



**ORIGINAL RESEARCH PAPER**

**Physical Medicine & Rehabilitation**

**A STUDY TO COMPARE THE EFFECTIVENESS OF FELDENKRAIS EXERCISE VERSUS PILATES EXERCISE ON FUNCTIONAL DISABILITY AND CORE MUSCLE ENDURANCE IN SUBJECTS WITH NONSPECIFIC CHRONIC LOW BACK PAIN**

**KEY WORDS:** Low back pain, Quebec back pain disability scale, McGill timed endurance test, Pilates exercise.

**Swetha Kuppusamy**

Sri Venkateshwaraa College of Physiotherapy (Intern), Ariyur, Puducherry.

**S Ramkumar**

Sri Venkateshwaraa College of Physiotherapy (Assistant Professor), Ariyur, Puducherry.

**Balaji Kuppusamy**

Sri Ramachandra Center for Sports and Exercise Science (PG 2nd Year), Chennai.

**ABSTRACT**

Low back pain is the most common health problem and has a huge impact on adults. Worldwide LBP is the problem that causes a greater number of years of disability. It leads to loss of functionality and affects ADL activities and Quality of life. The prevalence of LBP is more in undergraduate students of medical college in the age group of 18 to 25. The sample of 30 students with Non-specific chronic LBP was selected based on inclusion criteria, they were divided into group A (15), and group B (15), and these groups trained with specific training exercises for 6 weeks. After the training for 6 weeks, post-assessment was done using QBPDS and McGill endurance test. The statistical analysis done by using unpaired 't' test with the values of Group A and Group B shows the significance of (p<0.05). Between the group analysis of the post values shows in the Group B is significant than Group A. After the statistical analysis, it shows that there is an improvement in core muscle endurance and functional disability in Group B (Pilates exercise) than Group A (Feldenkrais exercise) which shows that Group B is more significant than Group A.

**INTRODUCTION**

Low back pain is the commonest health problem and has a huge impact on adults. Worldwide LBP is the problem that causes a greater number of years of disability. It leads to loss of functionality and affects ADL activities and Quality of life. The commonest form of low back pain is non-specific low back pain. This term is used when the pathoanatomical cause of pain cannot be determined<sup>[1]</sup>. The chronic non-specific low back pain duration has to be more than 12 weeks. Risk factors of non-specific low back pain incorporate physical factors such as prolonged standing, walking, and raise heavy weights and the psychological factor include depression and job dissatisfaction<sup>[2]</sup>. The prevalence of LBP is more in undergraduate students of medical college in the age group of 17 to 25<sup>[3]</sup>. Feldenkrais method is also called Feldenkrais exercise; it is a form of movement that is learned through a self-relaxation approach. Dr. Moshe Feldenkrais developed this technique and he basically used the self-realization technique for his own injuries. As a result, this technique style is said to be based on developmental movements. Feldenkrais method was helpful to people with restricted or reduced ROM due to any injury, chronic pain, or other physical or neurological problem. The FM has two modalities of instruction 1. Awareness through movement 2. Functional integration<sup>[4]</sup>. The regular practice of FM shows improvement in posture, balance, and flexibility as well as reduced muscle tension effective breathing pattern, and a generalized sense of well-being. The authorized result of embodied awareness practice on body structural map in sensorimotor activity<sup>[5]</sup>.

Pilates exercise was developed by Joseph Pilates in the early 1900s. This is a mind-body exercise named 'Contrology'. The Pilates exercise has six basic principles such as Centering, Concentration, Control, Precision, flow, and breathing. This method was first used for patients in the prison camp during World War 1. In 1920 he used this concept for the recovery of injured dancers<sup>[6]</sup>. In physical therapy, there are two primary ways to practice Pilates 1. 'Mat pilates' - exercise on a mat or floor 2. Equipment Pilates - exercise carried out in resistance apparatus or barrels<sup>[7]</sup>. This exercise reactivates the core muscle group and enhances the strength and stability of the lumbar region and also improves breath control, and ROM of the lumbar spine reducing pain and dysfunction<sup>[8]</sup>. In 2014, Hyun et.al showed that Pilates mat exercise was safer than the equipment Pilates<sup>[9]</sup>. In 2003, Brayon and Hawson said that

