

Effect Of Pilates On Core Muscle Endurance In Females

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Core has been described as box.¹ Core is referred as powerhouse, the foundation or engine for all four limb movement. Anatomically, core is musculature that surrounds the lumbopelvic region. Core musculature and thoracolumbar fascia are thought to play a role in trunk rotation and load transfer and stability of lumbopelvic region.² Core stability is achieved by integration of active spinal stabilizer(muscle), passive stabilizer(spinal column), and neural control which perform together to control joint range of motion in order to allow performance of activity of daily living.³ Dynamic stability is the ability to use muscle strength and endurance to control the spine beyond neutral zone while functional performance.⁴ Spine plays a important role in decreasing stress delivered to each segment when a person moves and balances shearing forces that occurs between spinal segment.⁵

Core muscles are divided into local and global categories. Local muscles are defined as muscle which attach to lumbar vertebrae and influence intersegment motion, while global muscle attach to hip and pelvis and promote mobility and orientation of spine.⁶

Lack of core stability is associated with low back pain.⁷ Core surrounds the lumbopelvic region and include abdominals anteriorly, paraspinal and posteriorly gluteus muscles, pelvic floor inferior, hip abductors and rotators laterally and diaphragm superiorly.⁸ Transverse abdominus increase intraabdominal pressure and tension the thoracolumbar fascia while abdominals collectively contract to stabilize the spine.⁹ The diaphragm assist with spinal stability. Hip and pelvic floor musculature act as base of support for core.¹⁰

Rapid growth in technology and sedentary life style has reduced physical activity. This in turn has reduced physical work of certain muscles specially trunk and hip muscles. Balance between anterior and posterior group trunk and hip muscles is necessary for normal alignment. In females, habitual wearing of high heels cause biomechanical and musculoskeletal changes that reduce base of support and increase anterior pelvic tilt, increase lumbar lordosis, short hip flexors and trunk extensors, weak abdominals and gluteal muscles. This decreases core stability and contribute to cause of injuries in females. Hormonal changes that occur during pregnancy allow the body to stretch and grow to accommodate baby and allow giving birth also affect stability.¹¹

Chronic low back pain is defined as the pain or discomfort between costal margins and the inferior gluteal folds, with or without radiating pain in lower limbs lasting more than 12 weeks.¹² Chronic low back pain is idiopathic.¹³ It is associated with disability, absence from work and mood changes.¹² Low back pain is common cause of disability and work loss and create large socioeconomic burden in developed countries.¹⁴ Between 60-80% adults affect with low back pain during life time¹⁵ and 30-40% with acute low back pain never recover completely.¹⁶ Major risk factors for non specific low back pain is lack of isometric low back muscles endurance.¹⁷

Guideline for treatment of chronic low back pain recommend optimizing spinal functionality, correcting posture and teaching patient to self manage symptoms as condition can easily become recurrent or chronic.^{18,19}

Guideline also shows the cost effective treatment for chronic low back pain are multidisciplinary intervention, exercise, acupuncture, spinal manipulation and cognitive behavioural therapy.²⁰ exercises are not only cost effective but also good option to treat chronic non specific low back pain.¹²

Core stability exercises are used to target specific muscle group to prevent from low back pain and other injuries in lower extremity.²¹ Pilate is the best option for improving stability of spine and endurance of the trunk muscles.²² These exercises improve static and dynamic stability as well as posture and movement.²³ Pilates is prescribed to the people having low back pain due to focus on activating stabilising muscles of trunk and lower back.^{24, 29} When all these local muscles contract together, they try to keep the spine in most stable position called local stability.²⁵ Pilate exercise involve contraction of deep abdominals.²⁶ Pilate is a mind body exercise that focus on core stability, strength, flexibility, posture, breathing, and muscle control.²⁷ Diaphragmatic breathing is essential for treating core muscles as the diaphragm is roof of core.²⁸ Emphasis is put on control of body position and movement as suggested by its original name contrology.²⁹

Joseph Pilate founded the Pilate in 1920.³⁰ He was born in small German town in 1880. Pilate is prescribed to the people having low back pain, chronic neck pain, postural problems, osteoporosis, arthritis, stress related illness due to focus on activating stabilising muscle of trunk and lower back.

