*International Journal of Health Sciences and Research*
*Volume 14; Issue: 4; April 2024*
*Website: www.ijhsr.org*
*Original Research Article* *ISSN: 2249-9571*

# Comparison of Lumbar Segmental Stabilisation and General Exercises on Pain, Functional Disability and Kinesiophobia in Patients with Low Back Pain: A Randomised Control Trial

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**DOI: https://doi.org/10.52403/ijhsr.20240405**

## ABSTRACT

**Background**: Lumbar segment instability in mechanical low back is ordinary now a days because of recurrence or by weaken muscles that provide stability in the neutral zone. Segmental instability can cause low back pain and severe functional disability that leads to Kinesiophobia (fear of movement). There are no studies done to check Kinesiophobia in context with segmental instability in mechanical low back pain. So, this study aims to compare lumbar segmental stabilisation (LSS) and general exercises (GE) on pain, disability and kinesiophobia in participants with non-specific low back pain.
**Methods**: A total of 56 participants were recruited after fulfilling the eligibility criteria. They were randomly allocated into two groups: Group A received LSS; Group B received GE for two weeks. Outcome measures were taken in form of Numeric Pain Rating Scale (NPRS), Oswestry Disability Index (ODI) and Tampa Scale of Kinesiophobia (TSK). The outcome measure was assessed at baseline and post intervention.
**Results**: As compared to baseline, all participants present significant difference in pain, disability and kinesiophobia ($P<0.05$). No between group difference was evident when LSS compare to GE group. More severe the disability there are more chances of developing kinesiophobia.
**Conclusion:** By comparing conventional exercises vs Lumbar segmental stabilisation exercises both are equally effective to reduce kinesiophobia along with pain and disability by strengthening the core muscles individually in patients with non-specific LBP. GE can compete with LSS to reduce the pain, disability and kinesiophobia. If severity of disability is higher than individual is more prone to develop kinesiophobia.

***Keywords:*** *Disability, kinesiophobia, LBP and Segmental stabilisation.*

## INTRODUCTION

Globally, patients with low back ache are becoming more and more common. Back pain is currently the leading cause of disability worldwide, because of the aging and increased global population, it is expanding [1] particularly in low- and middle-income nations. [1,2] The commonest form of low back ache is designated nonspecific or mechanical, because it lacks a pathoanatomic cause.

Complex biological, social and psychological, elements interacting with one another cause CLBP pain.[3] LBP was documented to be influenced by psychological issues. The way that psychological variables influence chronic pain and disability is often explained by the Fear Avoidance Model.

The main global causes of disease incidence are non-specific low back pain in both physical (such as improper lifting technique) and psychosocial factors.[4] LBP is linked to occupational elements such as longer periods of inactivity or office work, heavy workloads, and unsuitable workstation layouts. [5] In addition to other working environmental issues, it may be carried on by their prolonged sitting periods and certain body positions, such as improper neck or low back flexion or rotation. [6]

Strength and endurance have similar significance. Both muscle strength and endurance decline in people with LBP. These qualities contribute to endurance to maintain stability over extended periods of static postures and enhanced strength when the spine is subjected to unexpectedly increased stress such a fall or a fast loading of the spine. The active system works and muscle strength and endurance are measures of the active system, and they appear to be more significant than lumbar lordosis, pelvic tilt, and leg length discrepancy, which assess the passive system.

Changes in the recruitment type of the core muscles are a characteristic of LBP, particularly in its chronic form, which have been demonstrated to cause increased spinal loading and decreased spinal stability.[4,7] Transversus abdominis and Lumbar multifidus contractions were found to be delayed in individuals with LBP by Hodges and Richardson.[8]Studies show that muscle weakness can cause segmental instability and back pain even when there are no structural defects.[9] Encouraging the proper and sequential contraction of muscles is crucial [10].

Exercise and manual therapy are the major conservative physical treatment preferences [11]. According to a recent thorough investigation, in individuals with subacute LBP, high fear avoidance attitudes, as judged by the most often used questionnaire, the Tampa Scale of Kinesiophobia (TSK), were predictive of outcome.

