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Effectiveness of Pilates vs. Traditional Plank in Core-Strength, Balance and Agility among Badminton Players: A Randomized Controlled Trial

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ABSTRACT

Background of the study: Badminton requires exceptional core strength, balance, and agility for optimal performance. Core stability is fundamental for powerful strokes, rapid directional changes, and injury prevention in racquet sports. This study compared the effectiveness of mat Pilates exercises versus traditional plank exercises on core muscle strength, dynamic balance, and agility in recreational badminton players.

Methodology: A randomized controlled trial was conducted over six months at Sports Complex, Peshawar, using convenience sampling. Twenty-eight recreational badminton players were randomly allocated into two equal groups. Group A received mat Pilates exercises while Group B performed traditional plank exercises. Outcome measures were assessed at baseline and after six weeks of intervention. Data analysis was performed using paired sample t-tests for within-group comparisons and independent t-tests for between-group analysis via SPSS-22.

Results: Participants had a mean age of 19.86±2.70 years and BMI of 21.85±1.75 kg/m². Both groups demonstrated significant improvements in core muscle strength ($p<0.05$) and agility ($p<0.05$). Balance improvements were non-significant ($p>0.05$) except in anterior and anterio-medial directions ($p<0.05$). No significant between-group differences were observed.

Conclusion: Both mat Pilates and traditional plank exercises effectively improved core strength and agility in recreational badminton players, with minimal impact on overall dynamic balance.

Keywords: *Balance, Core Stability, Exercise Movement Techniques, Racquet Sports, Rehabilitation.*

INTRODUCTION

Sports performance is influenced by a wide variety of factors, including physical (both common and uncommon circumstances), psychological (personality and motivation), social, and physical elements[1]. Badminton is not a technical and complex recreational activity bit it does require a lot

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of core strength and complete body power for strokes, effective smashes, attentiveness, strong balance and coordination throughout postural motion on the court. In order to be competitive in badminton, player must be able to move swiftly toward a well balance position where they can handle the shuttlecock quickly[2].The core strength training also make it smooth to enhance swing stability and muscle coordination between lower and upper intensities, and also lowering the risk of injuries and muscle imbalance[3].Pilates observed a system of diverse physical exercises in the twentieth century which had been purposely designed to improve the thoughts and body of human[4]. It improves muscle tone, strengthens the core muscle group, improves flexibility, improves body awareness, protects from injuries, builds posture and balance stability, and allows relaxation of movement in daily life. Various athletes have utilized the Pilates method to improve their health-related fitness.Additionally, people with LBP, medical problems, and knee arthritis have used the Pilates method to improve their flexibility, strength, and balance[6]. Much prior research has concluded that the Pilates method enhances strength, muscular flexibility and different medical-associated results[7]. Core strength is described as the strength that transfers and connects the upper and lower extremities, managing the movement of the center of gravity, and stabilizing the central portion of the body[8]. The stability of core muscles plays an essential role in preventing numerous injuries like knee injuries, hip joints, and lumbar spine. To further improve the stability of the trunk, plank exercises are extensively used and are considered to be more beneficial and preventive for trunk balance exercises [10]. The previous studies have shown a positive impact of the plank exercise. Most of the previous studies have confirmed that adjustments occurred in muscle strength and the activity of muscle tissues. The studies based on the thickness adjustments are microscopic. The effects on the thickness of the rectus abdominis are extrinsic; oblique doubling is being investigated, simple data and application opportunities have been displayed as stabilization exercises in medical practices[11]. In recent times Pilates is regularly used to correct posture and improve fitness. For the human body, balance maintains the body shape under the effect of gravity, each inner and outer forces lowering the overall forces affecting the body[12]. The balance stability in the constructing of high performance and the showing of competencies has significant region in all sports activity branches[13].The impact of an 8-week education training program on core balance in junior girl elite gymnasts showed that conventional core stability training is advantageous to gymnasts in terms of improving core endurance instances up to twenty seconds interval, which may be helpful in overall performance[14]. Agility is another crucial physical adequacy for performance in sports[15]. Sheppard and Young put out a new definition for agility as a quick change in speed/direction in response to an external stimulus. Therefore, jobs requiring preplanned movements should be classified as requiring change of direction (COD) rather than agility[16]. Recent years have seen an increase in the admiration of badminton and participation of players in it as the sport's promotion, skill level, and fitness levels rise. Research had been performed on the core muscle strength, agility, and balance of professional badminton players. However, there has been no data available on the contrast of these variables in recreational players having different body features and fitness. This study was conducted to determine how the Pilates method and the conventional plank affected the athletes' balance, agility, and strength in their core muscles. The recommended speculation of this study is that there might be an enormous distinction between Pilates and traditional plank in the core muscle strength, agility, and balance in recreational badminton players. The objective of the study is to evaluate the effect of Pilates exercise and traditional plank exercise on core muscle strength, balance, and agility in recreational badminton players.