Benefits of Pilate:

- A refreshing mind body workout
- Develop a strong core
- Gain long, lean muscle and flexibility
- Create an evenly conditioned body improve sports performance and prevent injury.

Following points can be improved by Pilates:

- **Centring:** This is achieved by focus on abdominal muscles and pelvic floor muscles and deep abdominals to develop a strong core and enable the rest of body to function efficiently. All action initiates from the centre and flows outward to the extremities.
- **Concentration:** It is the connection between mind and body.
- **Relation:** This is important to start Pilates. Learning to relax and recognise areas of tension that need releasing
- **Alignment:** Proper alignment helps to maintain good posture during exercises.
- **Flow:** Pilate needs smooth and continuous movement that is strong and effortless.
- **Breathing:** Natural and conscious breathing pattern with movement activates the muscles and keep focus on exercise.
- **Stamina:** Endurance of core muscles builds up slowly, which challenges strength and stability.
- **Coordination:** Two or three movements are combined throughout the phase of learning. This is started with the cognitive phase; proceed to motor phase and then automatic phase. This is achieved by practice.

Principles: These basic principles help to educate the person how to hold the spine correct during movement.

- Lateral breathing
- Pelvic placement
- Rib cage placement
- Scapular movement and stabilisation
- Head and cervical placement

Many sportsmen and athletes use Pilates regularly in their training, now a days it is also popular among older persons. Post natal women are also encouraged to include these exercises after child birth to strengthen their abdominals and restore body shape.³¹

Methodology:

Study design was randomized controlled experimental study with one group. A sample of 18 patients had been taken in the study. Subjects were taken from Adharsh Colony, Neighbourhood and Sector 15 Hisar. Females between 25 to 40 years of age. Low back pain with no specific pathology. Duration of low back pain more than 12 weeks. Subjects who just complain about low back pain but do not taking treatment for it. Subjects who are able to comprehend command and willing to participate in the study. Subjects were prepared for the exercises i.e. comfortable clothing. Food gap was taken 30 minutes before and after the exercise. Some exercises were tailored for each patient. 5 minutes walk was performed by the patients before starting the exercises. Mat group exercises were performed on ground and were given to the patient on 5 days a week basis. The number of repetitions for each exercise was individualized for each patient and ranged from 5 to 10 repetitions. Some basic commands were given to the patients that are below.

Ten Commandments of set up position:

- Keep your feet apart in line with your knees
- Keep your knees in line with your hips.
- Your pelvis should be in its neutral position.
- Engage the transverse abdominus.
- Your rib cage is soft and down.
- Keep your shoulders away from your ears, arms by your side.
- Your shoulder blades are down.
- Keep your chin in and neck long.
- Breathe in to prepare. Breathe out to move.
- Your pelvic floor is engaged.

First week:

- **First day:**
 - Primary outcome pain intensity was measured by visual analogue scale, functional disability was measured by Oswestry disability questionnaire and core endurance was measured by plank test
 - Basic instructions on method and training were given to the patient.
 - Only 5 minute walk was performed by the patient.
- **Second day to sixth day:** 6 exercises were performed by the patients.
 - **Pelvic tilt:**
 - ✓ Starting position: Supine set position
 - ✓ Technique: Breathe in keeping the pelvis neutral
 - Breathe out and engage the transverse abdominus and pelvic floor.
 - Tilt the pelvis to imprint the spine.
 - Breathe in.
 - Breathe out to return to neutral pelvis and relax.
 - **Hamstring stretch:**
 - ✓ Starting position: Supine position with one leg extended. Place an exercise band or long scarf around the extended leg.
 - ✓ Technique: Breathe in to prepare.
 - Breathe out to tense transverse abdominus and pelvic floor. Raise the leg slowly off the floor maintaining neutral alignment in the spine.

