

EFFECTS OF PILATES AND CONVENTIONAL CORE STABILITY EXERCISES ON CORE STABILITY AND VERTICAL JUMP PERFORMANCE OF BASKETBALL PLAYERS.

- A COMPARATIVE STUDY

Dissertation submitted to the Tamilnadu Dr. M.G.R. Medical University towards partial fulfillment of the requirements of **MASTER OF PHYSIOTHERAPY (Advanced PT in ORTHOPAEDICS) DEGREE PROGRAMME**



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CERTIFICATES



CERTIFICATE

This is to certify that research work entitled “**EFFECTS OF PILATES AND CONVENTIONAL CORE STABILITY EXERCISES ON CORE STABILITY AND VERTICAL JUMP PERFORMANCE OF BASKETBALL PLAYERS**” was carried out by the candidate bearing the Register No: 27101605, KMCH College of Physiotherapy towards partial fulfillment of the requirements of the **Master of Physiotherapy (Advanced PT in Orthopaedics)** of the Tamil Nadu Dr. M.G.R. Medical University, Chennai-32.

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ABSTRACT

ABSTRACT

Objectives

Vertical jump plays a key factor in Basketball. There have been numerous ways developed over the years to help athletes to improve vertical jump height. The aim of this study is to find out the effect of Pilates and conventional core stability on core stability and vertical jump performance of basketball players.

Study Design

A Pre test and post test experimental design.

Study Setting

PSG College Of Technology, Coimbatore.

Methodology

40 healthy Basketball Players are taken and they were divided into two groups by purposive sampling. Group A is Pilates group who receives Hundreds, Articulating Bridge, Plank, Side Plank and Reverse Plank. Group B is Control Group who receives Conventional Core Stability exercises as Abdominal In drawing, Abdominal controlled Curls, Bridging, Wall Squats, and Bird Dog. Outcome measures were Plank Test for Core Stability and Vertical jump Test for Athletic Performance.

Results

Paired 't' test and Independent 't' tests were done and it was found that there was a significant difference in both groups in improving Core Stability and Vertical jump performance. There is statically significant difference found between the Pilates and Control Groups in improving the Core stability and Vertical jump performance.

Conclusion

Our findings suggest that the mean values of both groups result shows that the pilates exercise group shows better improvement than the conventional core stability exercise group on core stability and vertical jump performance.

So it is concluded that pilates exercise training is recommended to improve the core stability and vertical jump performance of basketball players.

.Key words: Core stability, Pilates, Conventional core stability, Plank, vertical jump.

INTRODUCTION

1. INTRODUCTION

“Core stability is an ability of the core muscles to work in an efficient and coordinated fashion to maintain correct alignment of the spine and pelvis while the limbs are moving”¹

These are the muscles of the lumbo-pelvic-hip complex, which is composed of 29 muscles. All movements are believed to be originated from the center of gravity, called core.¹⁵

Core should be stable for optimal posture and move the limbs. Stable spine is attaining, largely by core muscles and partly by passive and neural elements. Stable spine needs for lower limb activities. Good core reduces the undue strain on spine and prevent or reduces the low back injuries and improve performance in sport activities. Imbalance or weakness in core leads to low back injuries and reduces the performance level.

Core is the center of kinetic chain, links the upper limb and lower limb. A strong core allows an individual the full transfer of forces generated from the ground through the lower extremities, the torso, and finally to the upper extremities.³⁵ A weak core is believed to cause alterations in the transfer of energy, resulting in reduced sport performance. The ability to generate the lower body power is essential for enhanced performance in many sporting activities like volley ball, foot ball and basket ball.

Several methods of exercises have been administered for core stability. Among those Pilates is also more concerned about core stability. The Pilates exercise is popular method of core strengthening. The Pilates based exercises are believed to improve the torso or core strength and offers benefits including improve body balance and co ordination. The Pilates exercise focuses on postural symmetry, breathe control, abdominal strength, spine, pelvis and shoulder stabilization, muscular flexibility, joint mobility and strengthening through the complete range of motion of all joints.¹⁶

In order to prevent low back injuries and enhance the performance of sport activities, core stability has to be evaluated. Several methods are advocated for evaluating the core stability. Among these, plank test is efficient and easy to administer in field evaluation.

The most common sport in which one's vertical jump is measured are track and field, basket ball, foot ball and volley ball. Vertical jump measurements are used primarily in athletic to measure the performance.

There are much theoretical background on effects of Pilates and conventional core stability exercise on core stability and athletic performance. However due to lack of evidence on this area, it should be studied to help the athletics population in improving their performance. Hence this study focuses on the effects of Pilates and conventional core stability exercise on core stability and vertical jump performance of basketball players.

1.1 NEED FOR THE STUDY

Core stabilization is having an increased effect on athletic population today. The kinetic chain is how the movement and forces are transmitted through the body.

Currently there is limited and conflicting evidence to say that improving core stability or core muscle strength, improves the athletic performance. Hence there is a need to study the effects of Pilates and core stability exercises on core stability and vertical jump performance of Basketball players.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1 PILATES:

Siler B, et al., (2000) stated that the Pilates method of body conditioning by Joseph H. Pilates. Joseph Pilates began to develop the Pilates method of training during the First World War.³⁰

Liekens B, et al (1997) stated the true Pilates have six principles²³. They are:

1. **Centering:** The center or core of the body, called as Powerhouse.
2. **Concentration:** mind that guides the body. It is must when doing Pilates exercises.
3. **Control:** proper form for safe and effective
4. **Precision:** With the Accuracy Pilates exercises carried out.
5. **Breathing:** a rhythm of breathing to obtain enough circulation of oxygenated blood to all tissues of the body.
6. **Fluidity:** smooth graceful flow.

Gallagher et al., (2000): Pilates (1945) Pilates exercises main goal to attain healthy strong mind and use it to gain control over the body. Pilates gives equal importance to strengthening- body conditioning and the mind.⁹

Tony et al., (2007) studied the effect of Pilates exercise on trunk and postural stability and throwing velocity in college baseball pitchers and found significant effects in improving performance of double leg lowering, star excursion balance tests and throwing speed in college baseball pitchers.³²

Gonul babayigit irez et al., (2009) Conducted study about Pilates exercise positively affects balance, reaction time, muscle strength, number of falls and psychological parameters in 65+ years old women. It concludes that Pilates exercises improve the dynamic balance, flexibility, reaction time and decreases the anxiety.¹⁰

Kim emery et al., (2009) studied the effects of a Pilates training program on arm–trunk posture and movement. Stated that Pilates exercise training has effect in improving the abdominal strength along with stabilizing the core posture.¹⁸

Rochenda rydeard et al., (2006) done a study on Pilates-Based Therapeutic Exercise: Effect on Subjects with Nonspecific Chronic Low Back Pain and Functional Disability. With Pilates training which train to stabilize the lumbo-pelvic region has a significant decrease in low back pain and disability.²⁷