METHODOLOGY

A randomized control trial was conducted using the convenience sampling technique. The data was collected from the Sports Complex, Peshawar. The study duration was 6 months after the approval of the research board. The sample size was calculated using an online OpenEpi tool for the variable BADCAMP agility test. According to this study, a total of 28 participants would be

included, divided into two groups, 14 each. The criteria for recruiting the participants include: Both genders, male and female, aged 15-35 years, playing badminton for more than one year, and engaging in badminton for more than three days a week. Exclusion criteria included having a recent injury history, having musculoskeletal, neurological, or cardio-respiratory disorders that impair their playing activities and decrease their ability to participate. All individuals received an explanation of the procedure program and signed the informed consent. Demographic data such as the name of the participant, age, height, weight, BMI, experience of playing and history of previous injuries were recorded in the records series sheet. Group A includes players designated as Mat Pilates exercise, and Group B consists of players assigned as traditional Plank exercise. A total time of 45 minutes for training program (exercise) was selected for both Group A and B. Group A (Pilates exercise program) for I, II and III weeks includes three sets of 8 repetitions of Standing footwork, Hundreds with knee straight, Articulating bridge, Rolling like a ball, Plank followed by three sets of 15 repetition in the week IV and V. Group B (Traditional plank exercise program) for I, II and III weeks includes three sets of 8 repetitions of Prone bridge, Side bridge, On exercise ball supine bridge, On exercise ball prone bridge, On exercise ball superman followed by three sets of 15 repetition in the week IV and V. All position was hold for 15 seconds. Rest interval between the exercises was 10-20 seconds, and between sets of exercises was 45-60 seconds. Both groups received exercises for 6 weeks. There will be two sessions per week. All subjects had an assessment for core muscle strength, agility and dynamic balance before and after 6 weeks of exercises. The core muscle strength was measured with the help of a one-minute sit-up test and plank test (ICC = 0.98-0.99). The player lay supine on the floor with their bent knees at a 90-degree angle, both hands at their head side, with elbows pointing straight. To do an accurate sit-up execution, the elbows ought to contact the knees and then move back so the shoulders touch the floor. The SEBT (ICC 0.86 to 0.92) was carried out with the player standing amid a ground-based grid with eight lines extending at 458 increments from the grid's center for the measurement of dynamic balance. According to the direction of the excursion about the stance leg, the eight lines have been grouped into the following categories: Anterolateral (AL), Anterior (A), Anteromedial (AM), Medial (M), Posteromedial (PM), Posterior (P), Posterolateral (PL), and Lateral (L). The contestant stood on one leg while extending the other leg as far as they could to complete the SEBT. The participant-maintained balance by softly touching the line's farthest point with the most distal portion of their feet before returning to a bilateral stance. From the grid center to the contact point, the area was transformed into a tape measure with a tape degree in centimeters. The BADCAMP Agility test (ICC = 0.93) was used to test the players' agility, and it involved them standing in the center of the badminton court. Six objectives were positioned at six ends of the court square (5.6 x 4.2 m). The player was given command, the examiner first marked the corners that the player needed to follow. The players must touch each of the six markers as positively marked by the examiner. All participants completed the exam three times, with the fastest time accounting for the assessment. There is a rest period of at least one minute in between each trial. The data was entered and evaluated by using SPSS-22 software and expressed in a structure of tables and figures. All variables, mean, and standard deviation were calculated. The significance level is set at $p<0.05$. For between-groups analysis, parametric tests such as the Independent t-test and the paired sample t-test were used to compare the inter-group difference within the evaluation of the data collection for all variables.

RESULTS

A totall of 28 players had participated. In which 21 were males and 7 were females. Participants' mean age was 19.8571 ± 2.70 years, mean height was 1.7611 ± 0.12991, and the mean weight was 67.6786 ± 6.97112. The mean BMI was 21.8464 ± 1.745 kg/m^2 which showed that the majority of participants were in normal BMI range. Mean comparison of outcome measures was done for players in both groups. As within group comparison values showed that there was statistically

significant improvement. On the other hand Group A (1643.00 ± 42.86) Group B (51.28 ± 1.63) p>0.05, results are insignificant as shown in Table-1.