- Continue to lift the leg toward a 90 degree angle, but only lift as high as comfortable.
- Breathe in for 3-5 breaths.
- Breathe out and tense transverse abdominus and pelvic floor. Return leg to floor and relax.



Fig: Hamstring stretch

➤ **Seated spine twist:**

- ✓ Starting position: Seated set position
- ✓ Technique: Breathe in to prepare.
 - Breathe out to engage transverse abdominus and pelvic floor. Twist from the waist slowly to the right, turning head to the right too.
 - Breathe in to return to centre.
 - Add a 'c' curve here if the hip flexors and back feel tired. Breathing in, return to an upright position.
 - Breathe out and engage transverse abdominus and pelvic floor.
 - Breathe in to return to the centre again.

➤ **Roll down/ roll up:**

- ✓ Starting position: Supine set position with knee in front.
- ✓ Techniques: Breathe in to prepare.
 - Breathe out to engage transverse abdominus and pelvic floor. Tilt the pelvis to create a 'c' curve.
 - Continue to roll down segmentally towards the floor, keeping your feet down.
 - Breathe in to lengthen the legs away, taking the arms up and over the head.
 - Breathe in for skull rock and raise arms to the ceiling.
 - Slide the ribs towards the hip, lifting the head and shoulders and peeling the spine up off the floor.
 - Breathe out as you roll up and stretch toward toes.
 - Breathe in to start rolling back.

➤ **Hip flexors stretch 2:**

- ✓ Starting position: Supine set position
- ✓ Technique: Breathe in and bring one knee towards the chest.
 - Breathe out to lengthen the other leg away along the floor, keeping the other knee close to the chest.
 - Hold for 2-3 breaths and repeat on the other side.

➤ **Cat's tail:**

- ✓ Starting position: All four set position.
- ✓ Technique: Breathe in to prepare.
 - Breathe out to engage transverse abdominus and pelvic floor and tilt the pelvis, tucking the tail under keeping the upper back stable and still.
 - Breathe in to bring the pelvis back into a neutral position.



Fig: Hip Flexor Stretch 2

Second week to third week:

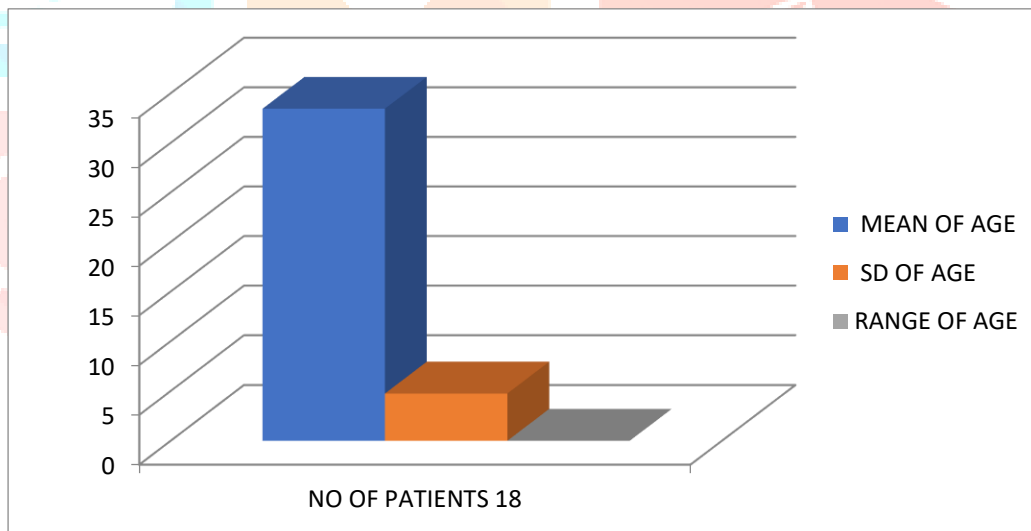
- Repetitions of exercises were increased as per the convenience of the patients.
- Added 2 more exercises i.e.
 - **Abdominal preparation:**
 - ✓ Starting position: Supine set position.
 - ✓ Technique: Breathe in to prepare.
 - Breathe out to engage transverse abdominus and pelvic floor.
 - Breathe in, drop chin slightly to chest.
 - Breathe out to slide the ribs toward the hips and hands toward the ankles, lifting the head and shoulders, looking toward the knees.
 - Breathe in to return to release and relax.
 - **Cat's pedals:**
 - ✓ Starting position: All four set position
 - ✓ Technique: Breathe in to prepare.
 - Breathe out to engage transverse abdominus and pelvic floor. Raise the left hand off the floor, bending at the elbow to avoid moving the shoulders.
 - Breathe in and replace the hand on the floor.
 - Breathe out, engage transverse abdominus and pelvic floor and raise the right hand.
 - Breathe in to replace again.