Pilates-based therapeutic exercises were established in the physical therapy community to enhance the rehabilitation program<sup>[10]</sup>. In 2016, Abdelraouf et al showed that core muscle endurance was reduced in patients with nonspecific low back pain than the healthy individuals, the core muscle endurance was assessed by using McGill timed endurance test<sup>[11]</sup>. This test was developed by Dr. McGill, it was a popular clinical test to assess the isometric endurance of the core muscle, he did this to healthy individuals to determine their endurance<sup>[12]</sup>. This protocol has four tests which include the trunk flexor test, the trunk extensor test (Sorensen test), and the left and right lateral musculature test. The endurance is assessed by holding a static position as long as possible<sup>[13]</sup>. The holding duration is calculated by using a handheld stopwatch, the test has to be ended when the patient lost the holding position.<sup>[11]</sup> The order of the test was set randomly and each test was repeated 3 times with 5 min of time intravel and the maximum score has to be recorded<sup>[13]</sup>. In 2019, Naeemeh et al showed that two repetitions are probably enough to reliably record the core muscle endurance in subjects with chronic specific and nonspecific low back pain<sup>[14]</sup>. Quebec back pain disability scale was a widely used and accepted scale for functional disability and it was developed based on the sound conceptual model of disability<sup>[15]</sup>. The QBPDS was developed from the world health organization's definition of disability 'any restriction or limitation in the normal range that the human can perform. The QBPDS was primarily made in English and French, later it was modified into several languages like Dutch, Persian, and Turkish. This questionnaire contains 20 items, which are based on normal physical activity related to low back pain. Caution is made while using QBPDS in languages apart from English and French because there is no strong evidence and justifiability for all QBPDS translations. The final set of items was selected by examining the test-retest reliability, item-total correlations, and responsiveness of individual items and by using techniques of factor analysis and item response theory<sup>[16]</sup>. The item-total score is between 0 to 100, with a greater number representing the higher disability<sup>[17]</sup>.

**AIM OF THE STUDY**

The aim is to compare the effectiveness of Feldenkrais exercise versus Pilates exercise on Functional Disability and Core Muscle Endurance in subjects with Nonspecific Chronic Low Back Pain.

**OBJECTIVES OF THE STUDY**

- To find out the effectiveness of Feldenkrais exercise on Functional Disability and Core Muscle Endurance in subjects with Nonspecific Chronic Low Back Pain.
- To find out the effectiveness of Pilates exercise on Functional Disability and Core Muscle Endurance in subjects with Nonspecific Chronic Low Back Pain.

**Inclusion Criteria**

- Subjects who are willing to sign the informed consent and participate.
- Subjects with NSCLBP in the age 17 to 25 years.
- Subjects Presented with NSCLBP for a minimum period of 12 weeks.
- Subjects with minimum score of 15 in QBPDS

**Exclusion Criteria**

- Subjects underwent surgeries or fractures of the spine in the past 1 year
- Subjects with back pain for less than 12 weeks
- Subjects with any systemic illness
- Other orthopedics conditions such as Acute disc bulge, IVDP, etc.
- Any neurological conditions excluded as per the history collected from the subjects.

**PROCEDURE**

**OUTCOME MEASURES**

**MCGILL TIMED ENDURANCE TEST:**

The endurance of the core muscle was assessed by using three tests proposed by McGill. The tests are trunk flexor test, trunk extensor test, and side bridge test. The subjects have to attain the static position and the duration is measured by using a stopwatch. The duration is measured till they withdraw the static position.

**TRUNK FLEXOR TEST:**

It is performed while the body is in 60° of flexion with the hip and knee in 90° flexion. The arms should cross over the chest. Subjects should attain this position as long as possible. The test was terminated when the subject withdrew the position.