Lee herrington et al., (2004) studied about the influence of Pilates training on the ability to contract the Transversus Abdominis muscle in asymptomatic individuals and concluded that the Pilates exercises group do better than regular abdominal exercises group or no abdominal exercises group in contracting transverse abdominis and has better maintain in lumbo-pelvic control.²¹

Neil A. Segal et al., (2005) conducted the topic about The Effects of Pilates Training on Flexibility and Body Composition and found that Pilates exercise program has improvement in the truncal flexibility in healthy subjects and little effect in body composition and posture.²⁵

Joseph E. Muscolino et al., (2004) studied the topic about Pilates and the power house. States that all the movements initiated from the center or core of the body called powerhouse. It can generate the force. The Pilates exercise helps to strengthen the powerhouse.¹⁵

Samir Lotfy El-sayed et al., (2010) Studied Impact of Pilates Exercises on the Muscular Ability and Components of Jumping to Volleyball Players. The author proposed that regular use of Pilates exercise led to strengthen the abdominal and middle muscles, flexibility of truncal muscles and increasing the biological capacity efficiency and regular practicing of Pilates exercise leads to improve in jump height.²⁸

Argo et al., (1999) The Pilates Method for a balanced body in this study, stated that modern Pilates exercises trainees should think of their bodies as single integrated units, with the goal of establishing a stable core around which all movement takes place.²

2.2 CORE STABILITY:

Richardson et al.,(1999) discussed about Therapeutic exercise for spinal segmental stabilization in low back pain and described core muscles are in front abdominals, in back paraspinals and gluteus, the diaphragm as a roof, in bottom hip and pelvic muscles.²⁶

Panjabi et al., (1992) conducted the research on Stability of the human ligamentous lumbar spine and described stability of lumbar spine relies on 3 sub systems. They are:

1. Neural subsystem: CNS and PNS(coordination, proprioception, reflexes, etc)
2. Passive system: osseous and ligament elements
3. Active sub system: muscular elements.³

Venu akuthota et al., (2004) studied about Core strengthening and the author discussed about Anatomy of core: divided into two

1. Local muscles(postural, tonic, segmental stabilizers): They are multifidi, psoas major, transversus abdominis, quadratus lumborum, diaphragm, internal oblique(posterior fibers), iliocostalis and longissimus(lumbar portions)
2. Global muscles(dynamic, phasic, torque producing): They are rectus abdominis, external oblique, internal oblique(anterior fibers), iliocostalis(thoracic portion)

And thoracolumbar fascia acting as a nature's back belt.¹

Konin et al., (2003) did research on functional rehabilitation. Facilitating the serape effect to enhance extremity force production and proposed that co-contraction of core muscles gives ample proprioceptive stimulus through thoracolumbar fascia called as serape effect. This stimulus enables the nearby body parts to act according for the optimal performance. The core stability is needs to transfer the optimal energy from upper limb to lower limb and vice versa. If the core stability decreased its affect the kinetic chain by loss of control and excessive movement over spine.¹⁹

Kimitake sato et al., (2009) studied the topic about Does core strength training influence running kinetics, lower-extremity stability, and 5000-m performance in runners? Conducted study on 5000 m runners by administering them core stability training and found significant improvement in their running performance.²⁹

John P. Abt et al., (2007) conducted study on relationship between cycling mechanics and core stability and found that core stability to lower extremity improvement in core strength and increase the torso stability and maintain the lower extremity alignment to give greater force while pedalling. Concluded that core stability improve the cycling mechanics.¹³

Stuart Mc Gill et al., (2010) studied about Core Training: Evidence translating to better performance and injury prevention and stated that the primary function of core is to stiffen the torso and prevent the motion and it is differing by activation of muscles of limb. The power generated at the hips is transmitted effectively by the core.³¹

Paul W Hodges et al., (1997) conducted a research on Contraction of the abdominal muscles associated with movement of the lower limb and study on muscles associated with lower limb movement found that CNS starts the contraction of abdominal muscles and multifidus advance to lower limb to initiate the movement. The contraction of these muscles relates with control of the stability of the spine against movement of the limb.¹¹

Darin T leetun et al., (2004) conducted study about core stability measures as risk factors for lower extremity injury in athletes. The author suggested that decreased core stability contribute to the aetiology of lower extremity injuries. For prevention of lower extremity injury, core stabilization has very important role.²²

Wendell P liemohn et al., (2005) Measuring core stability. The study proposed that core stability is the main key factor in training of the competitive athletes and the individuals who wants to improve their health and fitness and clinical rehabilitation.²⁴

W.Ben kibler et al., (2006) studied the topic about the role of core stability in athletic function. In athletic activities core stability is the pivotal component. Integrated activation of many segments that provides generation of force, proximal stability for distal mobility and generates the coordinated movements.³⁶

Thomas W. Nesser et al., (2008) conducted study on the relationship between core stability and division I foot ball players performance. The results of this study proposed that core stability is moderately linked to strengthen the performance.³²

Butcher Scott J et al.,(2007) done a study in trunk stability on vertical takeoff velocity and found that ninth weeks of trunk stability exercises training has similar effect like as leg strength training or the combination of trunk stability exercises and leg strength training in enhancing vertical takeoff velocity.⁵

Bliss Lisa S et al., (2005) discussed the topic about Core Stability: “The Centerpiece of Any Training Program” found that core stability exercises become the key factor of training programs of all level of athletes. The core muscles act as a link between upper and lower limbs and the force is transformed from the core, it’s often called the powerhouse to the limbs.³

Roetert et al., (1996) conducted the experiment on Shoulder range of motion in elite tennis players. Effect of age and years of tournament play and found that the abdominals stronger than the back muscles in elite tennis players. For every serve to hit, the players use the abdominal muscles to flex the trunk. This strength imbalance could lead to low back injury. Since the strong core allows a player to link the lower and upper body together in a normal healthy kinetic chain. In the future to prevent the injuries, the players should work to strength the entire core.¹⁷

Latey et al., (2001) studied the topic about The Pilates method: history and philosophy explained that necessity of training the core muscles to stabilize the torso and allow the whole body to move freely. This method inspired other type of exercises to reach the desired level of muscular strength and flexibility.²⁰

Willardson J.M et al., (2007) conduct study on Core stability training: Applications to sports conditioning programs. Core stability training applications to sports conditioning programs and found that core stability training programme more efficient in increasing the performance and endurance of the athletes than any other strengthening programme.³⁵

2.3 CORE STABILITY TEST OR PLANK TEST:

About the Test Design:

Core stability test was designed by Brian McKenzie, a senior athletics coach (UKA 4) with UK Athletics, the United Kingdom's National governing body for Track and Field Athletics.⁴

Conducting the test: position the watch or clock where can easily see it

1. Start in the plank exercise position(elbows on the ground) Hold
for 60 seconds
2. Lift your right arm off the ground Hold
for 15 seconds
3. Return your right arm to the ground and Lift your left arm off the ground
Hold for 15 seconds
4. Return your left arm to the ground and Lift your right leg off the ground Hold
for 15 seconds
5. Return your right leg to the ground and Lift your left leg off the ground Hold
for 15 seconds
6. Lift your left leg and right arm off the ground Hold
for 15 seconds
7. Return your left leg and right arm to the ground
8. Lift your right leg and left arm off the ground Hold
for 15 seconds
9. Return to the plank exercise position Hold
this position for 30 seconds .⁴

