



## Original Article

## The Comparison of the Effects of Selective Pilate's and Williams' Exercises on Pain and Flexibility in Men with Chronic Non-Specific Low Back Pain: A Randomized Clinical Trial

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### ABSTRACT

**Background:** Chronic non-specific low back pain is a common disorder that often has no clear mechanism. Exercise therapy is an effective and safe method for treatment of chronic musculoskeletal disorders such as back pain. Pilate's and Williams' exercises are two types of distinct exercises used for the treatment of back pain, but there is no evidence for the advantage of these two exercises in literature. Therefore, the aim of this study was to investigate and compare the effects of selective Pilate's and Williams' exercises on the back flexibility and back pain in men with chronic non-specific low back pain.

**Methods:** Forty men with chronic non-specific low back pain were divided into two equal groups who participated in 10 sessions (during two weeks) of treatment program. Patients in group 1 received an electrotherapy treatment followed by selective Pilate's exercises. Patients in group 2 received Williams' exercises after the same electrotherapy treatment. Back flexibility and pain level were measured before and after the interventions. Also, a pain follow up was done four weeks later. Statistical analysis was done using Mann-Whitney, Wilcoxon, mixed ANOVA and Friedman tests.

**Results:** The results showed that the back flexibility increased and pain decreased in both groups ( $P=0.001$ ). Selective Pilate's exercises were more effective in enhancing the back flexibility and reducing back pain ( $P=0.001$ ).

**Conclusion:** Comparison of these two types of therapeutic exercises showed that selective Pilate's exercises are more effective in treatment of patients with chronic non-specific low back pain.

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### Introduction

Non-specific Chronic Low Back Pain (CLBP) is one of the major public health problems all over the world. Its prevalence in some countries reaches 84 % and the prevalence of its chronic type reaches 23% of the population [1]. Many people experience at least one

episode of low back pain in their lifetime and its treatment often leads to great cost and can even increase the risks of other disorders [2]. Weakness of the abdominal muscles, lack of posterior trunk and hamstring muscles' flexibility and deep core muscles' weakness are the common causes of CLBP [3-4].

Exercise therapy is the first step in the conservative treatment of the lumbar spine musculoskeletal disorders which causes adaptation and adaptability of the body tissues to stress throughout the life. In most of the cases, back pains are mechanical, so a functional treatment

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method will have long-term effects [5]. Therefore, it seems that exercise therapy is the most effective treatment for LBP [6]. Pilate's exercises are types of exercises for the whole body which increase the strength and endurance of the core muscles and augment the trunk sensori- motor's and limbs motion's control [7]. Pilate's training program has been found to have beneficial effects on abdominal muscle endurance, abdominal and lumbar muscle activity and general flexibility in healthy adults [8]. Some studies have shown that these exercises enhance the flexibility over a period of two weeks [9]. Nowadays, the Pilate's method is suggested by physicians and used by physiotherapists in clinical context for postural reeducation and pain management. In fact, this method contributes positively as a way to maintain health or to promote the injury rehabilitation [10] and may have significant long-term effects in reducing pain and disability in patients with CNLBP by selective recruitment of muscles, neuromuscular re-education and stabilization strategies [11]. William's exercises include six therapeutic programs that reduce lumbar lordosis and were used to treat back pain for many years [12]. They increase the abdominal and gluteal muscles' strength and reduce the stress on the dorsal parts of the lumbar spine. Two weeks of William's exercises can be effective in reducing pain and disability in patients with chronic LBP [13]. It is generally agreed that these exercises help to treat chronic pain but it is not yet clear which type of exercise is more effective [14]. Sekendiz et al. showed that performing Pilate's exercises for 5 weeks could increase the posterior trunk muscles' flexibility in sedentary adult women [15]. Similarly, another research group has demonstrated that 8 weeks of doing Pilate's exercises increased the flexibility of the lower back muscles of healthy subjects [16]. Curnow et al. reported that 6 weeks of performing Pilate's exercises reduced the pain intensity and pain duration in subjects with chronic mild low back pain [17]. Also, another research group showed that doing Pilate's exercises for 6 weeks reduced the pain intensity and enhanced the functional ability of patients suffering from chronic non-specific LBP [18]. Research exists to support the effectiveness of William's exercises. Zehra et al. demonstrated that 5 sessions of doing William's exercises reduced the pain intensity in patients with chronic LBP [19]. Similarly, Ghiasi et al. reported that 2 weeks of doing William's exercises reduced the pain intensity and increased daily activities in patients with mechanical chronic LBP [20]. In previous studies, no research has compared the effects of Pilate's and William's exercises on the back extensor muscles' flexibility and back pain in men with CNLBP simultaneously. Therefore, the aim of this study was to compare the effects of selective Pilate's and William's exercises on the back flexibility and back pain in men with CNLBP.

