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Heli Nitin Savla
BPT, Dr. DY Patil College of Physiotherapy, Pimpri, Pune, Maharashtra, India

Mrudula Sangaonkar
MPT Musculoskeletal Sciences, Assistant Professor, Dr. DY Patil College of Physiotherapy, Pimpri, Pune, Maharashtra, India

Tushar Palekar
Ph.D., Professor and Principal, Dr. DY Patil College of Physiotherapy, Pimpri, Pune, Maharashtra, India

Corresponding Author:
Heli Nitin Savla
BPT, Dr. DY Patil College of Physiotherapy, Pimpri, Pune, Maharashtra, India

Correlation of core strength and agility in badminton players

Heli Nitin Savla, Mrudula Sangaonkar and Tushar Palekar

Abstract
Background: Badminton is racquet sport played using racquets to hit a shuttlecock across a net. The important factors for badminton players are muscle strength, muscular endurance, power, speed, agility, flexibility, balance and coordination. The core muscles strength help to improve muscle coordinator between upper and lower extremities as well as reducing injury risk and improving performance. Agility is required in required in badminton as it is characterized by changing actions of short period and high or intensity coupled with a short resting time. As core strength and agility has an equal importance among the players which has an impact on the players performance.
Aim: To find out the correlation of core strength and agility in badminton players.
Method: A total of 30 sub elite badminton players were selected considering their no. of hours of playing badminton daily and no. of years of playing badminton. The players were evaluated for the core strength test – ventral, left lateral, right lateral, and dorsal and illionis agility test. The relation between the core strength and agility were evaluated by correlation analysis. The individual core strength test was correlated with the illionis agility test.
Results: The result showed the correlation of core strength and agility. The result showed that there is a perfect negative correlation between core strength and agility in relation to time as the r values of ventral core strength test, left and right lateral core strength test and dorsal core strength test with agility are -0.64, -0.67, -0.67, and -0.58 respectively.
Conclusion: This study suggests that there is a correlation seen between the core strength and agility in badminton players.

Keywords: Badminton, core strength, agility

Introduction
Badminton is a racquet sport played using racquets to hit a shuttlecock across a net. For a player to be at elite level a high level skill is required, with good reflexes and be quick and agile around to be a successful player at court [1, 2, 5]. Badminton players requires factors like muscle strength, muscular endurance, power, speed, agility, flexibility, balance and coordination. Functional movements are highly dependent on this part of the body, resulting in predisposition of injury due to lack of core muscular development[2]. During the game badminton players require various movement patterns like specialized twists, jumps, footwork, and swings to strike the shuttlecock and keep it moving back and forth on the court. Badminton game is characterized with actions of short period and high or medium intensity coupled with short resting times by a changing temporal structure [10].
Core muscle includes transverse abdominal muscle, abdominal external oblique muscle, multifidus muscles, abdominal internal oblique muscle, and psoas major muscle [2, 4]. A core muscle provides internal pressure to expel substances and also used to stabilize the thorax and the pelvis during the dynamic movement. Static core functionally is the ability of one's core to align the skeleton to resist a force that does not change whereas dynamic stability is movement with the alignment. The core strength training plays an important role in reducing and preventing lower and knee joint injuries [2]. Core stability is the ability of the lumbopelvic-hip structures and musculature to withstand compressive forces on the spine and return the body to equilibrium after perturbations. Factors such as the endurance, strength, power, and coordination of the abdominal, hip, and spine musculature are important components of core stability. Core stabilization moreover precedes gross motor development, as the central nervous system activates the trunk musculature before movement to provide a stable foundation in anticipation of the forces produced by the limbs [14].

Agility is defined as a rapid movement of the entire body with a change in velocity or direction in response to a stimulus, such as the shuttlecock which an opponent player has hit. The change in velocity is the ability to accelerate to accelerate and decelerate concurrent with a change in direction [2, 5, 6]. Young *et al*. showed that this ability consisted of several factors such as straight sprint, leg muscle strength and running technique, demonstrating that agility requires muscle power in order to move quickly and technique to move efficiently [6]. According to Okada *et al*. to improve functional movement of sport related skills, athletes should perform training exercises that are similar to the movements and motions used during competition. Peak athletic performance requires high level of stability, strength, and power [3].

