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Research Article

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Effect of Agility Specific Exercise Program on Agility in Badminton Players

Niyati Mukesh Doshi [1], P. Sathya [2] and Jibi Paul [3]

[1]MPT Student, School Of Physiotherapy, D, Y, Patil Deemed To Be University, Nerul Navi Mumbai

[2]Associate Professor, School Of Physiotherapy, D.Y. Patil Deemed To Be University, Nerul, Navi Mumbai

[3]Professor, Faculty of Physiotherapy, DR. MGR . Educational And Research Institute, Chennai, Tamil Nadu, India

Abstract: Badminton is a casual outdoor sport as well as a formal game played on international level. The anatomical and physiological demands in badminton are affected by multiple factors, such as the gender, player's style, level, equipment and surface. Physical abilities of athletes and the techniques of play influence the performance of the player. Complex skill sets require higher level of co-ordination and movement control. The complex skill sets required by badminton players are aerobic endurance, speed & agility. Agility is a key complex skill set in badminton. Agility is related to physical traits like technique, strength and power. Thus, the study hypothesized that the effect of the 6 weeks agility specific exercise program would show significant improvements on agility performance in badminton players. The primary objective was to study the effect of 6 weeks intervention on agility performance in badminton players. An experimental study was conducted in which total 62 badminton players participated. They were divided in equal numbers to experimental and control groups via random allocation method. Experimental group performed the designed protocol for 6 weeks and the control group continued their daily training of the Multi-shuttle feed training program during the same time. Agility T- test was used to assess the agility performance. The time taken to perform the agility t-test by the groups before the intervention was approximately the same with a mean difference of 20 seconds. There was a reduction in the time taken to complete the agility T-test in the experimental group after the training with a mean difference of 90 seconds between the groups. The results of comparing pre and post agility T- test readings, revealed a statistically significant difference with $P<0.05$. This study concluded that the 6 weeks of Agility Specific exercise program did lead to an improvement on agility in badminton players.

Keywords: Racquet sports, Formal game, Agility program, Physical abilities, Badminton players.

***Corresponding Author**

Dr Jibi Paul, PhD , Professor, Faculty of Physiotherapy, DR. MGR . Educational And Research Institute, Chennai, Tamil Nadu, India

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1. INTRODUCTION

Badminton is a popular racquet sport played across the globe. It has evolved from a British Indian game "battledore and shuttlecock". In the 18th Century, it was known as "Poona" in India. The base for the International Badminton Federation 1934 is Badminton house in Gloucestershire[1]. It has two or four opposing players using rackets to rally a shuttlecock across the net in a distinctly marked playing surface. It is an explosive sport. A competitive badminton game lasts for 30-60 minutes. The varying speed and height to approach the shuttlecock require running speed and agility. Badminton players perform a combination of actions which include jumps, specialized twists, and swings. Thus, a varying temporal structure with events of short period and high or medium intensity along with small rest periods is illustrated in the game. The essential motor demands of the game are interrelated via reaction time, balance and foot stepping. The most commonly practiced method for agility training and footwork in badminton players is multi-shuttle feeding training program. The trainer feeds 8 shuttles which are hit by the player. This is the standard feeding method where the trainer serves the shuttles with a badminton racquet in different directions[2-6]. The above-mentioned actions make the ankle, knee, & hip joints of athletes go through repeated flexion and extension. Badminton is played on a hard surface which exposes the athlete's joints to high ground reaction forces. For these reasons, 63.1% of injuries occur in the lower extremities of which 37.1% is knee & 28.3% is ankle in badminton. The age group of 5 to 18 years was the major age group [58%] prone to injuries. The incidence of fractures and lacerations is higher than those of any other age group. The transition from high school to collegiate competition in this age group tends to amplify these injuries as the competition is more challenging. Challenging competitions require a boost in neuromuscular conditioning to be performing more precise and explosive actions[7-9]. Agility is the skill to change direction with quick start and stop. Agility should be trained in both the forms reactive agility as well as running agility. Exercises which involve rapid jumps stimulate muscle to increase power which helps to change the directions quickly[10-15]. Agility training generally consists of the back and forth jumps, side-to-side movements, and crisscross exercises. Improvement in power and efficiency helps players achieve their goals of agility**.** Drills that are considered as agility exercises generally involve backward movements[16-18].The protocol designed consisted of exercises like jumps-in place, standing jumps, & box drills. The drills require the player to jump forward or vertically which involve change of direction, zigzag patterns, 180 degree turns. There are many studies conducted on the effects of training solely/ combination of different components of badminton required to perform proficiently but to our knowledge there are less studies which have been conducted fundamentally focusing on agility performance. Hence, the principle of this study was analysing the effects of the 6 week agility specific exercise program on agility in Badminton players.

