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Research Article

Muscle Contraction Exercise for Non-specific Low Back Pain

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Abstract

Objective: The purpose of this study was to evaluate the effect of exercises combined with infra-red and TENS on core muscles in patients with non-specific low back pain.

Methods: Thirty participants, 16 males and 14 female aged between 22 and 50 years suffering from nonspecific low back pain. Sample was divided into two groups, group A isometric exercises and group B isotonic exercises, both group received conservative therapy of TENS and infra-red therapy. Outcomes measure; visual analog scale, modified oswestry disability index and endurance test were used pre-treatment and at the end of 4 weeks of treatment.

Results: Both groups were comparable in term of demographic data, there were no significant differences regarding the demographic data between the groups except issue in which weight; there were significant differences between the groups. Intergroup analysis of VAS score was done using Mann-Whitney test. Pre analysis showed no significant differences between group A and group B (P = 0.285) and post- analysis showed no significant difference between group A and group B (P = 0.838). Pre analysis of MODI score was done using Mann- Whitney test, there was no significant difference between group A and group. In their post analysis of MODI scores, there was no significant difference between group and group. Comparing between groups, pre and post abdominal endurance scores were done using the Mann-Whitney Test. On the pre- treatment scores revealed P value of 0.345 and the post treatment scores revealed P value of 0.305. So, there is no statistically significant difference between group A and group B in endurance scores.

Conclusion: There was no difference between the use isotonic and isometric exercises on non-specific low back pain patients.

Keywords: Isometric Exercises; Isotonic Exercises; Core Muscle; Nonspecific Low Back Pain

Abbreviations

LBP: Low Back Pain; VAS: Visual Analogue Scale; MODI: Modified Oswestry Disability Index; BMI: Body Mass Index; IRR: Infrared Radiation; TENS: Transcutaneous Electrical Nerve Stimulation; PAU: Palestine Ahliya University; N: Number; M: Male; F: Female

Introduction

Low-back pain (LBP) continues to be one of the main problems for which sufferers seek treatment in primary care [1] and presents a large challenge to the healthcare system despite improving scientific technology, medical insight, and suggested management strategies [2].

History of a non-specific low back is lifting or twisting while holding heavy object, operating a machine that vibrates, prolonged sitting, fall, coughing, sneezing, and straining [3]. Chronic low back pain, mild to severe pain in the lower back that has lasted for more than three months, morning stiffness, sleep interruptions due to pain tiredness and/or irritability, depression and inability to sit or stand for long periods of time [1].

Non-specific low back pain is defined as low back pain not attributable or recognizable, known specific pathology (e.g. infection, tumor, osteoporosis, lumbar spine fracture, structural deformity, inflammatory disorder, radicular syndrome, or cauda equine syndrome).

The core muscles, which are the primary muscle group for maintaining spinal stability [4], can be divided into two groups according to their functions and attributes. The first group of muscles is composed of the deep core muscles, which are also called local stabilizing muscles. These muscles primarily include the transversus abdominis, lumbar multifidus, internal oblique muscle and quadratus lumborum [5].

The second group of muscles, which are known as global stabilizing muscles, including the rectus abdominis, external oblique muscles, erector spinae, quadratus lumborum, and hip muscle groups. These muscles are not directly attached to the spine, but connect the pelvis to the thoracic ribs or leg joints, thereby enabling additional spine control. These muscles produce high torque

to counterbalance external forces impacting the spine; thus, this group of muscles is secondarily responsible for maintaining spinal stability [5].

Isotonic contraction is the force generated by a muscle while contracting, when the muscle lengthens and shortens during movement, with the force remaining constant. Therefore, when picking up a glass to take a drink your muscles would use the same force throughout the movement up and down, which is nearly impossible [6,7].

Isometric Exercise means muscle contraction without the muscle or joints moving. If you push against something that is immovable you are experiencing isometric contractions. This may also be called static tension [8,9].

Majiwala B and his colleagues reported the effect of isometric and isotonic exercise training on core muscle in patients with non-specific low back pain. As a result, both isometric and isotonic exercises are equally effective in reducing pain, increase endurance, and improve functional disability in patients with non-specific low back pain [10].

Purpose of the Study

The purpose of this study, firstly to investigate the effect of the isometric exercises on pain activity, functional disability and endurance test on the students and employee of PAU in Bethlehem. Secondly to investigate the effect of the isotonic on pain activity, functional disability and endurance test on the students and employee of PAU in Bethlehem. Thirdly, to investigate the significant difference between isometric and isotonic exercise on pain activity, functional disability and endurance with nonspecific low back pain among the students and employee at PAU.

Materials and Methods

It was a comparative study conducted in the physiotherapy department of Allied Medical Science Faculty. Ethical permission was obtained from the Faculty Ethical Committee, Allied Medical Science Faculty, Physiotherapy Department, Palestine Ahliya University. A total of 36 patients (18 males and 18 female) were selected according to inclusion and exclusion criteria. Written informed consent was taken, and the whole study was explained to them. A detailed musculoskeletal evaluation was done to screen the patients. Participants were equally divided into two groups, enrolled in the study and randomly assigned to one of the two groups, Baseline treatment was given to both the groups which consisted transcutaneous electrical nerve stimulation (TENS) and infra-red (IR). Group A was given isometric exercise (N = 18, M = 9, F = 9) and group B was given isotonic exercise (N = 18, M = 9, F = 9). Three patients in group A and three patients in group B dropped out for personal reasons. Exercises were performed for 1 hour, three times weekly, for 4 weeks.

Inclusion criteria were as follows: (1) Both male and female, (2) Age group 22 - 50 years, (3) Patients willing to participate in exercise program, and (4) History of non-specific low back pain since 3 months.

Exclusion criteria were as follows: (1) Any back injury or pathology within the previous 6 months, (2) History of back surgery, (3) Rheumatologic disorder, and (4) Spine infection.

Isometric exercises

- **Curl up**: Supine lying, one leg straight, the other leg flexed at 90°, support lower back with hands, elbow on the floor, keep torso and neck in line, engage core in raising head, and shoulders slightly off the ground.
- **Side bridge**: Side lying, lie on side with knees bent and prop upper body up on elbow, raise hips off the floor, and hold 10 seconds.
- **Bird dog**: Quadruped position, both hands are under the shoulder and knees are under the hips, opposing arms and legs raised off the floor separately.

Isotonic exercises

- **Bent knee sit-up**: Supine lying, hands by side, knee flexed 60°, heels flat on floor, head and upper back raise.
- **Cross curl up**: Supine lying, bent knee about 60°, feet flat on the floor, hands placed behind neck, one leg across the other, the participant raised their contralateral elbow to the opposite knee.
- **Prone back extension**: Prone lying, bodies cantilevered over the end, lowered their upper body at 90° of table after feet were secured with a strap and return to starting position.

Post-intervention scoring was recorded on the last day of treatment in the form of pain on visual analog scale (VAS), functional disability on modified oswestry disability index (MODI) and strength on endurance test.

Data analysis

Statistical analysis of the data was made with 95% confidence in the SPSS 15.0 for Windows package program. Categorical variables were shown as “n” and “%” and continuous variables as “Mean ± standard deviation”. Independent samples t-test was used to study the similarity of demographic data between groups. Wilcoxon Signed Ranks Test was used to study the change between pre- and post-treatment. Mann-Whitney Test was used to study the comparison between both groups.

Results

For this study thirty (n = 30) subjects, 53% of the participants were males and 47% were females, they were selected to compare the effectiveness of isometric and isotonic exercises for training core muscles in decreasing pain intensity, improving functional disability and abdominal endurance test for non-specific low back pain patients. These subjects were then randomly divided into two groups, group A (n = 15) and group B (n = 15).

The demographic data is shown in table 1. In both groups, there were no significant difference in terms of age, height, and BMI; but there was significant difference in weight.

Variables	Group A	Group B	t-value	p-value
	Mean (SD)	Mean (SD)		
Age	30.13 (12.84)	30.47 (8.69)	-0.083	0.934
Weight (Kg)	76.33 (17.75)	71.87 (11.67)	-16.36	0.000
Height (Cm)	169.5 (8.08)	167.3 (12.15)	0.583	0.564
BMI	26.7 (6.38)	25.8 (4.16)	0.460	0.649

Table 1: Comparisons of demographic data between groups.

BMI: Body Mass Index; W: Weight; H: Height; SD: Standard Deviation.

Within groups analysis of VAS score was done using Wilcoxon Signed Ranks Test. The result of the test in group A shows that the P value is (0.001) which is less than P = 0.05. Therefore, we conclude that there is statistically significant difference of the pain between the pre- treatment and post- treatment with isometric approach. The results revealed that the average on pain pre -treatment was (6.67), while post- treatment decreased to (3). Thus, we infer that isometric treatment reduces lower back pain significantly. In group B, the results revealed that P is equal to 0.019, which is less than 0.05. As a result, we conclude that there is statistically significant difference of the pain pre isotonic treatment and post isotonic treatment. Moreover, the result showed that the average pain pre isotonic treatment was 5.8, whereas the average pain post treatment reduced to 4.6. Consequently, we conclude that isotonic treatment reduces lower back pain significantly. Table 2 below present these findings.

Group	Pre-treatment	Post-treatment	P value
	Mean ± SD	Mean ± SD	
A (Isometric)	6.67 ± 1.71	3.0 ± 1.69	0.001
B (Isotonic)	5.9± 1.3	4.6 ± 5.8	0.019

Table 2: Comparisons between pre and post VAS score within groups.

VAS: Visual Analog Scale; SD: Standard Deviation.

Between groups analysis of VAS score was done using Mann-Whitney Test for the pre- and post-results of the both groups. In the pre-values, the results of the test disclosed that the P value before the two approaches was 0.285, which is greater than 0.05. Thus, we conclude that there was no statistically significant difference between the pain in group A and group B before the treatment. This means that the two groups are considerably identical.

In the results from the two approaches, the P value in post tests was equal to 0.838, which is greater than 0.05. Therefore, we conclude that there is no statistically significant difference between the two approaches. This also means that they have the same effect and reduce the pain. Table 3 and figure 1 below illustrate these findings.

Within groups Modified Oswestry Disability Index scores was done using Wilcoxon Signed Ranks Test. When comparing the pre- and post MODI scores in group A (isometric treatment), the results showed that the P value is equal 0.001, this means that there is statistically significant difference between pre- and post-MODI scores. In group A, the average MODI score pre-isometric treatment was 23.5%. While post- treatment decreased to 9.5%. Consequently, we can conclude that isometric treatment can improve MODI scores significantly.

Group	Pre- treatment	Post-treatment
	Mean ± SD	Mean ± SD
A (Isometric)	6.67 ± 1.71	3.0 ± 1.69
B (Isotonic)	5.9± 1.3	4.6 ± 5.8
P value	0.285	0.838

Table 3: Comparisons of pre and post-VAS score in between groups.

VAS: Visual Analog Scale; SD: Standard Deviation.

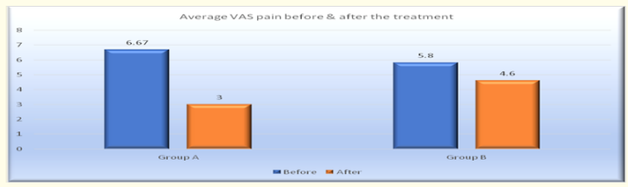

Figure 1: Comparison of pre and post-VAS score in between groups. VAS: Visual Analog Scale; SD: Standard Deviation.

Similarly, the P value in group B (isotonic treatment) was 0.001, which is less than 0.05. Hence, we conclude that there is statically significant difference between pre- and post MODI scores. Examining the average score of MODI before and after the isotonic treatment revealed that the average MODI score in group B before the treatment was 34.4%. In the post measures, the average decreased to 14.04%. This also means that isotonic treatment can improve MODI scores significantly. Table 4 below depicts these results.

Group	Pre- treatment	Post-treatment	P value
	Mean ± SD	Mean ± SD	
A (Isometric)	23.5 ± 14.8	9.5 ± 9.48	0.001
B (Isotonic)	34.4 ± 16.4	14.0 ± 8.02	0.001

Table 4: Comparisons of pre and post- MODI score within groups.

MODI: Modified Oswestry Disability Index; SD: Standard Deviation.

To compare pre- and post- MODI scores in between groups, we used Mann-Whitney Test. The test on the pre- treatment scores revealed P value of 0.061, which is greater than 0.05. Thus, we conclude that there is no statically significant difference between the 2 groups in MODI scores before the treatment. Moreover, this means that the 2 groups are indistinguishable. In the same way, the test on the post treatment scores revealed P value of 0.077. Again, this value is greater than 0.05, and thus we infer that there is no statistically significant difference between group A and group B in MODI scores after the treatment. This also means that the two approaches improve patients MODI scores equally. Table 5 and figure 2 illustrates these findings.

Group	Pre- treatment	Post-treatment
	Mean ± SD	Mean ± SD
A (Isometric)	23.5 ± 14.8	9.5 ± 9.48
B (Isotonic)	34.4 ± 16.4	14.0 ± 8.02
P value	0.061	0.077

Table 5: Comparisons of pre and post- MODI score between groups.

MODI: Modified Oswestry Disability Index;
SD: Standard Deviation.

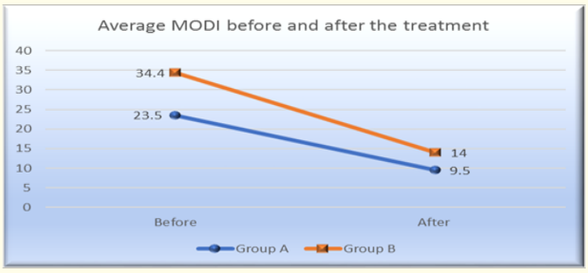

Figure 2: Comparison of pre and post-MODI score between groups.

Comparing between groups, pre- and post- abdominal endurance scores were done using the Mann-Whitney Test. The test on the pre- treatment scores revealed P value of 0.345, which is greater than 0.05. Thus, we conclude that there is no statically significant difference between the two groups in abdominal endurance scores before the treatment. Moreover, this means that the two groups are indistinguishable. In the same way, the test on the post treatment scores revealed P value of 0.305. Again, this value is greater than 0.05, and thus we infer that there is no statistically significant difference between group A and group B in abdominal endurance scores after the treatment. Table 6 and figure 3 below shows these results.

Group	Pre- treatment	Post-treatment
	Mean ± SD	Mean ± SD
A (Isometric)	35.9 ± 10.61	47.5 ± 11.39
B (Isotonic)	35.3 ± 18.46	52.7 ± 17.09
P value	0.345	0.305

Table 6: Comparisons of pre and post-abdominal endurance test between groups.

SD: Standard Deviation.

Discussion

The purpose of this study was to compare the effect of isometric and isotonic exercises training on core muscle in patients with non-specific low back pain. The results showed that both isometric and isotonic exercises provide a positive significant on pain relief, functional improvement and strength abdominal muscle endurance in patients with non-specific low back pain. Intergroup analyses were done using Mann-Whitney Test and the results of

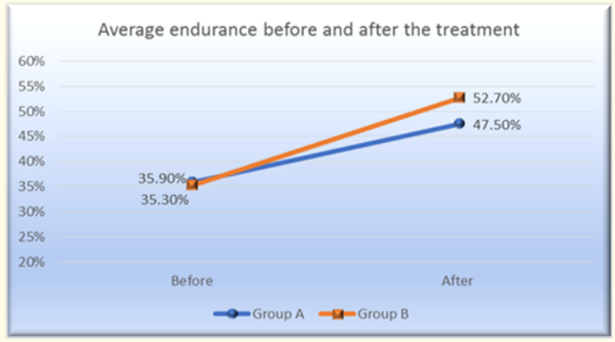

Figure 3: Comparison of pre and post-abdominal endurance test between groups.

the study confirm the hypothesis that there was no a significant difference between the two groups.

Stranjalis., *et al.* reported in this study that low back pain is more common in females [11]. In this study, the total number of participants included was 30, of which 16 were males and 14 were females, it means groups contained 53% males and 47% females. So, we report in our study that low back pain is more common in male.

Transcutaneous electrical nerve stimulation (TENS) is widely used as a therapeutic adjunct in the management of LBP. It is a relatively safe, non-invasive and easy to use modality that can be conveniently self-administered by patients at home, making it an attractive treatment option. TENS units deliver electrical stimulation to the underlying peripheral nerves via electrodes placed over the intact skin surface, near the source of maximal pain [12]. Melzack and Wall were reported that the development and application of TENS was based on the Gate Control Theory. According to this theory, the stimulation of large diameter (A-beta), primary sensory afferents activates inhibitory interneurons in the substantia gelatinosa of the spinal cord dorsal horn and, thereby, blocks the transmission of nociceptive signals from small diameter A-delta and C fibers [13]. Supraspinal mechanisms involving the endogenous opioid system have also been described [14-16]. Overall, TENS is postulated to close the gate and dampen the perception of pain.

Infrared radiation therapy is a physical therapy intervention modality classified under thermotherapy which is used in the treatment of low back pain. Infrared (IRR) is the electromagnetic radiation with longer rays than visible light shorter rays than a microwave but lying within the electromagnetic spectrum. IRR rays gives rise to heat when absorbed by matter, between the wavelengths of 4 x 10 Hz and 7.5 x 10 Hz. The heat emitted from IRR has been shown to increase tissue extensibility, improves joint range of motion, decreases pain and enhance healing of soft tissue lesions [17]. These actions are mediated through its physiologic effects of heating which results in a general increase in cell activity and blood flow and a reduction in the level of pain and decrease in metabolites such as bradykinin and histamine [17]. In our study, the results showed both isometric and isotonic exercises were effective in minimizing pain.

Van Tulder., *et al.* reported that exercise for the treatment of low back pain was effective in accelerating improvements in daily life activities and return to work [18]. In a meta-analysis, the patients with LBP treated with exercise therapy showed a significant improvement in terms of pain and functional status, compared to the patients who received no treatment or other conservative treatments [19].

Isometric exercise training is a static form of exercise, in which a muscle contracts and produces force without an appreciable change in the length of muscle without visible joint motion [20-22].

Hye Jin Moon., *et al.* reported the effect of lumbar stabilization and dynamic lumbar strengthening exercises in patients with chronic low back pain. As a result, both lumbar stabilization and dynamic strengthening exercise (isometric strength) strengthened the lumbar extensors and reduced LBP. However, the lumbar stabilization exercise was more effective in lumbar extensor strengthening and functional improvement in patients with nonspecific chronic LBP [23]. In our study, result revealed that isometric and isotonic approaches have a positive value for functional improvement in patients with nonspecific LBP.

In isotonic exercises, when a body segment moves through its available range, the tension that the muscle is capable of generating shortens or lengthens which is due to changing length, tension relationship of the muscle and the changing load. Hence, the isotonic exercise helps in relieving pain and improving strength by both of these mechanisms.

Jill A and colleagues reported that Exercise Therapy for Nonspecific Low Back Pain, exercise therapy seems to be slightly effective at decreasing pain and improving function in adults with chronic low back pain, particularly in health care populations. In subacute low back pain populations, some evidence suggests that a graded activity program improves absenteeism outcomes, although evidence for other types of exercise is unclear. In low back pain populations, exercise therapy is as effective as either no treatment or other conservative treatments [24].

Park., *et al.* indicated that an exercise program that simultaneously strengthens the deep abdominal muscles and muscles of trunk is an ideal method for maintaining spinal stability physical balance [25]. In our study between groups, pre- and post- abdominal endurance scores was done using the Mann-Whitney Test. we conclude that there is no statistically significant difference between group A and group B in abdominal endurance scores after the treatment. It means that both isometric and isotonic exercises increase abdominal endurance.

The result from the statistical analysis of the present study supported null hypothesis which stated that there will be no significant difference in isometric (stability) and isotonic exercise training in core muscle in patient with non-specific low back pain for all other outcome measures. Thus, it can be stated from the study that isometric and isotonic exercises along with infrared and TENS are most effective.

Conclusion

From the finding of the current study we can conclude that both isometric and isotonic exercises are effective of non-specific low back pain. There was no difference between the use isometric and isotonic in decrease pain intensity, improvement disability and abdominal muscles endurance.

Conflict of Interest

The author has no conflict of interest.

Disclosure

The author did not receive any type of commercial support in forms of either compensation or financial support for this study.

Ethical Approval

Obtained.

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