## Methods

Forty patients suffering from CNLBP (37.9±11 years old, height of 175.3±9 cm, and weight of 74.9±10 kg), who were

not familiar with either Pilate's or William's exercises, volunteered to participate in this study. The sample size was calculated by MedCalc statistical software (Version 15.8 for Windows, United States) based on an alpha value of 5% and beta of 10% (1-β=90%). These parameters generated a sample size of twenty subjects per group. CNLBP is defined as the pain between the twelfth rib and gluteal folds that lasts for more than three months [21]. The subjects were divided into two equal groups by block randomization method with the block size of four and then were treated by two different types of therapeutic exercises. All of them were given a complete description of the goals and procedures and then signed the informed consent form prior to participating in the study. This study was approved by The Board of Ethics, SUMS. Inclusion criteria were 20 to 50 year old men with CNLBP suffering pain for more than 3 months and less than 2 years with no pain in trunk flexion position. They did not have histories of rheumatic, neurological and congenital diseases, cognitive and nervous systems disorders, waist and hip fractures or dislocations, lumbar discs herniations, sacroiliac joint dysfunctions. Exclusion criteria were: an increase in back pain and inability to continue the treatment.

Patients, upon entering the study, were evaluated by Sit and Reach test and Pain Numeric Rating Scale (NRS). Patients in group 1 received electrotherapy treatment and then received selective Pilate's exercises. Patients in group 2 received electrotherapy treatment and then received William's exercises. Both groups had 10 treatment sessions for two weeks. Electrotherapy treatment was the same in both groups and was applied on the back's painful area. It included a low frequency TENS (300 μsec, 4 Hz) [22] and a Hot pack for 20 minutes and a continuous mode ultrasound (1MHz, 1.5 W/cm<sup>2</sup>) for 5 minutes [23]. Patients were again evaluated after the completion of 10 intervention sessions. Patients' pain was also evaluated 4 weeks later as a follow up. Meanwhile, the patients did not perform any exercises at the follow up period. Selective Pilate's exercises order was as below [24]:

1. Abdominal Prep: while keeping a soft ball between the knees in crook lying position, patients moved both arms toward the ceiling; then, they inhaled to prepare, exhaled, and began to float the arms toward the abdominal area, curling the head and shoulders up off the mat to the bottom tips of the shoulder blades for 5 counts. Then they returned to the starting position. This exercise was repeated 5 times.

2. Hundred: while keeping a soft ball between the knees in crook lying position, the patients pulled the abdomen in and up, inhaled and pumped the arms for 5 counts; then exhaled and pumped the arms for 5 counts. It was repeated for 5 times.

3. Adductor Squeeze: while keeping a soft ball between the knees in crook lying position, the patients inhaled to prepare, exhaled while drawing the abdomen in and up, and squeezed the ball without curling up. It was kept for a count of 5 and then released without losing the ball. It was repeated 5 times.

4. Saw: in long sitting position while the legs were

opened wider than the hip-distance apart and the arms were stretched out to each side the patients inhaled to prepare, exhaled, pulled the abdomen in and up and then twisted to the right from the waist. They brought the chin to the chest and reached the left hand to the outside of the right little toe. Inhaled, the patient returned to starting position, and then rotated the spine back to the center. It was repeated 5 times for each side of the body.

William's exercises performing order was as below [25]:

1. Sit up: in crook lying position, the patients pressed the lower back to the ground and then curled the head and shoulders up off the mat to the bottom tips of the shoulder blades for 5 counts. Then, they returned to the starting position. This exercise was repeated 5 times.

2. Pelvic tilt: in crook lying position, the patients pressed the lower back to the ground for 5 counts. Then, they relaxed. It was repeated 10 times.

3. Trunk flexion: while the patients were in supine position, they brought both knees to the chest as much as they could and maintained this situation for 5 seconds. Then, they returned to the starting position. It was repeated 10 times.

4. Sit and reach: in long sitting position, the patients bent forward and stretched out their upper limbs toward the toes of each side, held the position for 5 seconds and then relaxed. It was repeated 10 times.

