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EFFECT OF CORE STRENGTHENING EXERCISES ON LORDOSIS IN LOW BACKACHE

VISHAL SAHANI, MASTER IN PHYSIOTHERAPY, SANSKRITI UNIVERSITY

ABSTRACT

Background and Objectives: To evaluate the effect of Core Strengthening exercises for decreasing Lumbar Lordosis and reducing pain in low backache patients.

Method: Thirty subjects were selected by Convenient sampling technique from the patients who came to the Physiotherapy Department with the Low Backache. 15 subjects were allotted group A and the other 15 subjects were allotted group B. Control group was given Conventional exercises and the Experimental group was given Core Stabilization exercises for 6 weeks exercise intervention with 30 to 40 minute per session, thrice per week. The George line on X-Ray was used to measure lumbar Lordosis and Numeric Pain Rating Scale was used to measure pain. Outcomes were measured before and after intervention. Outcome measures for both the groups showed significance in reducing Disability.

Result:T-test was used for analysis. After 6 Weeks of exercise intervention with 30-40 minute per session , thrice per week. It showed that there is fulfilled improvement in post testlordosis values and post test numeric pain rating scale when compared to pre testlordosis values and pre test numeric pain rating scale in both the groups. But when the outcomes between the groups were compared Group B shows better improvement in Lordosis and Pain than Group A.

Interpretation and Conclusion

After interpretation it was concluded that Core strengthening exercise is beneficial to decrease lumbar lordosis and reducing pain in low backache patients.

Key words:

Exercise, low back pain, Core strengthening, Muscle, Pain.

INTRODUCTION

Low back pain represents a significant public health concern in developed nations, leading to substantial medical costs, work absenteeism, and disability. Epidemiological research suggests that approximately 80% of individuals will experience back pain at some point in their lives. Various factors such as modern lifestyles, degenerative conditions, structural irregularities, and inflammatory diseases contribute to the high prevalence of low back pain, resulting in notable economic implications due to decreased productivity and healthcare utilization.

Low back pain stands as a primary cause of functional limitations in individuals under 45 years old, ranking second in physician visits, fifth in hospital admissions, and third in surgical procedures. Recurrence rates for low back pain are notably high, ranging from 40% to 70%, with an increased likelihood of recurrence as individuals age.

The term "low back pain" refers to discomfort localized below the shoulder blades and above the buttock cleft, sometimes radiating to the lower limbs, including nerve-related pain like sciatica.

Non-specific low back pain is characterized by discomfort that lacks a specific identifiable cause, such as infections, tumors, osteoporosis, arthritis, fractures, or caudaequina syndrome.

Recurrent low back pain is described as a new episode of pain emerging after a symptom-free period of six months, distinct from the exacerbation of chronic low back pain. A variety of factors can lead to lower back pain, with most cases attributed to muscle or soft tissue injuries, disc degeneration due to aging, spinal conditions like stenosis and sciatica, as well as arthritis and poor posture adaptations.

The lumbar region, also known as the lower back region, comprises five vertebrae (L1-L5). Within these vertebrae lie fibrocartilage discs, known as intervertebral discs, which function as cushions to prevent vertebral friction while simultaneously safeguarding the spinal cord. Emerging from foramina within the vertebrae, nerves supply muscles with sensations and motor-related messages.

The fundamental biomechanical roles of the spinal systems include facilitating movements between vertebrae, bearing loads, and safeguarding the spinal cords and nerve roots. The mechanical stability of the spine is crucial for executing these functions, thus holding paramount importance for the human body.

The spinal stabilization system is conceptualized as being composed of three subsystems. The passive musculoskeletal subsystem encompasses vertebrae, facet articulations, intervertebral discs, spinal ligaments, and joint capsules, along with the passive mechanical characteristics of muscles. The active musculoskeletal subsystems comprise the muscles and tendons surrounding the spinal column. The neural and feedback subsystems involve various force and motion transducers situated in ligaments, tendons, and muscles, as well as neural control centers. Although the passive, active, and neural control subsystems are theoretically distinct, they are functionally interrelated.

The term "core" refers to a structure with the abdominals in the anterior, paraspinals and gluteus in the posterior, the diaphragm as the superior aspect, and the pelvic floor and hip girdle musculature as the inferior aspect. The muscles are categorized into two systems: the global stability system and the local stability system. The global stability system pertains to the larger, superficial muscles surrounding the abdominal and lumbar regions, such as the rectus abdominis, paraspinals, and external obliques, which are primary movers for trunk or hip flexion, extension, and rotation. Local stability, on the other hand, involves the deep, intrinsic muscles of the abdominal wall, like the transverse abdominis and multifidus. The core has received significant attention due to its function as a muscular corset that collaborates to stabilize the body and spine, both with and without limb movement.

The lumbar extensor or paraspinal muscle group comprises structures such as Thoraco-lumbar fascia, Erector spinae, Quadratuslumborum, Iliocostalislumborum, Iliocostalis thoracic, multifidus, among others. These muscles are responsible for generating and regulating the extension movement of the trunk while also providing stability for trunk motions involving the lower extremities.

The normal spinal column exhibits a series of anteriorly convex curves in the cervical and lumbar regions known as Lordosis. This condition represents an amplification of the spine's anterior curvature, often stemming from various pathological factors. Factors contributing to increased lordosis include postural abnormalities, weakened muscles (particularly abdominal muscles) coupled with tight hip flexors or lumbar extensors, excessive abdominal weight due to obesity or pregnancy, compensatory adaptations resulting from other deformities like kyphosis or spondylolisthesis, as well as congenital issues such as hip dislocation or neural arch anomalies. The typical lumbar lordotic curve measures around 50 degrees. Daily activities subject the bony ligaments of the back to significant repetitive, compressive, and shearing forces, while simultaneously imposing tensile stresses on muscular and ligamentous structures. Shearing forces intensify with greater anterior pelvic tilt, leading to accentuated lumbar lordosis, yet diminish as the back flattens and the lumbar spine angle decreases. Under normal conditions, the pelvic angle is approximately 30 degrees, but in cases of excessive or pathological lordosis, this angle increases to around 40 degrees, often accompanied by a mobile spine and anterior pelvic tilt. Exaggerated lumbar lordosis typically coincides with weakened deep lumbar extensors and tight hip flexors.

Core stability exercise refers to the enhancement or reinforcement of the neuromuscular system's capacity to regulate and safeguard the spine against potential injuries. There are generally two primary categories of strategies: those focused on enhancing coordination and supervision of the core muscles to better control the lumbar spine and pelvis, and those aimed at boosting the strength and endurance of these muscles to fulfill the requirements of control. Notably, deep core muscles such as the transverse abdominis and multifidus play a crucial role in upholding spinal stability. A recent trend in the treatment of individuals suffering from persistent lower back discomfort involves targeted workouts for the deep abdominal and lumbar multifidus muscles. Strengthening and revitalizing these muscles are believed to be efficacious in addressing chronic low back pain.

The transverse abdominis muscle, characterized by its extensive attachment to the lumbar vertebra through the thoracolumbar fascia and to the pelvis and rib cage, plays a significant role in spinal control by likely modulating intraabdominal pressure and tensioning the thoracolumbar fascia. Research indicates a close relationship between the transverse abdominis muscle and the regulation of intraabdominal pressure. Conversely, the lumbar multifidus muscle comprises five fascicles originating from the spinous process and lamina of each lumbar vertebra, descending in a caudo-lateral direction. The superficial fibers of this muscle span up to 5 segments, attaching caudally to the ilia and sacrum, while the deep fibers attach from the inferior border of a lamina, crossing a minimum of 2 segments to attach to the mamillary process and facet joint capsule. Notably, the superficial fibers, located further from the lumbar vertebra's rotation centers, possess an extension-moment arm crucial for controlling lumbar lordosis, whereas the deep fibers exhibit a limited moment arm and minimal capability in spine extension.

