



# International Journal of Physical Education, Sports and Health

P-ISSN: 2394-1685  
E-ISSN: 2394-1693  
Impact Factor (ISRA): 5.38  
IJPESH 2020; 7(5): 342-347  
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[www.kheljournal.com](http://www.kheljournal.com)  
Received: 03-07-2020  
Accepted: 07-08-2020

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## Effect of mat Pilates versus traditional plank on core muscle strength, balance and agility in elite badminton players: A randomised clinical trial

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### Abstract

The Aim of this study was to find out the effect of Mat pilates versus traditional plank on core muscle strength, Balance and agility in elite badminton players. Thirty Elite Badminton Players were divided into 2 groups by Simple Random Sampling method as Group A (Mat Pilates Exercise Group) and Group B (Traditional Plank Exercise Group). The Outcome Measures were One min Sit-up Test and Plank Test for Core Muscle Strength, Star Excursion Balance Test for Balance and Badcamp Agility Test for Agility. Both The Mat Pilates Exercise Group and Traditional Plank Group Completed Training for 5 weeks. There was significant difference in core muscle strength ( $p < 0.001$ ) and Agility ( $p < 0.001$ ). But There was no significant difference in the Balance ( $p > 0.05$ ). The Study Concluded that Group A i.e. Mat pilates group showed significant difference in Core muscle strength and Agility compared to Group B. But, No significant difference was seen in Balance.

**Keywords:** Core, plank, Pilates, Badcamp, agility, balance

### Introduction

In Today's World, Badminton is one of the most popular and most played sports in India and worldwide. Among the indoor games, badminton occupies a place of pride both as an individual as well as team sports<sup>[1]</sup>.

It is a complex physically enduring sport that requires an excessive amount of core strength as well as upper and lower body strength to produce strokes, powerful smashes, agility, good balance and coordination during rapid postural movement around the court. Thus, to be competitive in badminton, players should be able to move quickly toward a proper position that allows them to intercept and, simultaneously, to attack the shuttlecock<sup>[2]</sup>.

Thus, the game is characterized by a changing temporal structure with actions of short period and high or medium intensity coupled with a short resting times. Badminton requires a specific physical conditioning in terms of motor and action controls; coordinative variables such as reaction time, foot stepping and static or dynamic balances, which are essential motor demands in this sport. Therefore, badminton players need enough strength, Agility and a high level of dynamic balance during the rapid postural movements around the court<sup>[3]</sup>.

Pilates exercises or Joseph Pilates method began developing his exercise system over a period of approximately 50 years in early 1900s. Now-a-days it is used for posture correction and fitness Training. The main purpose of pilates is to organise the mind, body, and breathe to build up sleek and strong abdominal muscles and a strong and agile back. Pilates training method is based on 6 principles that are: Centering, Concentration, Control, Precision, Flow and Breathing in coordination with the exercise<sup>[1, 2, 3]</sup>.

The ability of a person ability to maintain a base support with minimal movement actions and dynamically to perform a motor task while maintaining a stable position can be defined as Postural control or balance. Balance can be defined as the ability to maintained dynamic integration of interior and exterior forces during motor action tasks. It is usually a static process, and in fact is a comprehensive, dynamic three-dimensional process contains multiple neural pathways<sup>[4]</sup>.

Core strength can be defined as the strength that has main function of stabilizing the core part of the human body, transferring and connecting the upper and lower limbs controlling the

movement of the center of gravity. Compared with general strength, core strength is more prominent on muscle innervations and control, more emphasis on the development of small muscles and the cooperation between big muscles and small muscles, improves relationship between power and coordination. The Global and local muscles constantly working to maintain the posture of the body in space and assist in changing postures and dynamic movements [1, 2, 4].

The Truncal muscles not only act as prime movers or antagonist to movement caused by gravity, they also have an important function to stabilize the spine. Without this stabilization by the trunk muscles, the spine would collapse in upright position. [2, 5].

The core muscles are divided into two groups: Superficial (Global) muscles, Deep (Segmental) muscles. Described the role of core muscles as to, transfer force and doing a link between upper and lower extremities, help passive existence protect and support the spine [5].