**TRUNK EXTENSOR TEST:**

This test is done on the treatment table the subjects should be prone lying. The pelvis, hip, and knee are fixed on the treatment table, trunk and the upper extremities should be out of the table. The subject arms should cross over the chest. Horizontal position has to be attained by the subjects. The subject should maintain this horizontal position as long as possible. The test was concluded when the subject withdrew the position.

**SIDE BRIDGE TEST:**

It is performed in side side-lying position. The subject should lift their body from the table while transferring the body weight through the lower elbow and feet. The subject should maintain the knee in full extension and feet together. This should be maintained as long as possible. The test should be terminated when the patient withdraws from the position.

**QUEBEC BACK PAIN DISABILITY SCALE:**

This scale consists of 20 daily activities that can be grouped into 6 types of activities, they are bed/rest time, sitting/standing items, ambulation items, movement items, bending/stooping items, and handling of large/heavy objects items. In every activity, there are 6 answer categories with 0-5 scores (0 – no effort, 5 – not able to do). The outcome score is within the range of 0 – 100, with higher numbers representing greater levels of functional disability.

**GROUP - A**

**Feldenkrais Method**

The subjects with Nonspecific Chronic Low Back Pain were instructed to follow Feldenkrais exercises. The exercises are

Tilting legs, Pelvic tilt, on all fours, and Gekko each has to be performed for 5 repetitions. All these exercises were performed in two sessions a day 4 times a week for 6 weeks.

**TILTING LEGS:**

Subjects should be supine lying with hip and knee flexion and the soles of the feet should be in contact with the floor. Ask the patient to tilt their knees actively a little bit to the left, and slowly ask to tilt to the right. Make the subjects move their legs slowly, smoothly, and comfortably, and do not allow too far (AVOID STRETCHING SENSATION) for 10 minutes. Subjects were directed to do each repetition a little bit smoother, softer, easier, and more comfortable. Then ask them to inhale while tilting the legs and exhale while bringing them back to the middle.

**PELVIC TILT:**

Subjects should lie supine with hip and knee flexion and the sole of the feet is in touch with the floor. Notice their lordotic curvature and ask them to flatten the lower back and come in touch with the floor. The subject was made aware to roll on to the back of pelvis along with the bone called the sacrum then the back will come closer to the floor or press into it and made subjects experience how their pelvis has rolled. Rolling pelvis, a bit far in the direction so the low back lifts up off the floor a little bit (AVOID STRETCHING SENSATION). This has to be done for 10 repetitions.

**ON ALL FOURS:**

Subjects should be in the Quadri pad position. The arms should be at the right angle to the floor and the right angle to the legs, knees directed below their hip joints, so the angle is close and comfortable. Ask them to inhale while lifting the abdomen up and exhale while bringing them back to a neutral position and this has to be done for 10 repetitions.

**GEKKO:**

Subjects should be in prone lying and the arms are rested on either side of the head. The legs were flexed and they were directed to abduct (move wide apart by tilting) in the opposite way and avoid extreme movement. It should be performed for 10 repetitions.

**GROUP - B**

**PILATES EXERCISE**

The subjects with Nonspecific Low Back Pain were instructed to follow the Pilates exercise. The exercise is pelvic tilt to pelvic curl, chest lift, swan prep, kneeling arm and leg reaching, child pose, Pilates saw, and swimming each has to be performed for 5 repetitions. All these exercises were performed in two sessions a day 4 times a week of 6 weeks.

**PELVIC TILT TO PELVIC CURL EXERCISE:**

Subjects should be supine lying with knees in the flexed position and the sole of the feet is in touch with the floor. Instruct the subjects to flatten the lower back and come in contact with the floor. This has to be done for 20 repetitions within 4 seconds.