Dr. Sighamoney *et al*. showed that core strength has an effect on dynamic balance and agility in badminton players[2]. It appears that repeated activation of core musculature along with extremity movements helps to improve postural control. During performance of sports skills, a stable core provides a foundation upon which muscles of upper and lower extremities can accelerate body segments and transfer force between distal and proximal body segments [2, 10].

Studies in badminton sport, have been shown an important role of core stability [16] emphasized on the specific needs requires of strength to passes from ankle-knee-badminton-core area-fingers-wrist in skills of badminton, which reflects the general system performance in this sport [16].

The human body is a complete kinetic chain in which muscle imbalance in one area can cause biomechanical changes in other areas also. The core muscles strength helps to improve muscle coordination between upper and lower extremities as well as reducing injury risk and improving the performance. Agility is required in badminton player as it is characterized by changing actions of short period and high intensity coupled movements with a short resting time. As core strength and agility are equally important among the players. Therefore there is a need to find the correlation between the core strength and agility in badminton players.

Material and Method

A total of 30 sub-elite badminton players of both genders playing badminton for atleast 1 years, with age criteria 13-26years participated in this study from Sudhanshu badminton academy with an exclusion criteria of an previous history of fracture, previous injury, open wounds, infections and no recent history of pain. This study was approved by D.Y.Patil university ethics committee and obtained an informed consent. Data regarding agility and core strength were collected.

Agility data were collected using the illionis agility test. Adequate warm-up was done before the test. It was introduced in 1942 as a test of motor ability with a combination of multidirectional maneuvers over obstacles. The course was marked by cones, with four center cones spaced 3.3m apart, four cones positioned 2.5m from the center cones. Players touch or cross the tape mark with their foot. The players turned and moved back to the first center cone, where he weaved back through the four center cones. Again players were required to touch or cross the end-line tape marks with their foot. Lastly the participant turned around and ran quickly as possible across the finish line. The time to complete the trial was recorded in seconds. Disqualification was determined if failed to reach to the end-line, failed to complete the course, or moves any cones.

Core strength measurements were performed in 4 postion ventral, lateral (left and right), and dorsal. For the ventral test position, player lays his face down in the plank position with his forearms and toes on the floor and with a straight line of head, shoulders, back, hip and legs. When a ventral test begins, the player asked to raise his feet separately and in alternative movement up and down for approximately 2 to 5 cm. The test was finished when straight body on plank position could no longer be maintained. Time was recorded with a stop watch in seconds. For the lateral test position either left or right side test, player lays in his side plank position with elbow on the floor with extended legs together. When a lateral test begins, the player asked to lower his hip down and then raise his hip up to the initial position accordingly. Time was recorded with a stop watch in seconds. For the dorsal test position, player lays his face down on the physio table in a straight horizontal line in an extended upper body out over the end of the table front edge. The players pelvis, hips, and knees were in a flat position on the physio table and both arms folded across the chest with hands placed on the opposite shoulders. The feet must be secured by a padded strap or held by the examiner. The player was asked to flex his upper body by moving downward to angle of 30 degree and then return upward to the initial position. The test was finished when a straight horizontal line position could no longer be maintained. Time was recorded with the stopwatch in seconds.

Data was analysed using Primer and linear regression and correlation method of statistical analysis was used. The relation between core strength and agility were evaluated using a correlation analysis (correlation coefficient=r).

Result

- Coefficient of correlation values between -1 and 1.
- 1 indicates a perfect positive correlation, while a 0 indicates no correlation and -1 indicates a perfect negative correlation.
- A negative correlation means when one variable increases, the other variable decreases or vice versa.
- Graph 1, Graph 2, Graph 3, and Graph 4 shows the correlation of ventral, left lateral, right lateral, and dorsal core strength compared with agility with respect to time.
- The r values of the relation are graph 1(-0.64), graph 2(-0.67), graph 3(-0.67), and graph 4(-0.58) respectively.