Initially the Core strengthening training was used for reducing injuries of lower back and lower limbs But now they are used to improve player performance [4].

Agility is an important physical capacity for sport performance. The sports-science literature presents different definitions of agility, but overall agility is defined as the ability to move and control the body as quickly as possible during required accelerations, decelerations, and direction changes [3, 5].

Sheppard and Young proposed a new definition for agility as a rapid whole-body movement with change of velocity or direction in response to a stimulus. Thus, the tasks involving preplanned movements should be considered not agility but change of direction (COD) [6].

Recently, the popularity of Badminton and number of players playing it is increasing day by day as the promotion of the game, the level of game and fitness is increasing. Previous studies are been conducted in which mat pilates versus badminton specific exercise training was done, but there is dearth of literature that shows the effect of mat pilates and traditional plank in badminton players

The Aim of this study is to Evaluate the effect of mat pilates versus traditional plank on core muscle strength, balance and agility in badminton players. The Hypothesis of this study is There will be significant difference between mat pilates and traditional plank On core muscle strength, balance and agility in Elite Badminton Players.

## Material and Methodology

This experimental study was conducted at District Sports Complex, Sangli. The study was approved by the Institutional Ethical Research Committee of Miraj Medical Centre, College of Physiotherapy, Wanless Hospital, Miraj.

Subjects those who fulfilled the inclusion and exclusion criteria were included in the study. The inclusion criterion of the study was both male and female players with the age group of 15-25 years, players who were playing badminton for more than 2 years with no history of any injury in past 6 months. Players who were excluded from the study were those having any musculoskeletal, Neurological, Cardiorespiratory or Cognitive problem that decreased the compliance of the players to participate in the study and any medical condition that would impair their playing activities. Written informed consent was obtained from all the subjects and the procedure of the training program was explained to the subjects in their vernacular language.

Demographic data like name, age, height, weight, BMI,

number of playing years, history of any previous injuries, and any medical condition of the player was recorded in the data collection sheet.

Players who fulfilled the inclusion and exclusion criteria were divided into two groups by simple random sampling method i.e., group A included 15 players which received Mat Pilates Exercise and group B included 15 players that received Traditional Plank Exercise. All players underwent baseline assessment for core muscle strength, dynamic balance and agility.

## Outcome measures in the study were

### Core muscles Strength was measured by one min Sit up test and Prone Bridge Test (Plank Test) [10, 11].

The subject lay supine on the floor with 90° flexion in the knee joints, hands at the side of their head, and with elbows pointing straight forward. To do a correct sit-up execution the elbows should touch the knees and then go back so the shoulders touch the floor. The number of repetitions performed was recorded.

The Prone Bridge Test was performed with the participants in the plank position in a smooth and stable surface. Participants were asked to hold the position volitional exhaustion or until repeated technique failure. The Time was recorded. (ICC-0.915)

### Dynamic balance was measured by Star Excursion Balance Test (SEBT) [12].

The SEBT was performed with the player standing at the center of a grid placed on the floor, with 8 lines extending at 45° increments from the center of the grid. The 8 lines were labeled according to the direction of excursion relative to the stance leg: Antero-lateral (AL), Anterior (A), Antero-medial (AM), Medial (M), Postero-medial (PM), Posterior (P), Postero-lateral (PL), and Lateral (L). To perform the SEBTs, the player maintained a single-leg stance while reaching with the opposite leg as far as possible. The player lightly touched the farthest point possible on the line with the most distal part of the reach foot then returning to a bilateral stance while maintaining their balance. The distance was measured from the center of the grid to the touch point with a tape measure in centimeters. (ICC-≥0.81)

### Agility was measured by Badcamp Agility Test [6].

The Badcamp Agility test was performed with players standing at the middle of the badminton court. Six targets were placed at six ends of the court. The players were given warning signal and the examiner started marking the corners which players have to follow. The players have to touch all 6 markers as marked by the examiner in an undecided manner. Each participant performed the test 3 times, and the shortest time was considered for analysis. At least 1 minute of rest was given between trials. (ICC-0.93)

## Result

Mean comparison of age, height, weight and BMI was done for players in both the groups.

