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EFFECT OF CORE STABILITY EXERCISES AND SURYANAMASKARA ON BALANCE IN FEMALE BADMINTON PLAYERS

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ABSTRACT:

Badminton is considered as one of the most popular sports over the world, in which two or four opposing players strike the shuttlecock over a dividing net between them to score a point. Badminton players need to conduct various movement patterns during the game including specialized twists, jumps, footwork and strike the shuttle cock and to keep it back and forth in the court. Hence, balance has its dynamicity in badminton.

Core stability in athletic setting is defined as the optimum production, which can transfer and control the force from the centre of body to the limbs, through stabilisation of the position and motion of torso. Suryanamaskara called sun salutation is an integral part of yogic approach. it consists of a sequence of 12 yoga postures, which are organised in a specific pattern, each posture counteracting the preceding one producing a balance between flexion and extension, performed with synchronized breathing and aerobic activity.

Balance is an important aspect of everyday life, especially for badminton players so it is imperative to find programs useful for maintaining or improving proper balance. There have been studies in the past demonstrating significant cardiorespiratory, musculoskeletal and metabolic health benefits of core stability and suryanamaskara but there were no comparative studies. Hence, this study is done to compare the effects of core stability exercises and suryanamaskara on balance in badminton players.

This study is a two way experimental study without control group conducted in the department of physiotherapy, SVIMS and the department of physical education S V University. A total 60 subjects were included in the study and were randomly allocated into two groupsi.e; suryanamaskara group and core stability group. Baseline values of SEBT were measured for all the subjects. Protocol is started and followed up for a period of 8 weeks. At the end of the 8 weeks, balance was re assessed by SEBT.

After the analysis, the results revealed significant improvement in balance by using star excursion balance test in both the groups ($p < 0.01$). The subjects of core stability group showed significant results when compared with suryanamaskara group. Hence the study concluded that core stability exercises was more significant than suryanamaskara group in the improvement of balance.

KEYWORDS:

CORE STABILITY, SURYANAMASKARA, BALANCE, STAR EXCURSION BALANCE TEST.

INTRODUCTION

Outdoor and recreational sports participation is increasing in adolescents and an increase in the frequency or duration of recreational sports participation is leading to proportional increase in the incidence of activity induced musculoskeletal injury[1]. In this changing scenario, fitness training and injury prevention, programs incorporating spinal muscular training, including core strengthening and suryanamskaraexercises have become popular because the core is considered to be the anatomic and functional centrepiece and the power house of the body [2].

Badminton is considered as one of the most popular racket sports over the world, in which two or four opposing players strike a shuttlecock over a dividing net between them to score a point. The overhead technique is one of the three main categories of badminton strokes, which divided into three strokes drop, clear and smash. In addition, the forehand and backhand overhead strokes commonly are a fundamental demand to play badminton. 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 [3].

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 [4]. Therefore, badminton players need enough strength and a high level of dynamic balance during the rapid postural movements around the court.

Postural control or balance is defined as an ability to maintain a base support with minimal movement actions and dynamically to perform a motor task while maintaining a stable position. Indeed, balance is the ability to maintain dynamic integration of interior and exterior forces during motor action tasks [3].

Balance is a complex process involving the reception and integration of sensory inputs, and the planning and execution of movement; to achieve a goal requiring upright posture; it is the ability to control the centre of gravity (COG) over the base of support in a given sensory environment [5].Balance is an integral component of most of the daily activities. As a complex sensorimotor function, balance control requires the integration of multiple systems such as vestibular, visual, and somaesthetic information into the central nervous system (pyramidal, extrapyramidal and cerebellar systems) in order to maintain antigravity postures and to produce a suitable response to any perturbation.

Balance is usually considered a static process, and in fact is a comprehensive, dynamic three-dimensional process contains multiple neural pathways. Badminton is a dynamic equilibrium process which involves loss of balance.Thus, players need body coordination and dynamic balance [3]. In context of impaired trunk control and weak balance ability, previous studies have confirmed that efficient neuromuscular control of trunk stability and a perfect trunk muscle recruitment patterns are vital factors for the control of spinal load in relation to given task or position during the body movement [6].