5. Hip flexor muscle stretch: the patients assumed the running starting position, leaned the trunk forward and put pressure on their back leg for 5 seconds. Then changed the legs, did the same movement for the other leg. It was

repeated 5 times for each side.

6. Standing: patients stood with the feet shoulder-distance apart, tried to keep the trunk perpendicular to the ground as much as possible. While their eyes looked forward, slowly bent their knees and lowered the trunk. Then, they returned to the starting position. This exercise was repeated 10 times.

The back flexibility was measured by Sit and Reach test [15]. The patients sat on the mat with their heels touching the side of a box. The box ceiling was marked in centimeters and the patients' finger tips were on the 0 cm edge of the box ceiling. They were instructed to stretch the finger tips on the box ceiling as far as they could while holding the leg straight and the hands parallel to the floor. The patients had to keep this reach long enough for the distance to be recorded. The farthest test score of three trials was recorded as the back flexibility.

The back pain was assessed by NRS [26]. NRS is a rating scale 0-10 in which 0 means no pain and 10 means the worst pain ever experienced. Patients had their pain assessed and allocated a number from zero to ten to them.

*Statistical Analysis*

Statistical analysis was performed using SPSS (SPSS for Windows, Version 16.0, Chicago, SPSS Inc, United States). Normality was checked by Shapire-Wilk test (P=0.001). As the Data did not meet the normality assumption, the effects of the intervention protocol on flexibility were examined using Mann-Whitney test and Wilcoxon test. The effects of the intervention protocol on

CONSORT Flow Chart

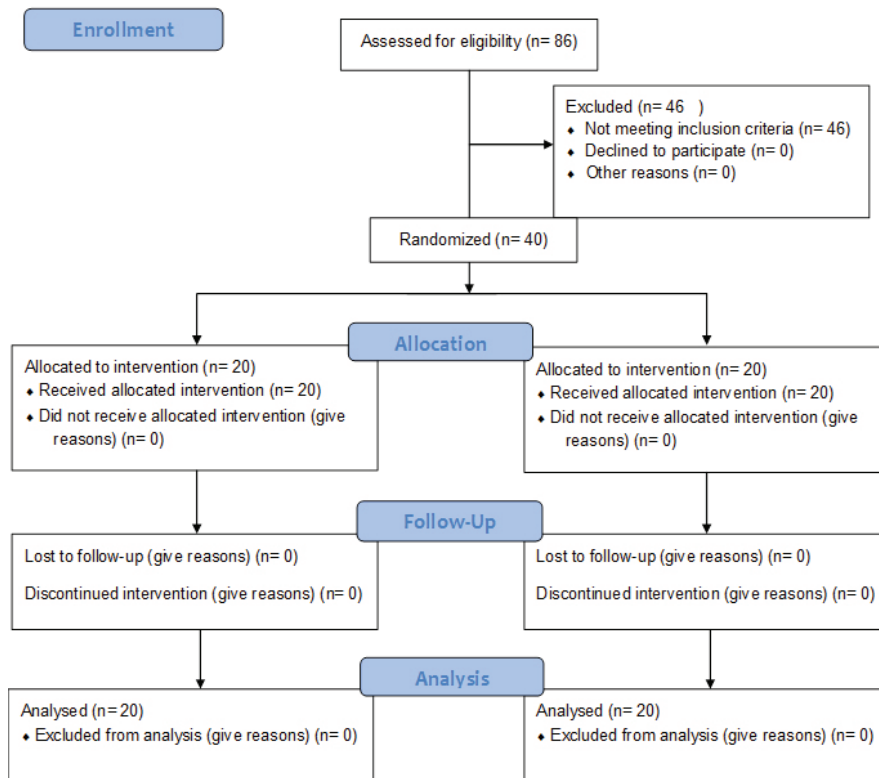


Figure 1: The CONSORT 2010 Diagram for subjects attrition in the study.

pain were examined using Mixed ANOVA and Friedman tests. The level of significance was set at  $P < 0.05$  (figure 1).

**Results**

Patients’ demographic data including age, weight and height were analyzed which showed that there were not significant differences between the groups ( $P=0.24$ ,  $P=0.76$ ,  $P=0.63$  respectively).

Each pre-measure of groups was analyzed by Mann-Whitney test which demonstrated no significant differences between the groups with respect to the back flexibility ( $P=0.93$ ), and back pain ( $P=0.59$ ).

