COMPARATIVE EFFICACY OF CORE STABILIZATION EXERCISE AND PILATES EXERCISE ON PATIENTS WITH NON-SPECIFIC CHRONIC LOW BACK PAIN

COMPARAREA EFICIENȚEI EXERCIȚIILOR DE TONIFIERE A MUSCULATURII POSTURALE ȘI A EXERCIȚIILOR PILATES LA PACIENȚII CU DURERE LOMBARĂ CRONICĂ NESPECIFICĂ

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Key words: core stabilization exercise, Pilates exercise, low back pain, range of motion, physical.

Abstract:

Introduction:

Objectives: Low back pain poses serious challenge to individual's health worldwide. Supervised therapeutic exercise has been reported as an effective intervention for the treatment of patients with chronic low back pain. This study compared the effect of core stabilization exercise and Pilates exercise on pain, functional disability, range of motion of the lumbar spine and level of physical activity in patients with non-specific chronic low back pain (NSCLBP).

Methods: The study involved 29 individuals (13 males and 16females) with non-specific chronic low back pain. They were randomly assigned into 3 different groups (mean age of 49.10 ± 11.85 years, 45.30 ± 11.31 years, and 40.33 ± 14.47) respectively, using computer generated numbers. Group 1 performed core stabilization exercise + infra-red radiation, group 2 performed Pilates exercise + infra- red radiation and group 3 received infra-red radiation and back care education. Measurement of pain intensity, functional disability, lumbar range of motion and level of physical activity were done using numerical rating scale (NRS), Roland Morris disability questionnaire (RMDQ), Modified Schobers test (MST) and International physical activity questionnaire (IPAQ) respectively at baseline, 2nd week and 4th week (post intervention). Data was analysed using statistical package for social science version 20.

Results: Findings of this study revealed an improved clinical outcome of the three groups post-intervention ($p<0.05$). However, there was statistically significant difference between core stabilization exercise group and control group in all outcome variables ($p<0.05$) except for range of motion.

Conclusion: The result of this study revealed that there was improvement in pain, functional ability and range of motion in the study groups. However both techniques are effective in the treatment of patients with non specific chronic low back pain.

Cuvinte cheie: exerciții de tonifiere a musculaturii posturale, exerciții Pilates, durere lombară, amplitudine demișcare, status fizic

Rezumat:

Obiective: Durerea lombară joasă constituie o provocare serioasă pentru lumea medicală de pretutindeni. Exerciții terapeutice supravegheate sunt considerate ca fiind o intervenție eficientă în tratamentul pacienților cu dureri lombare joase. Acest studiu compară efectul exercițiilor de stabilizare posturală și a celor Pilates asupra durerii, disabilității funcționale, amplitudinii de mișcare a coloanei lombare și nivelul de activitate fizică la pacienții cu durere lombară nespecifică (NSCLBP).

Metode: Studiul s-a realizat pe un număr de 29 de subiecți (13 bărbați și 16 femei) cu durere lombară nespecifică. Ei au fost distribuiți aleatoriu în 3 grupuri diferite (media de vârstă de 49.10±11.85 ani, 45.30±11.31 ani, și respectiv 40.33±14.47), folosind numere generate de computer. Grupul 1 a efectuat exerciții de stabilizare posturală + radiații infraroșii, grupul 2 a efectuat exerciții Pilates + radiații infraroșii și grupul 3 efectuat radiații infraroșii și școala spatelui. Evaluarea intensității durerii, a disabilității funcționale, mobilitatea coloanei lombare și nivelul de activitate fizică s-a realizat folosind scala numerică a durerii, (NRS), Chestionarul Roland Morris pentru disabilitate (RMDQ), testul Schobers modificat (MST) Chestionarul Internațional de activitate fizică (IPAQ), pentru o evaluare inițială, în a 2-a și în a 4-a săptămână, (post intervenție). Datele s-au analizat folosind statistatistical package for social science versiunea 20.