2. METHODOLOGY

This is an experimental study on 62 amateur badminton players divided as 31 in Experimental and 31 in Control Group with reference to figure I. Sample size was calculated on the basis of conducted pilot study. Study was conducted in badminton Academies in Mumbai and Navi Mumbai. Convenient sampling method is used and subjects are divided by Random allocation method. The randomization was done by lottery method in which chits of the same size, shape, and color were taken. The number was written in chits which was 1 and 2. The subjects were asked to pick the chits and were accordingly divided into 2 groups. Proforma for assessment was filled for the interviewing subjects which included information about age, gender, height, weight, BMI, years of playing experience, history of injury/Surgery, any other sport played. Inclusion criteria for selection of the subjects were the age group of 14-19 years who had minimum 1 year of playing experience. This age group is more prone to injuries.[7] Exclusion criteria was the subjects who had any lower limb injuries and/or surgery in the past 6 months as self-reported in the proforma, who were involved in multiple sports and /or attended less than 80% of the training protocol. Outcome measure assessed was the agility performance by using Agility T-test. The T-test is a test of agility for athletes which includes forward running, lateral shuffle and backward running. It mimics the movements frequently adapted by the badminton players on court.

2.1 Ethical Clearance

The study was reviewed and approved by the Institutional Ethics and Research committee of D.Y. Patil University School of physiotherapy, Navi Mumbai, Maharashtra, India in the year 2018 with the ethical committee approval reference number DYPUSOP/291(a) 2018.

2.2 Procedure

A written ethical consent and assent was obtained prior to the assessment from the parents & the participants respectively on a printed form. A pilot study was conducted on 20 subjects (10 in each group). The sample size was statistically calculated using the formula

$$\eta \geq \frac{\left[Z_{\left(1-\frac{\alpha}{2}\right)} + Z_{(1-\beta)}\right]^2 [{\sigma_1}^2 + {\sigma_2}^2]}{[\mu_1 - \mu_2]^2}$$

Exercises were practiced for 5 reps and 2 sets of each. Control group underwent the Multi-shuttle feed training for the same period of time. Time taken to complete exercises was 5 minutes in each session. There were 3 sessions per week for 6 weeks. During this agility training the subject didn't undergo any other training program. The training protocol[19-24] was devised in 4 stages and each stage had been practiced for 4 sessions as explained in Table I.

Table I: Training program

STAGE 1		STAGE 2		STAGE 3		STAGE 4	
1.	Quick run-1 In	1.	Lateral shuffle	1.	Carioca	1.	Agility cones
2.	Double-leg hops	2.	Double leg hops	2.	Backpedal	2.	Backpedal
3.	Quicksprint-2 In	3.	In-in/ out-out	3.	One foot out/ two feet in	3.	Hip drill
4.	Forward/ backward print	4.	Forward zig-zag	4.	Pro-agility drill	4.	Ali-shuffle
5.	Forward- lateral shuffle	5.	Backward zig-zag	5.	Hexagon drill	5.	Single-leg double square hops
6.	Backward- lateral shuffle	6.	Forward/ backward zig-zag	6.	Single-leg hop- square drill	6.	Single-leg hop - square drill
7.	Double leg hop Square drill	7.	Double leg hop-Square drill	7.	All crossover stutter step	7.	T-test
8.	Line crossover	8.	2-1-2 dot drill	8.	Side to side hop	8.	'W' shape cone drill
9.	Lateral stutter step	9.	180° dot drill	9.	Shuffle box	9.	Clover-leaf
		10.	Figure of 8 drill				