**Table 1:** Mean comparison of Age, Height Weight, and BMI

Variables	Mat pilates		Traditional plank		T statistic	P value
	Mean	Std. Dev.	Mean	Std. Dev.		
Age (years)	19.80	3.51	20.47	3.11	0.55	0.59
Height (cms)	161.27	13.41	163.07	13.82	0.36	0.72
Weight (kg)	55.53	9.58	60.73	12.51	1.28	0.21
BMI	21.28	1.95	22.55	1.87	1.83	0.08

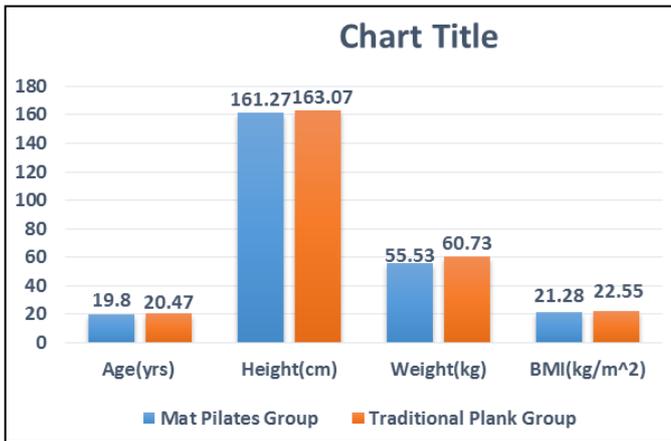


Fig 1: Mean Age, Height, Weight and BMI of badminton players

It was found that, mean age of badminton players in mat pilates group was 19.8 years and in traditional plank group was 20.47 years. Mean height of badminton players in mat pilates group was 161.27 cms and in traditional plank group

was 163.07cms. Mean weight of badminton players in mat pilates group was 55.53 kg and in traditional plank group was 60.73 kg and Mean BMI of badminton players in mat pilates group was 21.28 kg/m<sup>2</sup> and in traditional plank group was 22.55 kg/m<sup>2</sup>.

The Results of the study revealed, significant difference between mat pilates and traditional plank on core muscle strength in badminton players post 15 and post 30 days using One Min Sit-up Test ( $p < 0.001$ ).

Table 2: Mean comparison of One Min Sit-up Test between the groups

One Min Sit-up Test (Number of reps)	Mat pilates		Traditional plank		T statistic	p value
	Mean	Std. Dev.	Mean	Std. Dev.		
Pre exercise	48.73	8.12	43.67	8.66	1.60	0.12
Immediately	45.53	9.01	38.87	10.19	1.83	0.08
Post 15 days	67.0	8.22	54.07	9.19	4.06	<0.001*
Post 30 days	72.07	7.87	81.87	7.81	3.56	0.001*
F statistic	319.81		124.58			
p value	<0.001		<0.001			