Table-1: Within Group Comparison of Group A and Group B

		Group A (Mat Pilates Exercise)				Group B (Traditional Plank Exercise)			
		Mean	**SD**	**MD**	**P-value**	**Mean**	**SD**	**MD**	**P-value**
BADCAMP Test	Pre	12.58	.45	5.75	.000	12.76	1.91	6.60	.000
	Post	6.83	.28			6.15	.23		
SEBT Ant	Pre	157.78	4.70	-33.72	.031	162.52	19.70	22.21	.001
	Post	191.50	15.10			140.30	4.79		
SEBT Ant. Lateral	Pre	149.72	4.52	-68.32	.000	155.66	22.95	-68.35	.000
	Post	218.05	9.60			224.01	46.02		
SEBT Lateral	Pre	165.50	6.71	-46.12	.000	165.26	24.71	-32.08	.012
	Post	211.62	8.52			197.35	31.98		
SEBT Post. Lateral	Pre	149.12	4.40	-32.73	.000	156.20	16.96	-26.15	.002
	Post	181.86	3.82			182.35	22.28		
SEBT Post	Pre	141.51	4.75	-26.06	.000	152.45	23.54	-18.92	.033
	Post	167.57	5.04			171.38	25.30		
SEBT Post. Med	Pre	143.40	3.02	-31.32	.000	151.53	21.20	-28.19	.001
	Post	174.72	4.49			179.72	22.13		
SEBT Med	Pre	141.73	4.56	-54.42	.000	147.94	25.12	-39.64	.000
	Post	196.15	8.48			187.58	29.95		
SEBT Ant .Med	Pre	144.47	4.28	-10.82	.002	158.67	17.90	-11.07	.000
	Post	155.30	4.70			169.75	17.01		
SEBT Total	Pre	1914.05	708.09	271.04	.715	1243.92	166.02	-347.40	.000
	Post	1643.00	42.86			1591.32	214.80		
SEBT Percent	Pre	13.96	.41	-5.15	.000	14.75	2.40	-4.25	.000
	Post	19.12	.56			19.01	3.40		
One Min Sit-Up Test	Pre	49.78	2.38	-11.92	.009	49.42	7.93	-1.85	.374
	Post	61.71	3.25			51.28	1.63		

Between the groups comparison shows a significant difference between both groups on core muscle strength in badminton players after sixth weeks of intervention using the use of One Min sit-up test and BADCAMP test (p< 0.05). However for balance, star excursion balance test shows insignificant difference between group A and group B in badminton players except (Anterior, Anterio-medial) of each the dominant and non-dominant side after 6 weeks of intervention (p< 0.05) shown in Table-2.

Table-2: Between Group Comparison

		Group A (Mat Pilates exercise)		Group B (Traditional Plank Exercise)		MD	P-value	Df
		Mean	**SD**	**Mean**	**SD**			
BADCAMP Test	Pre	12.58	.45	12.76	1.91	-.17	.805	25.69
	Post	6.83	.28	6.15	.23	.68	.028	14.24
SEBT Ant	Pre	157.78	4.70	162.52	19.70	-4.73	.508	25.67
	Post	191.50	15.10	140.30	4.79	51.20	.005	13.18
SEBT Ant .Lateral	Pre	149.72	4.52	155.66	22.95	-5.93	.443	23.92
	Post	218.05	9.60	224.01	46.02	-5.95	.706	24.55
SEBT Lateral	Pre	165.50	6.71	165.26	24.71	.23	.980	25.99
	Post	211.62	8.52	197.35	31.98	14.27	.248	26.00
	Pre	149.12	4.40	156.20	16.96	-7.07	.273	25.97

SEBT Post. Lateral	Post	181.86	3.82	182.35	22.28	-.49	.945	22.16
SEBT Post	Pre	141.51	4.75	152.45	23.54	-10.94	.177	24.18
	Post	167.57	5.04	171.38	25.30	-3.80	.655	24.03
SEBT Post. Medial	Pre	143.40	3.02	151.53	21.20	-8.13	.217	19.84
	Post	174.72	4.49	179.72	22.13	-5.00	.506	24.26
SEBT Med	Pre	141.73	4.56	147.94	25.12	-6.20	.451	22.88
	Post	196.15	8.48	187.58	29.95	8.57	.469	25.91
SEBT Ant .Medial	Pre	144.47	4.28	158.67	17.90	-14.20	.036	25.69
	Post	155.30	4.70	169.75	17.01	-14.45	.036	25.69
SEBT Total	Pre	1914.05	708.09	1243.92	166.02	670.12	.354	13.10
	Post	1643.00	42.86	1591.32	214.80	51.68	.477	24.05
SEBT Percent	Pre	13.96	.41	14.75	2.40	-.790	.311	22.27
	Post	19.12	.56	19.01	3.40	.107	.921	21.81
One Min Sit-Up Test	Pre	49.78	2.38	49.42	7.93	.357	.912	25.65
	Post	61.71	3.25	51.28	1.63	10.42	.004	13.47