**PELVIC CURL:**

Subjects were directed to press their feet down and curl up towards the ceiling. The hip raises, then the lower spine and the middle spine. Then the subjects were asked to come to rest on the shoulder blades with a straight line from the hips to the shoulders. This has to be supported with the abdomen and hamstring. This was repeated for 3 to 5 times.

**CHEST LIFT:**

Subjects in supine lying with knees are flexed and the sole of the feet is in contact with the floor. Leg and feet are parallel-lined up so that the hip, knee, and ankle in one line and the toes are pointed directly away. Ask the patient to lift the lower spine slightly from the mat. Shoulders were kept down as the subjects brought the hands behind the head with

the fingertips touching. Then slowly bring it down towards the spine, allowing the spine to lengthen. This has to be done for 3-5 times.

**SWAN PREP:**

Subjects should be prone lying with arms close to the body and the elbows bent to bring the hands under the shoulder. Now ask the subjects to lift the umbilicus up from the mat, the abdomen remains raised throughout the exercise. Repeat for 3-5 times.

**KNEELING ARM AND LEG REACH:**

Subjects should be in the Quadri pad position and they were instructed to reach with hands directly under the shoulders and knees directly under the hips. The leg and feet are parallel and the hip is distanced apart. The back was in a neutral position permit the natural curves and supported abdominal muscles to be pulled in. Repeat this for 3-5 times on each side.

**CHILD'S POSE:**

Ask the subjects to keep the toes together and open the knees to at the minimum hip distance apart and lean forward to drape the body over the thighs so the forehead relax on the floor and arms are reached in front. Instruct them to alternately leave the arms along both sides. Ask them to breathe deeply and then relax.

**SPINE STRETCHES:**

Subjects were directed to sit erect with legs in an extended position. The subjects were asked to reach the peak of the head with shoulders in a relaxed position. Inhale and extend the arms out at shoulder height.

**PILATES SAW:**

Subjects were instructed to sit erect with legs in extended position and shoulders were kept wide apart. Shoulders were placed down as the arms were being stretched out to the sides, uniform with the shoulders.

**SWIMMING:**

Subjects should be prone lying with legs kept together, shoulder blade settled in the back and the shoulder kept aside from the ears, then stretch the arm straight overhead pulling the abdominals. Then subjects were asked to continue reaching out the arm and legs long from the center as they alternated lifting the right arm and left leg, then the left arm and right leg, pushing them up and down in small pulses.

**RESULT**

A total of 30 subjects were included in this study. The minimum age observed in this study was 17 years and the maximum age observed in this study was 25 years in all two groups.

Group A (Feldenkrais exercise) and Group B (Pilates exercise). The mean and standard deviation of pre and post values of Trunk Flexor Test, Trunk Extensor Test, Side Bridge Right and Left and Quebec Back Pain Disability Scale.

**Within Group Analysis Of Group A**

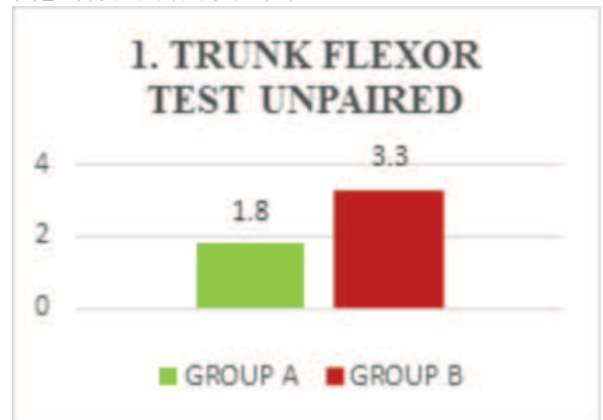
The mean and SD of Trunk Flexor Test pre and post values are 23.6±10.223 and 2.5±10.091 and 't' value is 7.897. The mean and SD of Trunk Extensor Test pre and post values are 12.8±6.720 and 15.6±6.987 and 't' value is 7.359. The mean and SD of Right-Side Bridge Test pre and post values are 19.4±8.903 and 21.8±9.344 and 't' value is 8.121. The mean and SD for Left Side Bridge Test pre and post values are 20.1±8.959 and 23.1±8.741 and 't' value is 6.873. The mean and SD for QBPDS pre and post values are 36.8±4.703 and 34.8±4.362 and 't' value is 7.751. The statistical analysis is done with paired 't' test with Group A analysis shows the significance of (p<0.001)