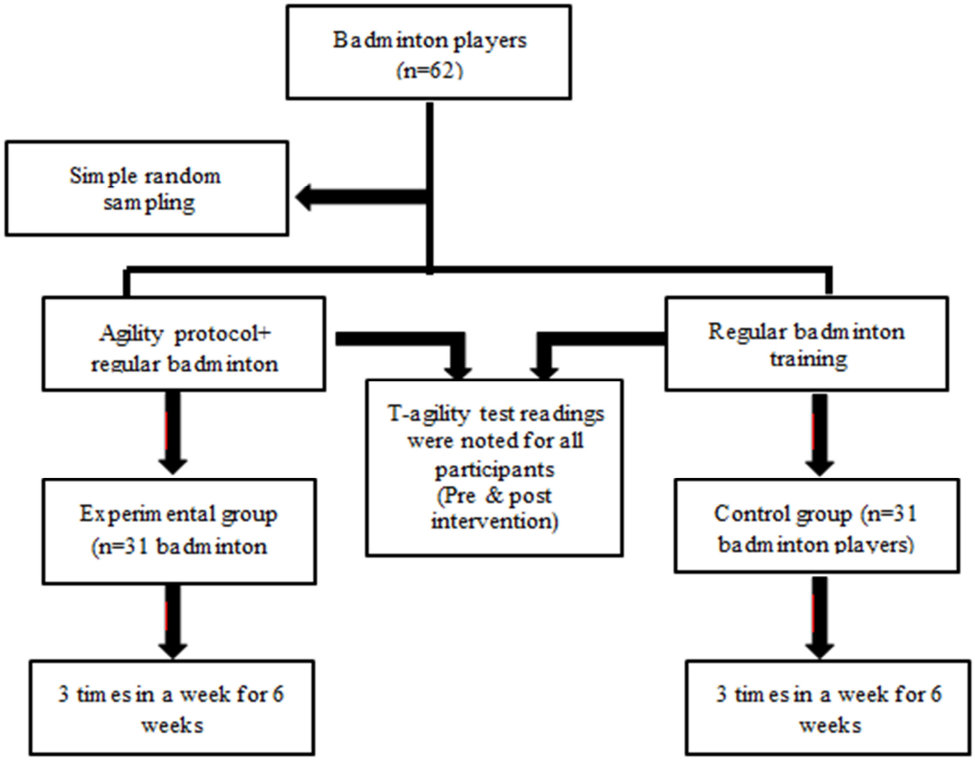

Fig I: Hierarchy of Methodology

3. STATISTICAL ANALYSIS

The data was collected and documented and graphs were prepared using Microsoft Excel 2017. Data analysis was done using IBM SPSS version 16 bit for windows. The Kolmogorov- Smirnov is a non-parametric test of equality used to check normality. The data passed the Normality test. Mean and standard deviations were calculated from the raw data. Unpaired T-test was applied to compare the data amongst the groups for the following variables

- Readings of T-agility tests taken before the intervention of control and experimental group.
- Readings of T-agility test taken after the intervention of control and experimental group.

3.1 Paired T-test was applied to compare the data for the following variables:

- Pre and Post T-test for agility in Control and Experimental group respectively.

4. RESULT

Table II: *Demographic Data*

Characteristic		Experimental group Mean ±SD [n=31]	Control group Mean ± SD [n=31]	Mean difference
1.	Age [in years]	15.29± 1.63	15.42 ± 1.68	0.13
2.	Height [in centimetres]	158.61± 11.46	159.84 ± 9.36	1.23
3.	Weight [in kilograms]	49.19± 5.48	45.56 ± 6.14	3.63
4.	B.M.I. [in kg/m^2]	19.72 ± 2.81	17.86 ± 2.14	1.86

The values are expressed as mean±SD; (n=31)

**p<0.05 has been considered as statistically insignificant According to the observations of Table 2. The mean difference in age is 0.13 years which is statistically insignificant. The mean difference in height is 1.23 centimetres which is statistically insignificant. The mean difference in weight is 3.63 kilograms which is statistically insignificant. .The mean difference in BMI is 1.86 kg/m^2 which is statistically insignificant.*

Table 3: Gender distribution

	Experimental roup (n=31)	Control group(n=31)
Male	11	13
Female	20	18

As observed in Table 3 There were 65% of female and 35% of male participants in group A and58% of female and 42% of male participants in group B.

Table IV : Results of the study

Variable	Mean ± SD [Pre training] (in seconds)	Mean ± SD [Post training] (in seconds)	Confidence interval Lower To Upper Limit	p-value
T-test experimental group	10.24±1.15	9.29±0.65	0.50 to 1.38	0.00
T-test control group	10.55±1.05	10.58±0.97	-0.21 to 0.15	0.75

The values are expressed as mean±SD;(n=31), *p<0.05 has been considered as statistically significant

In table 4, the minimal difference observed was 0.50 seconds and maximal difference observed was 1.38 seconds for group A whereas minimal difference observed was -0.21 seconds and maximal difference observed was 0.15 seconds for group B. The difference between mean T-agility test at pre and post level is statistically significant for Group A since p-value=0.00(p<0.05) on comparison with Group B the mean T-agility test at pre and post level is statistically insignificant since p-value=0.75(p<0.05).