Suryanamaskara called sun salutation is an integral part of yogic approach. Surya namaskara includes 12 asanas (postures) organized in a specific pattern. In other words it is an ancient technique of yoga, performed in sequence while facing the rising sun. Asanas or postures are to stabilize body and mind through static stretching. In Suryanamaskara, the alrternating pattern of backward and forward bending strengthen spinal cord and limbs to a maximum range[7].

According to Kibler, core stability is defined as "the ability to control the position and motion of the trunk over the pelvis to allow optimum transfer and control of force and motion to the terminal segment in integrated athletic activities. The function of core musculature is better explained by dividing the trunk muscles into local and global categories. Local muscles are defined as those attaching to the lumbar vertebrae and influencing inter-segmental motion, while global muscles attach to the hips and pelvis and provide mobility and proper orientation of the spine. The abdominal muscles, consisting of the transverseabdominis, rectus abdominis, and internal and external obliques, are involved primarily in controlling the position of the spine and pelvis [8].

It is believed that the core is important because of its anatomical location in the body where centre of gravity is located, thus where the movement stems. It functions to maintain the postural alignment and dynamic postural equilibrium during functional activities, which help avoid serial distortion patterns. The core musculature involves the muscles of the trunk and the pelvis that are responsible for maintaining the stability of the spine and pelvis[8]. Thus, it acts as a base for motion of the distal segments, or "proximal stability for distal mobility". Hence, it can be said that the stability of the core musculature is responsible for optimizing the functioning/performance of lower extremity and improved balance.

Star excursion balance test (SEBT) for dynamic stability is a simple, reliable and valid method of lower extremity functional performance and it is a low-cost alternative to more sophisticated instrumented methods that are currently available[1].

Previous studies have reported that balance measures like SEBT improve after 6 week core stabilization program, with few studies stating that there is significant correlation of the lower extremity balance performance with that of the core stability. However, the effect of core strengthening on dynamic balance performance in badminton players has not been reported in quantitative fashion till date conclusively. Thus, the aim of the present study was to compare the effects of core stability exercises and suryanamaskara on balance in badminton players.

NEED OF THE STUDY

Balance is an important component in badminton players to smash effectively. Badminton players need to conduct various movement patterns during the game including specialized body mechanics to strike the shuttle cock and to keep it back and forth in the court. The core plays an integral role in multi planar movement and postural control. Core muscles are activated prior to the gross body movements.Since balance is such an important aspect of everyday life, it is imperative to find programs useful for maintaining and improving proper balance. There have been studies in the past demonstrating significant cardiorespiratory, musculoskeletal and metabolic health benefits of core stability and suryanamaskara but there were no comparative studies between them. So, the need of the study is to compare the effects of core stability exercises and suryanamaskara on balance in badminton players.

AIM OF THE STUDY

To compare the effect of corestability exercises and suryanamaskara on balance in femalebadminton players.

OBJECTIVES OF THE STUDY

- To examine the effect of core stability on balance using SEBT.
- To examine the effect of suryanamaskara on balance using SEBT.
- To compare the effect ofcore stability exercise and suryanamaskara on balance.

HYPOTHESIS

Null hypothesis: There is no significant difference between core stability exercises and suryanamaskara on balance in female badminton players.

Alternate hypothesis: There is a significant difference between core stability exercises and suryanamaskara on balance in female badminton players.

MATERIALS

Electrical tape

Inch tape

Chalk piece

METHODOLOGY

STUDY DESIGN: Two way experimental study without control group.

ETHICAL COMMITTEE APPROVAL: Ethical approval was obtained from the Institutional EthicsCommittee (IEC) fromSVIMS UNIVERSITY, with IEC NO:-968.

STUDY SETUP: The study was conducted in the department of physiotherapy, SVIMS and department of physical education S V University.

SAMPLING TECHNIQUE:Subjects were selected through simple random sampling technique.

