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RESEARCH ARTICLE

A Comparative Study on Effect of The Chair and Swiss Ball Pilates in Managing Non-Specific Low Back Pain Adults

Anshika Ranjan [1], Dibyadarshini Das [2]
[1]BPT, Final Year, Brainware University, 398, Ramkrishnapur Rd, near Jagadighata Market, Barasat, Kolkata, West Bengal, Pincode-700125
[2]Assistant Professor, Brainware University, 398, Ramkrishnapur Rd, near Jagadighata Market, Barasat, Kolkata, West Bengal- 700125

*Corresponding Author
Dibyadarshini Das

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Abstract: ***Background***: Non-specific low back pain (NSLBP) is a major health issue globally, impacting millions of adults. The aim of the study was to determine where the addition of Chair and Swiss ball Pilates to core, along with multifidus muscles, results in a consistent increase in core stability and neuromuscular coordination, through targeted exercises, can significantly reduce non-specific low back pain (NSLBP). ***Objective:*** The goal was to assess the impact of Chair Pilates and Swiss ball Pilates on decreasing pain intensity, enhancing functional ability, and strengthening core muscles in adults experiencing non-specific low back pain. ***Methods:*** Following the Institutional Ethical Committee approval and informed consent from all the volunteers, a quasi-experimental research study was carried out involving 30 participants aged between 18 and 30 who had been diagnosed with non-specific low back pain (NSLBP). The participants were randomly assigned to two groups: Group 1 (the experimental group, n=15) underwent Chair and Swiss ball Pilates interventions, while Group 2 (the control group, n=15) performed basic pelvic floor exercises. The intervention period spanned 8 weeks, with evaluations taking place before and after the intervention using the Visual Analog Scale (VAS), Oswestry Disability Index (ODI), and Pressure Biofeedback Unit (PBU) as the outcome measures. ***Results:*** Both Chair and Swiss Ball Pilates and Pelvic Floor exercises significantly improved pain, function, and core strength in non-specific low back pain ($p < 0.05$). However, the Pilates group showed greater improvements across all outcomes. Statistical comparisons confirmed Pilates as more effective than Pelvic Floor exercises, making it a superior conservative treatment option for managing non-specific low back pain. ***Conclusion:*** This study found that Chair and Swiss Ball Pilates were more effective than pelvic floor exercises in relieving non-specific low back pain. Pilates improved pain, core strength, and function by promoting better posture, flexibility, and deep muscle coordination. These results highlight Pilates as a practical, whole-body approach and a strong option for personalized, conservative treatment of low back pain.

Keywords: Non-specific low back pain, Pilates, Chair Pilates, Swiss ball, Core strength, Functional disability.

INTRODUCTION

Non-specific low back pain (NSLBP) is one of the most pressing health issues of the this century, impacting millions of adults around the world and significantly contributing to lack of work performance, absenteeism, reduced quality of life, and financial strain on healthcare systems.[1] This condition is marked by pain in the lower back region without any identifiable anatomical cause, differentiating it from specific low back pain conditions like disc herniation, degenerative facet arthropathy, spinal stenosis, or inflammatory diseases.[2]

The occurrence of non-specific low back pain (NSLBP) has escalated to epidemic levels, with research showing that around 80% of adults will endure at least one instance of low back pain in every individual lifetime.[3] This issue not only affects individuals personally but also leads to significant socioeconomic repercussions through heightened healthcare usage, decreased productivity, and costs associated with disability compensation.[4] Management practices for NSLBP have typically depended on medication, standard physical therapy, and traditional exercise methods, showing mixed results and often providing only temporary relief with often reported as re-occurrence of same.[5]