Fig: Cat Pedals

Post exercise session: At the end of treatment session the outcome measures were taken again to check the improvement in condition of the subjects.

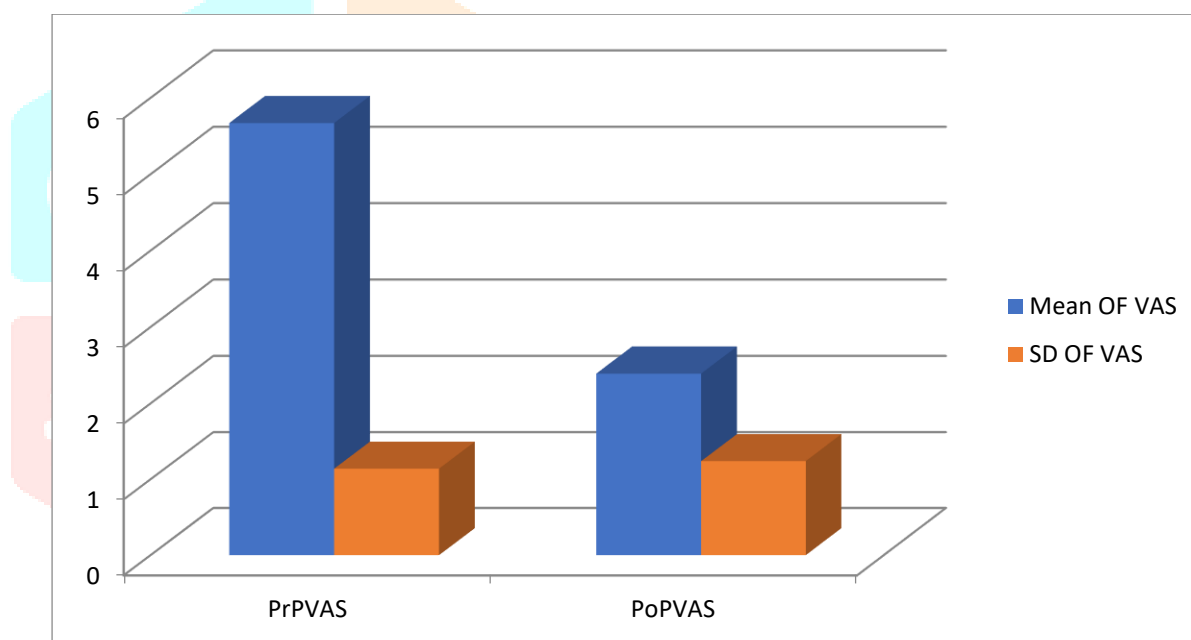
Data was collected from the eighteen subjects with the mean age of 33.44 years and $SD = \pm 4.74$. Mean and SD of all variables (VAS, Oswestry's disability questionnaire and plank endurance test) were calculated. Effect of exercises for all the variables i.e. pre and post was done using paired t test. Difference was considered significant in all variables if $p < 0.01$ or $p < 0.05$.



Demographic details of subjects participated in the study.

Table 1.1 Table showing comparison of VAS for pre and post Pilates exercises group.

