval

Ethical clearance has been obtained by the College of Physiotherapy, School of Health Sciences, Dayananda Sagar University. Ramanagara Dt.- 562112, Karnataka

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Trial Registration Clinical Trial: CTRI/2024/05/067527

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