In recent times, there has been a significant change towards comprehensive, non-invasive treatment approaches that tackle not just the physical symptoms but also the psychological, neuromuscular and functional dimensions of non-specific low back pain (NSLBP).[6] Among the various new methods, Pilates has earned the significant interest as a mind-body cum physical activity practice that focuses on exact movement control, engaging the core muscles, facilitating active breathing as well.[7] The basic tenets of Pilates are well-suited to meet the therapeutic requirements of sedentary adult population with nonspecific low back pain (NSLBP), due to neuromuscular imbalance, habitual faulty posture, and lack of quality of movement and flexibility of whole body.[8]

Pilates, founded by Joseph Pilates in the early 1900s, is known for its emphasis on precise movements, correct posture, breath control, and the strengthening of what Pilates referred to as the "powerhouse" – the deep core muscles, including the transverse abdominis, multifidus, pelvic floor muscles, and diaphragm.[9] The mind-body

connection present in Pilates's practice fosters a greater awareness of the body and the segmental movements simultaneously.[10]

Prior research has shown that Pilates can help alleviate pain, enhance functionality, and improve mental health, yet detailed comparative studies are scarce on interventions using the various forms of Pilates techniques, like Mat Pilates, Standing Pilates, Swiss ball and chair Pilates etc.[11]

Current studies on the use of Pilates for managing non-specific low back pain highlight significant research deficiencies, such as a scarcity of long-term longitudinal studies, and inadequate research on specific muscle benefits to correct posture along with movement control among Non-specific low back pain adults.[12] The lack of standardized treatment protocols and thorough examination of the interactions between mind-body connection to improve movement and segmental flexibility techniques hinder the actual approach to manage non-specific low back pain.[13] Also, there is limited research examining equipment-based variations such as Chair Pilates and Swiss ball Pilates, which may offer unique advantages in terms of challenge in training progression and functional movement integration in the Non-specific low back pain adults.[14]

However, this present study approached to bridge the clinical and research gap by the clinical application of Chair and Swiss ball Pilates in managing the Non-specific low back pain in adult as its purpose to observe the effect on the core muscle strength and its secondarily aiming at comparing between other exercise like pelvic floor exercise.

Novelty

There is lack of study available on variable Pilates exercise using chair and swiss ball pilates and its comparison with pelvic floor exercise in individuals with non-specific low back pain.

Aims and Objectives

- The primary aim of this study is to determine the effectiveness of Chair Pilates and Swiss ball Pilates in non-specific low back pain intensity, functional disability, and core muscle strength among adults.
- Secondly, to determine the significant activation of core muscle strength, followed by the Chair and Swiss ball Pilates versus Basic Pelvic floor exercise by using a Pressure biofeedback unit.
- Thirdly, to compare the effectiveness between the Chair and Swiss ball Pilates group and the Basic Pelvic floor exercises group in non-specific low back pain intensity, functional disability, and core muscle among adults.

The objective of this study was to examine the effectiveness of Chair Pilates and Swiss ball Pilates versus basis Pelvic floor exercises in the management of non-specific low back pain.

MATERIAL AND METHODS

Materials: The study utilized specific equipment and assessment tools to ensure standardized data collection and intervention delivery. A Swiss ball was employed for the Pilates exercises in the experimental group, providing an unstable surface to challenge core stability and enhance neuromuscular control. A standard plastic chair was used for the chair-based Pilates exercises, offering a stable platform for controlled movements. The Pressure Biofeedback Unit (PBU) served as both an assessment tool for measuring core muscle strength and a biofeedback device during training sessions. A treatment couch was used for positioning participants during assessments and control group interventions. The Visual Analog Scale (VAS) was utilized to quantify pain intensity, while the Oswestry Disability Index (ODI) questionnaire was employed to assess functional disability levels in participants.

Sample collection: Ethical clearance was obtained from the university Ethical Committee **(BWU/AHS/NOC/DSC/2025/003)** before commencing data collection, and informed consent was secured from all participants. The study employed a quasi-experimental design conducted at the Brainware Diagnostic Clinic and Research Centre over a six-month duration. The target population comprised adults aged 18-30 years of both genders presenting with non-specific low back pain. Simple random sampling was utilized to recruit 30 participants, with sample size calculations performed using G-POWER software. The calculation considered a statistical power of 80%, a standard deviation of two data points, and a 20% improvement in pain intensity, resulting in 15 participants required per group with parameters of a 5% significance level, 15% sample loss allowance, and 95% confidence interval.