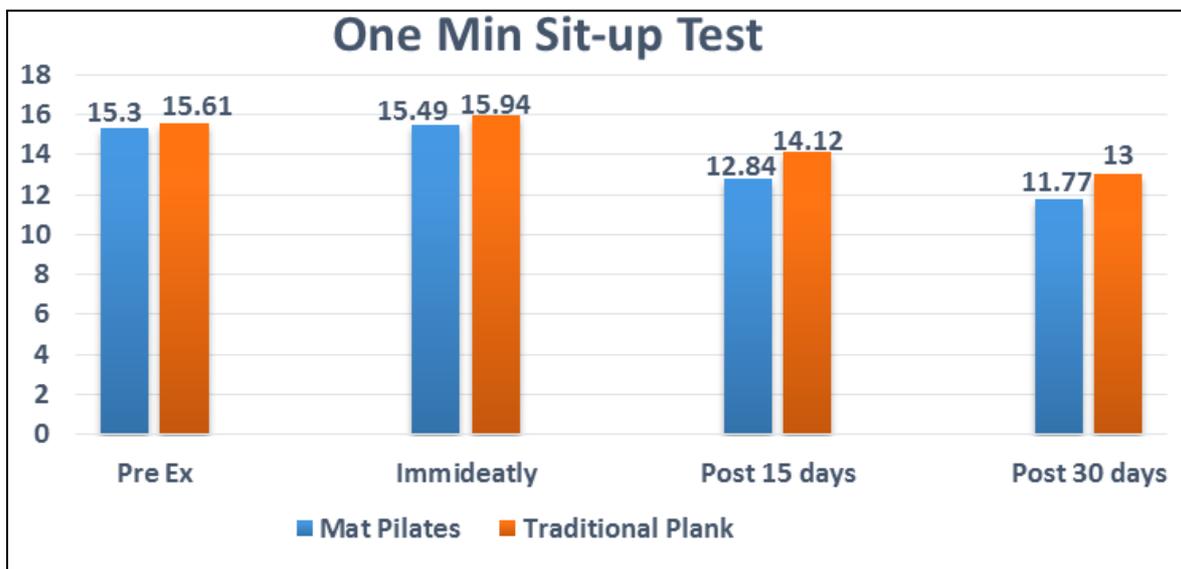


Fig 2: Mean comparison of One Min Sit-up Test between the groups

The results of the study revealed, significant difference between mat pilates and traditional plank on core muscle

strength in badminton players post 15 and post 30 days using plank Test ( $p < 0.001$ ).

Table 3: Mean comparison of Plank Test between the groups

Plank Test(Mins)	Mat pilates		Traditional plank		t statistic	p value
	Mean	Std. Dev.	Mean	Std. Dev.		
Pre exercise	2.18	0.68	2.34	0.55	0.68	0.50
Immediately	2.10	0.71	2.22	0.54	0.49	0.63
Post 15 days	3.72	0.69	2.89	0.69	3.77	<0.001*
Post 30 days	4.19	0.71	3.25	0.73	3.86	<0.001*
F statistic	314.68		108.21			
p value	<0.001		<0.001			

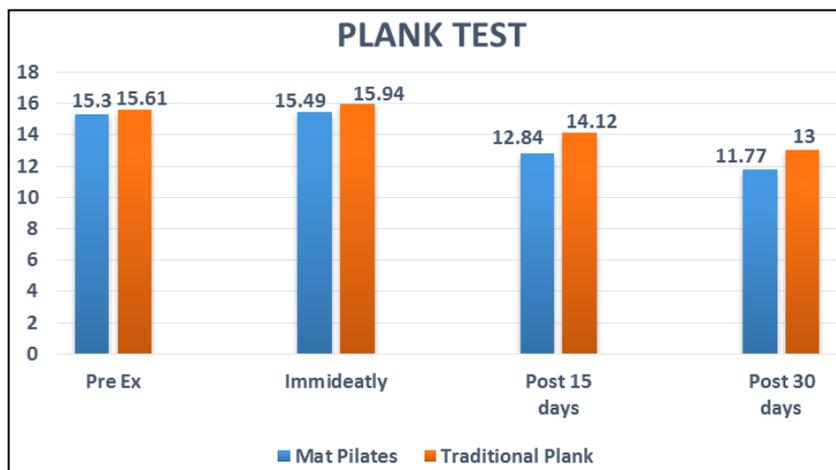


Fig 3: Mean comparison of Plank Test between the groups (no of reps)

The results of the study revealed, no significant difference between mat pilates and traditional plank on balance in badminton players using star excursion balance test in all 8 components (i. Ea nterior, Anterolateral, Lateral, Posterolateral, Posterior, Posteromedial, Medial, Anteromedial) of Both the dominant as well as the non-dominant side. ( $p>0.05$ ).

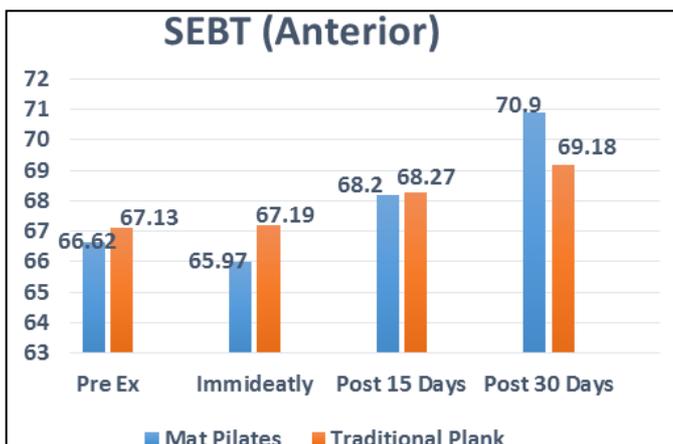


Fig 4: Mean comparison of SEBT (Anterior) between the groups

Table 4: Mean comparison Star Excursion Balance Test (Lateral) between the groups