Kevin F Rooney (2005) conducted study on an aquatic core exercises training program and a Pilates exercises training program on core strengthening in college athletes. In that study static core strength as measured by the plank position assessment. After five weeks of training program the plank position test score increased in both the groups.¹⁶

Elizabeth Quinn et al. studied about core muscle strength and stability test- how to assess your core strength. The objective evaluation of core stability test is to monitor the development and improvements of an athlete's core strength and endurance over the time.⁸

About Testing the Abdominals (Fitness 2u):

Abdominal strength is an indicator of core strength and therefore core stability and support of the lower back. Core stability test is used for measuring this.⁶

2.4 VERTICAL JUMP:

Wickstrom (1983), Fundamental Motor Patterns (3rd edition), in this book the author discussed about the fundamental motor skill. In that the author stated that vertical jumping is one of fundamental motor skill, emerges before 3 years of child.³⁴

Hudson J.L et al., (1990) conducted the experiment on coordination of segments in the vertical jump and stated that the vertical jump is important component many sport activities such as basketball, baseball, volleyball, soccer, gymnastics track and field and dance.¹²

Sergeant et al., (1921), there is numerous techniques in which the vertical jump test is administered and most of them are derived from the original sergeant jump test.¹⁴

Johnson & nelson et al.,(1974), done a practical study on Practical measurement for Evaluation of Physical Education found that vertical jump test or jump and reach test have reliability of 0.95 and an objectivity of 0.93.¹⁴

Xinshai Shan et al., (2008) conducted study on Biomechanical analysis of vertical jump performance of volleyball. The Results show that biomechanical analysis of vertical jump on volleyball players shows that first shoulder starts the acceleration followed by hip, then knee and last the ankle. Except shoulder other joints starts the acceleration upward period first, the shoulder starts the acceleration in downward phase.³⁷

AIMS & OBJECTIVES

3. AIM AND OBJECTIVES

3.1 AIM OF THE STUDY:

To study the effects of Pilates and core stability exercises on core stability and vertical jump performance of Basket ball players.

3.2 OBJECTIVES OF THE STUDY:

To find out the effects of Pilates exercise on core stability and vertical jump performance in Basketball players.

To find out the core stability exercises in core stability and vertical jump performance of Basketball players.

To find out difference between effects of Pilates and core stability exercise in core stability and vertical jump performance of Basket ball players.

MATERIALS & METHODOLOGY

4. MATERIALS AND METHODOLOGY

4.1 STUDY DESIGN:

Pre test and post test Comparative study Design

4.2 STUDY POPULATION

40 Basketball Players were selected and divided into two groups, with 20 in each group.

4.3 SAMPLE TECHNIQUE:

Purposive sampling technique.

4.4 STUDY SETTING:

PSG college of technology, Coimbatore.

4.5 STUDY DURATION

Six months

4.6 TREATMENT DURATION

Six weeks

4.7 INCLUSION CRITERIA:

Age – 18 to 25 years.

Sex – Males.

Subjects - Healthy Basketball players.

4.8 EXCLUSION CRITERIA:

Age less than 18 and more than 25 years.

Females

Recent surgeries.

Recent injuries in both upper limb and lower limb.

Cardiac diseases

Prior back or abdominal surgeries.

Pain or disability in upper or lower limb

Neuromuscular disorders.

Scoliosis

Limb length discrepancy

Postural asymmetries

4.9 OUTCOME MEASURES:

CORE STABILITY TEST OR PLANK TEST

SEARGEANT JUMP TEST OR VERTICAL JUMP TEST

4.10 NULL HYPOTHESIS:

H₀₁ There is no significant effect of Pilates in improving core stability.

H₀₂ There is no significant effect of Pilates in improving vertical jump performance.

H₀₃ There is no significant effect of core stability exercises in improving core stability.

H₀₄ There is no significant effect of core stability exercises in improving vertical jump performance.

H₀₅ There is no significant difference between Pilates and core stability exercises on core stability and vertical jump performance.

4.11 ALTERNATE HYPOTHESIS:

H_{A1} There is significant effect of Pilates in improving core stability.

H_{A2} There is significant effect of Pilates in improving vertical jump performance.

H_{A3} There is significant effect of core stability exercises in improving core stability.

H_{A4} There is significant effect of core stability exercises in improving vertical jump performance.

H₀₅ There is significant difference between Pilates and core stability exercises on core stability and vertical jump performance.

4.12 STUDY METHOD:

40 Subjects Divided into two Groups.

Group –A: Pilates exercises (20)

Group - B: Conventional Core stability exercises (20)

4.13 PROCEDURE:

ASSESSING PHASE:

CORE STABILITY OR PLANK TEST:

Conducting the test: position the watch or clock where can easily see it

1. Start in the plank exercise position (elbows on the ground).

Hold for 60 seconds

2. Lift your right arm off the ground.

Hold for 15 seconds

3. Return your right arm to the ground and Lift your left arm off the ground

Hold for 15 seconds

4. Return your left arm to the ground and Lift your right leg off the ground
for 15 seconds

Hold

5. Return your right leg to the ground and Lift your left leg off the ground
for 15 seconds

Hold

6. Lift your left leg and right arm off the ground.

Hold for 15 seconds

7. Return your left leg and right arm to the ground

8. Lift your right leg and left arm off the ground.

Hold for 15 seconds

10. Return to the plank exercise position.

Hold this position for 30 seconds.

The subject must attempt to maintain the position. While testing, the examiner is observing for any number of inefficiencies in the core such as feet flattening (pronate), external rotation, knees turn inward, knees bowing outward, asymmetrical weight shifting, low back arching, low back rounding, abdomen protruding, shoulder protraction, shoulder elevation, scapular winging, and/or forward head. Subjects were then scored on two variables, the number of inefficiencies seen and the level of assessment achieved.

SERGEANT JUMP TEST:

Required materials:

- A wall
- Inch tape measure
- Chalk

Procedure:

The athlete:

- chalks the end of his finger tips
- stands side onto the wall, keeping both feet remaining on the ground, reaches up as high as possible with one hand and marks the wall with the tips of the fingers (M1)
- from a static position jumps as high as possible and marks the wall with the chalk on his finger tips (M2)

Measures the distance from M1 to M2.