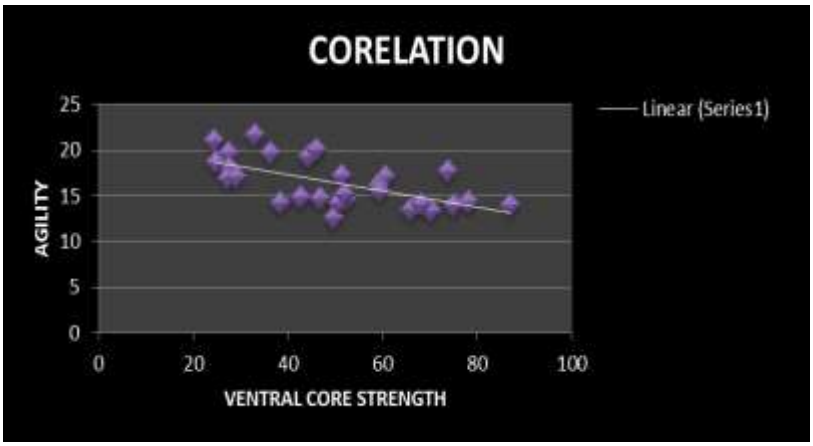

Fig 1: This figure shows that ventral core strength is negatively correlated with agility in relation with time

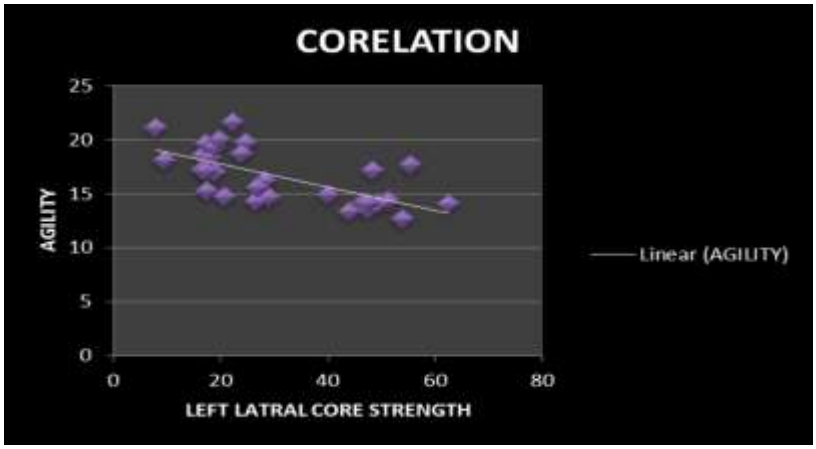

Fig 2: This figure shows that left lateral core is negatively correlated to agility in relation to time

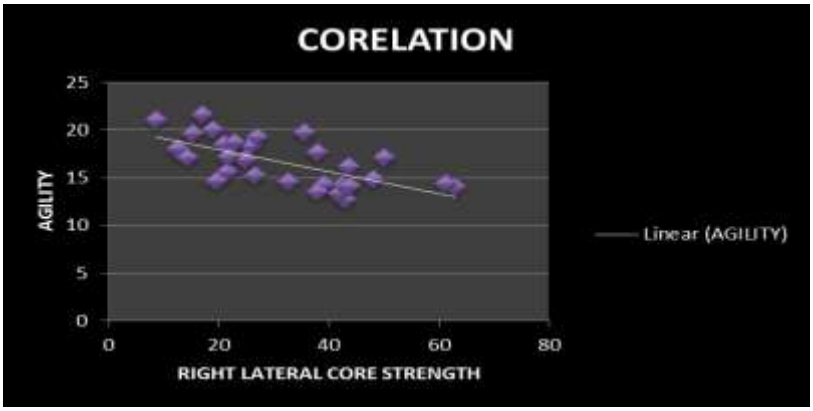

Fig 3: This figure shows that right lateral core strength is negatively correlated to agility in relation to time

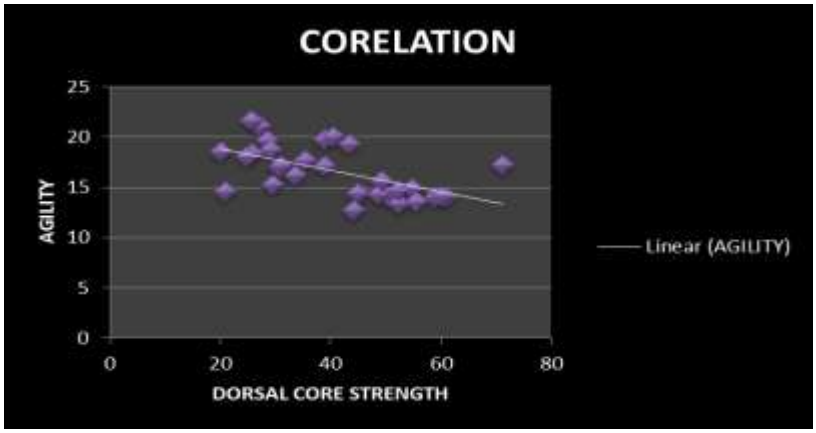

Fig 4: This figure shows that dorsal core strength is negatively correlated to agility in relation to time