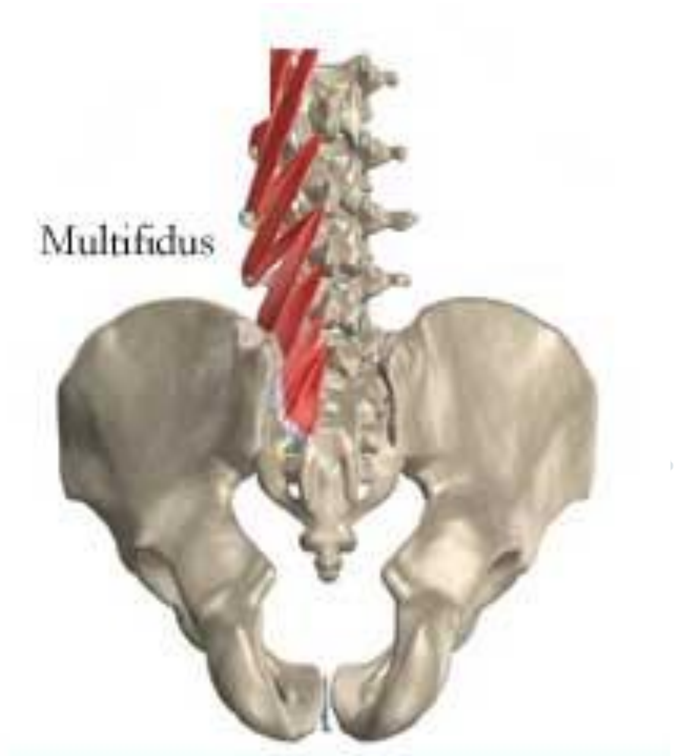


Figure 1.1 Multifidus

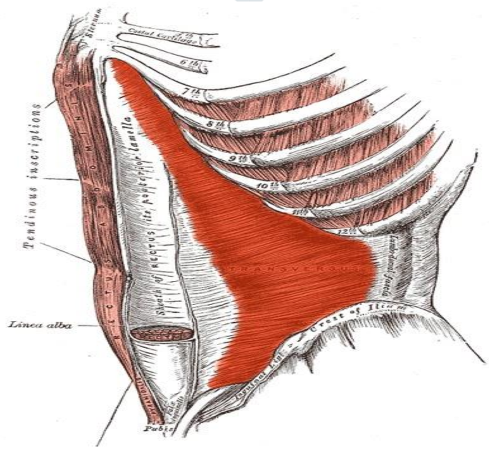


Figure 1.2 TransversusAbdominis

AIM AND OBJECTIVES OF THE STUDY

To assess the impact of core strengthening routines on the reduction of lumbar lordosis and alleviation of pain among individuals suffering from low backache.

NEED OF THE STUDY-

There is a shortage of academic literature addressing the impact of Core strengthening routines on the degree of lumbar lordosis among individuals suffering from low back pain.

HYPOTHESIS

Null Hypothesis

The impact of core strengthening exercises on reducing lumbar lordosis and alleviating pain in individuals suffering from low backache is expected to be substantial.

Alternate Hypothesis

The impact of core strengthening exercises on reducing lumbar lordosis and alleviating pain in individuals with low backache is not expected to show a significant difference.

REVIEW OF LITERATURE

Kumar Amit, Gupta Manish, and KatyalTaruna conducted a study published in the 'International Journal Of Medical Sciences' in July 2013. The study examined the impact of Trunk muscle Stabilization Exercises and General Exercises on pain in recurrent non-specific low backache among 80 subjects who were randomly assigned to either the control group (n=40) or the experimental group (n=40). Both groups underwent a 6-week exercise regimen lasting 30-40 minutes, thrice per week. The calculated P value indicated a significant difference in improvement at P=0.015. The study's findings suggest that specific stabilization exercises are effective in reducing pain and enhancing function in cases of chronic non-specific low back pain.

Martha L Walker et al published a study in the 'Journal of American Physical Therapy Association' in April 1987. The research aimed to explore 'The Relationship Between Lumbar Lordosis, Pelvic Tilt and Abdominal Muscle Performance' in 31 subjects (23 women and 8 men) in a normal standing position. Measurements of pelvic tilt and lumbar lordosis were taken before assessing abdominal muscle function. The Intraclass

Correlation Coefficients (ICC) values for the repeated measurements of pelvic tilt and lordosis were .84 and .90, respectively. The Spearman's rho Correlation of abdominal muscle test values with Pelvic Tilt Measurement was .18 and with lumbar lordosis was .06. The study confirmed the reliability of the Test-Retest measurements of pelvic tilt and lumbar lordosis.

Carolyn A. Richardson et al conducted a Comparative Study published in J Rehab Med 2002. The study focused on 'Lumbar Range Of Movement and Lumbar Lordosis in Back Pain Patients and Matched Controls.' They investigated 15 male back pain patients and 15 male controls matched for age, height, obesity, and physical activity. The evaluation of lumbar range of motion in flexion, extension, and lateral rotation, as well as lumbar lordosis, was done using the inclinometer technique. The study revealed no significant difference in the degree of lordosis between back pain patients and matched controls.

Megan Davidson and Jennifer L Keating conducted a study in the 'Journal of the American Physical Therapy Association' Vol. 82, No.1, 8-24, January (2002) which focused on comparing 5 different Low Back Disability Questionnaires for assessing disability in individuals with low back pain. The study compared the Modified Oswestry Disability Questionnaire, the Quebeck Back Pain Disability Scale, the Roland-Morris Disability Questionnaire, the Waddell Disability Index, and the Physical Health Scales of the Medical Outcomes Study 36-Item Short Form Health Survey among patients undergoing physical therapy for low back pain. Intra-Class Correlation Coefficients (2,1) were calculated to measure the reliability of these questionnaires for subjects classified as unchanged or self-rated. Results showed that the Oswestry and Quebeck Questionnaires along with the SF-36 physical functioning scale had reliability coefficients greater than .80, while the Waddell and Roland Morris questionnaires and SF-36 had coefficients less than .80. Among these, the most reliable measurements were obtained with the Modified Disability Questionnaire, the SF-36 Physical Functioning Scale, and the Quebeck Back Pain Disability Scale, demonstrating sufficient width scale to detect improvement or worsening in most subjects reliably.

James W. Youdas et al. conducted a study in the 'Journal of the American Physical Therapy Association' Vol. 76, No. 10, October 1996, focusing on Lumbar Lordosis and Pelvic Inclination of Asymptomatic Adults. The study examined 90 subjects (45 men, 45 women) without back pain or a history of surgery. Results indicated that abdominal muscle performance was correlated with the angle of Pelvic Inclination for women ($R2= .23$)

but not for men. Additionally, standing Lumbar Lordosis was associated with abdominal muscle length in women (R^2= .40), while in men it was multivariately associated with the length of abdominal and one-joint hip flexor muscles, as well as physical activity level (R^2= .38). No correlation was found between the angle of pelvic inclination and the depth of lumbar lordosis in a standing position.

AashimaDatta, Siddhartha et al., in Nov Physiother 2014,4:2 conducted a study on the effects of core strengthening on cardiovascular fitness, flexibility, and strength in patients with low back pain. The study included 30 patients who were assigned to either an experimental group or a control group and underwent the intervention daily for 4 weeks. Outcome measures included VO_2max, flexibility, and strength evaluation before the exercise and after each week. Results showed that both groups experienced significant improvements in VO_2max, flexibility, and strength by the end of the 4th week ($P<0.05$). The study concluded that core strengthening exercises can effectively improve muscle imbalances, posture, and enhance cardiovascular fitness, flexibility, and strength in patients with low back pain.

Fritz J et al (2001) conducted a study to assess the validity of a global rating of change as an indicator of substantial change in patient status. Additionally, they aimed to compare the measurement characteristics of the modified Oswestry Low Back Pain Disability Questionnaire (OSW) and the Quebec Back Pain Disability Scale (QUE). The study involved 67 patients with acute work-related low back pain who were referred for physical therapy. Both scales were initially administered and then after a 4-week physical therapy period. The findings indicated that the modified OSW exhibited superior levels of test-retest reliability and responsiveness in comparison to the QUE. The researchers concluded that the modified OSW displayed enhanced measurement properties when contrasted with the QUE.

Hides J et al (2001) performed a randomized controlled trial involving 39 patients with acute, first-episode Low Back Pain (LBP) who were under medical management. These patients were randomly assigned to either a control group or a specific stabilization exercise group. The medical management included advice and medication usage. Follow-up telephone questionnaires were conducted with the patients one year and three years post-treatment. Results from the questionnaires revealed that individuals from the specific exercise group encountered fewer instances of LBP recurrence than those in the control group. The researchers deduced that specific stabilization exercise therapy, when combined with medical management and resumption of regular activities, might be more effective in reducing LBP recurrences compared to solely medical management and normal activity.