Rezultate: Rezultatele studiului au demonstrat o îmbunătățire a statusului pacienților din cele 3 grupuri post-intervenție ($p<0.05$). AU existat totuși diferențe semnificative statistic între grupul carfe a efectuat exercițiile pentru stabilizare posturală, și grupul de control la toate variabilele evaluate ($p<0.05$) cu excepția amplitudinii de mișcare.

Concluzii: Rezultatul acestui studiu arată că a existat o ameliorare semnificativă a durerii, disabilității funcționale și amplitudinii de mișcare la grupele luate în studiu. Oricum, ambele tehnici sunt eficiente în tratamentul pacienților cu durere lombară nespecifică.

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Introduction

Low back pain (LBP) is a serious health problem and has attracted a significant amount of research [1] (Akinbo *et al,* 2012). Chronic low back pain being a major musculoskeletal condition encountered in the clinical setting is replete with several studies concerning the effectiveness of various techniques [2,3,4] (Smith *et al*, 2014; Stuber *et al*, 2014; Patti *et al*, 2015). Different treatment modalities have been used, but there is temporary relief of symptoms and lack of improvement of the atrophy of Lumbar multifidus muscles which improves stability of the lumbar spine [5] (Akodu *et al*, 2014).

Studies have shown that both core stability exercises and Pilate's exercises are effective in the management of pain and disability in individuals with Chronic LBP [6, 7, 8] (Wajswelner *et al*, 2012; Salimeh *et al*, 2014; Venkata and Sreekar 2015). However, it appears there is dearth of empirical data establishing which is more effective between the core stability exercises and Pilate exercises on individuals with non-specific chronic low back pain. Thus, there exist certain gaps involving the two therapeutic techniques.

Therefore, this study sought to determine the effect of core stabilization exercise and Pilates exercise on pain, functional disability, range of motion of the lumbar spine and physical activity in patients with non-specific chronic low back pain.

Materials and Methods

A total of 48 (23 males and 25 females) subjects with non-specific chronic low back pain (NSCLBP) participated in this study. They were recruited from Lagos University teaching hospital (LUTH), Idi-Araba and Lagos State University Teaching Hospital (LASUTH), Ikeja. All patients included into the study were subjects with history of non-specific chronic low back pain with or without pain radiating to one or both lower limbs, and Patients with recurrent history of LBP of not less than 3 months.

Excluded from the study were subjects confirmed to be pregnant, subjects with specific LBP, subjects with medical or surgical conditions that might hinder exercise performance. Prior to the commencement of the study the subjects' demographic data such as age, gender, weight, height, occupation, marital status, clinical history of LBP and number of LBP episodes during 12 months were obtained from the subjects and the baseline assessment of pain intensity, functional disability and Lumbar range of motion and level of physical activity were done using numerical rating scale (NRS), Roland Morris disability questionnaire (RMDQ) and Modified Schobers test (MST) and International physical activity questionnaire (IPAQ).

Informed written consent was obtained by providing a consent form for the subjects to fill in. Ethical approval was sought and obtained from the Health Research and Ethics Committee of Lagos University Teaching Hospital, Idi-Araba, Lagos (LUTH (Approval number ADM/DCST/HREC/APP/316). Of the 48 patients, 6 were found ineligible for the study after screening and were therefore excluded.

The eligible patients were randomly assigned to three groups using computer generated numbers. Each group had 14 patients from the 42 eligible patients.

Group 1 received core stabilization exercise and infra-red radiation. In addition to infra-red radiation, Groups 2 received Pilates exercise and group3 was the control and they received infra-red radiation and back care. However only 29 patients (13 males, 16 females) with mean age of (45.07±12.61) completed the study. 13 subjects did not complete with reasons ranging from illness, transportation problem and lack of effect.

Subjects went through the protocol twice weekly for 4 consecutive weeks.

Assessment of pain intensity, functional disability, Lumbar range of motion and physical activity were done at baseline, end of 2nd week and 4th week respectively.

Core stabilization exercise protocol

Abdominal bracing - 30 repetitions with 8-seconds: Patients were instructed in supine lying position to perform drawing- in maneuver of the abdomen and hold it for 8 seconds, 30 times for 2 minutes.