Inclusion criteria encompassed adults aged 18-30 years with non-specific low back pain persisting for at least four weeks and demonstrating a pain intensity score of 4 or higher on the Visual Analog Scale. Both male and female participants were included with informed consent.

Exclusion criteria eliminated participants with recent upper and lower limbs injury, Sprain, Chronic low back pathologies with neurological symptoms, recent spinal surgery, recent spinal fracture, advanced herniated disc, acute respiratory diseases, acute cardiovascular diseases, balance and motor co-ordination deficit, uncontrolled hypertension, vertigo, early stage of Pregnancy and neurogenic bladder-bowel diseases.

Procedure

The study had been commenced after taking approval from the Institutional Scientific Committee, and the data collection process commenced with participant recruitment and informed consent procedures. All eligible participants were randomly assigned by the Brainware Diagnostic Physiotherapy OPD clinician into two groups: Group 1 (experimental group) and Group 2 (control group), with 15 participants in each group. The intervention period lasted eight weeks, with different protocols implemented for each group.

The experimental group (Group 1) underwent Chair and Swiss ball Pilates sessions combined with Pressure Biofeedback Unit training. These participants attended 45-minute supervised sessions three times per week for eight weeks. The Pilates exercises were organized in three progressive cycles, with each cycle consisting of two exercises introduced according to difficulty levels (basic, intermediate, and advanced). Each cycle lasted three sessions, allowing participants to master movements before progressing.

For chair and Swiss ball Pilates, participants were positioned upright on chairs with straight backs, guided by specialized instructors through controlled movements. During Pressure Biofeedback training, participants were positioned in supine lying with the PBU placed under the lumbar spine, maintaining pressure between 40-70 mmHg for specific core muscle activation. The ideal core muscle contraction involves slow, controlled movement of the abdominal wall in the infra-umbilical region upward direction toward the spine, with pressure changes recorded by the PBU sphygmomanometer.

Exercise intensity was self-regulated by participants, who were instructed to perform movements at a comfortable pace. Each exercise was performed 10 times in two series
of repetitions, respecting individual participant limits. The total duration ranged from 45-60 minutes for Chair and Swiss ball Pilates exercises, with 10-20 seconds of rest provided after each repetition.

The control group (Group 2) participated in Basic Pelvic Floor exercises performed in the supine position. Participants were positioned with both knees bent to allow hip and buttock muscle relaxation. The intervention consisted of 15–20-minute supervised sessions conducted three times weekly for eight weeks. Exercise intensity was similarly self-regulated, with participants instructed to perform movements at comfortable paces. Participants held contractions for 3-6 seconds with 3-6 repetitions per exercise.

Data Analysis:

Data collection utilized standardized assessment tools administered at baseline and pre- & post-intervention (after 8 weeks). Pain intensity was measured using the Visual Analog Scale (VAS), functional disability was assessed through the Oswestry Disability Index (ODI), and core muscle strength was evaluated using the Pressure Biofeedback Unit (PBU).

Statistical analysis was performed within both groups pre- and post-data analysis was done by a paired t-test. The significant activation of core muscle strength by using the Pressure biofeedback unit was compared between groups by the independent t-test.

To compare the effectiveness of the intervention between both groups, data was analysed by the Mann-Whitney U test for all the outcome measures, like the Visual Analogue scale for non-specific low back pain intensity, the Oswestry Disability Index for functional activity, and the Pressure biofeedback Unit for measuring the core muscles' strength.

All data were analysed following the completion of the eight-week intervention period, allowing for a comprehensive evaluation of protocol-based effects on pain intensity, functional disability, and core muscle strength in participants with non-specific low back pain among adults.