Koumantakis G et al (2005) undertook a Randomized Controlled Trial with 55 patients suffering from recurrent nonspecific back pain. These participants were divided into two groups: stabilization-enhanced exercise group (n=29) and general exercise-only group (n=26). Both groups underwent an 8-week exercise intervention along with receiving written advice. The outcomes were evaluated based on self-reported pain (Short-Form McGill Pain Questionnaire) and disability (Roland-Morris Disability Questionnaire) immediately before and after the intervention, as well as 3 months post-intervention. Results indicated improvements in outcome measures for both groups. The researchers concluded that a general exercise program led to a greater reduction in disability in the short term compared to a stabilization-enhanced exercise approach among patients dealing with recurrent nonspecific low back pain ($p<0.0005$).

Marchand S et al (1993) conducted a study to explore the impact of Trans-cutaneous Electrical Nerve Stimulation (TENS) on chronic low back pain (CLBP). A total of 42 subjects with CLBP were randomly assigned to one of three groups: TENS, placebo-TENS, and no treatment (control). Visual Analog Scale (VAS) pain ratings were collected before and after each treatment session to determine the short-term effects of TENS. Following a comparison between pain evaluations before and after each treatment session, it was evident that TENS significantly outperformed placebo-TENS in reducing pain intensity but not pain unpleasantness. The researchers suggested that TENS should be integrated as a short-term analgesic procedure in a multidisciplinary approach for low back pain rather than being solely used as an exclusive or lengthy treatment option.

METHODOLOGY

Methodology is considered the most crucial aspect of a research investigation, as it empowers the researcher in establishing a framework for the undertaken study. The research methodology entails a systematic process through which the researcher commences from the initial identification of issues to the ultimate findings.

The primary objective of the current investigation is to examine the impact of Core Strengthening exercises on Lordosis in individuals experiencing Low backache.

This section delineates the methodology embraced by the researcher for the study, encompassing the research approach, the context, demographics, sampling methodology, selection of instruments, intervention protocols, data collection methods, and the proposed plan for data analysis.

RESEARCH APPROACH

The research methodology is a crucial component of any study, as the selection of the approach is contingent upon the study's objectives and aims that are being pursued.

RESEARCH DESIGN

Experimental design was used for this study.

RESEARCH SETTING

Study was conducted in Jammu.

POPULATION

Patients included in the study were those experiencing low back pain and meeting both inclusion and exclusion criteria, forming a homogeneous group.

SAMPLE SIZE

A total of 30 participants who fulfilled the selection criteria were included in the study. These participants were divided into two groups, with one group consisting of 15 individuals and the other group also comprising 15 individuals.

SAMPLING TECHNIQUE

Due to the comparative nature of the study, the Convenient sampling technique was employed for subject selection. To commence the process, an evaluation form was utilized to assess the cases of low backache based on essential criteria for all participants.

Among the total of thirty participants, fifteen individuals from the control group were assigned Conventional Exercises, while the remaining fifteen from the Experimental group were provided with Core Strengthening exercises.

SOURCE OF DATA COLLECTION

All Patients will be recruited from in patient Ample Physiotherapy Clinic.

CRITERIA FOR SELECTION

INCLUSION CRITERIA

- Age 30-50 years.
- Both genders.
- Complaints of low backache
- Subjects who have less than normal range lordosis.
- Back extensor weakness

EXCLUSION CRITERIA

- Patients with previous spinal surgery.
- Patients who have signs and symptoms of gross spinal instability, radiological diagnosis of spondylolysis and spondylolisthesis.
- Patients with serious spinal pathology.
- Patients with cardio-pulmonary disease .
- Patients with tumor, infection and fracture in spine.
- Patient with rheumatic and inflammatory condition.
- Patients with disc disease.
- Lumbar canal stenosis.

VARIABLES

DEPENDENT VARIABLES

- Lordosis , low backache.

INDEPENDENT VARIABLES

- Core strengthening exercises

INSTRUMENTATION

- Couch
- Markers

INVESTIGATION

- **X-ray-** The lateral view of lumbosacral spine was taken to measure the lordosis before and after the study by measuring the George line on x-ray.

gure 1.3 X-ray lateral view of lumbosacral spine

OUTCOME MEASURES

To alleviate low back pain, a 10 cm line was delineated on a sheet of paper, with markings ranging from 1 (indicating no pain) to 10 (representing the most severe pain). Participants were directed to indicate on the line the intensity of pain they experienced, and measurements were documented both before and after the intervention.

OSWESTRY LOW BACK DISABILITY QUESTIONNAIRE:

The questionnaire comprises 10 inquiries with 6 answer choices, from which the patient is required to select one. In order to evaluate a patient's enduring functional impairment, this tool is deployed. Assessment of functional disability was conducted using the Oswestry Disability Questionnaire, which is a functional scale aimed at gauging the influence of lower back pain on day-to-day tasks. The total score is computed by summing up the assigned values for each of the 10 specific questions, enabling the classification of disability into categories such as mild or no disability (0-20%), moderate disability (21%-40%), severe disability (41%-60%), incapacity (61%-80%), and confined to bed (81%-100%).

PROTOCOL

After meeting the criteria for inclusion and exclusion and obtaining their informed consent, each participant was conveniently allocated to both experimental groups.

Group A(n=15)	**Group B (n=15)**
Control group	**Experimental group**
Duration = 30- 40 minute	Duration = 30-40 minute
No. of repetitions = 10	No. of repetitions = 10
No. of sessions/week = 3 days/week	No. of sessions/week = 3 days/week
No. of weeks = 6	No. of weeks = 6

PROCEDURE

The participants were selected based on specific inclusion and exclusion criteria, and a formal written consent was obtained from all 30 participants following a detailed explanation of the procedure. Initial evaluation included an assessment of core muscle strength and posture. Data was recorded on day 0 prior to the intervention and at 6 weeks post-treatment.

Demographic information such as age, gender, and occupation was gathered from each participant. Additionally, a subjective evaluation was conducted to identify any symptoms such as a history of trauma, muscle weakness, radiating pain, or presence of surgical or medical conditions.

MEASUREMENTS

LORDOSIS - A lateral perspective of the lumbosacral X-ray spine was captured on day 0 prior to the commencement of the intervention and at the 6-week mark post-intervention, utilizing the George line measurement from the superior aspect of the L3 vertebra to the superior aspect of the L5 vertebra. Subsequently, the recorded measurements were duly documented.

NUMERIC PAIN RATING SCALE-

A line measuring 10 centimeters was delineated on a sheet of paper, with gradations ranging from 1 (indicating no pain) to 10 (representing the most severe pain), prompting the participants to indicate the level at which they experienced pain. Subsequently, the pain intensity reported by the subjects was documented both on the initial day and at the conclusion of the sixth week.

FUNCTIONAL DISABILITY –

Functional disability was assessed using the Oswestry Disability Questionnaire, a functional scale that evaluates the impact of low back pain on daily activities. The total score is determined by summing the values assigned to each of the 10 specific questions and is utilized to classify disability into different categories: mild or no disability (0-20%), moderate disability (21%-40%), severe disability (41%-60%), incapacity (61%-80%), and restricted to bed (81%-100%).

INTERVENTIONS-

Upon obtaining written informed consent and conducting a baseline examination, the participants will be allocated randomly into two distinct treatment cohorts, denoted as Group A and Group B. In Group A, 15 individuals will undergo traditional exercise regimens, whereas Group B will consist of 15 subjects engaging in core strengthening exercises. The degree of lordosis will be assessed through the examination of the George line on the lateral perspective of X-ray images of the lumbosacral spine. Pain intensity will be quantified utilizing a numerical pain rating scale (NPS), while the evaluation of treatment outcomes will be performed by administering the Oswestry Low Back Pain Disability Questionnaire. Each session of both interventions is scheduled to last between 30 to 40 minutes and will be conducted thrice weekly over a period of 6 weeks.

GROUP-A (CONVENTIONAL EXERCISE)

The participants in this cohort received a regimen of general exercises targeting the lower back over a period of 6 weeks. These exercises were performed three times weekly throughout the 6-week duration.

This includes

- The participants were positioned in a supine posture, following which they were instructed to flex one knee towards the chest while the other leg remained supine on the table. This position was to be maintained for a duration of three counts before returning to the initial position, repeating the sequence ten times. The same procedure was then carried out with the opposite leg.
- Subjects were directed to assume a quadruped or 4-point kneeling stance and engage in hollowing of the lower abdomen for ten repetitions, three times a week over a six-week period. This routine was then replicated on the alternate side.
- The individual was asked to lower themselves onto their hands and knees, with palms flat on the ground, shoulder-width apart. The knees were to be positioned at hip-width apart and bent at a 90-degree angle. This exercise was to be completed ten times weekly for the following six weeks..

GROUP B(CORE STABILIZATION EXERCISES)

In this group the subjects were given stabilization exercisefor 6 weeks.