STUDY DURATION: 2 months (8 weeks)

SAMPLE SIZE CALCULATION :The minimum sample size was found to be n = 30 in each groupi.e;

minimum of 60 subjects in both groups. Sample size was calculated using the following formula:

$N= 2 (Z_\alpha + Z_\beta)^2 / (\delta/\sigma)^2$

INCLUSION CRITERIA

I. Age : 18 to 25 years
II. BMI: upto 25kg/m^2
III. Sex : female badminton players

EXCLUSION CRITERIA

I. Age: below 18 and above 25 years
II. BMI: morethan 25 kg/m^2
III. Sex : males
IV. Subjects who had undergone previous core stability training.
V. Subjects who practice suryanamaskara.
VI. Subjects with other injuries.

INTERVENTION

After fulfilling the inclusive and exclusive criteria, 60 badminton players with mean age between 18 to 25 years were randomly allocated into two groups namely suryanamaskara group and corestability group, each group consisting of 30 subjects.

Informed consent was obtained from all the participants. All the participants also received verbal explanations of the exercise program and the tests prior to the commencement of the study.

The pre values of balance were assessed by Star Excursion Balance Test (SEBT). Before the SEBT was performed, a small setup was done,four strips of athletic tape was cut to a length of 6-8 feet each, two pieces were used to form a '+',other two placed over top to form an 'x' so that a star shape is formed. Lines should be separated from each other by a 45° angle. The goal of the SEBT is to maintain single leg stance on one leg while reaching as far as possible with the other leg.

Initially subject was made to stand in the center of the star, and must maintain their balance on one leg, while using the other leg to reach as far as possible in 8 different directions. The subject must reach in 8 different positions, once in each of the following directions: anterior, anteromedial, medial, posteromedial, posterior, posterolateral, lateral and anterolateral.

1. Anterior
2. Anteromedial
3. Medial
4. Posteromedial
5. Posterior
6. Posterolateral
7. Lateral
8. Anterolateral

TEST PROCEDURE

Warm-up

Participants were made to warm upthoroughly, prior to the commencement of the test, it corresponds to the biomechanical and physiological nature of the test. In addition, sufficient recovery (e.g. 3-5 minutes) was given following the warm-up and prior to the commencement of the test.

Conducting the test

Subjectswere instructed to wear lightweight clothing, and should be with bare foot.They were instructed to stand in the centre of the star and await further instruction.

When using the right foot as the reaching foot, and the left leg to balance, the subject is instructed to complete the circuit in a clockwise fashion. Likewise, when balancing on the right leg, the subject was instructed to perform the circuit in an anti-clockwise fashion.

Subjects were asked to place their hands firmly on their hips and then instructed to reach with one foot as far as possible and lightly touch the line before returning back to the starting upright position.

With a chalk piece, the spot was marked where the subject touched the line with their toe. This is measured from the centre spot after the test to

calculate the reach distance of each reach direction. Reach distances were recorded to the nearest 0.5cm.

Subjects were asked to repeat this with the same foot for all reach directions before changing foot. After completing full circuit (every reach direction) with each foot, they were then permitted to step away from the testing area.

Recordings were made to each reach distance of each successful attempt, in order to calculate the subjects SEBT score.[33]

SURYANAMASKARA GROUP

After randomization process, 30 subjects were included in suryanamaskara group and started the session with warm up for a period of 5 minutes which included brisk walking for 2minutes and major muscle group stretchings for 3 minutes.

Pranamasana (Prayer pose) – 1st& 12th Pose

Pranamasana or the prayer pose is the starting and twelth pose for suryanamaskara. In sanskrit, the word pranam means to pay respect; so this asana known as pranamasana.

Method: Subjects were asked to stand erect with folded hands close to the chest and palms were held together in the form of prayer pose and they were asked to look straight ahead andinstructed to exhale the breath normally.

Hastauttanasana (Raised arms pose) - 2nd& 11th pose

Hastauttanasana or the raised arms pose is part of the suryanamaskara series come at 2nd and the 11th steps.