Variable	Mean	SD	<i>P</i> value	Result
PrPVAS	5.67	1.14	0.01	Significant
PoPVAS	2.39	1.24		

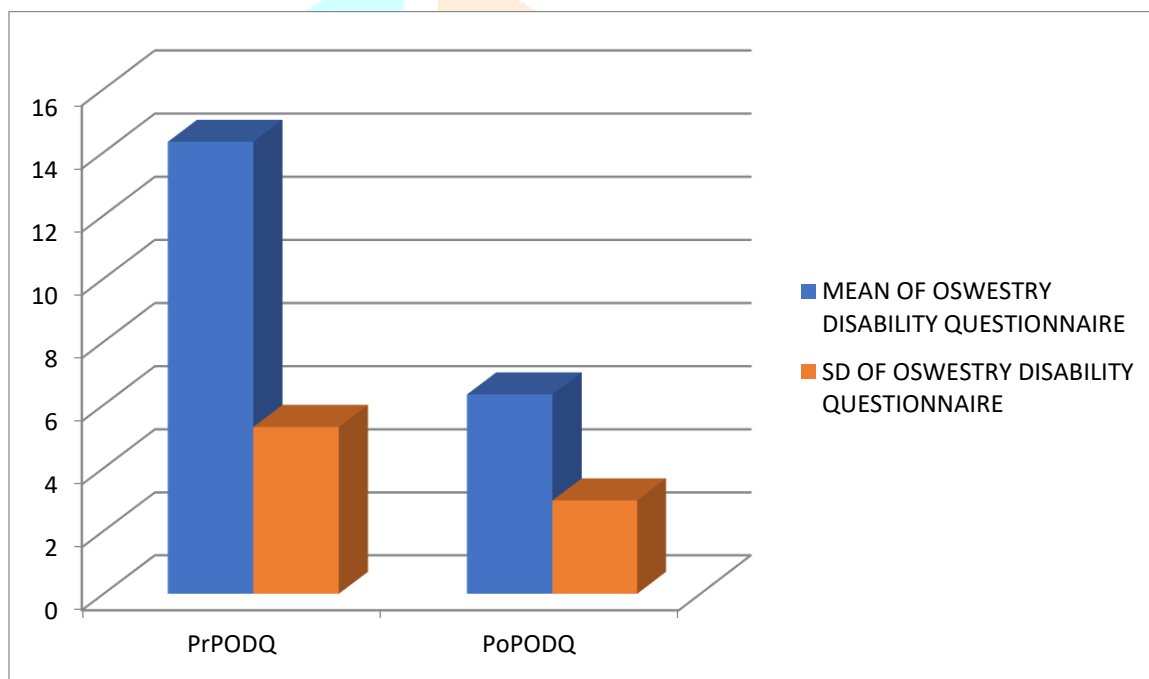
Graph 1.1

Interpretation: The table 1.1 explains the parameters i.e. mean value and standard deviation of VAS in experimental group pre and post Pilates exercises. Pre Pilates exercises mean and SD of VAS is 5.67 and 1.14 and post Pilates mean and SD is 2.39 and 1.24. The graph 1.1 represents the difference in the mean values and SD value of VAS.

Table 1.2 showing comparison of Oswestry disability questionnaire for pre and post Pilates exercises group.

Variable	Mean	SD	<i>P</i> value	Result
PrPODQ	14.33	5.30	0.01	Significant
PoPODQ	6.33	2.97		