TRAINING PHASE:

Group A:

Hundreds:

- Supine lying with arms at his sides
- Neutral pelvis
- The subject instruct to curl his head and shoulders off the floor to the point just the neutral pelvis lost
- The arms then move up and down slowly, initiating the movement from shoulder joint
- The subject inhale for a count of five and exhale for a count of five
- 10 sets of 10 seconds, totalling 100 seconds (progress by lifting the leg into table top position)

Articulating bridge:

- Supine lying with feet flat on floor(knee bent)
- Arms at the side of the body
- To draw the stomach in
- Begin peeling the vertebra from the floor one at a time beginning with tail bone. The movement ended when it reached the shoulder blade
- The subjects then returning to the standing position
- Subject inhale while preparing for the movement and exhale as he lift his torso into breach
- He then inhale at top of position and exhale while lowering (progress one leg prior to the starting to bridge)
- 8 times

Plank:

- Kneeling
- Hands aligned directly beneath the shoulder and knees directly beneath the hips
- While keeping the shoulders wide and flat, the subject lifts into a push up position by placing by one leg at a time on the floor behind him
- While maintaining body alignment the subject extend one leg at a time(progress by bending knee in extended position)
- 8 times

Reverse plank:

- The subject begin by sitting with his arms behind him
- Weight was on the hands with the fingers point at the heel
- The subject then lift his torso and pelvis into plank position
- Then the subject rose onto one leg at a time without losing proper body alignment
- 3 times with 5 alternating leg extensions on each leg
- The subject inhale to prepare for movement, exhale as he lift the torso upward, inhale at the top position and exhale while lowering

Side plank:

- The subject sits on the side of his hip with the legs extended slightly in front
- The subjects crosses the top leg over the bottom, resting on ball of his foot
- The hand place on the floor align comfortably with the shoulder
- The subject then he lifts his hips off of the floor in the movement and sweeps his top arm upwards
- The subject then allows the body to rest on the lower hand and foot
- Ribs should be directly above the pelvis and the hip square with the body
- The subject hold this position for a set of breaths and then lowers to the floor maintain body alignment
- 5 times
- Subject inhales as he prepares for the movement and exhales as he lifts into the plank position
- He holds this position while inhaling and exhaling for this breathing sets

GROUP B:**Abdominal in drawing:**

- Supine lying
- Feet on the floor, knees bent to 60 degrees
- Neutral spine position
- Holding that position, gently draw lower stomach to spine
- Hold 5 sec, keep breathing

Abdominal controlled curls:

- Supine lying
- Neutral spine, drawing lower stomach in
- Arms by side slowly curl up lifting shoulder blades off the floor
- As lower the shoulder do not let the stomach go, keep the lower stomach drawn in

Bridging:

- Supine lying
- Neutral spine, drawing lower stomach in
- Slowly push down through the feet and lift the bottom right up, trunk is straight(shoulders, hips, and knees in line)
- Hold the lift for 5-10 seconds

Wall squats:

- Standing back to the wall
- Take one step away from the wall, still leaning against the wall
- Toes should be in line and slightly turned out
- Neutral spine, lower stomach draw in
- Holding this position, slowly perform a half squat (bottom should stay in contact with the wall)
- Hold the squat for 5 seconds

Bird dog:

- Quadruped leg reach: Pre position spine in slight lordosis
- Perform abdominal brace
- Reach back or sweep the floor with the leg until the leg is in line with the back without arching or rotating spine (progress to alternate arm and leg raise)

4.14 PHOTOGRAPHIC ILLUSTRATION

4.14.1 PILATES EXERCISES FOR CORE STABILITY:



(A)



(B)



(C)



(D)



(E)

A- Hundreds

B- Articulating Bridge

C- Plank

D- Reverse Plank

E- Side Plank

4.14.2 CONVENTIONAL CORE STABILITY EXERCISES:



(A)



(B)



(C)



(D)



(E)

A- Abdominal In drawing

B- Abdominal Controlled Curls

C- Bridging

D- Bird Dog

E- Wall Squats

4.14.3 CORE STABILITY TEST: PLANK TEST



4.14.4 VERTICAL JUMP TEST:



4.15 STATISTICAL ANALYSIS:

4.16.1 PAIRED 't' TEST (within groups)

It is used to find out the significance of the mean of difference between the three related samples and the calculated t- value is compared with table t- distribution (for 5% level of significance) to the given degree of freedom. If t- value equals or exceeds the t- distribution value, then we can say that there is a significant difference between the sample mean.

$$t = \frac{\bar{d}\sqrt{n}}{S}$$

Substitute s in the formula,

$$S = \sqrt{\frac{\sum d^2 - [\bar{d}]^2 \times n}{n-1}}$$

- X 1 - Pre- test value
- X2 - post test value
- d - X2 - X
- S - Combined standard deviation

d_1 & d_2 = difference between initial & final readings in group A & group B respectively.

n_1 & n_2 = number of patients in group A & group B respectively.

4.16.2 INDEPENDENT 't' TEST (between groups)

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S} \sqrt{\frac{n_1 n_2}{(n_1 + n_2)}}$$

Where,

$$S = \sqrt{\frac{\sum d_1^2 + \sum d_2^2}{n_1 + n_2 - 2}}$$

- X 1 - Pre- test value
- X2 - post test value

n_1 & n_2 = number of patients in group A & group B respectively.

\bar{X}_1 & \bar{X}_2 = Mean of group A & group B respectively.

DATA PRESENTATION

5. DATA PRESENTATION:

5.1 TABULATION:

5.1.1 PAIRED 't' TEST:

Paired 't' test – values of plank test for Pilates group:

	MEAN	't' value		LEVEL OF SIGNIFICANCE
		Calculated 't' value	Table 't' value	
PRE-TEST	30.36	53.77	2.093	AT 5% SIGNIFICANT
POST-TEST	41.56			

Paired 't' test- values of vertical jump test for Pilates group:

	MEAN	't' value		LEVEL OF SIGNIFICANCE
		Calculated 't' value	Table 't' value	
PRE-TEST	42.21	20.79	2.093	AT 5% SIGNIFICANT
POST-TEST	45.18			

Paired 't' test- values of plank test for control group:

	MEAN	't' value		LEVEL OF SIGNIFICANCE
		Calculated 't' value	Table 't' value	
PRE-TEST	29.41	21.89	2.093	AT 5% SIGNIFICANT
POST-TEST	33.94			

Paired 't' test- values of vertical jump test for control group:

	MEAN	't' value		LEVEL OF SIGNIFICANCE
		Calculated 't' value	Table 't' value	
PRE-TEST	38.90	24.45	2.093	AT 5% SIGNIFICANT
POST-TEST	39.78			

5.1.2 INDEPENDENT (t) TEST:

Independent ‘t’ test- pre-test values for plank test:

	MEAN	‘t’ value		LEVEL OF SIGNIFICANCE
		Calculated ‘t’ value	Table ‘t’value	
PILATES GROUP	30.36	1.12	2.086	AT 5% NOT SIGNIFICANT
CONTROL GROUP	29.42			

Independent‘t’ test- post-test values for plank test

	MEAN	‘t’ value		LEVEL OF SIGNIFICANCE
		Calculated ‘t’ value	Table ‘t’value	
PILATES GROUP	41.56	8.38	2.086	AT 5% SIGNIFICANT
CONTROL GROUP	33.94			

Independent ‘t’ test- pre-test values for vertical jump test:

	MEAN	‘t’ value		LEVEL OF SIGNIFICANCE
		Calculated ‘t’ value	Table ‘t’value	
PILATES GROUP	40.41	.74	2.086	AT 5% NOT SIGNIFICANT
CONTROL GROUP	38.90			

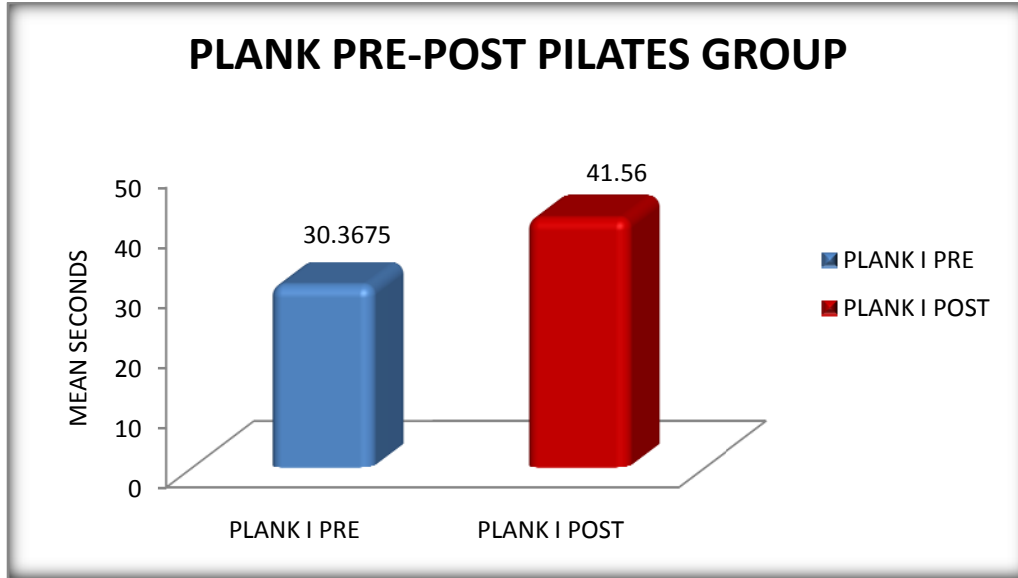
Independent ‘t’ test - post-test values for vertical jump test:

	MEAN	‘t’ value		LEVEL OF SIGNIFICANCE
		Calculated ‘t’ value	Table ‘t’value	
PILATES GROUP	45.18	7.98	2.086	AT 5% SIGNIFICANT
CONTROL GROUP	39.78			

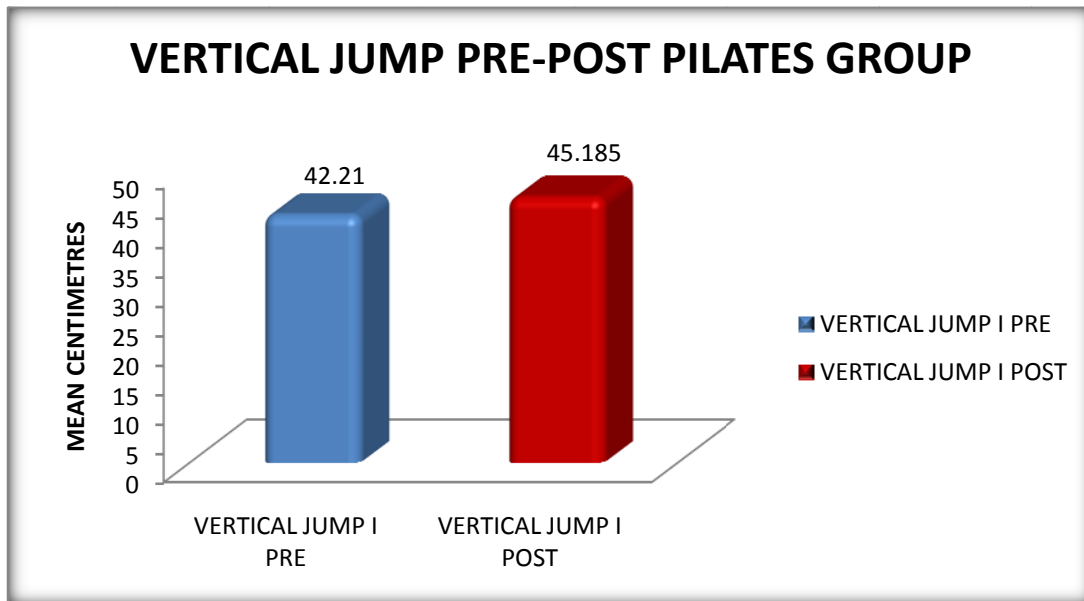
5.2 GRAPHICAL ILLUSTRATION

5.2.1 PAIRED ‘t’ TEST:

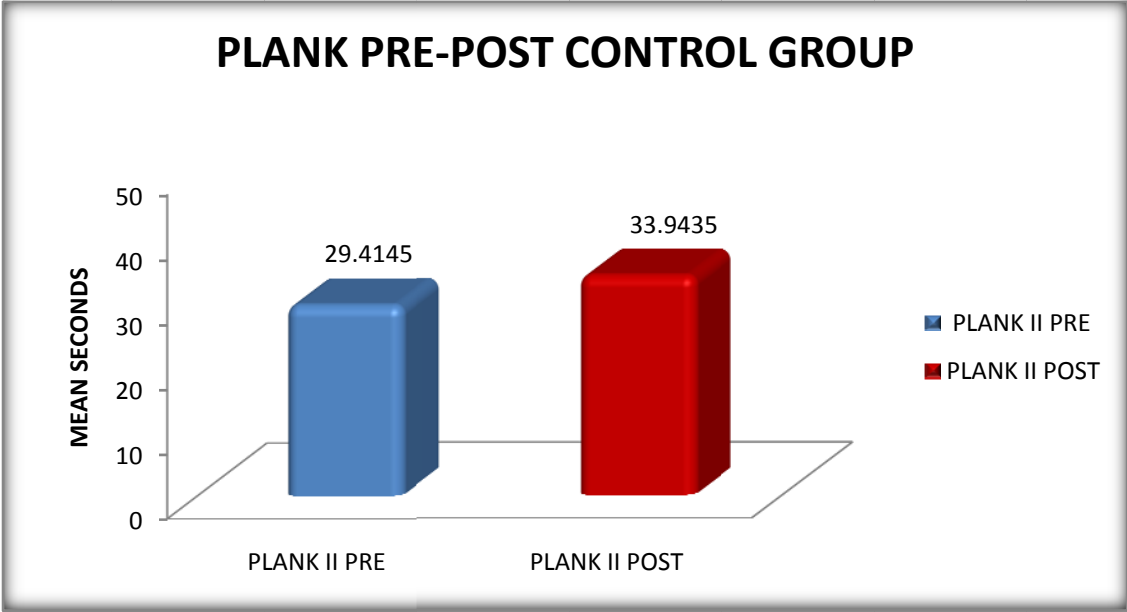
Paired ‘t’ test- mean values of plank test for Pilates group:



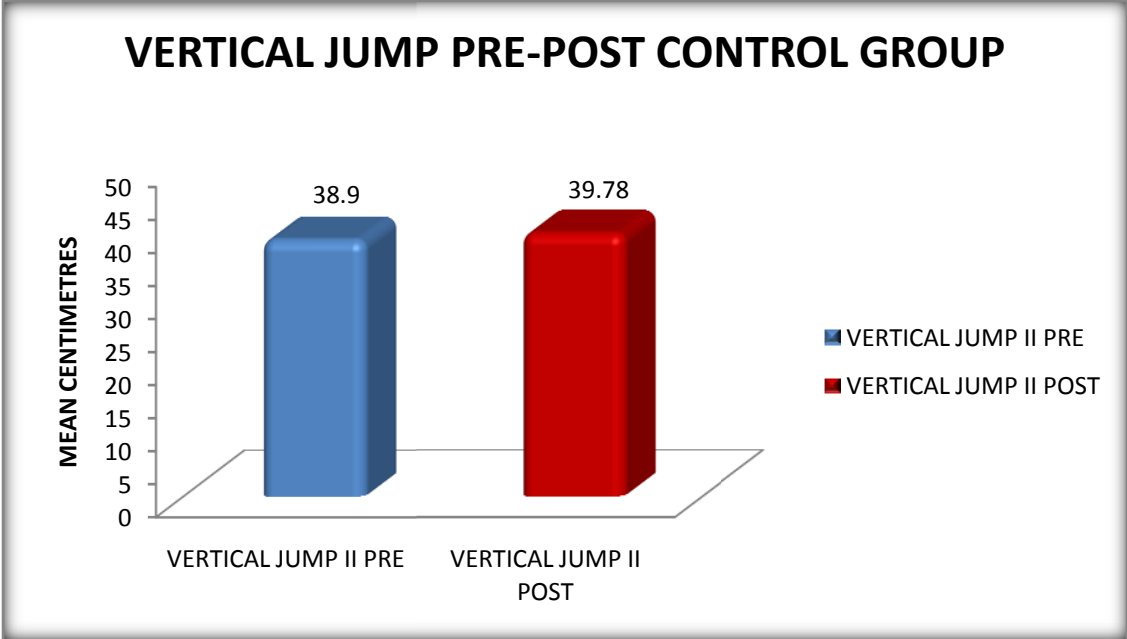
Paired ‘t’ test- mean values of vertical jump test for Pilates group:



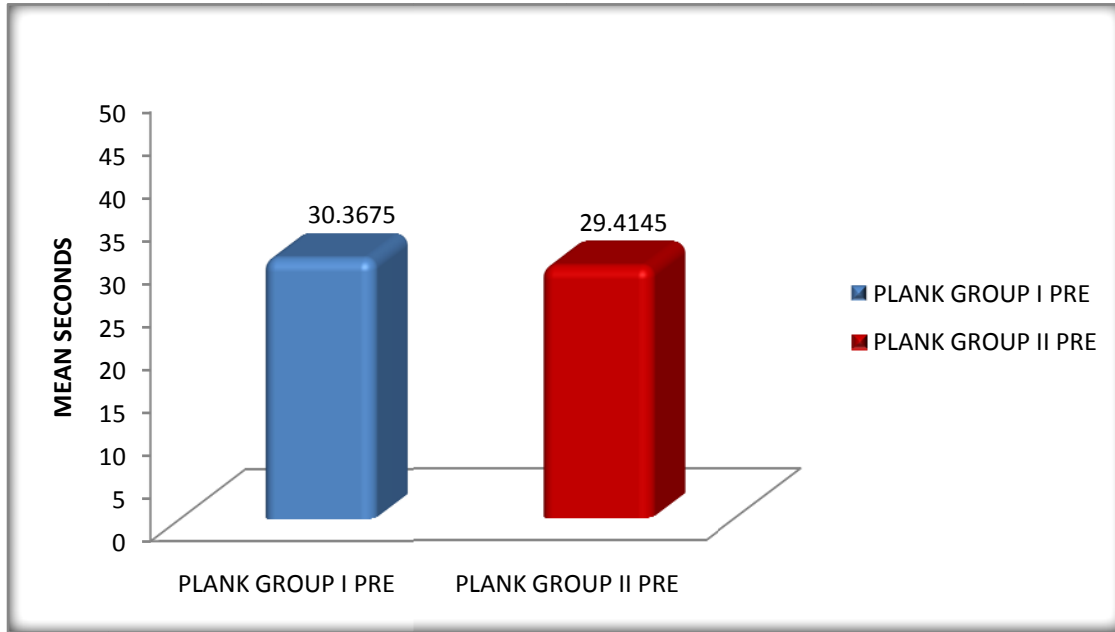
Paired 't' test- mean values of plank test for control group:



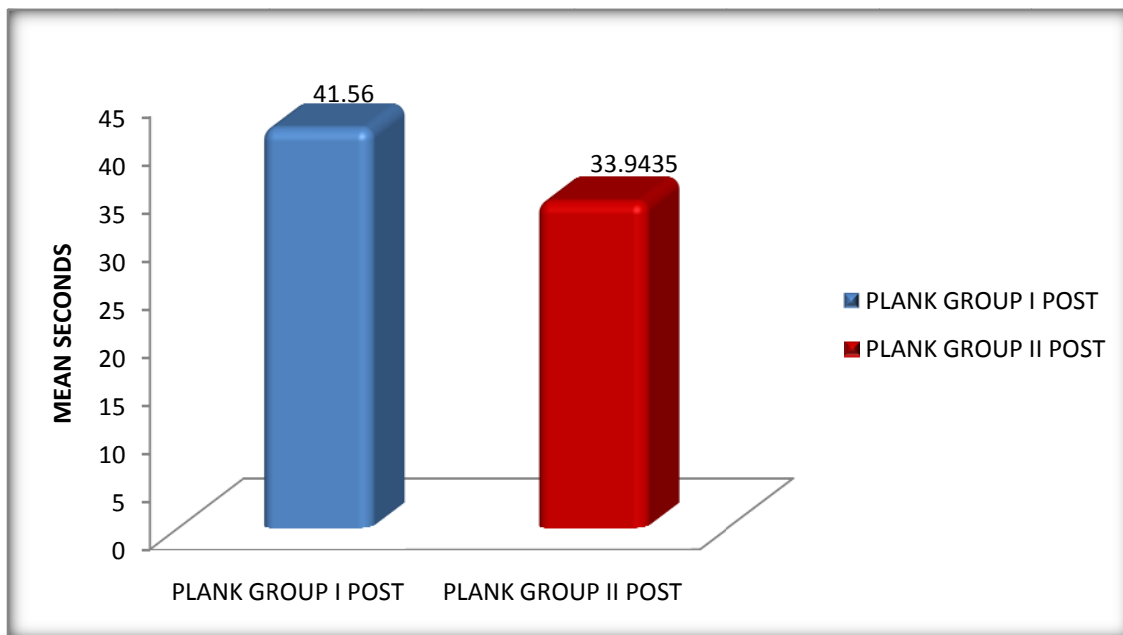
Paired 't' test- mean values of vertical jump test for control group:



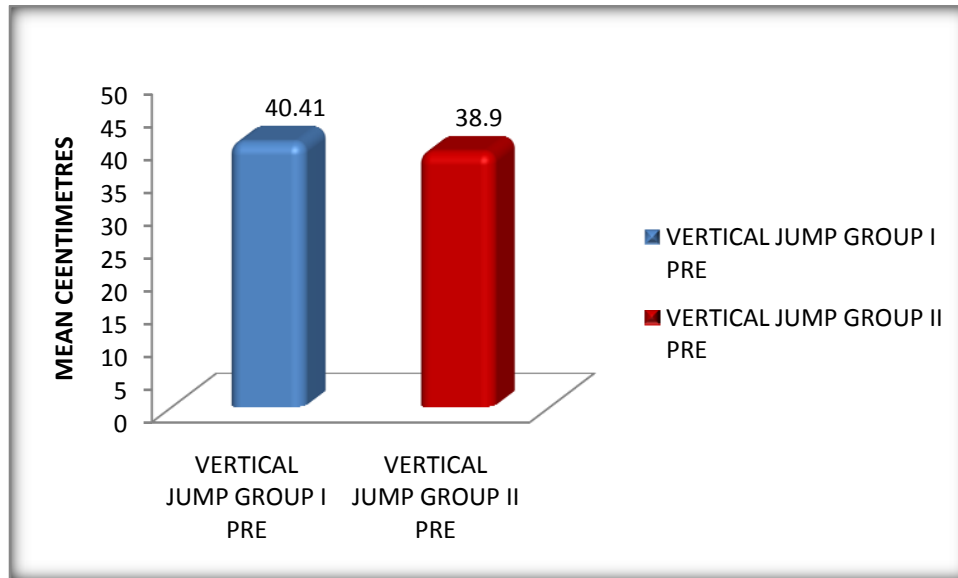
5.2.2 INDEPENDENT ‘t’ TEST: Independent ‘t’ test of mean pre-test values for plank test:



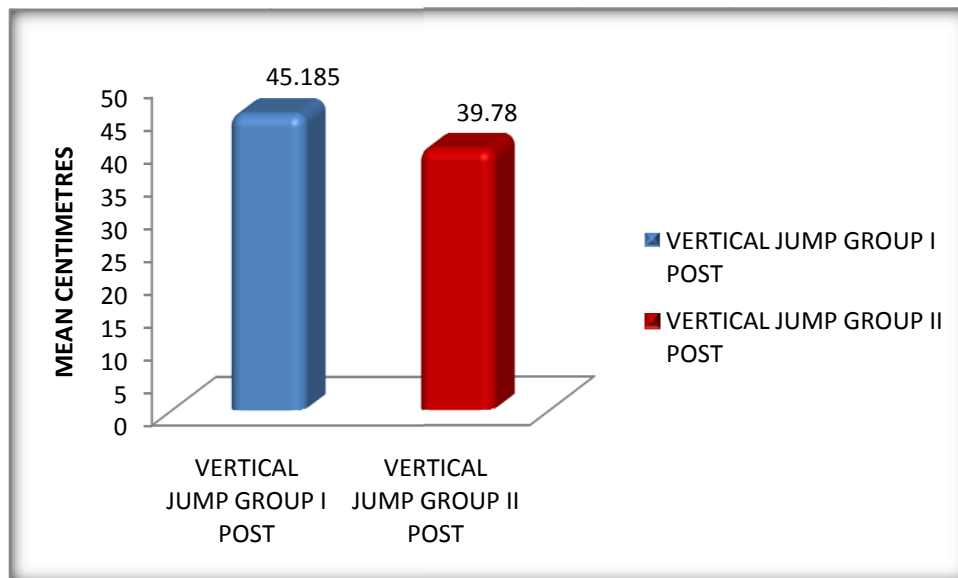
Independent ‘t’ test of mean post test values for plank test:



Independent 't' test of mean pre-test values for vertical jump test:



Independent 't' test of mean post-test values for vertical jump test:



DATA ANALYSIS & RESULTS

6. DATA ANALYSIS AND RESULTS:

6.1 PAIRED ‘t’ TEST:

Paired “t” test values of plank test for Pilates group:

The pre test and post test values of plank test was analysed using paired ‘t’ test. For 19 degrees of freedom and at 5% level of significance, the table ‘t’ value is 2.093 and the calculated ‘t’ value was 53.77. As the calculated ‘t’ value was greater than the table ‘t’ value, null hypothesis was rejected. Hence there was significant effect of Pilates on core stability in Basketball players.

Paired “t” test values of plank test for control group:

The pre test and post test values of plank test was analysed using paired ‘t’ test. For 19 degrees of freedom and at 5% level of significance, the table ‘t’ value is 2.093 and the calculated ‘t’ value was 21.89. As the calculated ‘t’ value was greater than the table ‘t’ value, null hypothesis was rejected. . Hence there was significant effect of Conventional Core stability exercises on core stability in Basketball players.

Paired “t” test values of vertical jump test for Pilates group:

The pre test and post test values of vertical jump test was analysed using paired’ test. For 19 degrees of freedom and at 5% level of significance, the table ‘t’ value is 2.093 and the calculated ‘t’ value was 20.79. As the calculated ‘t’ value was greater than the table ‘t’ value, null hypothesis was rejected. . Hence there was significant effect of Pilates on Vertical jump Performance of Basketball players.

Paired “t” test values of vertical jump for control group:

The pre test and post test values of vertical jump test was analysed using paired’ test. For 19 degrees of freedom and at 5% level of significance, the table ‘t’ value is 2.093 and the calculated ‘t’ value was 24.45. As the calculated ‘t’ value was greater than the table ‘t’ value, null hypothesis was rejected. . Hence there was significant effect of Conventional core stability exercises on Vertical jump Performance of Basketball players.

6.2 INDEPENDENT 't' TEST:

Pre test values of plank test for both group A and B:

The pre test values of both the groups were analysed using independent 't' test. For 38 degrees of freedom and 5% level of significance, the table 't' value 1.960 and the calculated 't' value is 1.12. As the calculated 't' value was lesser than the table 't' value, there was no significant difference between the pre test values of both groups. Hence there was homogeneity between both the groups before the experiment.

Post test values of plank test for both group A and B:

The post test values of both the groups were analysed using independent 't' test. For 38 degrees of freedom and 5% level of significance, the table 't' value 1.960 and the calculated 't' value is 8.38. As the calculated 't' value was greater than the table 't' value, null hypothesis rejected. Hence there was significant difference found between both the groups.