5. DISCUSSION

The hypothesis of the present study was to see the effect of the 6 week agility specific exercise program on agility performance in male and female badminton players. Agility performance was measured with the Agility T- test. There were 2 groups, of which one received the intervention i.e. experimental and another control group that performed their regular training. The results obtained from both the groups were statistically analysed. According to Table 4**,** the mean for pre agility of experimental group is 10.24± 0.98seconds and post agility is 9.29 ± 0.66 seconds whereas the mean of control group for pre agility is 10.55± 1.07seconds and post agility is 10.58± 0.98 seconds. The mean difference observed in comparison between readings of pre and post t-agility tests in the experimental group is -0.947 seconds and the control group is 0.028 seconds. The results of comparing pre and post t-agility test readings revealed a statistically significant difference in the experimental group with p-value of 0.00 with p>0.05 and insignificant difference in the control group with p-value of 0.75 with p>0.05. But then again, the mean difference observed in the experimental group of -0.947 is lesser than the control group of 0.028. Equality of variants was assumed. This shows that after the agility specific exercise training program the time taken by the players of the experimental group for agility is reduced and has significantly improved their performance. For the control group there is negligible change in the agility time. This suggests a significant improvement on agility performance of the experimental group after 6 weeks of agility specific exercise program training [25,26]. This is consistent with the findings of Walklate BM. et.al. 2009 where agility-based exercise drill was found to improve agility in athletic volunteers.[22] Maman Paul et. al. 2011 concluded that an 8 week agility training program in tennis players was more effective to improve agility over traditional program[27]. Agility is one of the bio motor components that occur due to the explosive power movement. The reason specified for improvement in agility in the study can most likely be attributed to the improvement in power output of the athlete. Central nervous system input and proprioceptive response from the muscles and joints carrying out the movement recruit muscle fibers which are required for neural adaptation. Proprioceptors positioned in muscle and joints facilitate quick and faster movements of the body in particular direction and direct it to move rapidly. Thus, this allows the central nervous system to monitor the effects of its commands on feedback mechanisms until the movements are finished which are required to improve agility[28,29]designed to include a proprioceptive component promote dynamic joint and functional stability[26]. The Agility specific exercise program incorporated ladder drills of foot, plyometric exercises which had repetitive jumping, running, and explosively altering motion. J. Nirendan et.al. 2019 summarized footwork drills significantly improved agility and reaction time of school level badminton players[30]. This study had a few jumping based exercises which focus on stretch-shortening cycles to generate maximum power. The rapid movement in jumping leads to change from the eccentric phase to the concentric phase to stimulate the proprioceptors[31]. This correlates with the findings of Cesar meylan et.al. 2009 where the short-term plyometric program had a beneficial impact on explosive actions, such as sprinting, change of direction, and jumping, improving their agility and jump performance[31]. Another study by Miller MG et.al. 2006 propounded that plyometric training is an effective training method to improve agility[25].This facilitates increased muscle recruitment in a minimal amount of time. With the number of motor units activated the neural adaptation will increase which will affect agility, especially to improve intramuscular coordination. Agility training improves medial hamstrings activation during a sidestep pivot maneuver. Agility training which improves hamstrings activity helps in reducing ligament sprain injury. This was in accordance with Wilderman DR. et.al. 2009 where hamstring activation lead to decrease in ACL injuries[32]. We observe considerable difference in the agility performance amongst the two groups as the control group was not being trained profoundly. Lockie RG et. al. 2014 suggested if a properly periodized speed and agility program is imparted, it will improve factors important for athletes, including multidirectional speed, leg power, and dynamic stability[33]. The pilot study by Iris Dijksma et.al. 2019 provides preliminary evidence that Agility training will help retain body control and change of direction speed which may

reduce attrition due to injuries[34].Herman K. et.al. 2012 advised a warm-up strategy that includes stretching, strengthening, balance exercises, sports-specific agility drills and landing techniques when applied consistently helps prevent injuries in the athletes[35]. Multi-shuttle feed training program was given to the control group. It showed insignificant changes in the agility performance of the players which increases their risk of injury with reduced optimal play performance. Thus, in comparison we found that the 6 weeks devised agility specific exercise training program was more beneficial over the multi shuttle feed training program to improve agility performance in badminton players.

6. CONCLUSION

The six weeks of agility specific exercise program was effective in reducing the time taken to complete the agility T-test. This suggests that the agility specific exercise program can be a part of the training programs of badminton players to not only improve the agility performance but also break the monotony of training. It can also be incorporated in other sports requiring agility as one of the core skill sets. The agility specific training may also help to reduce the injury rates and improve the game performance.

7. AUTHORS CONTRIBUTION STATEMENT

Ms. Niyati Doshi was involved in the conceptualization of the study & data collection. Dr. P. Sathya contributed to the analysis and writing of the manuscript. Dr. Jibi Paul has contributed towards the discussion part in the manuscript. All authors collectively discussed the methodology & results and contributed their valuable work.

8. CONFLICT OF INTEREST

Conflicts of interest declared none.

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