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DISCUSSION

The study objective was to evaluate the comparison between mat Pilates exercise and traditional plank exercise on core muscle strength, balance, and agility in recreational badminton players. According to the study's findings, both groups had improved in all the respective parameters by the end of the sixth week of sessions. A significant difference was seen in core muscle strength, and agility measured by a One-minute Sit-up test and BADCAMP test respectively. However, there was no significant difference shown in the result except (anterior, anterio-medial), which was measured by SEBT. The present study findings have proved that the stated training manner is beneficial for enhancing the Pilates and traditional plank on core muscle strength, balance stability, and agility in recreational badminton players. According to a study, strengthening the core increases the neuromuscular system's capacity to carry out dynamic, eccentric, isometric stabilizing contractions in response to gravity and momentum. Higher motor unit synchronization and less neural inhibitory reflexes may be the cause of improved core stability and normal overall performance. Additionally, a previous study found that improving core stability as well as core muscular strength is achieved by core training. Higher performance levels in the core stabilizer muscle groups enable optimum and prolonged sustained contraction. Stabilizer muscle groups, because of their proximity to the spine, are accountable for better management of the inter segment motion of the spine and, for this reason, COG will be better control. This study concluded that core stability exercise program results in improvement of dynamic balance and agility[17-18]. A study was conducted in 2022 on the impact of neuromuscular education on single limb stability in younger female athletes. Three sessions per week for a six-week training exercise improved balance. The findings revealed a considerable improvement in young female athletes' single limb stability[16]. S.H. Bassett and Llyod L. Leach studied the effects of 8-week training regimen on junior elite gymnasts' core muscle stability. It was determined that performing standard core muscle stability exercises helped gymnasts increase their core endurance times up to twenty-second intervals, which may have improved performance[19]. The study was carried out to determine how dynamic balance and agility in badminton players were affected by core training. It proposed that badminton players' balance stability would increase following a six-week program of core strengthening exercises. The findings of this study supported the possibility that core strengthening might improve dynamic balance, stability, and agility[20]. The purpose of another study is to determine the effectiveness of core muscle stabilization training exercises on endurance and balance stability in cricketers. Star excursion increase distance significantly from pre and posttest for the exercise group. The core muscle can play an integral function in dynamic balance and movement[21]. Lotfy S. and colleagues researched Pilates' impact on biological efficiency and lower limb strength. They concluded that Pilates enhances trunk muscular strength, which enhances limb motor coordination

and, ultimately, enhances motor performance[8]. Pilates training is an efficient way for cricket players to build physical skills including abdominal muscular strength, hamstring muscle flexibility, agility, speed, and power. This can, in addition, improve the overall performance of cricket players[22]. A study conducted in 2022 reported that the MSEBT lower limb anterior, posteromedial, and composite scores have a weak to moderately positive significant connection with the plank test of isometric core muscular strength, as well as substantially with the non-dominant anterior reach[23]. The limitation of the study is small sample size and limited age group because of which result cannot be generalized, another limitation of the study is that the ratio of the female participants was low. Professionals can effectively incorporate agility training into an athlete's overall conditioning program if the athlete is aiming to develop explosive leg power and dynamic athletic performance to a high level

CONCLUSION

This study concluded that both groups are effective in improving core muscle strength and agility. However, there was no significant difference between balance except (Anterior, Anterior-Medial) as evaluated by One min Sit-up test, BADCAMP test and SEBT.

AUTHORS' CONTRIBUTION:
The following authors have made substantial contributions to the manuscript as under:
Conception or Design: Najla Ammar, Maria Arif, Furqan Yaqub, Aadil Omer, Ghazal Azhar
Acquisition, Analysis or Interpretation of Data: Najla Ammar, Maria Arif, Furqan Yaqub, Aadil Omer, Danish Latif, Ghazal Azhar
Manuscript Writing & Approval: Maria Arif, Furqan Yaqub, Danish Latif, Ghazal Azhar

All authors acknowledge their accountability for all facets of the research, ensuring that any concerns regarding the accuracy or integrity of the work are duly investigated and resolved.

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