The result of the analysis on pre-measurement and post-measurement of the back flexibility in both groups by Wilcoxon test in table 1 indicated that both exercises could enhance this variable. Mann-Whitney test showed

that selective Pilate’s exercises were significantly more effective than Williams’ exercises in increasing the back extensor muscles’ flexibility. Means and standard deviations of the measured variable are also demonstrated in table 1.

The results of Mixed ANOVA test demonstrated that there is no interaction between the within group factor (time) and the between group factor (treatment) of the groups ( $P=0.30$ ). Meanwhile, both exercises significantly reduced the back pain ( $P=0.001$ ) based on the results of table 2.

Mixed ANOVA test followed by Friedman test showed that selective Pilate’s exercises were significantly more effective than Williams’ exercises in reducing the back pain after performing two weeks of exercises and four weeks later in patients with CNLBP based on the results of table 3 and figure 2.

**Table 1:** Median and Interquartile range of pre- and post-measurement and difference of the back flexibility

Flexibility (cm) Exercise	Pre [Median-(IQR)]	Post [Median-(IQR)]	P value	Difference [Median-(IQR)]	P value
Pilate’s	[29-(17.5-37.5)]	[33-(24.25-40.75)]	0.001	[5-(3-7)]	0.001
Williams	[28.5-(21.5-32.75)]	[30.5-(23.5-35.5)]	0.001	[2-(1-3)]	0.001

**Table 2:** Median and Interquartile range of pain

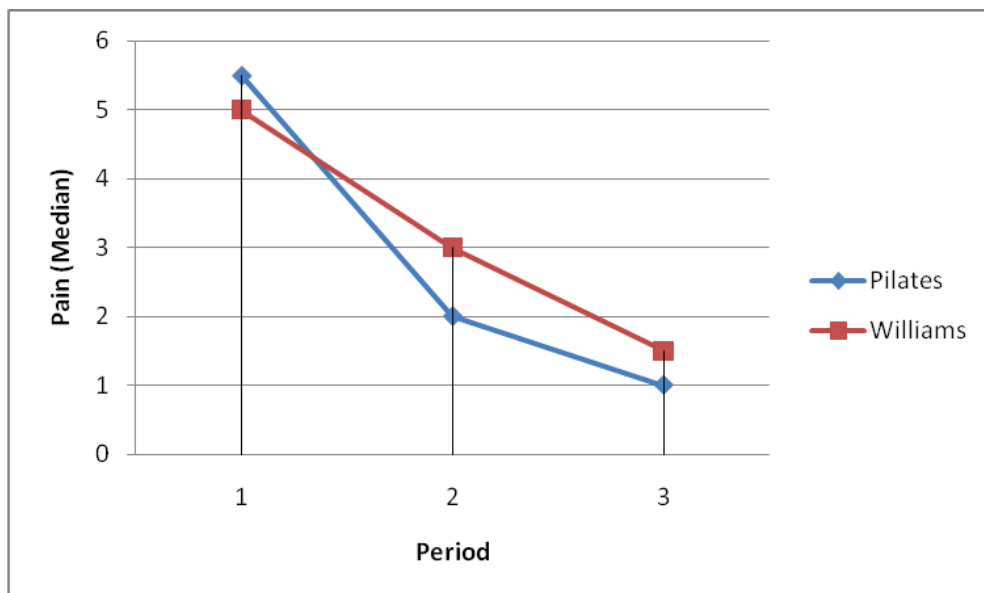
Exercise	Period 1 [Median-(IQR)]	Period 2 [Median-(IQR)]	Period 3 [Median-(IQR)]	P value
Pilate’s	[5.5-(5-6)]	[2-(2-3)]	[1-(1-1.75)]	0.001
Williams	[5-(5-6)]	[3-(4-2)]	[1.5-(2-1)]	0.001

Period 1=Before treatment, Period 2=After 10 treatment sessions, Period 3=4 weeks later

**Table 3:** Comparison of both groups’ pain differences

Pain difference	Median (Standard Error)	P value
1st and 2ed periods	1 (0.22)	0.001
1st and 3rd periods	1.96 (0.22)	0.001
2ed and 3rd periods	0.96 (0.22)	0.001

Period 1= before treatment, Period 2=After 10 treatment sessions, Period 3=4 weeks later



**Figure 2:** (Comparison of pain between both exercises)

Period 1=Before treatment; Period 2=After 10 treatment sessions; Period 3=4 weeks later

## Discussion

With regard to the results of this study, selective Pilate's and William's exercises were found to be efficient training approaches having significant positive changes in the back flexibility and back pain in patients with CNLBP. Our results also showed that selective Pilate's exercises are more effective than William's exercises in treatment of this disorder.