Pre test values of vertical jump test for both group A and B:

The pre test values of both the groups were analysed using independent 't' test. For 38 degrees of freedom and 5% level of significance, the table 't' value 1.960 and the calculated 't' value is 0.74. As the calculated 't' value was lesser than the table 't' value, there was no significant difference between the pre test values of both groups. Hence there was homogeneity between both the groups before the experiment.

Post test values of vertical jump test for both group A and B:

The post test values of both the groups were analysed using independent 't' test. For 38 degrees of freedom and 5% level of significance, the table 't' value 1.960 and the calculated 't' value is 7.98. As the calculated 't' value was greater than the table 't' value, null hypothesis rejected. Hence there was significant difference between both the groups.

DISCUSSION

7. DISCUSSION

Recent trends are about core stability is the main key factor in training of the competitive athletes and the individuals who want to improve their health and fitness and clinical rehabilitation.

This study aimed to find the effectiveness of Pilates exercises training on core stability and athletic performance.

The paired 't' test was performed between pre and post test values of plank test and vertical jump test in both the groups. Using paired 't' test, calculated t value for Pilates training group was 53.77 and control group was 21.89. Since both group calculated 't' value greater than table value 2.093. So both groups have significant effect in improving core stability and vertical jump performance.

The Independent 't' test was performed between pre test values of plank test and vertical jump test in between Pilates and control group to analyse the homogeneity. Since the calculated pre test 't' value of plank test 1.12 and vertical jump pre test value 0.74 were lesser than table value of 1.960. So there is no significant difference between both the groups before the experiment.

The independent 't' test was performed between post test values of plank test and vertical jump test in between to find out the effect. Mean Post test values of plank test was 41.56 for Pilates group, 33.94 for control group. And the mean post test values of vertical jump test were 45.18 for Pilates trained group, 39.78 for control group. From the mean values itself shows that there is a significant difference between the Pilates and control group in improving core stability and athletic performance.

Finally, statistical findings in this study postulates that both exercise groups had significantly improved the core stability and vertical jump performance and in between the groups, Pilates exercise group had significant difference than conventional core stability exercise group.

The mechanism for the improvement of core stability and vertical jump on performance of Pilates training group might be due to biological efficiency and kinetic chain activities. In any athletic activities, the players spontaneously hold their breath, which could affect their performance by reducing the air entry and therefore reducing the oxygen uptake and energy.

One of the principle of Pilates is breathing control which makes awareness of one's own breathing during dynamic activities, which would enhances the performance by increasing air entry and therefore increases the oxygen uptake and energy. This increased air entry increase the amount of air largely in air vesicles of lungs. So it can improve the floating time and jumping.²⁸

The proposed mechanism for this improvement in Pilates group might be due to kinetic chain activities. When core stability is attained the local group of core muscles gives stability to the mobility of the distal segments and the global group of core muscles increase the moment arm for lower limb movements, generate and transfer the forces from lower limb to upper limb and vice versa.²⁶

Pilates improves the body position awareness, it increases the more stable spine in dynamic activities. It reduces the load and to do the activities. By improving the work of back and abdominal muscles with balance and integration between them is considered as the important factor for improving the muscular ability of legs. Thereby improving the jumping performance.²⁸

Any sporting activities the performance influenced by psychological status of that athlete. Pilates exercises also concentrate about mind and body coordination. It can reduce the anxiety and enhance the athletic performance.¹⁰

In control group, the mechanism behind in improving the core stability and athletic performance co contraction of core muscles gives ample proprioceptive stimulus through thoracolumbar fascia called as “serape effect”.¹⁹ This stimulus enables the nearby body parts to act according for the optimal performance. The core stability is needs to transfer the optimal energy from upper limb to lower limb and vice versa. If the core stability decreased it's affect the kinetic chain by loss of control and impaired movement over spine.

But there is significant difference between the Pilates and conventional core stability exercises training group in improving core stability and vertical jump performance. The Pilates has much significant improvement than control group because the regular use of Pilates exercise led to strengthen the abdominal and middle muscles, flexibility of truncal muscles and increasing the biological capacity efficiency by breathing control and regular practicing of Pilates exercise leads to improve in jump height. And Pilates exercises main goal to attain healthy strong mind and use it to gain control over the body. Pilates gives equal importance to strengthening- body conditioning and the mind.⁹Incorporating the Pilates exercises training program in core stability gives spectacular effect in improving core stability and athletic performance.

SUMMARY AND CONCLUSION

8. SUMMARY AND CONCLUSION

This study was done to find out the effect of Pilates and conventional core stability exercises on core stability and vertical jump performance in basketball players. 40 subjects were taken for the study and allotted into two groups. They are Pilates group and conventional group. All the subjects were screened for contraindications. The plank test and vertical jump test taken as the outcome measurement tool.

The outcomes of the study were taken on the first study and after six weeks. Subjects are advised not to indulge in other activities other than the given exercise protocol. The core stability was measured by plank test and the athletic performance measured by vertical jump test.

The statistical analysis was done using paired 't' test and independent 't' test at 5% level of significance. The paired t test result shows that there was significant difference in both Pilates and conventional group. The independent t test result shows that there was significant difference between two groups.

The mean values of both groups result shows that the Pilates exercise group shows better improvement than the conventional core stability exercise group on core stability and vertical jump performance.

So it is concluded that Pilates exercise training is recommended to improve the core stability and vertical jump performance of basketball players.

LIMITATIONS & SUGGESTIONS

9. LIMITATIONS AND SUGGESTIONS

The study was limited to small sample size. It can be done on large sample size.

The samples were limited to an age group between 18-25 years. It can be generalized to other age group.

It was done only on males. It can be done on females.

This study was done on healthy subjects, it's recommended in future studies can be done in athletes who are more prone for low back injuries as a prevention strategy.

This study suggest to progress the complexity of the exercise program in less stable surfaces like Swiss ball, medicine ball, and wobble board.

This study suggests the incorporation of Pilates exercises in sports specific activities in improving athletic performance.

The results of this study suggests Pilates exercises training program can be implement in elite and professional Basketball players.

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10. BIBLIOGRAPHY

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APPENDIX

S.N O	ATHLETS	PLANK TEST		VERTICAL JUMP	
		Pre test	Post test	Pre test	Post test
	Name: Age : Height: Weight: Mob. No:				
	MEAN				
	Name: Age : Height: Weight: Mob. No:				
	MEAN				
	Name: Age : Height: Weight: Mob. No:				
	MEAN				
	Name: Age : Height: Weight: Mob. No:				
	MEAN				
	TOTAL MEAN				

APPENDIX I

INFORMED CONSENT TO PARTICIPATE IN THE RESEARCH STUDY

I _____ voluntarily consent to participate in the research study

“EFFECT OF PILATES AND CONVENTIONAL CORE STABILITY EXERCISES ON CORE STABILITY AND VERTICAL JUMP PERFORMANCE OF BASKETBALL PLAYERS”

The researcher has explained to me about the exercise approach in brief, the risk of participation and has answered the questions related to the research to my satisfaction

Signature of the applicant:

Signature of the researcher:

Signature of the witness: