**EFFECT OF PILATES ON AGILITY AND COORDINATION SKILLS IN ASPIRING STATE LEVEL BADMINTON PLAYERS: A PILOT STUDY**

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Conflicts of Interest: Nil

**ABSTRACT:**

**Background:** Badminton is a complex, physically enduring sport that requires a substantial amount of core strength as well as full body power, agility, good balance and coordination during rapid postural actions around the court. Badminton players need excellent court speed, agility and fitness training.Pilates incorporates the principles of trunk stability, also referred to as “core stability”.

**Aim:** Aim of the study is to see the effect of Pilates on agility and coordination skills in aspiring state level badminton players. **Method:** Ten 17-28 years male aspiring badminton players participated in the study. Players having minimum playing age of 2 years with training frequency of at least 30 minutes a day for 4 days per week were included. Players were excluded from study those had any medical conditions that would impair their playing activities. All players received Pilates for 5 weeks twice a week, with a total 10 ses**s**ions for 30 minutes. During each 30 minutes training session, subjects completed the warm up and sports specific exercises for 5 minutes and Pilates for 25 minutes which included: standing footwork, the hundred, articulating bridge, the plank, reverse plank, rolling like a ball and side plank. All players was performed each repetition in a slow, controlled manner, 5-8 repetition of all exercises for 30 minutes. Agility and Coordination skills of players were tested on 1stweek and last day of 5th week by 10m Shuttle Run Test and Hand-Eye Coordination Test. **Result:** Student T-test was used to analyze the result of variables. Data was analyzed by using SPSS 24 version. Agility and coordination skills showed a significant (p<0.00) improvement of 41% and 53% respectively after the intervention of 5 week. **Conclusion:** Pilates was found to be effective for improvement in agility and coordination skills in badminton players.

**Keywords:** Core, Strengthening exercises, Pilates, Badminton, Athletes.

**Introduction**

Badminton is most popular played racquet sports all over world. The decision of participation in badminton increased in the 1992 during Olympics1. Badminton became an increasingly popular and fitness program for professionals and college students2. Badminton has been internationally recognized as an athletic sport requiring fast reaction and skilled movements3. Badminton is a complex, physically enduring, sport that requires a substantial amount of core strength as well as full body power, agility, good balance, coordination during rapid postural actions around the court4.  It builds fundamental physical skills in children as well as in young, and is also an excellent aerobic workout. Badminton is a sport that is related to strength, the performance of a player is influenced by strength5.

Pilates-based exercises or Joseph Pilates method began developing his exercise system over a period of approximately 50 years in early 1900s6.  Pilates-based exercise incorporates the principles of trunk stability, also referred to as “core stability”. The core is defined as the lumbo-pelvic hip complex, where the center of gravity is located and body originates movements. There are many muscles associated with the core7. A core is also a stabilizer for lower extremity movements and operates as a functioning unit. The core needs to be trained properly for distribution of weight, absorption, and transfer ground reaction forces during movements8.  “Core is described as a box, with the abdominals (transversus) in front, para spinal (multifidusportings) in back, the diaphragm in the top and pelvic floor at the bottom"9. Multifidis is the most important muscle, it is responsible for providing intrasegmental stabilization to the lumbar spine in all positions10. The pilates training method is based on 6 principles that are Centring, Concentration, Control, Precision, Flow, Breathing. Pilates improves posture, balance, increase core strength, peripheral mobility, which may be helpful for improving athletic performance11.

Agility is the important bodily element for the overall performance in game. Agility has been defined as the ability to change direction rapidly and accurately 12. According to the scientific literature, agility is suggested as an important physical quality which should be well developed throughout childhood and adolescence. Agility is highly dependent on coordination and movement control but apart from coordination there are substantial number of factors that affect the level of agility such as mobility of joints, dynamic balance, power and flexibility, strength, speed and optimal biomechanical structure of movement13.

Coordination is the potential to repeatedly carry out movements smoothly and appropriately. It contains muscular contraction and joint motion in a rhythmic manner. Racket sports activities require the coordination of eye, hand, foot, whole frame, and a ball14. Sports performance abilities and coordination are measured and recorded by means of Hand-eye coordination test15.The current study intends to see the effect of Pilates in aspiring state-level badminton players.

**Methodology:**

This Pilot study was carried out at D’Valls Badminton School, Gurugram. The study was approved by the Ethical Research committee. The whole procedure of training program was explained to the players and written informed consent was taken from all the players.

10 aspiring state level male players were recruited from D’Valls Badminton School. Players who fulfilled the inclusion and exclusion criteria were selected in the study. Inclusion criteria for the study age group between 17 – 28 years, playing badminton for more than 2 years and no history of any injuries past 6 months. Players who were excluded from the study those having any musculoskeletal problem that will decrease the compliance of the players to participate in the study and any medical conditions that would impair their playing activities. All players underwent baseline assessment for agility (10m Shuttle Run Test) and coordination skills (Hand-Eye Coordination Test).

**Procedure:**

The 10m shuttle run test and hand-eye coordination test used to determine agility and coordination skill.The volunteer players were assigned to the Pilates group. All playerscompleted pretest and posttest measures for the 10m shuttle run test and hand-eye coordination test to determine agility and coordination. All players performed a normal 5-min warm-up prior to the tests. Players received Pilates for 30 minutes twice a week for 5 consecutive weeks, with a total of 10 sessions under the supervision of the therapist. During the training session, the players completed the warm-up and sports specific exercises for 5 minutes. Pilates Exercises: 25 minutes of following activities: standing footwork, the hundred, articulating bridge, the plank, reverse plank, rolling like a ball and side plank (Table 1). The exercises were progressed as needed per player to maintaining difficulty while challenging the core musculature. All players were instructed to perform each repetition in a slow, controlled manner; 5-8 repetition were performed for all exercises for 30minutes15.Agility was measured by 10m Shuttle Run Test16 and coordination skill was measured by Hand Eye Coordination Test17.

**Table 1: TRAINING SCHEDULE OF PILATES**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr. No.** | **Pilates** | **Repetitions**(R× Sets with 20sec hold) | **Progression****(**R× Sets with 20sec hold) |
| 1 | Standing Footwork | **10×3** | **15×3** |
| 2 | The Hundred  | **10×3** | **15×3** |
| 3 | Articulating Bridge | **10×3** | **15×3** |
| 4 | The Plank | **10×3** | **15×3** |
| 5 | Reverse Plank | **10×3** | **15×3** |
| 6 | Side Plank | **10×3** | **15×3** |
| 7 | Rolling like a ball | **10×3** | **15×3** |

Note: R- Repetitions, Pilates protocol

**Data Analysis:**

The data was analyzed by using the software package SPSS 24 for window version by using student t-test.A repeated measures T-test was used to calculate the hypotheses Anthropometric characteristics of the Pilates group and Values are means (SD) ( age-20.8 ±2.5 and BMI-20.1 ±1.7).

**Results:**

Mean and standard deviation of all variables were calculated. The level of significance was set at p<0.00(Table 2). Analysis of variance was used to compare the pre and post values after the intervention. There was a significant difference in the pretest and posttest scores for the 10m shuttle run test (Fig.1) and hand-eye coordination (Fig.2).

**Table 2: Mean of agility and coordination skills by using student T – test**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables | 0 week | 5th week | t | p |
| Agility (sec) | 12.2 | 5.0 | 14.0 | 0.00\*\* |
| Coordination skill(catches) | 15.2 | 28.4 | 20.9 | 0.00\*\* |

Note : \*\* = highly significant , p = significance level

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**Figure 1: 10m Shuttle run test for Agility showed improvement in improvement in 0- 5th week in line graphs.**



**Figure 2: Hand-eye coordination test for coordination skill showed improvement in 0- 5th week in line graphs.**

**DISCUSSION:**

The purpose of the current study was to see the efficacy of Pilates on agility and coordination skill in badminton players. The results of this study showed that Pilates was found to be effective on agility 41% and coordination skill 53% in badminton players.

Badminton players conduct numerous movement patterns during the game which includes jumps, footwork, and swings to strike the shuttlecock and moving back and forth on the court. Thus, the sport is characterized by changing actions rapidly on a short period and high intensity with a short resting times18. The key elements for badminton players are muscle strength, muscular endurance, power, speed, agility, flexibility, balance, and coordination.

According to Minna et al. the strategy oriented/ instruction group was able to improve its badminton knowledge, game understanding and serving skill significantly whereas the traditional group improved its badminton serving skill19.

Core musculature is located in the vertebral column and around the abdominal cavity. Depending on the role and properties of the core muscles are divided into deep and shallow core muscles. The position of the spine notably determines the position of the body’s COG and compensatory muscle synergy to counteract the perturbations, to maintain the body's equilibrium state and to regulate the body’s postural control. Higher core stability performances permit optimal and long sustained contraction of the deeper spinal stabilizer muscles. These stabilizer muscle due to their close proximity with the spine are responsible for better control of the intersegment movement of the spine and therefore better control of the body’s COG important for balance and coordinaton20.

Hodges and Richardson examined the sequence of muscle activation at some point of entire-body movements and observed that a number of the core stabilizers (i.e., transversus abdominis, multifidus, rectus abdominis, and abdominals) were continually activated earlier than any limb actions24. These findings stated that movement and stability are advanced in a proximal-distal and a cephalo-caudal progression21.

Rajiv et al. stated that core training improves the core muscle strength as well as it also improves the stability of the body movement which requires the coordination of the upper and lower extremity22.

A recent study indicated that Pilates training can enhance the control of trunk movement, and improves the neuromuscular coordination of movements in badminton players23.

Yu JH et. al study stated the effectiveness of Pilates exercise on Fitness Factors related to motor performance including flexibility, agility, power, and balance. The Pilates group performed Pilates exercises 3 times a week for 8 weeks, 60 minutes each time. The results showed significant improvement in the Pilates group in the following areas: flexibility, agility, power, balance and muscle endurance.24

The result of this study showed that Pilates improved agility 41% (Fig.1)and coordination skill 53% (Fig.2 ) in 5 weeks of intervention.

**CONCLUSION:**

It is concluded that Pilates has showed a significant effect on agility and coordination skill in aspiring state level badminton players after the intervention of 5 weeks**.**

**LIMITATION OF STUDY:**

1. Less sample size.
2. Due to biomechanical differences between male and female players, the generalized ability of findings is limited to the group of male badminton players

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