Method: Subjects were asked to raise both the hands up above the crown from pranamasana pose and were asked to bend the trunk and neck slightly backward.

Padahastasana (Hand to foot pose) - 3rd & 10th pose

Padahastasana or the hand to foot pose is part of the suryanamaskara series which comes at 3rd and the 10th steps.

Method: Subjects were asked to bend forward from hastauttanasana pose and try to touch the floor with their both hands and were asked to exhale breathe normally while bending forward.

Ashwasanchalanasana (Equestrian Pose) – 4th & 9th pose

Ashwasanchalanasana or the equestrian pose is part of the suryanamaskara series which comes at 4th and the 9th steps.

Method: Subjects were asked to stretch the left leg as far back as possible from padahastasana pose while inhaling the breath normally. At the same time, they were asked to bend the right knee while looking straight ahead they were instructed to keep their hands straight with fingers touching the floor. Arch should be made at the back a little with head tilted back. The same steps should be repeated with left knee in the second round of suryanamaskara.

Parvatasana (Mountain Pose) – 5th & 8th pose

Parvatasana or the mountain pose is part of the suryanamaskara series which comes at 5th and the 8th step. In sanskrit terminology, ―parvata means mountain and this pose looks like a mountain so it is known as parvatasana.

Method: Subjects were asked to take the right leg backward from ashwasanchalanasana pose and asked to place parallel to the left leg and should raise the buttocks at the same time. Hands should be placed straight supporting the weight of the body. The head should be placed between the hands.

Ashtanganamaskara (Eight-limbed salutation) – 6th pose

Ashtanganamaskara or the eight-limbed salutation is part of the suryanamaskara series,which comes at 6th step. In this pose, the body touches the ground in eight locations –the head, the chest, the two palms, the two knees, and the two toes. In Sanskrit grammar, ―ashta means eight and anga means part. Hence this asana is known as ashtanganamaskara.

Method: Subjects were asked to lower the body to the ground from parvatasana pose in such a way that it touches the floor at eight locations.

Bhujangasana (Cobra pose)- 7th pose

Bhujangasana is also famous as a cobra pose in yoga. The meaning of bhujanga in Sanskrit means cobra snake and asana means pose. In this asana, person‘s head and trunk resembles a cobra with raised hood, hence the name bhujangasana. It is a major backward bending asanas used in yoga. It appears as the 7th pose in the suryanamaskara series ofasanas.

Method: Subjects were asked to raise the body by using the hands from ashtanganamaskara pose and were asked to arch head backward. This position looks like the cobra which has raised its hood.[37,38,39]

After 5 minutes of warm up, subjects were instructed to do suryanamaskara exercises. On the day one, all the subjects were explained about the poses clearly and were clarified with their doubts. From the next day subjects were allowed to do based on instructions. There was a designed protocol which the subjects should follow.In the first 1 to 10 sessions, 5cycles of suryanamaskarawas be done with 2 minutes of rest in between each cycle. In the next 11 to 20 sessions, 10 cycles of suryanamaskarawas performed with 2 minutes of rest in between each cycle. In the last 21 to 40 sessions, 12 cycles of suryanamskara had to be performed with 2 minutes of rest in between each cycle. At the end of each session, cool down was performed for a period of 5 minutes which include mainly stretchingsof major muscle group.

CORE STABILITY GROUP

Core stability (or core strengthening) has become a wellknown fitness trend that has started to transcend into the sports medicine world. The core can be described as a muscular box with the abdominals in the front, paraspinals and gluteals in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom. Within this box are 29 pairsof muscles that help to stabilize the spine, pelvis, and kinetic chain during functional movements. Without these muscles the spine would become mechanically unstable. The core is particularly important in sports because it provides proximal stability for distal mobility. Core stability exercises appear to be especiallyimportant in cases of imbalance.A core exercise program should be done in stages withgradual progression. A core stability exercise programbegins with recognition of the neutral spine position (midrange between lumbar flexion and extension), touted to be the position of power and balance for optimal athletic performance in many sports.

