International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Efficacy of Mat Pilates on Pain, Flexibility and Disability among Young Adults with Low Back Pain

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Abstract

Background: Low back pain (LBP) has emerged as a leading cause of disability worldwide, impacting the quality of life and functional abilities of individuals. Those experiencing LBP often exhibit reduced flexibility in the spinal and paraspinal structures compared to asymptomatic individuals. In recent years, Mat Pilates has gained increasing attention as a therapeutic approach due to its focus on core stability and posture. However, there remains a need to evaluate its effectiveness in managing LBP. Objective: This study evaluated the effects of Mat Pilates on pain, flexibility, and disability among young adults with low back pain. Methodology: 30 subjects, both male and female with low back pain, between the age group of 18-25 years were selected for the study and randomly divided into 2 groups with a minimum of 15 subjects in each group. The control group was treated with moist hot pack, interferential therapy (IFT) and back isometrics. The experimental group was treated with Mat Pilates in addition to moist hot pack and interferential therapy (IFT). All subjects underwent a total of 30-45 minutes session for 2 weeks, 4 days per week. The baseline data was recorded on first day pre-intervention and on the last day of second week (post-intervention). Outcome measures were Numeric Pain Rating Scale (NPRS) for pain, Modified-Modified Schober's Test (MMST) for flexibility and Oswestry Disability Index (ODI) Questionnaire for disability. Results: Post-intervention analysis revealed statistically significant improvements within both the Mat Pilates and control groups ($p < 0.001$). However, between the groups comparison indicated a statistically significant reduction in pain scores in the Mat Pilates group relative to the control group. While improvements in flexibility and reduction in disability were observed in the intervention group, but there was no statistical significant difference when compared to the control group. Conclusion: The findings of the present study suggest that incorporating Mat Pilates into standard physiotherapy protocols may be effective in reducing pain, improving flexibility and minimizing disability among young adults and can be taken into consideration while treating young adults with low back pain.

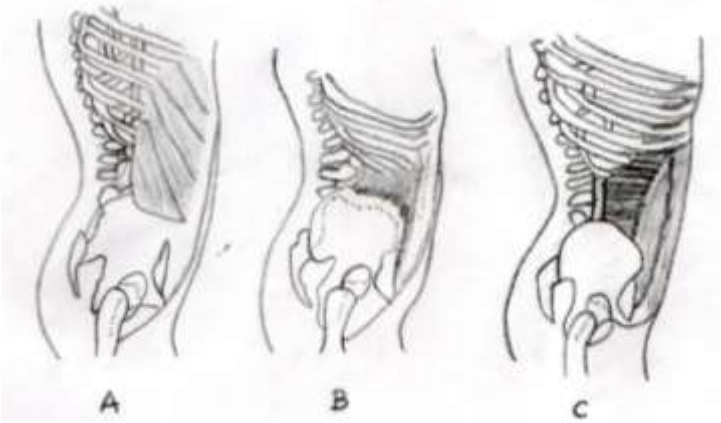
Keywords: Low back pain, Mat Pilates, Young adults.

1. Introduction

Low back pain (LBP) is presently the most common cause of disability globally (1) (2) (3). Pain that is localized to the area below the posterior ribs and above the lower margin of the buttocks, with or without radiating leg pain, is described as low back pain (4). The complexity of LBP is further compounded by a multitude of potential anatomical contributors, which may include nerve roots, musculature, fascial structures, skeletal elements, joints, intervertebral discs (IVDs), and abdominal organs (5). It has been observed that individuals experiencing lower back pain commonly exhibit a reduction in the mass of paraspinal muscles, demonstrate diminished strength in trunk muscles, reduced endurance, and decreased flexibility (6). Low back pain is more common as people age; incidences range from 1% to 6% among children aged 7 to 10 years, 18% among teenagers and a peak frequency of 28% to 42% in those aged 40 to 69 (7). Pain in low back was reported by 619 million individuals globally in 2020, with 843 million cases projected by 2050 (8). Compared to worldwide population, yearly and lifetime occurrence rates of low back pain are higher in the Indian population, primarily among women. Among the Indian population, lifetime and yearly prevalence of low back pain are 66% and 51%, respectively (9). A study reported, 42.4% of Indian young adults aged 18 to 35 experienced low back pain at once in a year and 22.8% on weekly basis (10).