- The participants were instructed to elevate their head and shoulders from the floor, maintaining the position for three deep inhalations before returning to the initial stance. The muscle contraction was repeated ten times consecutively over a period of six weeks.
- Participants were positioned in a supine lying posture, engaging in abdominal hollowing while having their legs supported and their hips and knees flexed at a 90-degree angle. The bridging exercise was executed ten times daily for the following six weeks.
- Subjects were directed to lie supine and perform abdominal hollowing without leg support, keeping their hips and knees flexed at a 90-degree angle. This specific exercise was repeated ten times in sets of three over a six-week period.
- Individuals were instructed to lie supine and engage in single-leg bridging on both sides, ensuring a neutral spine position throughout the exercise. This routine was repeated ten times daily over the course of six weeks.

Figure 1.4 ABDOMINAL CRUNCHES

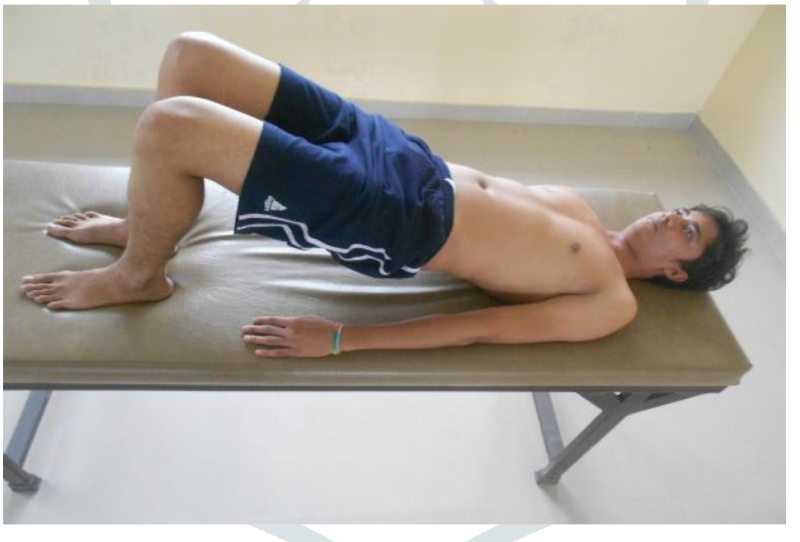


FIGURE 1.5 BRIDGING

Figure 1.6 One leg bridging

Figure 1.7 knee to chest

Figure 1.8 Cat and camel exercise

Figure 1.9 Quadruped exercise

DATA ANALYSIS

Statistical analysis and data were conducted utilizing SPSS 13 software. An independent t-test was employed to compare between groups. The significance threshold was determined to be $P<0.05$.

OBSERVATION AND DATA ANALYSIS

Statistical analyses were conducted utilizing the software SPSS 13, with the outcomes derived at a significance level of 0.05.

The calculation of the mean for various variables across a specified number of subjects was accomplished through the application of statistical formulas.

$$\bar{X} = \frac{\sum X}{N}$$

Where,

N = Number of subjects X = each subjects value

STANDARD DEVIATION (σ)

$$s = \sqrt{\frac{\sum x^2}{N}}$$

x = deviation of score from mean

N = Number of subjects

t-test of independent means

The formula for the independent t-test is

$$t = \frac{X_1 - X_2}{\sqrt{\left(\frac{SS_1 + SS_2}{n_1 + n_2 - 2}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}},$$

where

X_1 is the mean for group 1, X_2 is the mean for group 2,

SS_1 is the **sum of squares** for group 1, SS_2 is the **sum of squares** for group 2,

$\mathbf{n_1}$ is the number of subjects in group 1, and $\mathbf{n_2}$ is the number of subjects in group 2.

t-test of dependent means

The formula for the dependent t is:

$$t = \frac{\sum D}{\sqrt{\frac{n\sum D^2 - (\sum D)^2}{n-1}}}$$

Where D is the difference between pairs of scores,

$$D = X_2 - X_1$$

df = n – 1 and n **is the number of pairs of subjects in the study.**

GROUP DESCRIPTION

Total Subjects →**30**

GROUP A →**15**

GROUP B →**15**

Level of Significance → **95%**

P < 0.05 → Significant

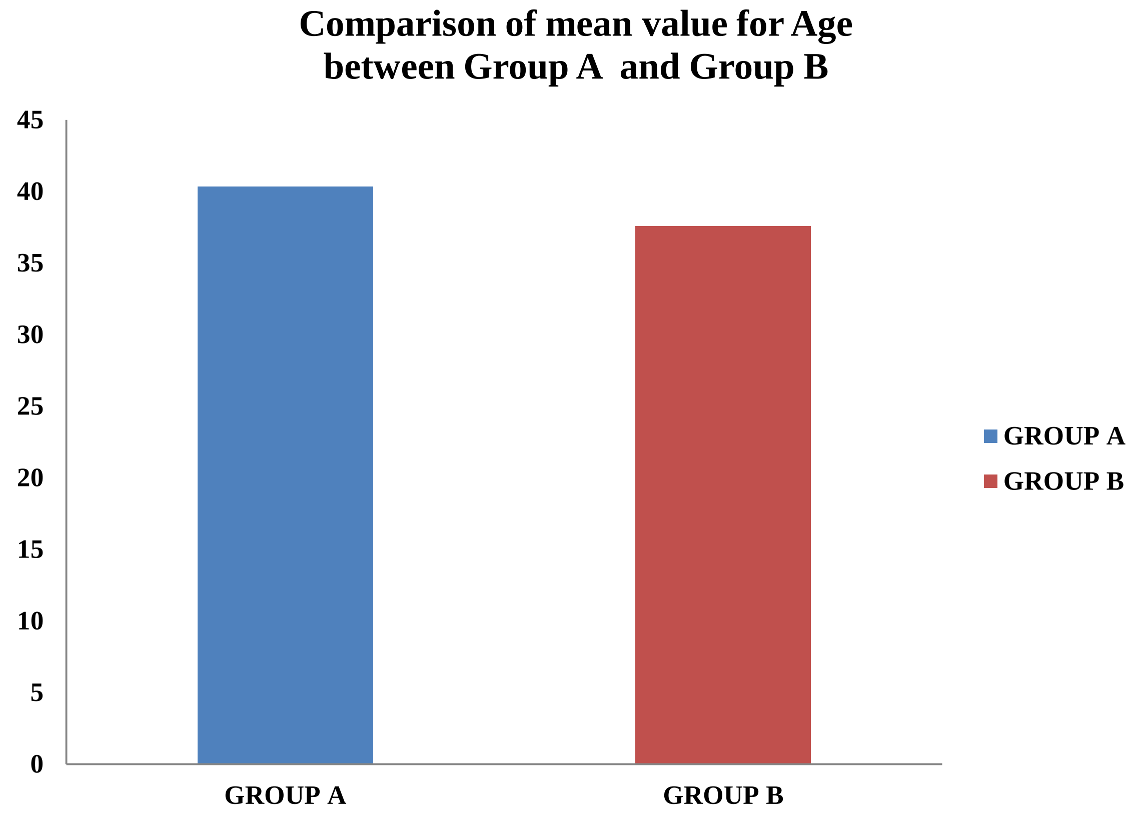
P > 0.05 → Not Significant

RESULTS

Table 4.1: Mean and SD of Age for the subjects of Group A and Group B

Demographic	GROUP A		GROUP B	
	Mean	SD	Mean	SD
Age	40.33	7.18	37.60	5.74

Table 4.1: The statistics illustrating the distribution of age among 30 participants are presented. Within this cohort, the average age of 15 individuals in category A was 40.33, accompanied by a standard deviation (SD) of 7.18. Similarly, the average age of the 15 subjects in group B was 37.60, with a SD of 5.74.



Graph 1: The comparison of the mean value for age between Group A and Group B indicates that Group A exhibits a marginally higher mean age value than Group B.

Table 4.2: Mean and SD of Lordosis at Pre, Post and MD (Pre – Post) interval for the subjects of Group A and Group B

Lordosis	GROUP A		GROUP B	
	Mean	SD	Mean	SD
Pre	22.13	5.87	25.53	4.80
Post	33.86	7.92	43.26	8.21
MD (Pre – Post)	11.73	4.69	17.73	5.53

Table 4.2: The Mean and Standard Deviation of Lordosis at pre intervention in group-A are reported to be 22.13 and 5.87, respectively, while post intervention values are 33.86 and 7.92, respectively. In Group-B, the Mean and Standard deviation at pre intervention are 25.53 and 4.80, respectively, and post intervention values are 43.26 and 8.21, respectively. Group A's Median at pre-post intervention is found to be 11.73 with a Standard Deviation of 4.69. Conversely, Group-B's Median at pre-post intervention is 17.73 with a Standard Deviation of 5.53.