**Within Group Analysis Of Group B**

The mean and SD of Trunk Flexor Test pre and post values are 18±9.206 and 21.3±9.170 and 't' value is 6.271. The mean and SD of Trunk Extensor Test pre and post values are 13.3±8.599 and 17.6±8.507 and 't' value is 11.870. The mean and SD of Right-Side Bridge Test pre and post values are 18±6.855 and 22±7.411 and 't' value is 9.444. The mean and SD for Left Side Bridge Test pre and post values are 20.8±8.046 and 25.8±8.953 and 't' value is 12.426. The mean and SD for QBPDS pre and post values are 42.4±9.279 and 38.9±9.168 and 't' value is 10.770. The statistical analysis is done with paired 't' test with Group A analysis shows the significance of (p<0.001) Within the group analysis, it has been shown that the pre and post – test values of Trunk Flexor Test, Trunk Extensor Test, Side Bridge Test Right and Left and QBPDS shows significant improvement in Group B than the Group A

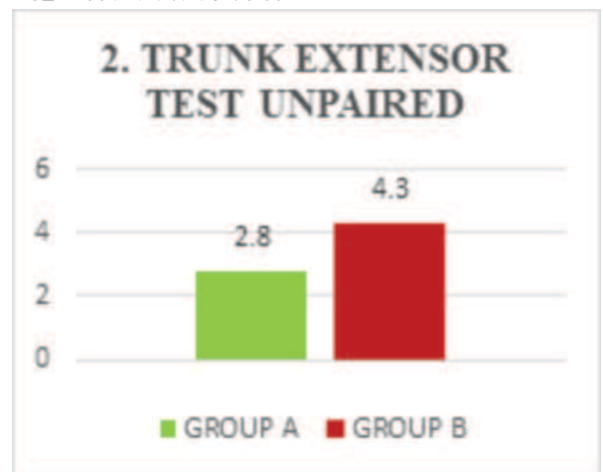
**Between the Group A and B Trunk Flexor Test:**

The mean and SD for Trunk Flexor Test are 1.8±0.915 and 3.3±2.058 and 't' value is 2.310.



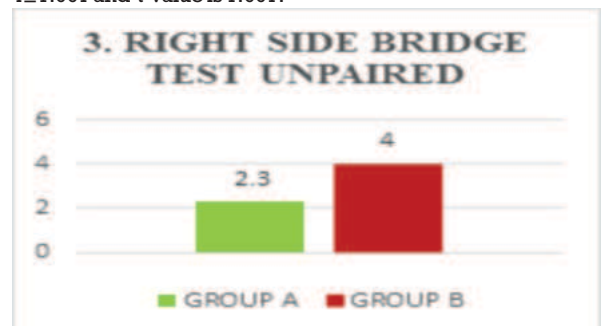
**Between The Group A And B Trunk Extensor Test:**

The mean and SD for Trunk Extensor Test are 2.8±1.473 and 4.3±1.290 and 't' value is 3.031.



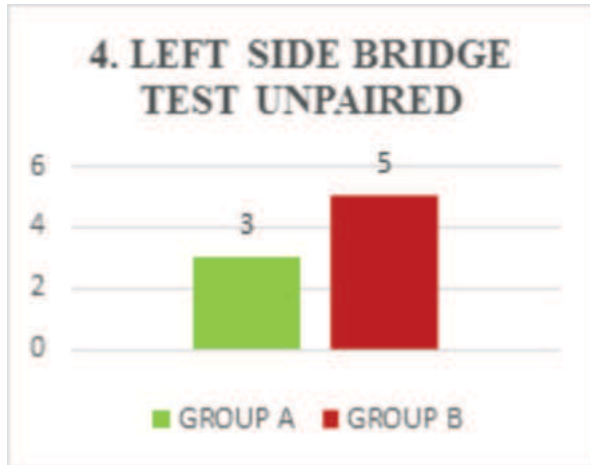
**Between the Group A and B Right Side Bridge Test:**

The mean and SD for Right Side Bridge Test are 2.3±1.112 and 4±1.667 and 't' value is 1.667.