Low back pain is categorized either as “specific” or “non-specific”. Specific type has a specific pathophysiological etiology, such as nucleus pulposus hernia, infection, osteoporosis, inflammation, rheumatoid arthritis, tumor or fracture. Only about 10% of patients with low back pain have a specific underlying condition detected. Low back pain of unknown origin, which is characterized by symptoms that lack a clear, known cause is defined as non-specific low back pain and affects about 85% of population (4). According to duration, acute low back pain (less than six weeks), sub - acute low back pain (between six weeks and three months), or chronic low back pain (greater than three months) are major types of non-specific low back pain (4) (5). About one – third of acute low back pain (LBP) cases are estimated to develop chronic low back pain (11,6). The severity of pain associated with low back pain (LBP) is linked to the diminished ability of individuals to engage effectively in daily activities, resulting in a marked decline in overall productivity (12). Adolescents and young adults (15–39 years) experience physical, emotional and psychosocial changes that along with lifestyle and environmental factors like poor posture, inactivity and stress, increase their risk of developing low back pain (13,14).

Figure 1: Shows (A) External Obliques, (B) Internal Obliques, (C) Transversus Abdominis



The core can be conceptualized as a muscular enclosure, also referred as lumbo-pelvic-hip complex, with the diaphragm serving as its superior boundary, pelvic floor and hip girdle muscles at its base, the abdominal muscles anteriorly and the paraspinals and gluteal muscles posteriorly (15) (16). Collectively, these components consist of 29 pairs of muscles, some of the trunk muscles that make up the core are quadratus lumborum, the lateral thoracolumbar muscle, the lumbar muscles (lumbar multifidus, longissimus thoracic pars lumborum, intertransversii, iliocostalis lumborum, pars lumborum, rotatores and interspinalis) and the abdominal muscles (rectus abdominis, transversus abdominis, internal and external oblique abdominals) (17) (16). The intrinsic characteristics of these muscle confines create a corset-like stabilizing effect on the torso and spine (15). Muscle in the abdomen- tranversus abdominis is almost always active to support stabilization of the trunk while maintaining posture (17). Patients with low back pain experience instability and a higher risk of recurrence due to atrophied lumbar Multifidus muscle, which allows functional movement as well as stabilizes the low back area (16) (18) (19) and have more lumbar multifidus and erector spinae stiffness at rest (18) (20). They also exhibit substantial changes in muscle activation patterns (21) (20) (22). Proprioception is also impacted, especially in conjunction with the Thoracolumbar fascia (22) (23). Furthermore, electromyographic investigations have identified early signs of muscular fatigue within low back muscle groups (24).

The management of low back pain (LBP) encompasses a range of therapeutic approaches due to its multifactorial etiology (25). Literature describes physiotherapy management which comes under non-pharmacological management includes electrotherapy modalities- hydrocollator packs, Interferential Therapy (IFT), and Transcutaneous Electrical Nerve Stimulation (TENS), lumbar spine traction along with core strengthening exercises are useful in improving back functions (16) (26). Pilates is one of the form of physical training and movement re-education that draws inspiration from Joseph Pilates's principles which works on core (27). It was during World War I, Joseph Pilates started to create his method of bodily training. In total, there are more than 500 stretching and strengthening exercises in the Pilates body conditioning system. These workouts fall into two main categories: equipment and mat exercises (28). There are six fundamental elements of the Pilates technique: centering, focus, control, precision, breath, and flow (28) (29). Clinical Pilates comprises exercises that focus on strengthening of the back and abdomen muscles, improving trunk motion and stability/motor control (30). As mentioned before, the main focus of the Pilates method is the abdominopelvic region which is the core muscles, however it works on all body's muscles by stretching and strengthening those (28) (31). Despite the rising prevalence of low back pain among young adults, there is lack of studies evaluating the role of mat based Pilates in this age group.

Hence, the aim of this study was to evaluate the effectiveness of Mat Pilates on pain, flexibility and disability among young adults with low back pain.

2. Subjects and Methodology

2.1 Study Design: The study was of Quasi-Experimental design comparative in nature. A total of 30 subjects were selected via convenient sampling from the outpatient department of D.A.V. Institute of Physiotherapy and Rehabilitation, Jalandhar and randomly assigned to control and experimental groups using simple random technique.