Lateral	Mat pilates		Traditional plank		t statistic	p value
	Mean	Std. Dev.	Mean	Std. Dev.		
Pre exercise	52.63	4.39	52.34	3.22	0.20	0.85
Immediately	52.67	4.38	52.42	3.15	0.17	0.87
Post 15 days	55.93	5.44	53.41	3.24	1.53	0.14
Post 30 days	57.40	5.39	54.24	3.23	1.93	0.06
F statistic	36.39		201.36			
p value	<0.001		<0.001			

Table 5: Mean comparison Star Excursion Balance Test (Posterior) between the groups

Posterior	Mat pilates		Traditional plank		t statistic	p value
	Mean	Std. Dev.	Mean	Std. Dev.		
Pre exercise	56.62	4.05	57.99	3.93	0.91	0.37
Immediately	56.75	4.05	57.89	4.14	0.74	0.47
Post 15 days	57.55	4.22	58.94	3.96	0.90	0.38
Post 30 days	59.23	4.06	59.61	3.91	0.26	0.80
F statistic	23.11		60.74			
p value	<0.001		<0.001			

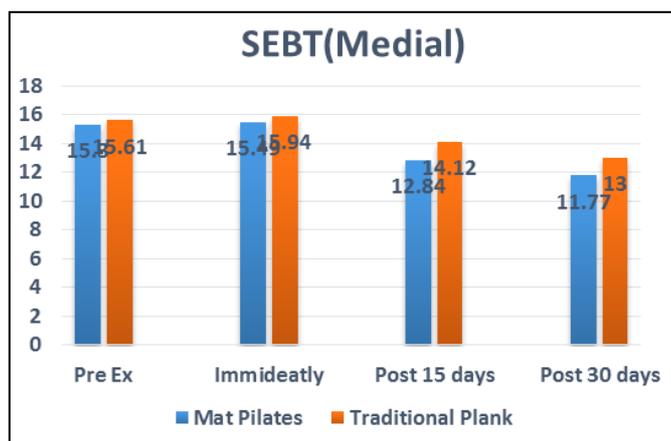


Fig 5: Mean comparison of SEBT (Medial) between the group

The results of the study revealed, significant difference between mat pilates and traditional plank on core muscle strength in badminton players post 15 and post 30 days using Badcamp Agility Test ( $p<0.01$ ).

Table 6: Mean comparison of Badcamp Agility Test(seconds) between the groups

Badcamp Agility Test(seconds)	Mat pilates		Traditional plank		T statistic	P value
	Mean	Std. Dev.	Mean	Std. Dev.		
Pre exercise	15.30	1.40	15.61	1.59	0.55	0.59
Immediately	15.49	1.47	15.94	1.86	0.71	0.48
Post 15 days	12.84	1.24	14.12	1.37	2.77	0.001*
Post 30 days	11.77	1.04	13.00	1.23	2.97	0.006*
F statistic	450.36		116.91			
p value	<0.001		<0.001			

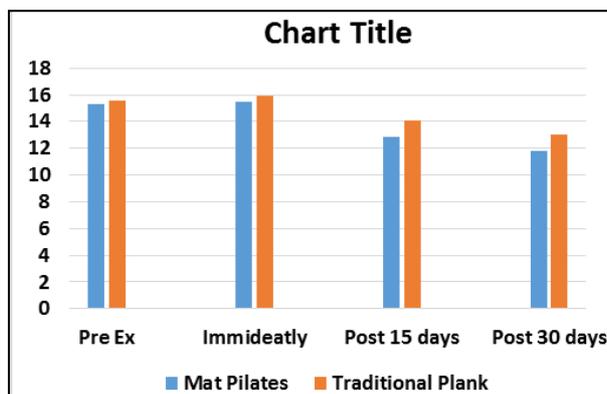


Fig 6: Mean comparison of Badcamp Agility Test(seconds) between the groups

## Discussion

The Study aimed to find the effect of mat pilates and traditional plank on core muscle strength, balance and agility in elite badminton players. The subjects in this study had similar baseline values of age, height, weight and BMI.