The key conservative treatment preferences for a chronic low back without substantial pathology are exercise, yoga, biofeedback, progressive relaxation, massage, manual therapy, and interdisciplinary rehabilitation [11].

Similarly, after reviewing the previous research, because of recurrence of mechanical low back pain, patients are more prone to develop muscular weakness that result in segmental instability and later due to pain or severity in disability individuals develop fear of avoidance [12] i.e. kinesiophobia. Studies comparing the effectiveness of lumbar segmental stabilization against general exercise for kinesiophobia are limited.

Therefore, the aim of the current study was to compare the impacts of lumbar segmental stabilization exercises vs. general exercises on instability by reducing pain, disability and kinesiophobia on NSLBP.

## MATERIALS & METHODS

### STUDY DESIGN:

A Randomized Control Trial. The data of the study were recruited from OPD of K M Patel Institute of Physiotherapy, Shree Krishna Hospital, Anand, after receiving approval by the Institutional Ethical Committee of the H M Patel Centre for Medical Care and Education. CTRI registration was also done.

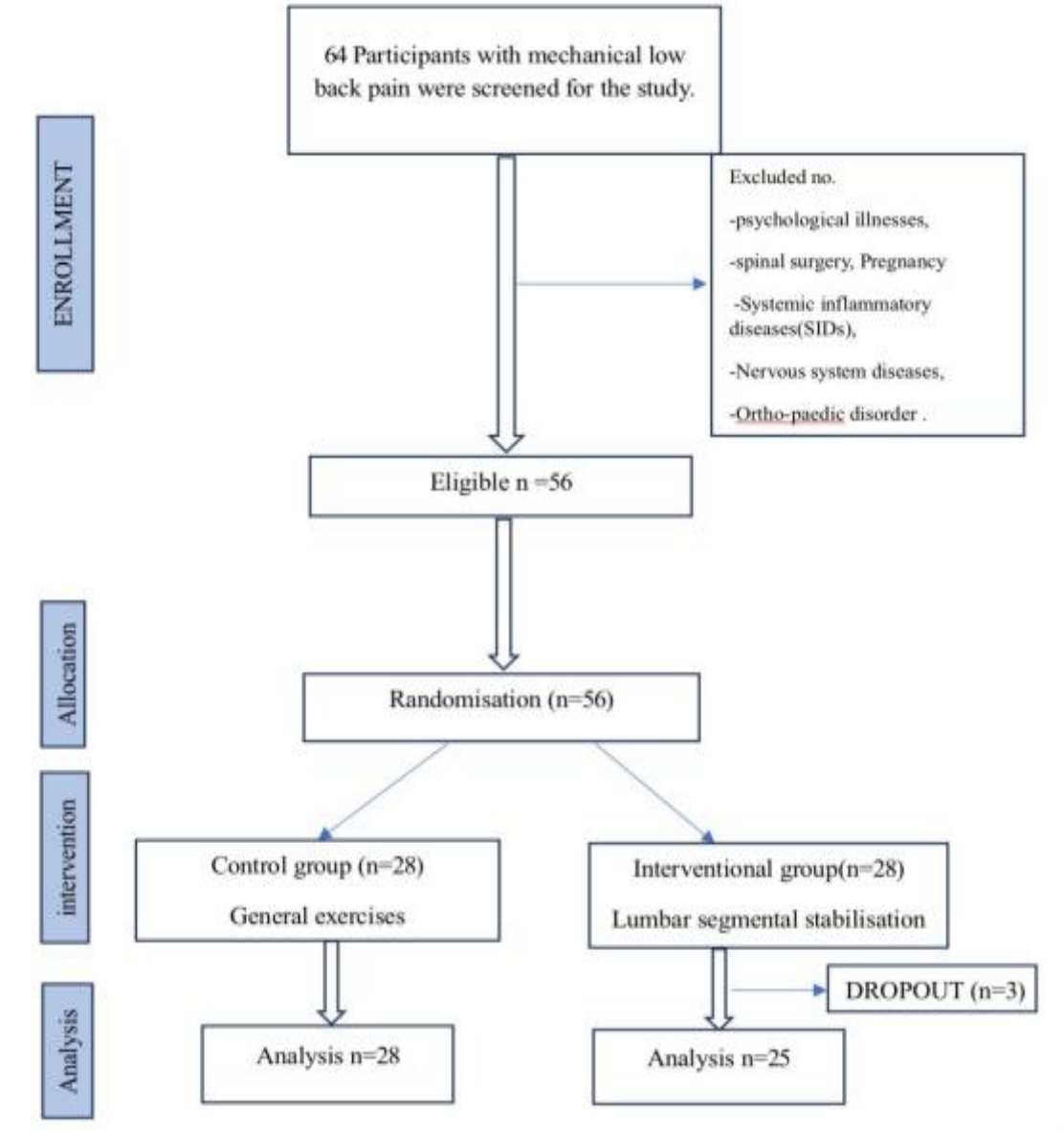
### SUBJECTS:

Total 63 participants screened. A licensed physiotherapist(investigator) had conducted the screening. 56 individuals were recruited out of the patients who satisfied the inclusion criteria. They were then randomly assigned to two groups: experimental group (lumbar segmental stabilization exercises) and control group (general exercises). There

were 28 patients in each group. During the intervention, 3 patients from the experimental group were dropped out of the study for personal reasons. A total of 25 patients (males and females) in the experimental group and 28 individuals (males and females) in the control group completed the intervention. The flowchart of the study is shown in (Figure 1).

The inclusion criteria of this study were: men and women aged 25–59 years, suffering from LBP with or without leg pain, lasting more than 3 months (Mohanty & Pattnaik, 2016).

Patients with psychological illnesses (in reliance on physician's diagnosis) (O'sullivan et al., 1997), history of spinal surgery (O'sullivan et al., 1997), history of exercise therapy for back pain in the last 3 months, pregnancy, systemic inflammatory diseases, nervous system diseases (Mohanty & Pattnaik, 2016), orthopaedic disorders of the lower extremities and the spine, professional athletes and body mass index (BMI) above 35 and below 18, were excluded from this RCT.




**(Figure 1-CONSORT)**

## PROCEDURE

**Intervention:**

The patients were visited every day for 2 weeks at the Physiotherapy OPD. The interventions were practiced under the supervision of a physiotherapist. The duration of each physiotherapy session varied depending on treatment protocol and patients' conditions. Each exercise was hold for 5–10 s and it was then repeated 10 times, once a day. Moist heat was applied for 10 mins to both the groups during intervention priorly to exercises.

Experimental Group: (Lumbar segmental stabilization exercises)

Individuals who are part of the intervention group perform lumbar segmental stabilization exercises as per the procedure proposed by Richardson and Jull (Richardson, Hodges, & Hides, 2004). Abdominal hollowing (co-activation of lumbar multifidus, transverse abdominis, diaphragm and pelvic floor muscles) was thus performed first in a static position; then, in the closed kinematic chain; and finally in the open kinematic chain exercises (Richardson et al., 2004). To guarantee that the exercises had been practiced correctly, abdominal hallowing were instructed during the first class with the help of pressure biofeedback (O'Sullivan, Twomey, & Allison, 1998; Richardson et al., 2004). Exercises are as follows:

1. Abdominal hallowing(AH) in crook lying position..
2. AH in prone position.
3. Isolate Multifidus contraction.
4. AH in sitting position.
5. AH in standing position.
6. Bridging with AH.
7. Squatting with AH.
8. Limbs movements with AH.
9. Limbs movements with AH in sitting.
10. Limbs movements with AH in standing.