2.2 Procedure:

A total of 30 subjects of low back pain between age group of 18-25 years who met the inclusion criteria: pain at low back, who were cooperative and had intact sensations, were recruited from the D.A.V Institute

of Physiotherapy and Rehabilitation, Jalandhar for the study. Subjects with recent history of spinal surgery, spinal fracture or lower limb fracture, pre-diagnosed spinal pathologies, neurological conditions, slip disc with radicular symptoms and inflammatory diseases like rheumatoid arthritis, acute ankylosing spondylitis, spinal infections, malignancy of spine and with ongoing pregnancy were excluded. A written informed consent was obtained from all the subjects. Pain was assessed by Numerical Pain Rating Scale (NPRS), flexibility was assessed by using Modified-Modified Schober's Test (MMST) and disability was assessed by Oswestry Disability Index (ODI) Questionnaire. The subjects were randomly divided into 2-groups: Group-A (Control Group, n=15) received moist hot pack, interferential therapy (IFT) and back isometrics. Group-B (Experimental Group, n=15) received Mat Pilates along with moist hot pack and interferential therapy (IFT). Moist Hot Pack and Interferential therapy (IFT) was applied in quadripolar method with beat frequency 80-120 Hz for 15 minutes each. The baseline data was recorded on the 1st day pre-treatment session and then on the 8th day post-treatment session. Total of 8 treatment sessions were given to each group for 2 consecutive weeks (4 sessions each week).

2.3 Control Group- Back isometrics involving the dart, bridging, prone glutes squeeze and bird dog were done for 10-15 times and holding the contraction for 10 second for 15 minutes in two sets with 1 minute rest in between sets. The Dart Exercise (lying prone, then subjects lifted the head, neck, chest, and upper spine off the couch with arms by the sides, holding for 10 seconds), Bridging Exercise (in a supine position with knees bent, they raised the pelvis off the couch and held for 10 seconds), Prone Glute Squeeze Exercise (while lying prone, subjects contracted their gluteal muscles, held for 10 seconds), Bird Dog Exercise (from a four-point kneeling position, they extended one arm and the opposite leg, held for 10 seconds, then switched sides).

Figure 2: The Dart Exercise

Figure 3: Bridging Exercise

Figure 4: Prone Glutes Squeeze Exercise

Figure 5: Bird Dog Exercise

2.4 Experiment Group- Mat Pilates involving pelvic tilt, chest lift, spine stretches and pilates saw were performed for 3 to 5 times for 15 minutes in two to three sets with 1 minute rest in between sets.

1. Pelvic tilt- Subjects were instructed to lie on his/her back with both knees bent and feet flat on the floor. The feet, ankles and the knees were to be aligned, hip distance apart. Pelvic tilt was done by engaging the abdominal muscles, pulling them in towards the spine.
2. Chest lift- The subjects lay on their back with knees bent, feet flat, and legs parallel, aligning hips, knees and ankles. They maintained a neutral spine with a slight lumbar curve and placed fingertips behind the head, keeping shoulders relaxed and core engaged. After inhaling to prepare, they exhaled while lifting the head, neck, and upper shoulders off the mat by curling the chest toward the ribs. Elbows remained wide, gaze toward the knees and the movement was driven by the abdominals without pulling the head, allowing the spine to lengthen.
3. Spine stretches- Subject was instructed to sit up tall, the legs extended in front, shoulder width apart, and the knees were facing the ceiling with feet flex. The subject was then asked to reach the top of the head with shoulders relaxed, inhale and extend the arms out in front, shoulder height. Alternatively, subject was instructed to place the fingertips on the floor in front between the legs. Then subject was instructed to exhale while maintaining a lengthened position then curve forward i.e. deep C-Curve and reach the fingers toward the toes.
4. Pilate saw- Subjects were instructed to sit up straight with the legs extended and to sit tall with legs extended and opened slightly and arms were stretched out to the side (T position) with inhalation. Then they were instructed to rotate the spine in one direction, the arms go with it with exhalation and continue to bend over the leg. The little finger of the forehand was pulled towards the little toe, the

palm of the backhand pointed towards the body with both arms pulled apart and the gaze set towards the knee. Then it was repeated it to another side.