The results of the study revealed that although both the groups improved at the end of 3<sup>rd</sup> and 5<sup>th</sup> week in all the respective parameters, But group A i.e Mat Pilates group showed more improvement in Core Muscle strength as measured by Sit-up Test and Plank Test and agility which was measured by the badcamp agility test compared to Group B i.e. Traditional Plank Group. But, no significant difference was seen in Balance measured by star excursion Balance Test.

Results of this study are similar to study by Yeole UL *et al.*, the effect of core strengthening on dynamic balance and agility in badminton players showed that compared to group that performed conventional exercises. They found out that core strengthening improves ability of the neuromuscular system to perform dynamic, eccentric, isometric stabilization contractions in response to gravity and momentum. Higher core stability performance might lead to improved synchronization of motor units and lowering of neural inhibitory reflexes. Study also determined that core training not only improved core muscle strength but also core stability. Higher core stability performances allow optimal and long sustained contraction of the deeper spinal stabilizer muscles. These stabilizer muscles due to their close proximity with the spine are responsible for better control of the intersegment motion of the spine and thus a better control of the body's COG. Thus, Pilates training group had significant improvements in agility, core strength, neuromuscular coordination and dynamic balance at the end of 4 week of training [7].

Tarik Ozmen, Mert Aydogmus, Studied effect of core strength training on dynamic balance and agility in adolescent badminton players. According to them the Core muscles function as a rigid cylinder and a greater moment against body perturbation while providing a stable base for lower and upper extremity mobility. The CST Improves strength in pelvic girdle muscles such as the abdominals and the erector spinae. Also the flexibility and strength of hip and thigh muscles of moving limb in the target directions may effect reach distance while participants stand on single limb during SEBT It was concluded that 6 weeks of CST improves dynamic balance and core endurance but not agility in adolescent badminton players. The strengthening of core muscles might be contributed to athletic performance. Coaches should incorporate core strengthening exercises into badminton training [3].

S.H. Bassett And Llyod L. Leach found The effect of an eight-week training programme on core stability in junior female elite gymnasts. According to them the core muscles offer saggital and coronal plane stabilization. The given interventions may have improved the core strength which would have contributed to increase in core stability. They concluded that traditional core stability training is beneficial to gymnasts in terms of enhancing core endurance times up to 20 second intervals, which may be beneficial to performance [14].

Results of the study are similar to study by Yadav P *et al.* A pilot study which was done to assess the efficacy of Pilates on agility and coordination skills in badminton players concluded that there was a significant improvement in agility and coordination skills as measured by shuttle run test and hand eye coordination test by 41% and 63% respectively after an

intervention of 5 weeks hence Pilates training can enhance control of trunk movement that causes improvement in Agility [7, 9].

In any of sporting activities, the performance is influenced by the psychological status of that athlete. Pilates exercises also concentrate on the mind and body coordination. If done in proper manner pilates can reduce anxiety and enhance athletic performance. The Mat Pilates group had much significant improvement than Traditional Plank Group, As the regular use of Pilates exercise might have led to strengthening of abdominal and core muscles, flexibility of truncal muscles and increased the biological capacity efficiency by breathing control [15].

## Conclusion

The Study aimed to find the effect of mat Pilates and traditional plank on core muscle strength, balance and agility in elite badminton players. It was found that Both Groups improved the parameters respectively but comparatively. But, Group A i.e. Mat Pilates was more effective in improving Core muscles strength and agility than Group B i.e. Traditional Plank and no significant difference was seen in Balance as seen by One min sit-up test, Plank Test, Star excursion balance test, badcamp agility test. Coaches should incorporate Mat Pilates exercises into badminton training to improve core muscles strength, balance and agility.

## Acknowledgement:

The Authors are highly grateful to all the players who participated in this study. To District Sports officer, District Sports Complex, Sangli. To the Coach of Timeer's School of Badminton, Sangli for helping in conducting this study and to all others who were directly or indirectly associated with this study.

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