Table 4.3: Comparison of mean value for Lordosis at Pre, Post and at Pre and Post interval within Group A and Group B

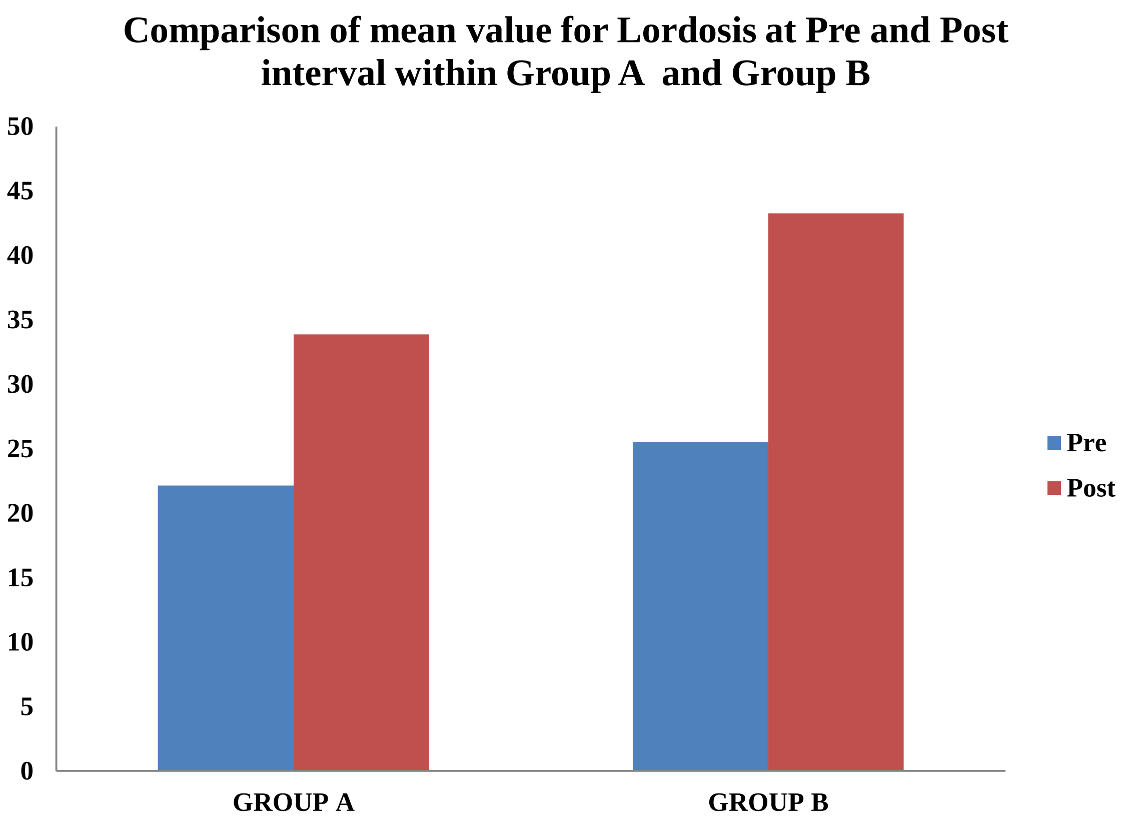
Lordosis	GROUP A		GROUP B	
	t value	P value	t value	P value
Pre Vs Post	-9.674	**$P < 0.05$**	-12.408	**$P < 0.05$**

Table 4.3: the t-value for Lordosis in group-A is reported as -9.674 with a significance level of $p < 0.05$. This suggests a statistically significant difference in Lordosis within Group A when examining the pre and post intervention data. Similarly, the analysis indicates that Group B yielded a t-value of -12.408 with a significance level of $p < 0.05$, signifying a substantial difference in Lordosis within Group B between the pre and post intervention periods.

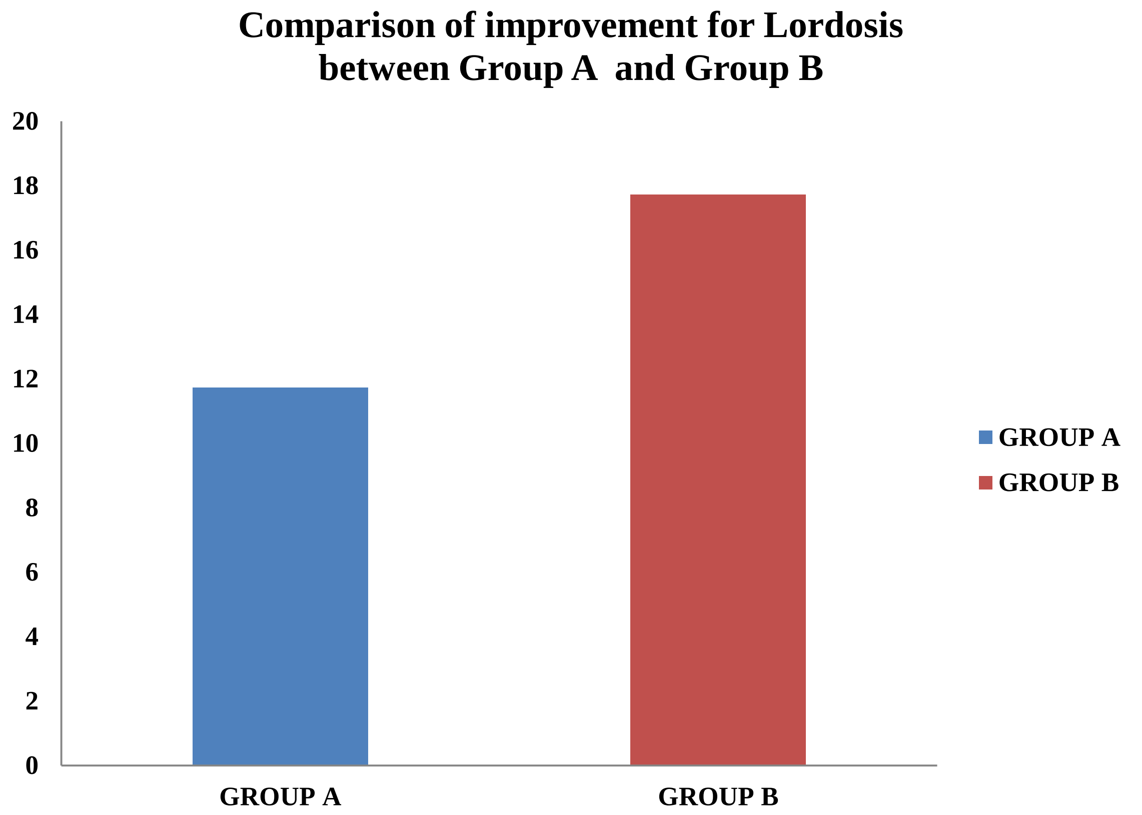
Table 4.4: Comparison of mean value for Lordosis at Pre, Post and MD (Pre – Post) interval between Group A and Group B

Lordosis	GROUP A Vs GROUP B	
	t value	P value
Pre	-1.734	P > 0.05
Post	-3.189	**P < 0.05**
MD (Pre – Post)	-3.201	**P < 0.05**

Table 4.4: Demonstrates that upon conducting a comparison of Lordosis between Group A and B at the pre-intervention level, the t value yielded was -1.734 with a $p > 0.05$, indicating the absence of a statistically significant distinction in Lordosis between the two groups. Conversely, the t value for Lordosis at the post-intervention stage between Group A and B was determined to be -3.189, with a $p < 0.05$, signifying a notable variance in Lordosis when juxtaposed between the two groups. Additionally, the analysis reveals that the t value at the Median (pre-post) was -3.201, with a $p < 0.05$, underscoring a significant differentiation in Lordosis at the Median level between the two groups.



Graph 2: The presentation illustrates a contrast in the average lordosis measurement before and after the intervention in both Group A and Group B. The analysis indicates that Group B exhibited a marginally greater lordosis value following the intervention.



Graph 3: The comparison of the enhancement of lordosis between Group A and Group B is demonstrated. The results illustrate that Group B exhibited more significant enhancements in Lordosis during the post-intervention period in comparison to Group A.