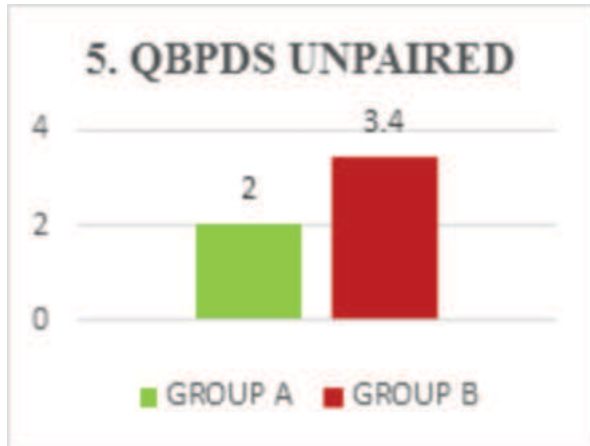
**Between the Group A and B Left Side Bridge Test:**

The mean and SD for Left Side Bridge Test are  $3 \pm 1.690$  and  $5 \pm 1.550$  and 't' value is 3.369.



**Between the Group A and B QBPDS:**

The mean and SD for QBPDS are  $2 \pm 1.032$  and  $3.4 \pm 1.245$  and 't' value is 3.350.



The statistical analysis done by using unpaired 't' test with the values of Group A and Group B shows significance of ( $p < 0.05$ ). Between the group analysis of the post values shows in the Group B is significant than Group A. After the statistical analysis, it shows that there is an improvement in the core muscle endurance and functional disability in Group B (Pilates exercise) than Group A (Feldenkrais exercise) which shows that the Group B is significant than Group A.

**DISCUSSION**

This study was selected for the purpose to find out the effectiveness of Feldenkrais exercise versus Pilates exercise on Functional Disability and Core Muscle Endurance in subjects with Nonspecific Chronic Low Back Pain. On the basis of inclusion criteria, the subjects have been selected between the age group of 17 – 25 years. Only college students have been selected in this study. The pre- test was taken for 30 subjects (group A – 15 and group B – 15) using McGill timed endurance test and Quebec Back Pain Disability Scale. After 6 weeks of training, post- test was taken for both the groups. Statistical analysis was done using the paired 't' test.

In this study the sample size is relatively small; however, the power analysis revealed that 30 participants are sufficient to obtain a statistically significant interaction effort for an investigation of functional disability and core muscle endurance. Core muscle endurance and functional disability were much improved for the subjects after the training of Pilates exercise.

Most of the college students experience NSCLBP due to

various factors which may affect their daily activities. Core muscle endurance may decrease to the subjects with NSCLBP, but it is unnoticed.

**CONCLUSION**

From the above result and discussion, the study concludes that the Pilates exercise (GROUP B) shows beneficial effects than the Feldenkrais exercise (GROUP A) on subjects with Nonspecific Chronic Low Back Pain using McGill timed endurance test and Quebec Back Pain Disability Scale after 6 weeks of intervention.

**LIMITATIONS**

- Sample size was small.
- The treatment duration was shorter.
- Only college students were selected in this study.
- Only age group between 17 – 25 were taken.
- Specific and localized muscle strength was not verified.

**Recommendations**

- Further study can include more participants.
- Long term effect has to be reported.
- Further study can be concluded with more outcome measure.
- Further studies done in older population.