GRAPH- 1.2

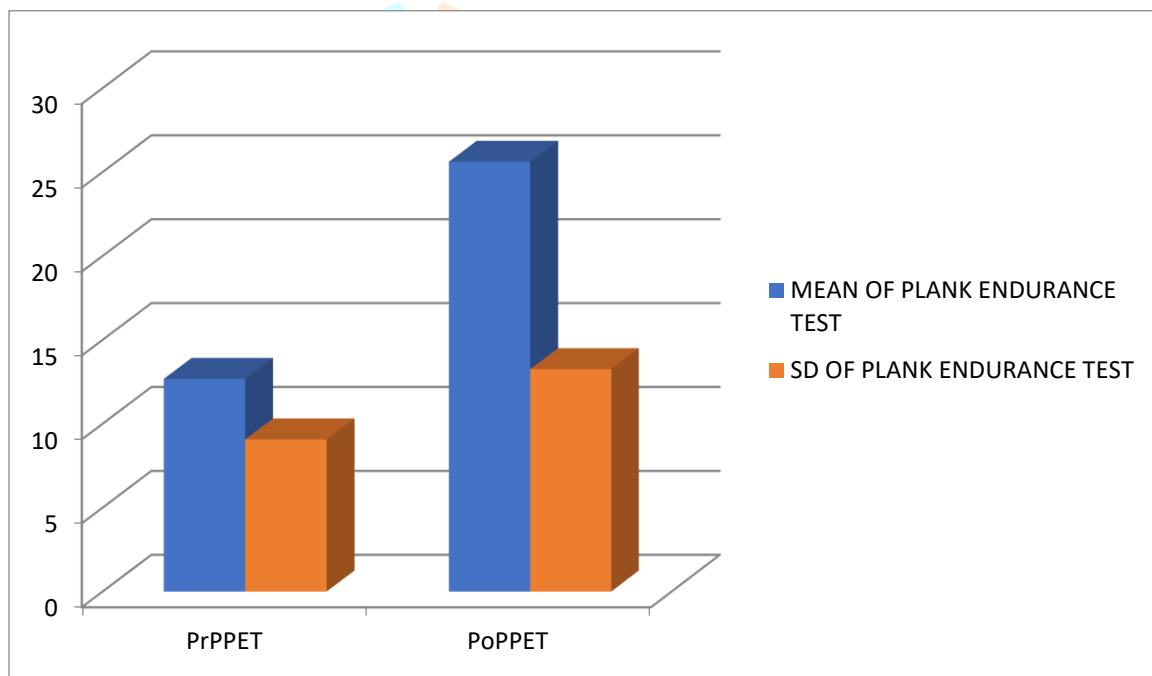


Interpretation: The 1.2 table explains the parameters i.e. mean value and standard deviation of Oswestry disability questionnaire in experimental group pre and post Pilates exercises. Pre Pilates exercises mean and SD of Oswestry disability questionnaire is 14.33 and 5.30. and post Pilates mean and SD is 6.33 and 2.97. The graph 1.2 represents the difference in the mean values and SD value Oswestry disability questionnaire.

Table 1.3 showing comparison of plank endurance test for pre and post Pilates exercises group.

Variable	Mean	SD	<i>P</i> value	Result
PrPPET	12.67	9.06	0.01	Significant
PoPPET	25.61	13.25		