Table 4.5: Mean and SD of Pain at Pre, Post and MD (Pre – Post) interval for the subjects of Group A and Group B

Pain	GROUP A		GROUP B	
	Mean	SD	Mean	SD
Pre	7.26	1.33	8.26	1.33
Post	4.20	1.14	2.53	0.91
MD (Pre – Post)	3.06	0.88	5.73	0.96

Table 4.5:the data displays the Mean and Standard Deviation of pain levels in Group A before the intervention as 7.26 and 1.33, and after the intervention as 4.20 and 1.14 respectively. In Group B, the Mean and SD before the intervention are 8.26 and 1.33, and after the intervention are 2.53 and 0.91 respectively. For Group A, the Median (pre-post) demonstrates a Mean and SD of 3.06 and 0.88 respectively. On the other hand, the Median values for Group B indicate a mean and SD of 5.73 and 0.96 respectively.

Table 4.6: Comparison of mean value for Pain at Pre, Post and at Pre and Post interval within Group A and Group B

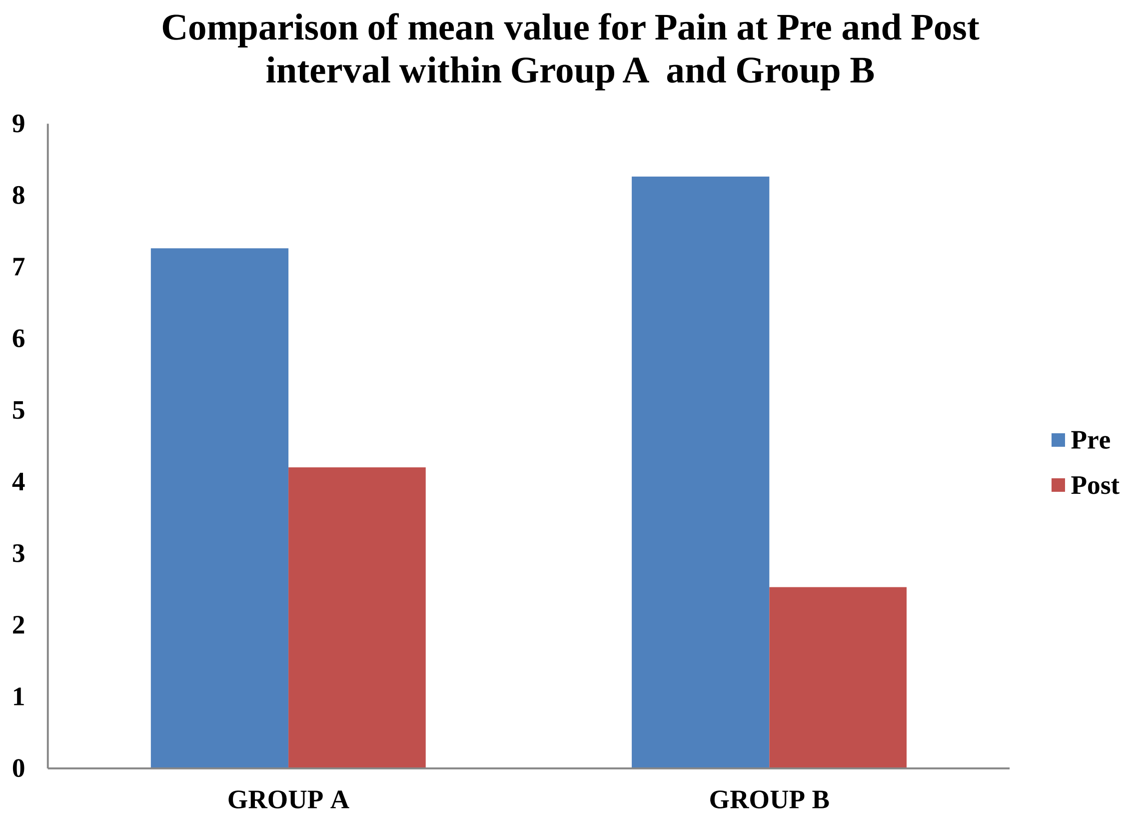
Pain	GROUP A		GROUP B	
	t value	P value	t value	P value
Pre Vs Post	13.440	**$P < 0.05$**	23.103	**$P < 0.05$**

Table 4.6:the t-value of pain in group A is reported as 13.440 with a significance level of $p < 0.05$. This finding indicates a statistically significant difference in pain perception within Group A when comparing pre and post intervention measurements. Similarly, the statistical analysis reveals that Group B exhibited a t-value of 23.103 with a significance level of $p<0.05$, signifying a significant variation in pain perception within Group B between the pre and post intervention periods.

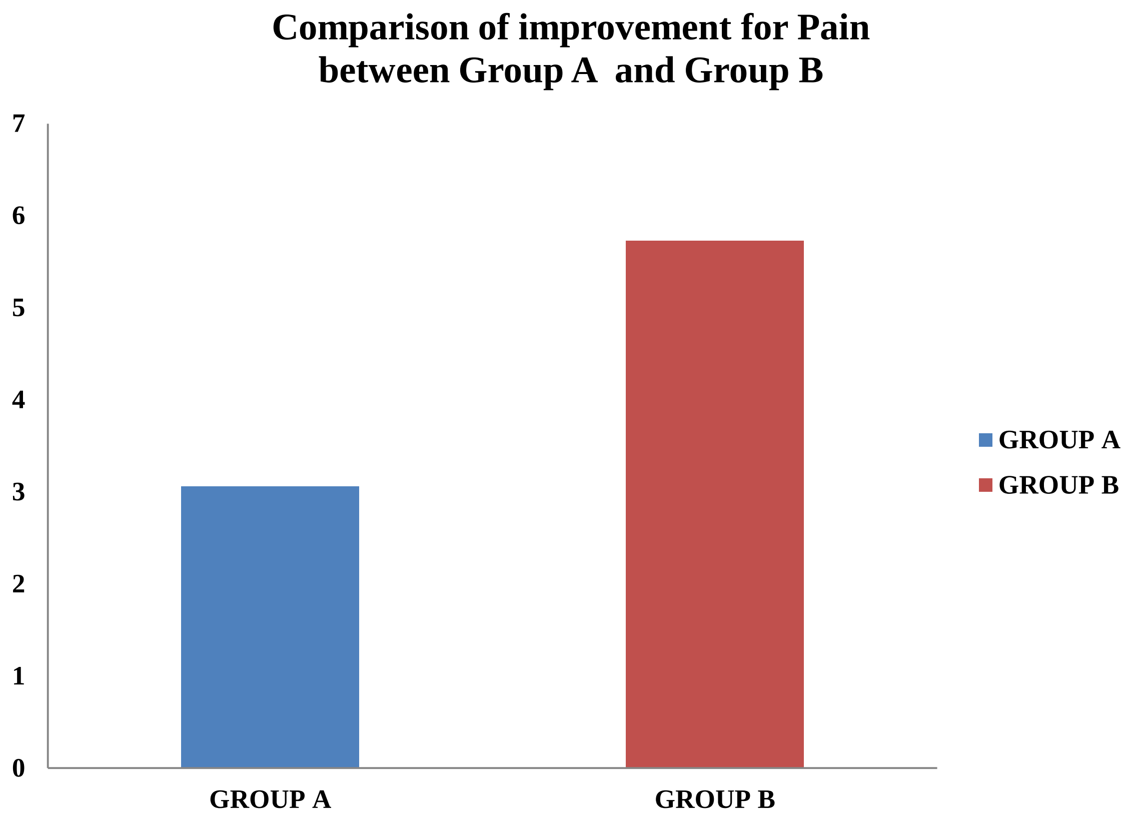
Table 4.7: Comparison of mean value for Pain at Pre, Post and MD (Pre – Post) interval between Group A and Group B

Pain	GROUP A Vs GROUP B	
	t value	**P value**
Pre	-2.052	P > 0.05
Post	4.400	**P < 0.05**
MD (Pre – Post)	-7.910	**P < 0.05**

Table 4.7: The findings demonstrate that upon conducting a pain comparison between Group A and B at the pre-intervention stage, the t value yielded was -2.052 with a $p > 0.05$, indicating a lack of statistical significance in pain levels between the two groups. Conversely, the t value for pain at the post-intervention stage between Group A and B was determined to be 4.400, with a $p < 0.05$, signifying a notable difference in pain experienced between the two groups. Moreover, the analysis revealed a t value of -7.910 for pain at the median (pre-post) along with a $p < 0.05$, indicating a significant disparity in pain levels at the median between the aforementioned groups.