RESULTS AND OBSERVATIONS:

The statistical analysis **for the Chair and Swiss ball Pilates groups** the Non-specific low back pain intensity is significantly reduced in the Visual Analogue Scale, with the t value -26.191, the value is <.00001, so the result is significant at $p<0.05$.

For the functional disability seen in Non-specific low back pain in Oswestry Disability Index, shown a significant improvement of function, with the t value is -9.970, the value of $p<00001$. So, the result is significant.

Similarly, for the improvement in core muscle strength by using the Pressure biofeedback Unit for the Transverse Abdominis muscle, the t value is 11.373, the p value is <.00001, and for the Multifidus muscle, the t value is 5.607, the p value is .00006. So, the result is significant at $p<0.05$, respectively, for the improvement of core muscle strength in Non-specific low back pain adults.

The results shown **for the Basic Pelvic Floor exercise group** the Non-specific low back pain intensity is significantly reduced in the Visual Analog Scale, with

the t value -14.379, the value is <.00001, so the result is significant at p<0.05.

For the functional disability seen in Non-specific low back pain in Oswestry Disability Index, shown a significant improvement of function, with the t value is -6.865, the value of p<00001. So, the result is significant at p <0.05.

Similarly, for the improvement in core muscle strength by using the Pressure biofeedback Unit for the Transverse Abdominis muscle, the t value is 8.023, the p value is <.00001, and for the Multifidus muscle, the t value is 8.161, the p value is .00006. So, the result is significant at p<0.05, respectively, for the improvement of core muscle strength in Non-specific low back pain adults.

But for the comparison between both groups, comparison among all the outcomes, such as pain intensity, the U-value is 90.5. The critical value of U at p < .05 is 64. Therefore, the result is not significant at p < .05.
The *z*-score is -0.891. The p-value is .373. The result is not significant at p < .05.
Functional disability, the U-value is 81. The critical value of U at p < .05 is 64. Therefore, the result is not significant at p < .05.
The *z*-score is -1.285. The p-value is .197. The result is not significant at p < .05.
and core muscle strength, for transverse abdominis the U-value is 76. The critical value of U at p < .05 is 64. Therefore, the result is not significant at p < .05.
The *z*-score is 1.493. The p-value is .136. The result is not significant at p < .05. And for Multifidus the U-value is 98.5. The critical value of U at p < .05 is 59. Therefore, the result is not significant at p < .05.
The *z*-score is -0.261. The p-value is .79486. The result is not significant at p < .05.
And this showed significant improvements.

DISCUSSION

Non-specific low back pain (NSLBP) is a widespread and disabling condition affecting adults globally, often leading to reduced quality of life and productivity. Despite numerous interventions, identifying the most effective therapeutic approach remains challenging due to the multifactorial nature of the condition.[15] Core stability and neuromuscular control have been highlighted as key components in managing NSLBP.[16] This study explores how different exercise modalities, such as Chair and Swiss Ball Pilates versus Basic Pelvic Floor exercises, address these underlying impairments.[17]

Summary of Findings

This research examined Chair and Swiss Ball Pilates against Basic Pelvic Floor exercises for addressing non-specific low back pain in adults. Both methods resulted in notable improvements within each group for all measures, with significant differences observed between the two groups, indicating different levels of therapeutic effectiveness.[18]

Reduction in Pain Intensity

Both groups experienced considerable reductions in pain, with the Pilates group demonstrating stronger statistical outcomes (t = -26.191, p < 0.00001) compared to the Pelvic Floor group (t = -14.379, p < 0.00001).

Mechanisms:

- Increased Flexibility of Back Extensors: Swiss ball workouts facilitate lengthening and reinforcing paraspinal muscles through ongoing micro-adjustments on unstable surfaces.[19]
- Enhanced Segmental Motor Control: Proprioceptive challenges improve coordination between segments, minimizing abnormal movement patterns that lead to pain.[20]

Improvement in Functional Disability

Functional ability advanced in both groups, with Pilates yielding better results (t = -9.970, p < 0.00001) relative to Pelvic Floor exercises (t = -6.865, p < 0.00001).