Discussion

The primary purpose of this study was to determine the correlation of core strength and agility in badminton players. The study included with 30 samples. We assessed the core strength by core strength endurance of badminton players in four separate position tests which defined as (ventral, lateral-left, lateral-right, and dorsal) as modified by Ibrahim Hamed Ibrahim Hassan and M. W. Hoppe [10, 14]. Agility was assessed with the help of Illinois agility test. The result indicated that core strength and agility have a negative correlation.

The findings in this study are in accordance with Dr. Rajiv Sighamoney *et al*. Stated that there is effect of core strengthening on dynamic balance and agility. It has explained that core muscles strength will respond like any other skeletal muscles, to training, thereby improving the ability of the neuromuscular system to perform dynamic, eccentric, isometric stabilization contractions in response to gravity and momentum. It also indicated that core strength not only improve the core muscle strength, but also improve the stability of the body movement during the LOS test which requires the well coordination of the upper and lower extremity limb. Deficiency in the control of the neuromuscular system of the body's trunk or core may affect the dynamic stability of the lower extremity. It is well known that position of the spine significantly determines the position of the body's COG and compensatory muscle synergy/strategy to counteract the perturbations, to maintain the body's equilibrium state and to regulate body's postural control [2].

Justin Shinkle *et al*. Stated the study on effect of core strength on the measure of power in the extremities. The muscles of the core are responsible for providing the stable base for extremity function and force transfer. The primary intent of this study was to gain an insight into any effect that the muscles of the core have to transfer of forces through the body. By developing and implementing a dynamic core test, several indices of the effect that the core has on the forces in the body have shown [8].

Mengyao Xie has given a study on the role of core strength training in badminton. In this study the important role of core strength training of badminton players, badminton enthusiasts all make a preliminary understanding of the value of core strength training in badminton sport, can pay attention to core strength training in peacetime exercise and learning, strengthen the core strength training. Core strength training plays an important role in badminton sport, can enhance stability, the badminton athletes in the movement of the spine and pelvis to improve the ability of athletes to improve work efficiency, output coordination and cohesion of upper and lower limbs, connecting and injury prevention [9].

The upper body and rotational trunk strength are important vital variables for badminton players because both play an important role to drive the body during smashing movement in the final phase of smash skill. In this regard, trunk rotation and core muscles endurance are integral parts of the improvement power and transfer the energy up to the kinetic chain from lower body to upper body extremity transferred, this mechanism reported significant improvements in trunk strength after core stability training [10].

Agility is defined as a rapid movement of the entire body with a change in velocity or direction is response to stimulus. As stated by Takuya Sonada *et al*. There is a relationship between agility and lower limb muscle strength targeting university badminton players. The study indicated that number of years of badminton experience is correlated with agility. It also indicated that a badminton player who has best overall agility had greater hip extension and ankle plantar flexion strength [5].

The good performance in agility required the ability to quickly change directions. To perform well, core stability is necessary to withstand shear forces on the spine that occur in the multidirectional task. The core stability is used to measure the muscle endurance. Stability and mobility combined with body coordination and integration were important for better throwing distance, they contribute to efficiently transfer the kinetic energy through a kinetic chain and prevent an "energy leak" while performing the task[3]. It was suggested that badminton players routinely react with quick side steps and change in direction, which is likely to improve agility. Many reports showed that specific training is required to improve agility [18]. Therefore, the experience of playing badminton may be correlated with agility as the players undergo specific training for a long time [5].

Functional training refers to the training of specific exercises consistent with human needs, in order to improve the sport action efficiency. It could do it well by developing athletes' stability, strength, speed, power, and neuromuscular efficiency. Compared with traditional physical training, functional training is better targeted and more effective for improving athletes' overall abilities and power transmission efficiency. It does direct promotion in realization of badminton skills [17].

Conclusion

From the above study we can conclude that, the core strength i.e., ventral, lateral (left and right) and dorsal have a negative correlation with the agility.

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