1. **Supine bridge**

   Subjects were asked to lie in the supine positionwith knees bent and feet flat on ground, arms by sides, palms facing down. They were now asked to bridge upwardby pushing through the heels and lifting the hips off the ground. As the hips come up, they were asked to try to squeeze gluteus muscles for a few seconds, then slowly lower the hips and repeat the exercise. Instructions were given to keep head on the floor at all times.[40]

2. **Prone bridge**

   The starting position for the prone bridge is similar to the push-up, except the elbows are bent and the forearms flat on the floor. The palms can either rest on the floor or can be together with the fingers interlaced. Next, subjects were asked to use their elbows and toes to hold the body up off the floor. It is important to keep back flat, abs tight, and body completely straight. Instructions were given to hold this position for 10 seconds.

3. **Full plank**

   From the position of prone bridge, subjects were asked to straighten the elbows with palm resting on the ground and maintained for 10 seconds.

4. **Arm plank**

   Full plank is taken as starting position, subjects were asked to take left hand off the floor, holding it lightly alongside while maintaining the plank position, with shoulders and hips parallel to the floor. Subjects were instructed to hold this position for 10 seconds.
   After 30 seconds, they were asked to bring left hand back to the floor and switch sides, bringing right arm up and holding it along side as maintain plank position.Hold for 10 seconds on this side as well, and then return to the starting position.

5. **Plank knee tucks**

   Instructions were given to take supine position as the starting position, from this position subjects were asked to flex knees and abdomen as one unit and extend as one unit at a time, repeated for 10 times.

6. **Crunches**

   Supine position is taken as starting position with knees flexed, subjects were asked to lift up head and neck as much as possible for 10 times.

7. **Diagonal crunch**

   In the supine position with right hip flexed and left knee flexed subjects were asked to do the crunch diagonally to the left side. For the other side it was done oppositely i.e., with left hip flexed and the right knee flexed, crunch was done diagonally to the right side and were asked to repeat this alternatively for 10 times.

8. **Reverse crunch**

   Supine position is taken as starting position with hip and knee flexed to 90 ˚ and then subjects were instructed to lift off the hip from the ground and were asked to repeat this for 10 times.

9. **Hip cross overs**

   Supine position is taken as starting position, with arms outstretched at side, knees bent and heels on the ground.Subjects were asked to slowly fall their both legs to the left until they touch the ground.Then legs should be twisted toright and were asked to repeat for 10 times.

10. **Pitcher squat**

    Subjects were asked to split their stance with the back foot placed on a bench or chair i.e., approximately the height of knee, by keeping spine straight, they were asked to perform a lunge until the thigh of stance leg is parallel to the ground. Back is pushed up to return to the starting position.

11. **Knee drive**

    Standing is taken as starting position, subjects were instructed to place left foot in air and drive through, as full extension is reached with left leg, they were asked to drive right knee up and press left leg on to ground. Subjects were asked to repeat on opposite side and continued in alternating fashion.

12. **Knee tucks**

    Full plank is taken as starting position, subjects

were asked to maintain this position by tucking opposite knee to elbow and were asked to repeatthis for 10 times.

After 5 minutes of warm up, subjects were instructed to do core stability exercises. On the day one, all the subjects were explained about the exercises clearly and were clarified their doubts. From the next day subjects were allowed to do based on instructions. There was a designed protocol which the subjects should follow.In the first 1 to 10 sessions, 5cycles of core stability had to be done with 2 minutes of rest in between each cycle. In the next 11 to 20 sessions, 10 cycles of core stability exerciseshad to be performed with 2 minutes of rest in between each cycle. In the last 21 to 40 sessions, 12 cycles of core stability exerciseshad to be performed with 2 minutes of rest in between each cycle. At the end of each session, cool down should be performed for a period of 5 minutes which include mainly stretchings of major muscle group.

STATISTICAL ANALYSIS&RESULTS

The SEBT data was entered into MS excel sheet and tabulated for statistical analysis. The pre and post values were analysed for both thegroups, by using SPSS 22.0 version.