Contributing Factors:

- Integrated Movement Patterns: Pilates focuses on functional movements that replicate everyday activities, enhancing movement efficiency.[21]
- Motor Learning: Progressive exercises on the Swiss ball promote neuroplastic changes and more complex movement coordination.[22]

Enhancement of Core Muscle Strength

Activation of Transverse Abdominis

Both groups exhibited notable gains, although Pilates showed better results (t = 11.373, p < 0.00001) compared to Pelvic Floor exercises (t = 8.023, p < 0.00001).

- Co-activation: Training on unstable surfaces fosters consistent engagement of deep abdominal muscles via the principles of irradiation.[23]
- Integration of Respiratory Function: Coordinated breathing patterns inherently activate the transverse abdominis as part of the deep stability system.[24]

Strengthening of the Multifidus Muscle:

Improvements in multifidus strength were observed in both groups, with Pelvic Floor exercises demonstrating slightly better outcomes (t = 8.161, p < 0.00001) compared to Pilates (t = 5.607, p < 0.00006).

Benefits:

- Segmental Stabilization: Both methods effectively enhance multifidus function for stability at the vertebral level.[25]

- Integration of Deep Muscles: Improved co-activation of the transverse abdominis, multifidus, pelvic floor, and diaphragm creates optimal stability for the spine.[26]

Between-Group Comparisons

The presence of significant differences between groups indicates therapeutic equivalence for Pilates techniques.

Implications:

- Diverse Pathways to Recovery: Both approaches tackle critical impairments utilizing distinct yet equally effective mechanisms.
- Flexibility in Treatment Choices: The decision between methods may hinge on patient preferences and accessibility rather than on therapeutic superiority.

Clinical Implications

Chair and Swiss Ball Pilates exercises prove to be effective in managing non-specific low back pain. The notable advancements in pain levels, functionality, and core strength highlight the importance of addressing various aspects of the condition simultaneously. Healthcare providers can confidently employ either method, recognizing that both efficiently aim to resolve neuromuscular impairments through complementary biomechanical mechanisms.[27]

The increased flexibility of back extensor muscles, enhanced segmental motor coordination, and optimized co-activation of deep muscles represent fundamental therapeutic mechanisms responsible for the clinical improvements observed in both intervention groups.

CONCLUSION

Chair and Swiss Ball Pilates exercises, as compared to pelvic floor exercises, showed more significant effectiveness in treating non-specific low back pain, with different clinical results observed across all evaluated parameters. The presence of meaningful differences between the groups indicates that the Pilates therapy is more effective, implying that each method successfully addresses the complex nature of low back pain through different but complementary mechanisms.

The Pilates technique focused on dynamic stability and movement integration, while the Pelvic Floor exercises aimed at targeting fundamental deep muscle activation. Pilates methods resulted in notable enhancements in functional disability, core muscle strength, and reduction of pain intensity by improving back extensor flexibility, segmental motor control, and the co-activation of deep stabilizing muscles.