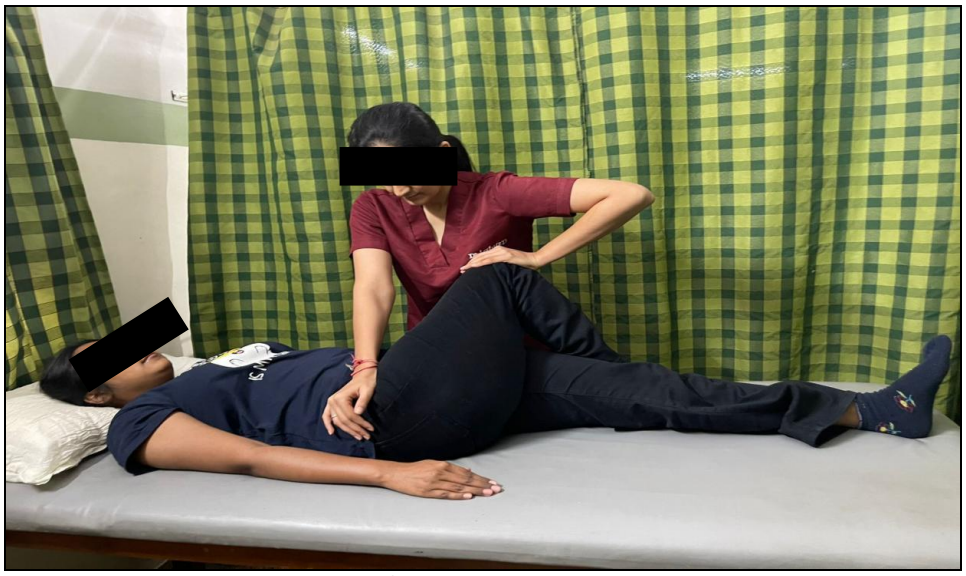
**(Figure 2: Abdominal hallowing in sitting position)**

**(Figure 3: Limbs movement with Abdominal hallowing in sitting position)**

**(Figure 4: Squatting with Abdominal hallowing)**

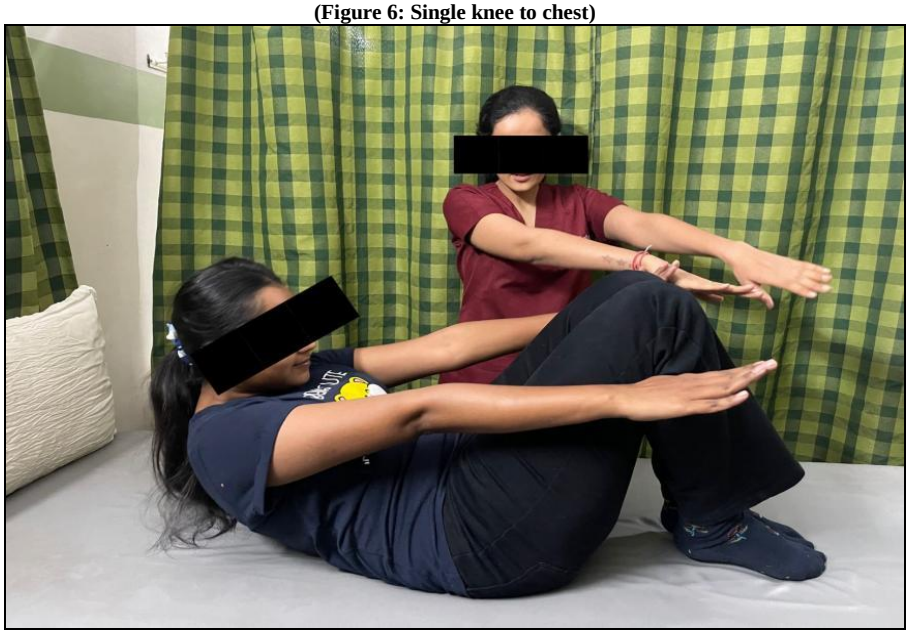
**Control Group: (General Exercises)**

General exercises included stretching, strengthening, and flexion-type exercises working with minimal stress on the lumbar spine to reduce pain and spasm (Koumantakis, Watson, & Oldham, 2005; Mohanty & Pattnaik, 2016). Exercises are divided into 3 types: stretching, strengthening and flexion based all were performed. Hip flexor stretch, piriformis stretch and hamstring stretch. Exercise includes: partial curl up, Diagonal curl up, Leg cycling, Bridging, single knee to chest, Double knee to chest and heel slide.