Graph 4: The study presents a contrast in the average Pain scores before and after the intervention, comparing groups A and B. The results indicate that Group B exhibited a decreased level of pain following the intervention.



Graph 5: The study presents a comparison of pain improvement between Group A and Group B, indicating that Group B exhibited a greater enhancement in pain levels post-intervention in comparison to Group A.

DISCUSSION

Katyal et al. (year) conducted a study to investigate the impact of trunk muscle stabilization exercises and general exercises on pain in patients with recurrent non-specific low back pain. The study comprised 80 participants who were randomly assigned to either the control group or the experimental group. The control group underwent a 6-week exercise program, with sessions lasting 30-40 minutes, three times a week. Pain levels were assessed using a VAS scale before and after the intervention. The analysis involved a t-test to compare pre- and post-test results. Results indicated a significant improvement in post-test VAS values compared to pre-test values in both groups. The calculated p-value of 0.05 demonstrated that the experimental group experienced greater pain relief than the control group. In conclusion, the study showed that specific stabilization exercises can effectively reduce pain and improve function in individuals with chronic non-specific low back pain.

The aim of this research was to examine the influence of core strengthening exercises on Lordosis in individuals with low back pain. The findings suggest that both exercise regimens are effective in reducing lumbar lordosis and alleviating pain in low back pain patients. However, core strengthening exercises were found to be more beneficial in decreasing lumbar lordosis and pain levels in these patients.

Statistical analysis was conducted using SPSS 13 at a significance level of 0.05. Pre- and post-test comparisons were made using t-tests, revealing a significant improvement with core strengthening exercises in low back pain patients before and after treatment.

This prospective study focused on the effects of core stabilization exercises on lordosis in low back pain patients. The analysis showed a significant enhancement in Lordosis values, Numeric pain rating scale, and functional disability in both groups, with core stabilization exercises (Group B) proving to be more effective than Conventional exercises (Group A). The differences in the effects of core stabilization exercises on lordosis were tested by comparing values between the groups. Results indicated that the lordosis scores in both groups had a mean and standard deviation at pre-intervention of 22.13 and 5.87 for group A and 25.53 and 4.80 for group B, respectively. Post-intervention values were 33.86 and 7.92 for group A, and 43.26 and 8.21 for group B. The medians for group A pre- and post-intervention were 11.73 and 4.69, while for group B they were 17.73 and 5.53, respectively.

The T-value of lordosis in group-A is -9.674, with a p-value of 0.05, indicating an absence of statistically significant difference in pain levels between the two groups. Following the intervention, a t-value of 4.400 was observed with $p<0.05$, signifying a significant disparity in pain levels between the groups. The t-value for the median (pre-post) was -7.910, with $p<0.05$, suggesting a notable divergence in pain at the median between the two groups.

Therefore, the findings indicate a slight enhancement in both groups, with a more significant improvement observed in group B compared to group A. This research is grounded in current exercise management trends for addressing low back pain.

The aim is to assess the impact of core strengthening exercises on lordosis in individuals with low back pain. In this investigation, measurements of lordosis were conducted by assessing the George line on the lateral view of the lumbo-sacral spine x-ray, as well as utilizing the numerical pain rating scale and Oswestry Low Back Pain Disability Questionnaire as outcome measures for pain and functional status. The scales and questionnaire used have established reliability and validity. In terms of pain as an outcome measure, group B demonstrated a marked enhancement in NPS compared to group A.

Functional enhancement was also evaluated as an outcome measure. The research exhibited a significant amelioration in the Oswestry Low Back Pain Questionnaire, primarily due to the prevalence of lumbar instability in individuals with low back pain. Specific stabilization exercises target muscles such as the multifidus and transverse abdominis, which provide spinal stability. As muscle strength improves, lumbar instability diminishes.

In this study involving individuals with low back pain, a notably greater reduction in lordosis and pain was observed post-treatment among participants who underwent core stabilization exercises (group B) compared to those who received conventional exercises only (group A).

The outcomes of this study align with Richardson and Jull's proposition that targeted training of these muscles is advantageous for patients with low back pain. Additional studies have indicated compromised muscle functionality.

LIMITATIONS OF STUDY

1. A greater sample size might have provided enhanced clarity in the discerned patterns.
2. The study exclusively focused on a particular age group, thus complicating the generalization of findings.
3. There was an absence of intermediate and long-term follow-up assessments.
4. The utilization of the McGill questionnaire could have been considered..

FUTURE RECOMMENDATION FOR STUDY

1. The investigation could potentially be conducted on a broader sample size. Given that the evaluation was specifically focused on addressing issues related to lower back discomfort, subsequent research endeavors could explore the rehabilitation of alternative forms of back pain.

2. It is plausible to consider employing alternative outcome metrics such as algometer in lieu of Numeric Pain Scale (NPS)..

CONCLUSION

According to the results of the current investigation, it can be inferred that stabilization exercises (group-B) represent a superior therapeutic option compared to conventional exercises (group-A) for individuals suffering from low back pain, despite the fact that both modalities have demonstrated efficacy in diminishing lordosis and alleviating pain in this patient population.

SUMMARY

This research study conducted a comparison of the impact of core strengthening routines on lordosis in individuals experiencing low back pain. Thirty participants who met specific selection criteria were chosen using a convenient sampling method. The subjects were divided into two groups: group A received traditional exercises, while group B underwent core stabilization exercises. Measurements of lordosis and pain levels were taken on the initial day before the intervention and six weeks post-intervention. Group B exhibited a marked enhancement in both lordosis and pain in contrast to Group A. The findings of this study demonstrate a functional enhancement in the results of the Oswestry Low Back Pain Questionnaire.

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CONSENT FORM

I Vishal Sahani hereby voluntarily consent to participate in this study. All my questions have been satisfactorily answered and the risk involved has been explained to me in my known language. I have been informed about the title, nature of procedure related to the studyand I have been given the opportunities to ask all / any question. I have given the right to withdraw myself from the study at any time. I acknowledge that no guarantee and promise has been made to me concerning the result of procedure/treatment. I havethecontact address of Vishal Sahani MPT (Musculoskeletal) 2nd Year if I require any further information.

Patient's Signature Researcher's signature

Address: ……………………………………………………

……………………………………………………

Contact No.:………………………………………………..

ASSESSMENT FORM

1) PATIENT PROFILE

- Name
- Age
- Gender
- Occupation

2) CHIEF COMPLAINT

3) SUBJECTIVE EXAMINATION-

i. Present history-
ii. Past history-
iii. Medical history
iv. Personal history-
v. Socio- economic history.
vi. Family history-
vii. Drug history-
viii. Surgical history-

4) PAIN ASSESSMENT-

- Site of pain:
- Side of pain:
- Onset of pain:
- Nature of pain:
- Type of pain- continuous or intermittent
- Aggravating factors -
- Relieving factors-
- Irritability

- Mild
- Moderate
- Severe

- Duration of pain- minutes/hours/weeks/months.
- Severity of pain- Numeric pain rating scale.

5) ON OBSERVATION-

a) Built:

- Endomorphic
- Ectomorphic
- Mesomorphic

b) Posture:

c) Skin Colour: Normal/redness

d) Swelling:

e) Deformity:

f) Atrophy:

g) Muscle spasm-

h) External appliances

i) Ambulation

j) Bony & soft tissue contour.

k) Gait

6) ON PALPATION-

Normal bony prominences of the spine.

- Tenderness
- Warm

7) ON EXAMINATION-

Examination of pelvic tilt:

- Anterior pelvic tilt
- Posterior pelvic tilt.

Examination of George line on x-ray.

a) Active Range of Motion:

Forward flexion-

Extension

Lateral flexion

Rotation

b) Passive range of motion:

c) End feel – normal

d) Resisted isometric movements of lumbar spine- This is first tested in neutral position.

- Forward flexion
- Extension
- Side flexion (left & right)
- Rotation (left & right)

e) Manual Muscle Testing (MMT)

f) Strength testing

g) Muscle girth measurement

8) Diagnostic test

9) Evaluation of functional assessment: oswestry disability questionnaire.

DATA COLLECTION FORM

NAME- …………………………

AGE -……………………………

SEX- ……………………………..

OCCUPATION-………………….

DATE-……………………………..