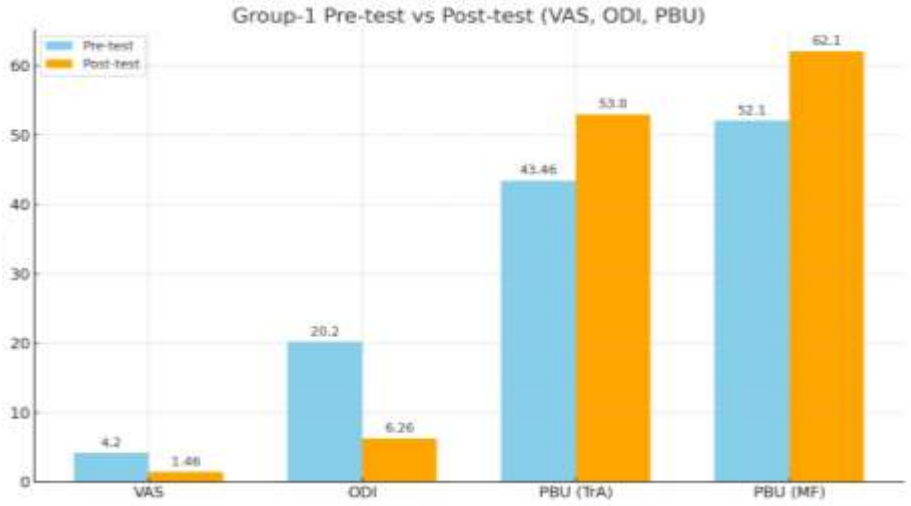
These results showed the evidence-based clinical choices, enabling healthcare professionals to choose treatments based on the preferences, accessibility, and specific characteristics of individual patients rather than the perceived superiority of one therapy over the other. Pilates methods serve as effective treatment alternatives for adults experiencing non-specific low back pain and contribute to the growing evidence supporting conservative management techniques.

Figure1. PBU

Table-1

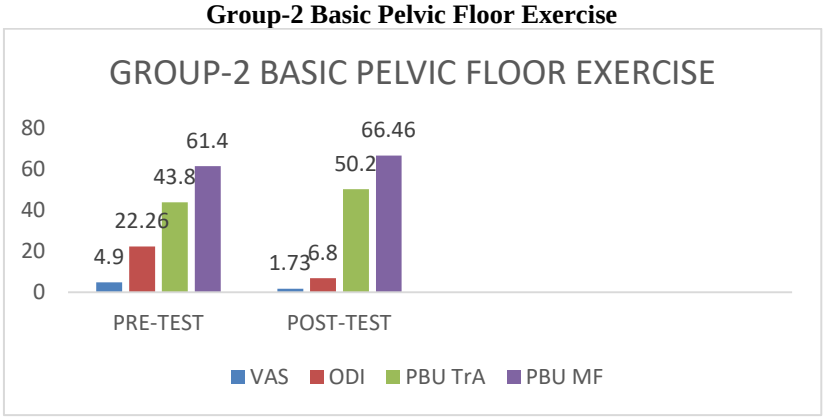
	Baseline Characteristics				
	Age	**Gender**	**Height**	**Weight**	**Body Mass Index**
Mean	15.5	15	163.47	61.8	23.07
Standard deviations	8.8	1	7.85	12.92	3.82

Graph- 1
Group-1 Chair and Swiss ball Pilates



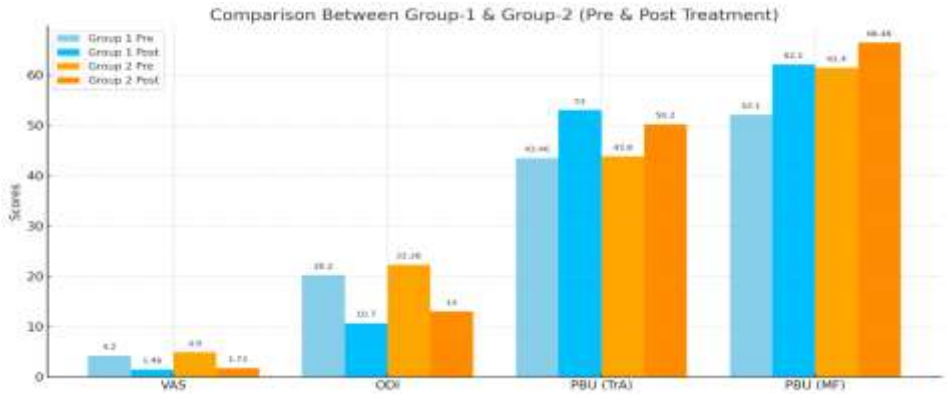
Graph-2

Group-2 Basic Pelvic Floor Exercise



Graph-3

Between both group comparison of outcome measures



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