Based on our results, selective Pilate's exercises could increase the back flexibility which is similar to the Sekendiz et al. and Phrompaet et al.'s study results. These exercises emphasize on muscle stretching; therefore, are effective in increasing the joints' range of motions and muscles' flexibility [24]. So, they can increase the back flexibility.

Based on our results, William's exercises can significantly increase the flexibility. No study was found on the evaluation and comparison of the effect of William's exercises on the back flexibility. William suggests that these exercises can stretch the back, gluteal and hip muscles. So they are kinds of total body stretch exercises. There is a need to stretch the hamstring and back muscles in patients with LBP because their proper flexibility allows the lumbar full flexion [12].

Some previous studies have reported that Pilate's exercises reduce pain in patients with LBP [3,7,11,17-18]. Our results are consistent with these studies. It seems that patients with CNLBP suffer a motor control disorder which weakens the core muscles (multifidus and transverse abdominus), proprioception and muscular coordination that leads to the abnormal movements of the spine. These exercises increase the endurance of the core muscles, trunk sensorimotor and limbs' motion control. Therefore, they are kinds of exercises for the whole body that appear to contain the biological, educational and psychological aspects which are all important things to improve the back pain [7]. It sounds that Pilate's exercises enhance the function of the core stabilizer muscles by increasing neuromuscular coordination of agonist and antagonist muscles [27].

We observed that William's exercises significantly reduced the back pain after the therapeutic sessions. Ghiasi et al. [20] and Zehra et al. [19] also observed significant pain reduction in patients with back pain who were treated by performing William's exercises. Adding exercise therapy to the patients' education is the first step in conservative treatment of the lumbar spine musculoskeletal disorders. Exercise causes adaptation and adaptability of the body tissues to stress throughout the life. In most cases, back pains are mechanical, so a functional treatment method will have long-term effects. William's exercises keep the spine in a normal position and prevent putting too much pressure on the dorsal parts of the lumbar spine; finally reducing the back pain [5]. It can also be argued that Williams' exercises are beneficial in reducing pain in patients with CNLBP by adding the stretching of lower limbs' joints and muscles to stretch the spinal muscles [12].

Based on our findings, selective Pilate's exercises were

significantly more effective than Williams' exercises in increasing the back flexibility and reducing the back pain in patients with CNLBP. Pilate's exercises contain concentration and precision principles which may help the subject focus on stretching exercises such as Saw; therefore, probably providing more stretching of muscles than William's stretching exercises. Another fact about the Saw exercise is that it contains an oblique trunk rotation component which may allow stretching of more numbers of muscles and be more effective in increasing flexibility than William's similar stretching exercises.

The breathing principle of Pilate's exercises provides proper rhythmic breathing; supplying the oxygen needed by the body. Deep breathing can improve circulation and reduce fatigue [28] thus causing pain reduction.

Re-education of neuromuscular control strategies by the Pilate's exercises and their combination with the functional activities are beneficial to improve the patients' rehabilitation. They may have significant long-term effects on reducing pain and disability in patients with CNLBP by the role of muscles' selective recruitment and neuromuscular re-education of stabilization providing strategies [11]. Patti mentioned that it is generally agreed that the exercise will help to treat the chronic pain and Pilate's exercises are more effective than minimal physical activity interventions in reducing short-term pain and disability in patients with CNLBP [14]. This idea is consistent with the findings of the current study. Physicians might consider Pilate's exercise training as a novel approach on future exercise prescriptions [29].

Some limitations of the present study should be highlighted. The duration of Pilate's exercises was short. The patients did not continue the exercises in the follow up period. Moreover, our results should be related only to the selected mat Pilates exercises. The present study acknowledges that future studies are required to enable better understanding of the effects of the Pilates principles among different exercises, populations and ages.

## Conclusion

We conclude that selective Pilate's exercises are more effective than William's exercises in increasing the back flexibility and diminishing back pain in patients with CNLBP. So adding these exercises to 10 sessions of electrotherapy can be an effective remedy for these patients.

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**Conflict of Interest:** None declared.

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