Bracing with Heel Slides - 20 repetitions per leg with 4-seconds: Patients were instructed in supine lying position to perform drawing- in maneuver of the abdomen and hold it with sliding of the heel per leg for 4seconds, 20 times for 4 minutes.

Bracing with Leg Lift -20 repetitions per leg with 4-seconds: Patients were instructed in supine lying position to perform drawing - in maneuver of the abdomen and hold it with raising up the leg for 4 seconds, 20 times for 4 minutes.

Bracing with Bridging - 30 repetitions with 8-seconds, then progress to one leg: Patients were instructed in supine lying position to perform drawing-in maneuver of the abdomen and gently lift up the buttock and hold it for 8seconds, 30 times for 2 minutes.

Bracing with Bridging and Leg Lift - 30 repetitions with 8-seconds, Patients were instructed in supine lying position to perform drawing-in maneuver of the abdomen and gently lift up the buttock and hold it with raising up the leg for 8seconds, 30 times for 4 minutes.

Bracing in Standing - 30 repetitions with 8-seconds: Patients were instructed to perform drawing - in maneuver of the abdomen in standing for 8 seconds, 30 times for 2 minutes.

Quadruped Arms Lifts with Bracing (Flex one upper extremity) - 30 repetitions with 8 seconds on each side: Patients were instructed in prone kneeling position to perform drawing-in maneuver of the abdomen, flex one upper extremity and hold it for 8 seconds, 30 times on each side for 4 minutes.

Quadruped Leg Lifts with Bracing (Extending one lower extremity and lifting it off the exercise mat) - 30 repetitions with 8 seconds on each side: Patients were instructed in prone kneeling to perform the drawing- in maneuver of the abdomen, extend one lower extremity and lift it off exercise mat and hold it for 8 seconds, 30 times on each side for 4 minutes.

Quadruped Alternate Arm and Leg lift with Bracing (flex one upper extremity and extend contralateral lower extremity) - 30 repetition with 8seconds on each side: Patients were instructed in prone kneeling to perform the drawing- in maneuver of the abdomen, flex one upper extremity and extend contralateral lower extremity and hold it for 8 seconds, 30 times for 4 minutes. (Hick *et al*., 2005; Donald and Robert, 2006, Akodu *et al*, 2015).

Pilate exercise protocol

Exercise 1: Pelvic tilt to Pelvic curl exercises:

The participants were instructed to lie on their back with both knees bent and feet flat on the floor, the feet, ankles and the knees are aligned and the hip distance apart. Pelvic tilt was done by engaging the abdominal muscles, pulling them in towards the spine. This was done for 20 repetitions within 4 seconds.

Pelvic curl:

Participants were instructed to press down the feet allowing to curl up toward the ceiling.

The hips raise, then the lower spine, and finally the middle spine. The Participants were then asked to come to rest on the shoulders at the level of the shoulder blades, with a nice straight line from the hips to the shoulders. This movement was supported with the abdominals and hamstrings. The abdominals was used to roll the spine back down to the floor until the lower spine settles to the floor. This was repeated for 3 to 5 times.

Exercise 2: Chest Lift

The Participants were instructed to lie on their back with the knees bent, feet flat on the floor. Legs and feet parallel - lined up so that the hip, knee and ankle are in one line and the toes pointing directly away. The patients were then in neutral spine position with the natural curve of the lower spine creating a slight lift off the mat. Shoulders were kept down as the participant brings the hands behind the head with the finger tips touching. The patients then slowly pulled down towards the spine, allowing the spine to lengthen. This was repeated for 3-5 times

Exercise 3: Swan Prep

The Participants were instructed to lie face down with arms close to the body as they bend the elbows to bring the hands under the shoulders. The abdominal muscles were engaged, lifting the umbilicus up away from the mat, the abdominals remain lifted throughout the exercise. Repeat 3 to 5 times.

Exercise 4: Kneeling Arm and Leg Reach

The Participants were instructed to reach with the hands directly under the shoulders and the knees directly under the hips. The legs and feet were parallel and hip distanced apart.
The back was in a neutral spine position allowing the natural curves, and supported by the abdominal muscles which was pulled in. Repeat this exercise 3-5 times to each side.