GRAPH- 1.3

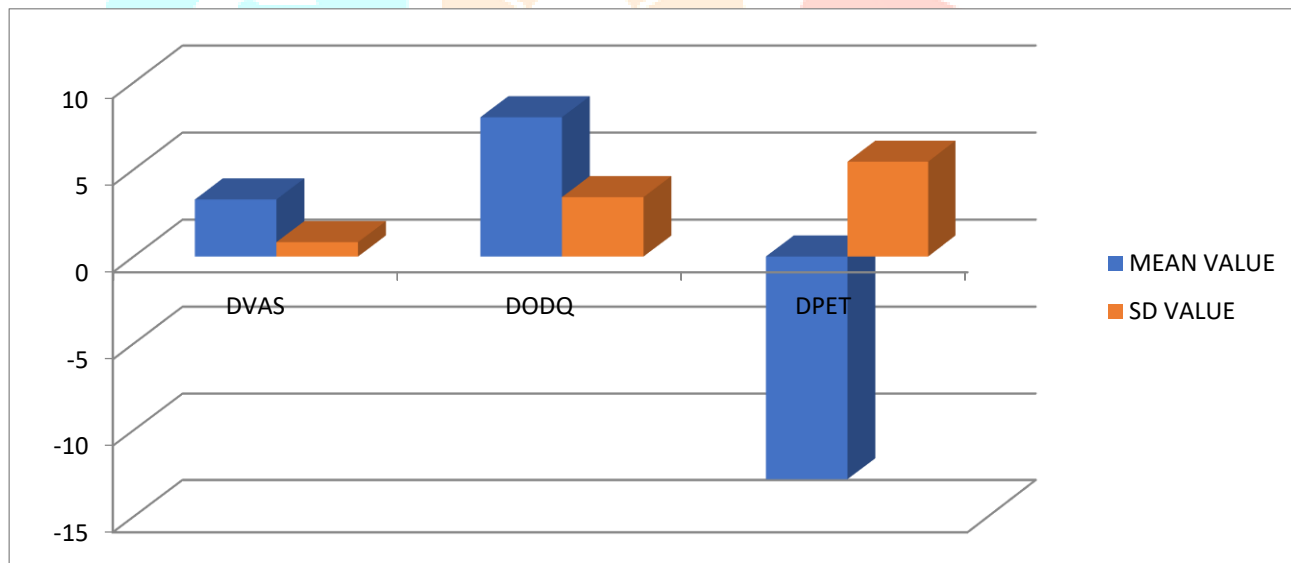


Interpretation: This table explain the parameters i.e. mean value and standard deviation of pre Pilates plank endurance test in experimental group and post Pilates plank endurance test. pre Pilates plank endurance test mean and SD is 12.67 and 9.06. and post Pilates plank endurance test mean and SD is 25.61 and 13.25. The graph represents the difference in the mean values and SD value of Plank endurance test.

Table 1.4 showing difference of VAS, Oswestry disability questionnaire and plank endurance test for pre and post Pilates exercises group.

Variables	Mean	SD	t value	p value
DVAS	3.277	.826	16.82	0.0001
DODQ	8.000	3.412	9.94	0.0001
DPET	-12.833	5.447	9.99	0.0001

GRAPH- 1.4



Interpretation: This table explain the parameters i.e. mean value, standard deviation and t value of difference of VAS, difference of Oswestry disability questionnaire and difference of plank endurance test. Mean, SD and t value of DVAS is 3.277, 0.826 and 16.82 and p is <0.01 , so the result is significant. Mean, SD and t value of DODQ is 8.000, 3.412 and 9.94 and $p < 0.01$, so the result is significant. Mean, SD and T value of DPET is -12.833, 5.447 and 9.99 and $p < 0.01$, so result is significant. The graph represents the difference in mean, SD and t value of DVAS, DODQ and DPET.

Discussion

Through this study it is found that females suffer from back pain because most of the females are working and do not have time or their health. Other reason is cesarian delivery which is more common now a day. But it is also noticeable that females are more conscious about their body tone and want to maintain fit. So they show interest in pilates for fitness.

Some females also informed that they have improvement in their urine incontinence and feel flexible throughout the day.

Results of the study demonstrate that Pilates is significant in decreasing low back pain and improvement in core muscle endurance in eighteen females with mean age is 33.44 years. Significant reduction in VAS with the mean difference of 3.277 which is significant at $p < 0.01$, improvement in functional disability with the mean difference of Oswestry disability questionnaire is 8.00 which is significant at $P < 0.01$. Likewise improvement in the core muscle endurance with the mean value difference of plank test is -12.83 which is also significant at the $P < 0.01$. So through this it is found that Pilates is effective in improving core muscle endurance and improve low back pain which is more common due to weakness of core muscle endurance and it is beneficial exercise in treatment of low back pain.

Limitations of the study:

1. The study was conducted on small sample size.
2. Subjects were only from Hisar.
3. Only female subjects were included.

Conclusion:

The result of the present study shows the significant improvement in low back pain of the female patients. Therefore, it is concluded that Pilates exercises are effective intervention in treatment of chronic non-specific low back pain.