**REFERENCES**

1. Cuenca-Martínez F, Cortes-Amador S, Espi-López GV. Effectiveness of classic physical therapy proposals for chronic non-specific low back pain: a literature review. *Physical Therapy Research*. 2018 Jun 20;21(1):16-22.
2. Chiarotto A, Koes BW. Nonspecific low back pain. *New England Journal of Medicine*. 2022 May 5;386(18):1732-40.
3. Aggarwal N, Anand T, Kishore J, Ingle GK. Low back pain and associated risk factors among undergraduate students of a medical college in Delhi. *Education for health*. 2013 May 1;26(2):103-8.
4. Sheikh MK, Pt NI, Pt SC, Indurkar I, Mutkure K, Dharmik RC. Effect Of Feldenkrais Method And Conventional Exercise Protocol On Neck Pain And Low Back Pain In Corporate Employees Working From Home: A Comparative Study. *Journal of Survey in Fisheries Sciences*. 2023 May 4;10(45):3096-102.
5. Crivelli D, Di Ruocco M, Balena A, Balconi M. The Empowering Effect of Embodied Awareness Practice on Body Structural Map and Sensorimotor Activity: The Case of Feldenkrais Method. *Brain Sciences*. 2021 Dec 1;11(12):1599.
6. Elik M, Zgorzalewicz-Stachowiak M, Zeńczak-Praga K. Application of Pilates-based exercises in the treatment of chronic non-specific low back pain: state of the art. *Postgraduate medical journal*. 2019 Jan;95(1119):41-5.
7. Suárez-Iglesias D, Miller KJ, Seijo-Martínez M, Ayán C. Benefits of Pilates in Parkinson's disease: a systematic review and meta-analysis. *Medicina*. 2019 Aug 13;55(8):476.
8. Huang J, Park HY. Effect of pilates training on pain and disability in patients with chronic low back pain: a systematic review and meta-analysis based on randomized controlled trials. *Physical Activity and Nutrition*. 2023 Mar;27(1):16.
9. Patti A, Bianco A, Paoli A, Messina G, Montalto MA, Bellafiore M, Battaglia G, Iovane A, Palma A. Effects of Pilates exercise programs in people with chronic low back pain: a systematic review. *Medicine*. 2015 Jan;94(4).
10. Bryan M, Hawson S. The benefits of Pilates exercise in orthopaedic rehabilitation. *Techniques in Orthopaedics*. 2003 Mar 1;18(1):126-9.
11. Abdelraouf OR, Abdel-Aziem AA. The relationship between core endurance and back dysfunction in collegiate male athletes with and without nonspecific low back pain. *International journal of sports physical therapy*. 2016 Jun;11(3):337.
12. Waldhelm A, Li L. Endurance tests are the most reliable core stability related measurements. *Journal of Sport and Health Science*. 2012 Sep 1;1(2):121-8.
13. Nesser TW, Huxel KC, Tincher JL, Okada T. The relationship between core stability and performance in division I football players. *The Journal of Strength & Conditioning Research*. 2008 Nov 1;22(6):1750-4.
14. Esfahani NH, Rezaeian ZS, Dommerholt J. The number of repetitions of the McGill tests to reliably determine core muscle endurance in subjects with and without chronic nonspecific low back pain: A cross sectional study. *Medical Science*. 2019;23(98):452-61.
15. Riecke J, Holzapfel S, Rief W, Lachnit H, Glombiewski JA. Cross-cultural adaptation of the German Quebec Back Pain Disability Scale: an exposure-specific measurement for back pain patients. *Journal of Pain Research*. 2016 Jan 11:9-15.
16. Wewege MA, Jones MD, McAuley JH. *Clinimetrics: Quebec Back Pain Disability Scale*. *Journal of Physiotherapy*. 2020 Jul 10;66(4):270-.
17. Fritz JM, Irrgang JJ. A comparison of a modified Oswestry low back pain disability questionnaire and the Quebec back pain disability scale. *Physical therapy*. 2001 Feb 1;81(2):776-88.