Figure 6: Pelvic tilt of Mat Pilates

Figure 7: Chest lift of Mat Pilates

Figure 8: Spine stretches of Mat Pilates

Figure 9: Pilates saw of Mat Pilates

3. Results

The aim of the study was to see the efficacy of Mat Pilates on pain, flexibility and disability on low back pain among young adults. The statistical analysis was performed using SPSS software version 18.0. Level of significance $p \leq 0.05$ was used to determine the statistical significance. Both within the group and between the group analysis was done to analyse dependent variables - NPRS (Numerical Pain Rating Scale) scores for pain, Modified-Modified Schober's test (MMST) values for flexibility and Oswestry Disability Index (ODI) score for disability on Day 0 (baseline) and on Day 8 (Post-Intervention) to understand differences among groups**.** Paired t test was applied for comparisons of NPRS, MMST and ODI within the groups (intragroup) and independent t test between the groups (inter group). Statistical analysis between the Group showed that there was a statistically significant difference between both the groups- Control group (Group A) and Mat Pilates (Group B) in terms of pain but statistically non-significant difference in terms of flexibility and disability among young adults with low back pain, as shown in Table 1. The paired t-test showed statistically significant difference within both the groups $p<0.001$ across all outcome measures. Figures 10, 11 and 12 demonstrate the same for Mat Pilates group.

Table 1. The comparison of outcome measures on Baseline and 8thDay of GA and GB between the groups

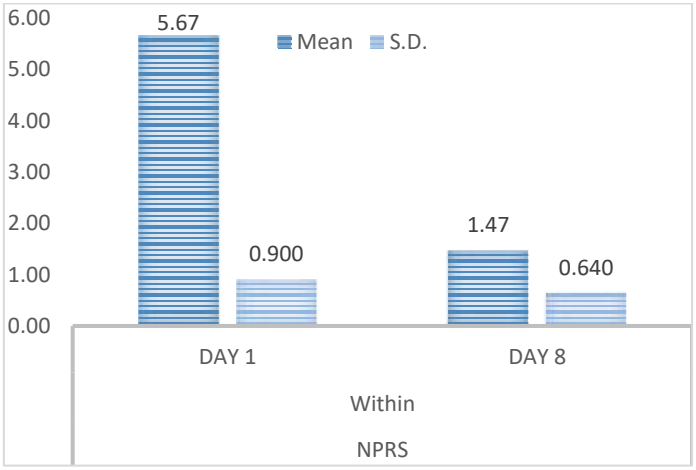
	Group	Baseline (Day "0") Mean±SD	8thDay Mean±SD	T-test	P-Value
NPRS	GA	6.00±0.756	2.67±0.976*	3.98	<0.001
	GB	5.67±0.900	1.47±0.640*		
MMST	GA	5.30±1.730	5.82±1.493*	0.39	0.69
	GB	5.25±1.305	6.01±1.038*		
ODI	GA	24.04±11.78	7.74±6.236*	1.31	1.98
	GB	30.70±9.267	5.44±2.627*		

NPRS-Numerical Pain Rating Scale, MMST-Modified-Modified Schober's test values (in cm), ODI-Oswestry Disability Index scores (in %), *p<0.001 from baseline within the group

Numerical Pain Rating Scale was used to assess pain intensity on Day 0 and Day 8. On Day 0, there was no significant difference between the groups with an independent t-test value of 1.09 and a p-value of 0.28. The mean NPRS scores were similar across both the groups: 6.00 for Group A and 5.67 for Group

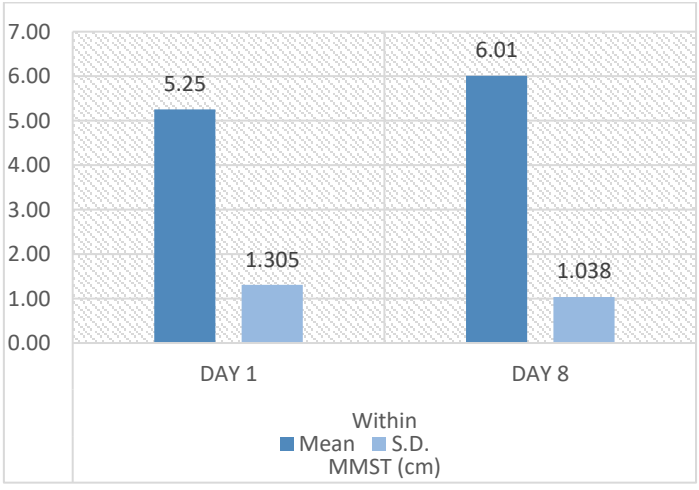
B. This suggests that the subjects in both the groups started with comparable levels of pain. On Day 8th, a significant difference emerged with t-test value of 3.98 and a p-value of <0.001. The pain levels continued to decrease as Group B showing the most improvement (mean NPRS score of 1.47) and Group A (2.67), indicating that the intervention for Group B mat Pilates was more effective in reducing pain intensity by the 8th day.