The outcome of this study: star excursion balance test.

To compare the pre and post values of SEBT within the group, simple t-test was performed. Paired t-test has performed between the SEBT values of control and experimental groups. Descriptive measures like mean, standard deviation have been reported along with p-value

TABLE: 1 PRE AND POST MEAN VALUES OF SEBT IN SURYANAMASKARA GROUP

Categories		N	Mean	Std. Deviation	t-value	P-value
Anterior	Pre	30	28.13	5.66	5.61	0.01
	Post	30	35.66	7.23		
Anterior medial	Pre	30	30.20	6.48	6.76	0.01
	Post	30	37.16	7.12		
Medial	Pre	30	29.06	5.96	4.89	0.01
	Post	30	36.25	7.58		
Posterior medial	Pre	30	27.40	5.47	5.26	0.01
	Post	30	34.51	6.72		
Posterior	Pre	30	22.66	5.10	6.12	0.01
	Post	30	29.26	6.25		
Posterior lateral	Pre	30	20.36	4.81	7.88	0.01
	Post	30	31.67	6.34		
Lateral	Pre	30	17.90	3.52	4.31	0.01
	Post	30	24.86	4.97		
Anterior lateral	Pre	30	25.33	5.36	5.86	0.01
	Post	30	33.03	6.58		

RESULTS

Table -1showsthe mean and standard deviation of pre and post values of SEBT for suryanamaskara group. There was a significant improvementin post values.

INFERENCE

On performing the paired t-test, there was a statistical significance ($p<0.01$) existing within the pre and post intervention values for suryanamaskara group.

FIG 1: GRAPHICAL REPRESENTATION OF PRE AND POST MEAN VALUESOF SEBT IN SURYANAMASKARA GROUP.

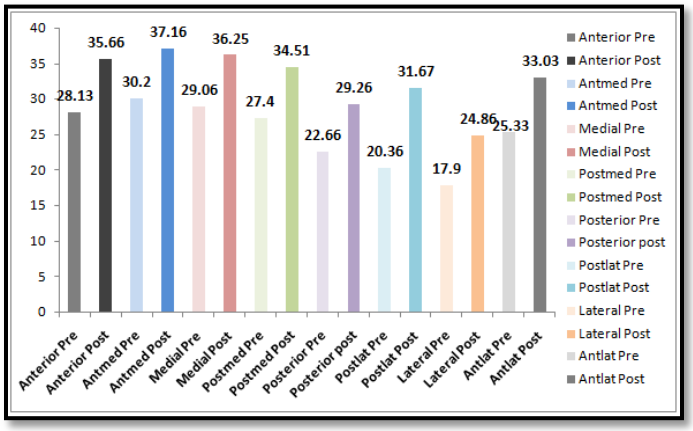


TABLE: 2 PRE AND POST MEAN VALUES OF SEBTIN CORE STABILITY GROUP.

Categories		N	Mean	Std. Deviation	t-value	P-value
Anterior	Pre	30	31.02	6.35	5.26	0.01
	Post	30	38.90	7.87		
Anterior medial	Pre	30	32.21	6.54	6.01	0.01
	Post	30	40.13	8.09		
Medial	Pre	30	31.10	6.74	4.56	0.01
	Post	30	38.86	7.86		
Posterior medial	Pre	30	29.56	6.21	6.33	0.01
	Post	30	37.76	7.50		
Posterior	Pre	30	24.16	4.25	7.71	0.01
	Post	30	33.86	6.12		
Posterior lateral	Pre	30	25.67	5.45	4.14	0.01
	Post	30	31.33	6.34		
Lateral	Pre	30	19.41	3.92	5.70	0.01
	post	30	27.20	5.04		
Anterior lateral	Pre	30	27.76	5.78	3.95	0.01
	Post	30	35.30	7.24		

RESULTS

Table -2 shows the mean and standard deviation of pre and post values of SEBT for core stability group. There was a significant improvement in post values

INFERENCE

On performing the paired t-test, there was a statistical significance ($p<0.01$) existing within the pre and post intervention values for core stability group.