Ref no.	Sex	Age		PRE	POST

			Lordosis		
			NPS/Pain		

MASTER CHART A

S.NO	SEX	AGE	FOR CONTROL GROUP LORDOSIS		PAIN	
			PRE	POST	PRE	POST
1.	F	36	18^0	30^0	6	4
2.	M	45	20^0	38^0	8	5
3.	M	30	15^0	28^0	7	3
4.	F	45	20^0	42^0	9	6
5.	F	45	18^0	30^0	6	4
6.	M	38	22^0	28^0	7	5
7.	M	35	27^0	39^0	10	6
8.	M	50	30^0	40^0	9	5
9.	F	40	34^0	47^0	6	3
10.	M	50	30^0	45^0	8	4
11.	F	35	14^0	25^0	6	2
12.	M	32	18^0	24^0	7	3
13.	M	30	19^0	22^0	6	4
14.	M	50	22^0	32^0	8	5
15.	M	44	25^0	38^0	6	4

MASTER CHART B

S.NO	SEX	AGE	FOR EXPERIMENTALGROUP LORDOSIS PAIN			
			PRE	POST	PRE	POST
1.	M	43	25^0	42^0	9	4
2.	M	31	28^0	41^0	10	3
3.	M	30	18^0	27^0	8	2
4.	F	48	20^0	30^0	9	3
5.	M	41	25^0	40^0	7	2
6.	F	33	30^0	42^0	8	4
7.	F	37	18^0	38^0	10	3
8.	M	44	32^0	50^0	9	3
9.	M	34	28^0	48^0	8	2
10.	M	42	21^0	39^0	6	1
11.	F	31	27^0	42^0	10	3
12.	F	40	30^0	54^0	9	2
13.	F	43	33^0	56^0	8	3
14.	M	32	25^0	49^0	7	2
15.	F	35	23^0	51^0	6	1

DATA ANALYSIS SAMPLE

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
AGE	15	30.00	50.00	40.3333	7.18795
PRE LORDOSIS	15	14.00	34.00	22.1333	5.87813
POST LORDOSIS	15	22.00	47.00	33.8667	7.92705
MD LORDOSIS	15	3.00	22.00	11.7333	4.69752
PRE PAIN	15	6.00	10.00	7.2667	1.33452
POST PAIN	15	2.00	6.00	4.2000	1.14642
MD PAIN	15	2.00	4.00	3.0667	.88372
Valid N (listwise)	15				

T-Test

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pair 1	PRE LORDOSIS - POST LORDOSIS	-11.73333	4.69752	1.21289	-14.33473	-9.13194	-9.674	14	.000
Pair 2	PRE PAIN - POST PAIN	3.06667	.88372	.22817	2.57728	3.55605	13.440	14	.000

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
AGE	15	30.00	48.00	37.6000	5.74208
PRE LORDOSIS	15	18.00	33.00	25.5333	4.80872
POST LORDOSIS	15	27.00	56.00	43.2667	8.21555
MD LORDOSIS	15	9.00	28.00	17.7333	5.53517
PRE PAIN	15	6.00	10.00	8.2667	1.33452
POST PAIN	15	1.00	4.00	2.5333	.91548
MD PAIN	15	4.00	7.00	5.7333	.96115
Valid N (listwise)	15				

T-Test

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pair 1	PRE LORDOSIS - POST LORDOSIS	-17.73333	5.53517	1.42917	-20.79861	-14.66806	-12.408	14	.000
Pair 2	PRE PAIN - POST PAIN	5.73333	.96115	.24817	5.20107	6.26560	23.103	14	.000

T-Test

Group Statistics

	VAR00001	N	Mean	Std. Deviation	Std. Error Mean
PRE LORDOSIS	1.00	15	22.1333	5.87813	1.51773
	2.00	15	25.5333	4.80872	1.24161
POST LORDOSIS	1.00	15	33.8667	7.92705	2.04676
	2.00	15	43.2667	8.21555	2.12125
MD LORDOSIS	1.00	15	11.7333	4.69752	1.21289
	2.00	15	17.7333	5.53517	1.42917
PRE PAIN	1.00	15	7.2667	1.33452	.34457
	2.00	15	8.2667	1.33452	.34457
POST PAIN	1.00	15	4.2000	1.14642	.29601
	2.00	15	2.5333	.91548	.23637
MD PAIN	1.00	15	3.0667	.88372	.22817
	2.00	15	5.7333	.96115	.24817

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PRE LORDOSIS	Equal variances assumed	.558	.461	-1.734	28	.094	-3.40000	1.96089	-7.41670	.61670
	Equal variances not assumed			-1.734	26.942	.094	-3.40000	1.96089	-7.42381	.62381
POST LORDOSIS	Equal variances assumed	.097	.758	-3.189	28	.004	-9.40000	2.94769	-15.43807	-3.36193
	Equal variances not assumed			-3.189	27.964	.004	-9.40000	2.94769	-15.43842	-3.36158
MD LORDOSIS	Equal variances assumed	.994	.327	-3.201	28	.003	-6.00000	1.87447	-9.83968	-2.16032
	Equal variances not assumed			-3.201	27.279	.003	-6.00000	1.87447	-9.84427	-2.15573
PRE PAIN	Equal variances assumed	.020	.889	-2.052	28	.050	-1.00000	.48730	-1.99819	-.00181
	Equal variances not assumed			-2.052	28.000	.050	-1.00000	.48730	-1.99819	-.00181
POST PAIN	Equal variances assumed	.470	.499	4.400	28	.000	1.66667	.37880	.89072	2.44261
	Equal variances not assumed			4.400	26.693	.000	1.66667	.37880	.88901	2.44433
MD PAIN	Equal variances assumed	.194	.663	-7.910	28	.000	-2.66667	.33712	-3.35723	-1.97610
	Equal variances not assumed			-7.910	27.805	.000	-2.66667	.33712	-3.35745	-1.97589

OSWESTRY LOW BACK PAIN DISABILITY QUESTIONNAIRE

Section 1 – Pain intensity

- I have no pain at the moment.

- The pain is very mild at the moment.
- The pain is moderate at the moment.
- The pain is fairly severe at the moment.
- The pain is very severe at the moment.
- The pain is the worst imaginable at the moment.

Section 2- Personal care (washing, dressing etc)

- I can look after myself normally without causing extra pain.
- I can look after myself normally but it causes extra pain.
- It is painful to look after myself and I am slow and careful.
- I need some help but manage most of my personal care.
- I need help everyday in most spects of self- care
- I do not get dressed, I wash with difficulty and stay in bed.

Section 3- lifting

- I can lift heavy weights without extra pain.
- I can lift heavy weights but it gives extra pain.
- Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently placed eg. on a table.
- Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.
- I can lift very light weights .
- I cannot lift or carry anything at all.

Section 4 – walking

- Pain does not prevent me walking any distance
- Pain prevents me from walking more than 2 kilometres
- Pain prevents me from walking more than 1kilometre.
- Pain prevents me from walking more than 500 kilometre.

- I can only walk using a stick or crutches.
- I am in bed most of the time.

Section- 5- sitting

- I can sit in any chair as long as I like.
- I can only sit in my favourite chair as long as I like.
- Pain prevents me from sitting more than one hour.
- Pain prevents me from sitting more than 30 minutes.
- Pain prevents me from sitting more than 10 minutes.
- Pain prevents me from sitting at all.

Section-6 –standing

- I can stand as long as I want without extra pain
- I can stand as long as I want but it gives me extra pain .
- Pain prevents me from standing for more than one hour.
- Pain prevents me from standing for more than 30minutes.
- pain prevents me from standing for more than 10 minutes
- pain prevents me from standing at all.

Section 7- sleeping

- My sleep is never disturbed by pain.
- My sleep is occasionally disturbed by pain.
- Because of pain I have less than 6 hours sleep.
- Because of pain I have less than 4 hours sleep.
- Because of pain I have less than 2 hours sleep.
- Pain prevents me from sleeping at all

Section 8- sex life (if applicable)

- My sex life is normal and causes no extra pain.
- My sex life is normal but causes some extra pain.
- My sex life is nearly normal but is very painful
- My sex life is severely restricted by pain.
- My sex life is nearly absent because of pain.
- Pain prevents any sex life at all

Section 9- Social life

- My social life is normal and gives me no extra pain.
- My social life is normal but increases the degree of pain.
- Pain has no significant effect on my social life apart from limiting my more energetic interests eg, sport.
- Pain has restricted my social life and I do not go out as often.
- Pain has restricted social life to my home.
- I have no social life because of pain.

Section 10- Travelling

- I can travel anywhere without pain.
- I can travel anywhere but it gives me extra pain.
- Pain is bad but I manage journeys of over two hours.
- Pain restricts me to journeys of less than one hour.
- Pain restricts me to short necessary journeys under 30 minutes.
- Pain prevents me from travelling except to receive treatment.