Figure 10: Analysis of NPRS scores of Mat Pilates group



Modified-Modified Schober's test (MMST) was used to assess flexibility on Day 0 and Day 8. On Day 0, there was no significant difference between the groups with an independent t-test value of 0.083 and a p-value of 0.93. The mean flexibility values (in cm) were similar across both the groups: 5.30 for Group A and 5.25 for Group B. This suggests that the subjects in both the groups started with comparable levels of flexibility. On Day 8th, a non-significant difference emerged with independent t-test value of 0.39 and a p-value of 0.69, indicating that the intervention for Group B mat Pilates was equally effective to control group in improving flexibility by the 8th day.

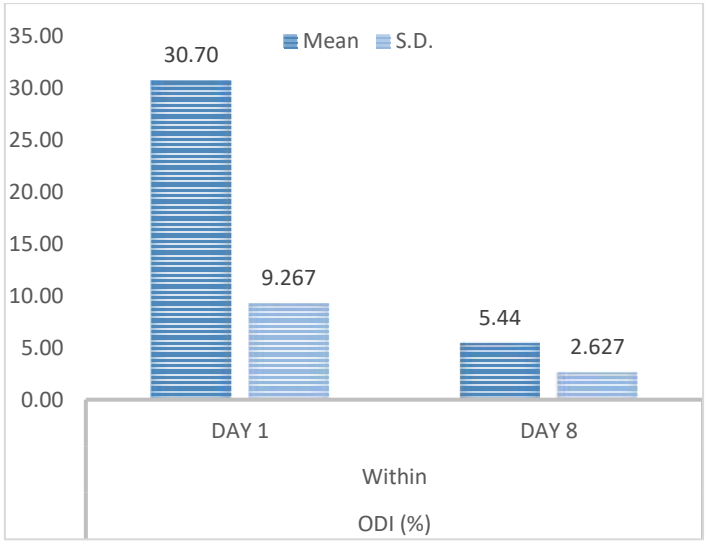
Figure 11: Analysis of MMST (cm) values of Mat Pilates group



Oswestry Disability Index was used to assess disability on Day 0 and Day 8. On Day 0, there was no significant difference between the groups with an independent t-test value of -1.71 and a p-value of 0.09. The mean disability scores (in %) were similar across both the groups: 24.04 for Group A and 30.70 for

Group B. This suggests that the subjects in both the groups started with comparable levels of disability. On Day 8th, a non-significant difference emerged with independent t-test value of 1.31 and a p-value of 0.19, indicating that the intervention for Group B mat Pilates was equally effective to control group in decreasing disability by the 8th day.

Figure 12: Analysis of ODI scores (%) of Mat Pilates group



4. Discussion

Long-term low back pain or discomfort can affect participation in community activities, employment, and education by reducing movement, increasing financial responsibilities, and decreasing work productivity which leads to functional disability (32). Also Ganesan S et al. in 2017 found Indian youth are more likely to acquire LBP likewise the Western countries and found job satisfaction, previous history, marital status, strenuous exercise, stress, monotony, family history of spinal problems, and long studying hours could be associated with LBP in young adults (10). Individuals with LBP typically have weak and slow-reacting deep spine muscles (33) (34) (35). Exercise is the best treatment for low back pain, according to many guidelines, but no evidence was reported mentioning superiority of particular kind of exercise (36) .The aim of this study was to evaluate the effectiveness of Mat Pilates on pain, flexibility and disability among young adults with low back pain.

The results of the present study showed that Mat Pilates, resulted in significantly greater reduction in pain compared to conventional treatment including back isometrics. The Pilates method is a mind-body workout that emphasizes breathing, strength, flexibility, posture, core stability and muscular control. The Pilates approach stabilizes the pelvic-lumbar region by deliberately using the trunk muscles. The goal of a Pilates mat exercise program is to enhance posture and mobility in general, as well as dynamic and static stability (37). This is in accordance with the findings by Alves de Araújo ME et al (2012). In this study Pilates showed significant improvement in trunk flexion and a significant decrease in pain compared to control group with no intervention when given for 60 min session twice a week for 3 months (38). Similarly Kwok BC et al. (2025) also reported that clinical pilates had significantly improved hamstring and lumbar flexion flexibility in patients with chronic LBP immediately after 1-4 pilates exercises in which they found ease and comfort (39). When a Pilates-based stretch is performed slowly, it targets soft tissues—muscles, tendons, joint capsules, and skin—activating the Golgi tendon organ, which detects

tension changes during passive and active movements. This activation reduces alpha motor neuron activity, promoting muscle relaxation and sarcomere elongation. The mechanical response of tissues during this process, explained by the stress-strain curve, involves initial collagen fiber straightening, followed by elastic deformation. Beyond the elastic limit, energy is lost as heat (hysteresis), leading to a lasting increase in tissue length (40). These sequence of events might emphasize flexibility in our study.