FIG 2: GRAPHICAL REPRESENTATION OF PRE AND POST MEAN VALUES OF SEBT IN CORE STABILITY GROUP.

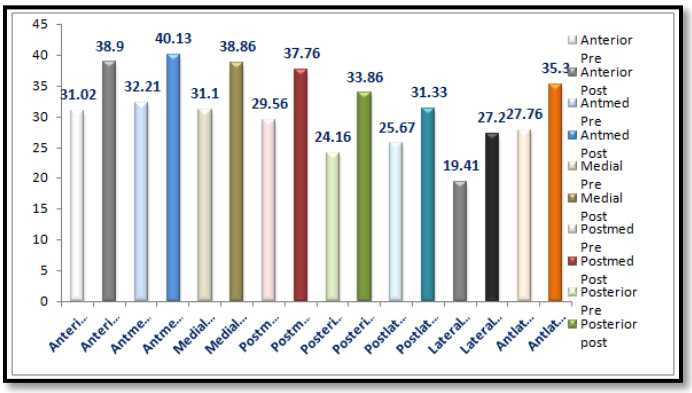


TABLE: 3COMPARISION OF POST VALUES OF SEBT IN SURYANAMASKARA AND CORE STABILITY GROUPS

Categories		Mean	Std. Deviation	t value	p value
Anterior	Suryanamaskara group	32.40	7.38	5.60	0.01
	Core stability group	35.52	8.26		
Anterior medial	Suryanamaskara group	31.68	6.56	5.61	0.01
	Core stability group	36.17	7.28		
Medial	Suryanamaskara group	30.55	6.48	5.61	0.01
	Core stability group	35.98	6.76		
Posterior medial	Suryanamaskara group	30.95	7.15	5.61	0.01
	Core stability group	34.66	8.69		
Posterior	Suryanamaskara group	24.71	6.60	5.61	0.01
	Core stability group	28.51	7.54		
Posterior lateral	Suryanamaskara group	26.91	6.17	5.61	0.01
	Core stability group	29.05	7.05		
Lateral	Suryanamaskara group	21.38	5.70	5.61	0.01
	Core stability group	24.30	5.57		
Anterior lateral	Suryanamaskara group	28.48	6.02	5.61	0.01
	Core stability group	33.53	6.94		

RESULTS

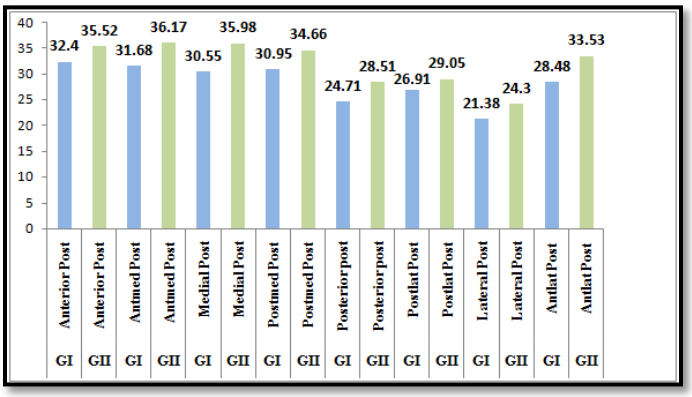
Table -3 showsthe mean and standard deviation of post and post values of SEBT forsuryanamaskaragoup. There was a significant improvement in post values of core stability group than the suryanamaskara group.

INFERENCE

On performing the paired t-test, there was a statistical significance ($p<0.01$) existing within the post and post intervention values for suryanamaskara group and core stability group.

By these values we can find that there is a significant improvement in both the groups but there is more improvement observed in core stability group than the suryanamaskaragroup.

FIG 3: GRAPHICAL REPRESENTATION OF COMPARISON OF POST VALUES OF SEBT IN SURYANAMASKARA GROUP AND CORE STABILITY GROUP.