Exercise 5: Child's Pose

With the toes together, the Participants were instructed to open the knees to at least hip distance apart then lean forward and drape the body over the thighs so that the forehead rests on the floor and also reach the arms out in front. Alternately, the Participants were instructed to leave the arms along the both sides. Breathe deeply and then relax.

Exercise 6 spine stretches:

Participants were instructed to sit up tall, the legs were straightened in front with shoulder width apart, and the knees faced the ceiling with feet flexed. The Participants were then asked to reach the top of the head with shoulders relaxed, Inhale and extend the arms out in front, shoulder height.

Alternatively, Participants were instructed to place the fingertips on the floor in front between the legs. Exhale as the spine lengthens to curve forward i.e. deep C-Curve, and then reach the fingers toward your toes.

Exercise 7: Pilate saw

Participants were instructed to sit up straight with the legs extended in front of the shoulder width apart. Shoulders were kept down as the arms were being stretched out to the sides, even with the shoulders.

Exercise 8: Swimming

Patients were instructed to lie prone with the legs straight and together, keeping the shoulder blades settled in the back and the shoulders away from the ears, then stretch the arms straight overhead pulling the abdominals. Participants were then asked to continue reaching out the arms and legs very long from the centre as they alternate lifting right arm/left leg, then left arm/right leg, pumping them up and down in small pulses (Wallwort *et al*, 2009).

Data Analysis

Statistical Package for Social Science (SPSS Inc., Chicago, Illinois, USA) version 20.0 for Windows package program was used to analyze the data. Demographic and quantitative data were expressed as mean ± standard deviation (SD).

One-way analysis of variance (ANOVA) was used to detect any statistically significant differences in the (improvement) changes between the three groups. A post-hoc evaluation of ANOVA using the least significant difference (LSD) was carried out to compare the mean changes between the three groups in order to detect where statistical differences existed and which treatment was statistically more effective. Level of significance was set at $p< 0.05$.

Results

Forty eight (48) participants with non- specific chronic low back participated in this study; however twenty-nine (29) completed the study, 10 (34.5%) participants were in group 1, 10 (34.5%) were in group 2 and 9 (31.0%) participants were in the control group.

Thirteen (44.8%) of the participants were males while sixteen (55.2%) were females.

The three groups did not differ significantly in age and body mass index (Table 1).

Table 1: Physical characteristics of the participants

	All participant X±SD N=29	GRP1 X±SD N=10	GRP2 X±SD N= 10	GRP3 X±SD N=9	P-value
AGE (Yrs)	45.07±12.61	49.10±11.85	45.30±11.31	40.33±14.5	0.45
BMI (kg/m²)	25.80±4.17	27.73±4.30	25.69±3.95	23.78±3.64	0.82

Significant at $p<0.05$

KEY:

X±SD = Mean ± Standard Deviation
BMI = Body Mass Index
GRP 1 = Core Stabilization exercise only (Group 1)
GRP 2 = Pilates exercise only (Group 2)
GRP 3 = Control (Group 3)

Analysis of variance test was conducted to compare the differences within Group 1, Group 2 and Group 3 on mean changes in outcome at baseline, end of 2nd week and 4th week post intervention. The clinical outcome variables after 8 sessions (4weeks) are presented in table 2.

Table 2: Analysis of variance of clinical outcome parameters of participants in the three groups at baseline (pre intervention), end of 2nd week and 4th week end of intervention.

Variable	Pain X± SD	FD X± SD	ROM (^{0}) X± SD	PA X± SD
Group1				
Pre-Rx	6.20± 1.14	11.40±2.67	4.75±1.93	1.40±0.52
End of 2nd wk	3.29± 1.42	6.90±2.02	5.00±1.76	2.30± 0.68
End of 4th wk	1.1.±1.29	3.60±2.54	5.65± 1.68	2.80±0.42
F- value	1.41	0.91	0.81	1.85
P-value	0.00*	0.01*	0.19	0. 00*
Group 2				
Pre-Rx	6.90±1.45	11.10±2.80	4.15±1.56	1.20±0.42
End of 2nd wk	3.69± 1.42	8.30±1.49	4.40±1.78	1.78± 0.44
End of 4th wk	2.10± 1.91	5.40±3.03	5.29± 1.62	2.30± 0.68
F-value	0.05	0.21	0.36	0.06
P- value	0.13	0.14	0.89	0.11
Group 3				
Pre-Rx	5.89± 0.93	11.11± 2.85	4.22±1.64	1.40± 0.53
End of 2nd week	3.40± 1.51	8.22± 2.11	3.89±1.82	1.78± 3.70
End of 4th week	3.56± 2.09	7.78± 3.70	4.80± 1.27	1.78± 0.67
F-value	1.41	0.91	1.27	1.83
P-value	0.00*	0.01*	0.28	0.00*

*: Significant at $p< 0.05$

KEY:

Rx= Treatment ROM= Range of motion
PA= Physical activity
X± SD= Mean ± Standard deviation FD= Functional disability F= Analysis of variance
GRP 1 = Core Stabilization exercise only (Group 1)
GRP 2 = Pilates exercise only (Group 2)
GRP 3 = Control (Group 3)

Comparison of Clinical Outcome parameters among the three groups

Analysis of variance (ANOVA) showed that there was statistically significant difference existing among the groups post intervention (Table 3).

Least significance difference (LSD) (post hoc analysis) showed that the significant difference lies between group 1 & 3 for pain, functional disability, physical activity, physical functioning (Table 4).

Table 3: Analysis of variance results of clinical outcome parameters of participants among the three groups, pre intervention, end of 2nd week and 4th week (end of intervention)

	Sum of Squares	Mean Square	F-Value	P-Value
(Baseline)				
PAIN	5.16	2.58	1.79	0.19
ROM(^{0})	2.12	1.06	0.36	0.70
Disability	0.57	0.29	0.04	0.96
PA	0.33	0.17	0.69	0.51
(2ND Week)				
PAIN	0.82	0.41	0.19	0.82
ROM	5.89	2.94	0.92	0.41
Disability	12.20	6.10	1.71	0.20
PA	1.71	0.86	2.40	0.11
(4TH Week) Post-intervention				
PAIN	28.74	14.37	4.56	0.02*
ROM	4.31	2.16	0.91	0.42
Disability	82.89	41.44	4.30	0.02*
PA	4.95	2.48	6.95	0.00*

* Significant difference at p< 0.05

KEY
ROM = Range of motion
PA= Physical Activity
F= Analysis of variance

Table 4: Post Hoc analysis of change in the clinical outcome measure parameters across the three groups.

Variables	Group(I)	Group	Mean Difference	p-values
Pain	Group 1	Group 2	-1.00	0.66
		Group 3	-2.46	0.02*
	Group 2	Group 1	-1.46	0.66
		Group3	-2.46	0.25
	Group 3	Group 1	2.46	0.02*
		Group 2	1.46	0.23
Disability	Group 1	Group 2	-1.80	0.62
		Group 3	-4.18	0.02*
	Group 2	Group 1	-0.50	0.62
		Group 3	-2.38	0.32
	Group 3	Group 1	4.18	0.02*
		Group 2	2.38	0.32
Physical Activity	Group 1	Group 2	0.50	0.22
		Group 3	1.02	0.00*
	Group 2	Group 1	-0.50	0.22
		Group 3	0.52	0.20
	Group 3	Group 1	-1.02	0.00*
		Group 2	-0.52	0.20

*: Significant at p< 0.05 within the treatment group

Discussion

Participants in the three groups were similar in age and physical characteristics; this means that all the groups were homogenous and therefore comparable.

In this randomised controlled study, marked improvement in the clinical outcomes (Pain intensity, Functional disability, range of motion, physical activity) were observed in the two study groups that is core stabilization exercise (group 1) and Pilates exercise (group 2). This finding shows that most Physiotherapeutic modalities commonly used in the treatment of CLBP are effective [9] (Kumar *et al*, 2013). This finding support the result of the study by Akodu *et al*, [10] 2015 who reported that stabilization exercise is effective in the management of NSCLBP.

This is also in agreement with the study by Natour *et al*, [11] (2014) who assessed the effectiveness of Pilates exercise (PE) on patients with NSCLBP and found PE to be effective in the management of NSCLBP.

The findings that there was significant improvement in core stabilization and Pilates groups buttress the use of exercise therapy in the management of patients with CLBP. However this study shows that both core stability exercise and Pilates exercise are effective in the management of CLBP. This was supported by the findings of Salimeh *et al*, [7] (2014) who in their study on the comparison of the effect of eight week stabilization exercise and Pilates exercise on pain and functional disability of women with chronic low back pain, concluded that the two groups experienced the same improvement on pain and functional disability in patients with chronic low back pain. Other studies [12,13,9,8] (Gladwell *et al*, 2006; Hides *et al*, 2008; Kumar *et al*, 2013; Venkata and Sreekar, 2015) compared either stabilization exercise with general exercise or Pilates exercise with general exercise [6, 11] (Wajswelnar *et al*, 2012; Natour *et al*, 2015) and discovered that there was significant improvement in both stabilization and Pilates group when compared to the other groups. This is however contrary to the finding of Mindy *et al. 14* (2006) who in their study of randomized controlled trial of specific spinal stabilization exercises and conventional physiotherapy for recurrent low back pain do not support the use of stabilization exercise in treatment of NSCLBP. This also disagrees with the study by Pereira *et al*, [15] 2012 who compared Pilates method and stabilization programs and concluded that Pilates did not improve the functional ability and pain in CLBP patients.

The improvement in the parameters measured that is pain, range of motion, functional disability and physical activity could be as a result of reestablishment of the normal control of the deep spinal muscles (DSM), thus reducing the activity of the more superficial muscles which when recruited stiffens the spine and increases the activity of the low back muscles. This can also be as a result of the ability of the exercises to mobilize and stabilize the body thereby activating specific muscles in a functional sequence at controlled speed emphasizing quality, precision and control of movement. This enables the co-contraction of the local muscles such as TrA and LM within the neutral zone [16] (Wells *et al,* 2015).

The finding that there was an improvement in physical activity of patients in CE and PE except the control group was corroborated by previous studies [7] (Salimeh *et al*, 2014). The studies reported that both stabilization exercise and Pilates exercises are effective for improving the physical activities in patients with NSCLBP. This must have led to the improved stability of the spine thereby allowing dynamic control of the spine [5] (Akodu *et al*, 2014). This is also in accordance with study by McGill [17] (1998) that performing exercises on labile surfaces increased the abdominal muscle activity, which changes the level of muscle activity and also increases muscle performance and endurance levels. This could also be due to the reason that Lumbar stability is maintained by improving the activity of the lumbar segmental muscles and highlighting the importance of motor control to coordinate muscle improvement during functional activity.

The present study revealed that there was significant difference between core stabilization and control group on pain, functional disability and physical activity. This is in accordance with the findings by Venkata and Sreekar, [8](2015) who compared Stabilization program and conventional exercises on patients with CLBP and concluded that core stabilization is more

effective in the management of mechanical low back pain. This is also in agreement with the conclusion of systematic review of literature and findings by O'Sullivan *et al 18,19,2* 1997; Brumitt *et al*, 2013; Smith *et al*, 2014. These investigators found that training approach that followed the principles of segmental stabilization and neuromuscular control was effective in reducing pain and disability in a group of individuals with CLBP.

Findings from this study revealed that mean range of motion at the end of the intervention for CSE, PE and control groups was 5.65± 1.68, 5.29± 1.62, 4.80± 1.27 respectively, this shows that both core stabilization exercise (group 1) and Pilates exercise (group 2) had better improvement in range of motion. This is also similar to the result of the study by Javadian *et al. 20* (2012) who in their study for the effect of stabilization exercise on pain and disability of patients with lumbar instability found out that the range of motion increased significantly in the stabilization group.

Conclusion

Findings of this study revealed that both Pilates exercise and stabilization exercise reduced pain severity, improved functional ability. Also the two groups experienced the same effect on the entire clinical outcome measure parameters in patients with chronic low back pain. Therefore both exercises are effective in the management of patients with NSCLBP.

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