The results of our current study are consistent with the findings of Natour J et al. (2014). This study found the impact of Pilates exercise (PE) on NSCLBP patients and concluded that PE was useful in managing NSCLBP (41). Similarly a review by Yamato TP et al. (2016), concluded that Pilates was more beneficial than minimal intervention, according to low- to moderate-quality evidence, with the majority of effect sizes being categorized as medium in patients with nonspecific subacute, acute, or chronic LBP (42). Pilates exercises were considered more better in pain relief than a minimal physical exercise program in CLBP patients found by Patti A et al. (2015) (37) . In similar to this , review by Wells C et al. (2014) found pilates improved pain and functional abilities of patients with CLBP to greater strength than other physical activity in short period (43). Similarly Aladro-Gonzalvo AR et al. found Pilates-based therapeutic exercise had comparable effects and was somewhat better than little intervention for pain reduction and found more effective than another physiotherapeutic treatment at reducing disability, and it offered advantages comparable to minimal intervention, even if co-interventions with Pilates might increase treatment effectiveness for pain alleviation (44). Strength exercises which target the pelvic and abdominal muscles as well as spinal stabilizers are commonly utilized as therapies for patients with LBP by Kim ST et al.(2017) (45) because LBP can occur when the core muscles—the diaphragm, transverse abdominal muscle, pelvic floor muscles, and multifidus muscles—are weak or impaired (46). In this regard, Pilates exercises are a good way to improve trunk stability because they put the most emphasis on the core muscles and are simple to practice with little chance of harm (47). Because a current Pilates program incorporates breathing exercises and the pelvic floor muscles voluntary contraction, enhancing trunk muscles with Pilates-based therapies is therefore crucial to improving LBP by Cruz-Díaz D et al.(2015) (48). Since Pilates alters muscle contraction patterns and enhances neuromuscular control, LBP treatment by Pilates is not just powered by a gain in muscle strength but also by improved balance and decreased pain by Sorosky S et al., (2008) (49). Additionally, Pilates uses movement control to bring the brain and body into harmony (50). The enhancement of assessed parameters, including pain levels, range of motion, functional disability, and physical activity, is likely attributable to the restoration of normal control over the deep spinal muscles (DSM). This restoration results in a reduction of the engagement of superficial muscles that, when activated, contribute to spinal stiffness and an elevation in the activity of the lower back muscles. Furthermore, the efficacy of the prescribed exercises in mobilizing and stabilizing the body can be identified as a contributing factor, as these exercises facilitate the activation of specific muscles in a functional sequence. This sequence is characterized by controlled speed and a strong emphasis on the quality, precision, and control of movement. Consequently, this process promotes the co-contraction of local muscles, such as the transverse abdominis (TrA) and lumbar multifidus (LM), within the neutral zone, thereby optimizing spinal function (51). This could be possible mechanism behind the effectiveness of Pilates Execises.

In contrast, according to a review by Pereira LM et al. (2012), who compared the Pilates approach with stabilization regimens, and reported that Pilates did not help individuals with CLBP with their pain or functional abilities (52). Similarly Gagnon LH (2005) compared effects of Pilates and lumbar stabilisation exercise and found no significant difference between the both on pain and disability among LBP patients

when given for 30-45 minutes for 5 months because of small sample size (53). Limitations of our study could be no long term follow-ups and home exercise program was advised. The sample size for the study was small and was defined to limited population. Subjects might not have perceived the clear instructions given to them like abdominal drawing in.

5. Future Scope

The study could be replicated with a larger sample size. Future research may also include long-term follow-ups. Conducting the study over an extended period and involving subjects of different populations could further enhance its scope.

6. Conclusion

The findings of the present study suggest that incorporating Mat Pilates into standard physiotherapy protocols may be effective in reducing pain, improving flexibility and minimizing disability among young adults and can be taken into consideration while treating young adults with low back pain.

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