GROUP 1: SURYANAMASKARA GROUP

GROUP 2: CORE STABILITY GROUP

DISCUSSION:

The aim of the present study is to known the influence of core stability exercises and suryanamaskara exercises on balance in female badminton players.

As per the inclusion criteria 60 female badminton players were taken into the study and randomly allocated into two groups. Group -Iwith 30 female badminton players underwent suryanamaskaratraining for 8 weeks and inGroup-II, 30 female badminton players underwent core stability training for a period of 8 weeks. SEBT is the outcome measure. Values are measured before the start of training on the first day and at the end of training after 8 weeks.

Results of table1 : pre and post mean values of SEBT in suryanamaskara group show that there was a significant improvement in star excursion balance test after 8 weeks of suryanamaskara training($p<0.01$).

A study conducted by Jahnvi Vira et al. (2012) concludesthat 6 weeks of suryanamaskara program enhanced the thickness of deep abdominal muscles and static balance.[15]

A study by Ratnesh Singh et al (2016) quoted that 8 weeks of suryanamaskara training improves dynamic balance and flexibility. The probable reason was the suryanamaskara isthe combination of twelve exercises that includes stretching, holding and relaxation exercises that increases the flexibility and dynamic balance.[11]

A study done by Ashwini Deshmukh et al (2018) quoted that 6 weeks of suryanamaskara training but when comparison was made between two groups suryanamaskara training is effective to observe improvising in balance.

Similar study was done by KomalJakhotia et al (2015), in which it was concluded that 8 weeks of Suryanamaskara training has an impact in increasing flexibility, the attributing reasons for improvement are, there are a number of changes that occur over time in the anatomical structure and physiological function of the contractile units (sarcomeres) in muscle if a muscle is stretched during an exercise. Suryanamaskara helps to stretch the muscle, which leads to increase in the number of sarcomeres and thus reduces tightness and increases flexibility [35]

Suryanamaskara helps to pump vital nutrients to muscles and tendons, which help to keep them healthy and minimize risk of injury. It also stimulates the production of joint lubricants (synovial fluid) and prevents adhesions. As circulation increases, legs, back, neck, and shoulders loosen up, relieving aches and stiffness

Results of table2 : pre and post mean values of SEBT in core stability group show that there was a significant improvement in star excursion balance test after 8 weeks of core stability training($p<0.01$).

In a study done by Ibrahim Hamed et al. (2017) concluded that 8 weeks of core stability training provides an improvement for lower limb dynamic balance and increased performance level of smash stroke.[3]

A study conducted by Maitri Modi et al. (2017) quoted that 6 weeks core stability training improves dynamic balance, hence it can be used to improve balance in individuals with balance deficits and reduce the risk of falls and injuries[6]

It was supported by Hassan Sadeghi et al. (2013) in their study illustrated that there was a significant differences in scores of SEBT after 8 weeks of core stability protocol conducted in 30 volley ball players.[9]

Results of table3: post mean values of SEBT in suryanamaskara group and core stability, by these values we can find that there is a significant improvement in both the groups but more improvement was observed in core stability group than the suryanamaskara group.

The core muscles after eight weeks of strengthening responded like any other skeletal muscle, to training, thereby improving the 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.[36]

The position of the spine significantly determines the position of the body's COG. Compensatory muscle strategy arevital to counteract the perturbations, there by helps to maintain the body's equilibrium state. 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.[21]

CONCLUSION

There was improvement of balancein both the groups. But the subjects in the core stability grouphas more improvement of balance than the subjects of suryanamaskara group.

Hence,alternate hypothesis is accepted and null hypothesis is rejected.

LIMITATIONS & RECOMMENDATIONS

Limitations

- Only female badminton players were included
- This study was done on a smaller sample size of 60 subjects.
- This study was done for a short duration of 8 weeks

RECOMMENDATIONS:

- Different age groups can be taken to know the balance based on their ages.
- Both the genders can be included
- Further studies can be recommended over large samples and longer durations.
- Further studies are recommended to improve balance by using other protocols.

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