**(Figure 5: Piriformis stretching 30 sec hold 3 sets)**

**(Figure 6: Single knee to chest)**



**(Figure 7: Curl up)**

**(Figure 8: Double knee to chest)**

**Outcomes:**

The Oswestry Disability Index (ODI) was used to determine the degree of functional disability. Previously, the reliability and the validity of its Persian version had been reported in the study by Mousavi et al. (Mousavi, Parnianpour, Mehdian, Montazeri, & Mobini, 2006)

To measure pain intensity, the Numeric Pain Rating Scale (NPRS) was employed. This scale is being widely administered in research studies and its internal reliability of 0.91 (Price, McGrath, Rafii, & Buckingham, 1983).

Tests to measure disabling fear is the Tampa Scale of Kinesiophobia. The intraclass correlation coefficient is 0.79 and 0.86; respectively (Jafari, Ebrahimi, Salavati, Kamali, & Fata, 2010).

## STATISTICAL ANALYSIS

Statistical analysis of the study was done by using STATA 14.2 software. The data was entered into the computer using Microsoft excel sheet, tabulated and subjected to statistical analysis. Descriptive analysis was used to depict demographic characteristics of participants. Dependent 't' test was to compare the difference of pre and post intervention values of ODI, NPRS and TAMPA within conventional and experimental groups. Independent t-test was used to compare the differences between both the groups for the same outcome measures. It was decided that a probability value was statistically significant if it was less than 0.05($p<0.05$).

## RESULT

**Baseline Measures:**

Baseline characteristics were taken in the form of age and gender distribution. It is shown in Table 1 and Table 2. The frequency of Males (68%) in both groups was higher than Females (32%). And the mean age in both groups were similar.

**TABLE: 1 BASELINE CHARACTERISTICS OF PARTICIPANTS**

| | Group | Mean | Std. Deviation |
|---|---|---|---|
| AGE | Intervention | 35.82 | 6.72 |
| | Control | 35.10 | 10.28 |

**TABLE 2: DISTRIBUTION OF PATIENTS GENDER**

| Group | Male(N)(%) | Female(N)(%) | Total |
|---|---|---|---|
| Intervention | 21(75.0) | 7(25.0) | 28 |
| Control | 17(60.7) | 11(39.2) | 28 |
| Total | 38(67.86) | 18(32.14) | 56 |

**TABLE: 3 INTRA GROUP COMPARISON OF INTERVENTION GROUP (WITHIN GROUP).**

| Outcomes | | Mean | Std. Deviation | P value |
|---|---|---|---|---|
| ODI | Pre | 13.2 | 3.84 | <0.001 |
| | Post | 5 | 2.41 | |
| NPRS | Pre | 6.28 | 1.42 | <0.001 |
| | Post | 2.44 | 1.04 | |
| TAMPA | Pre | 43.28 | 4.66 | <0.001 |
| | Post | 36.72 | 6.26 | |

**TABLE 4: INTRA GROUP COMPARISON OF INTERVENTION IN CONTROL GROUP (WITHIN GROUP).**

| Outcomes | | Mean | Std. Deviation | p-value |
|---|---|---|---|---|
| ODI | Pre | 11.57 | 4.122 | <0.001 |
| | Post | 5.07 | 2.60 | |
| NPRS | Pre | 5.75 | 1.48 | <0.001 |
| | Post | 2.28 | 1.11 | |
| TAMPA | Pre | 42.03 | 4.88 | <0.001 |
| | Post | 36.07 | 7.32 | |

**Within group analysis:**

Pain intensity a was reduced in the control group and intervention group from 6.28 to 2.4 in intervention and 5.75 to 2.28 in control group, this shows that there was reduction in all the outcomes in both the groups with p value <0.005 which is statistically significant.

Disability was checked by ODI and there was reduction in both the groups from 13.2 to 5.0 in intervention and 11.57 to 5.07 in control group and statistically significant but more in interventional group than control group. Tampa scores during pre and post intervention in the interventional group and control group were statistically significant and reduced in both the groups by 43.28 to 36.72 and 42.03 to 36.07 respectively.

**TABLE 5: TO COMPARE PAIN, LEVEL OF DISABILITY AND KINESIOPHOBIA (BETWEEN GROUPS)**

| Outcomes | | Mean | Std.Deviation | p-value |
|---|---|---|---|---|
| ODI | Intervention | 8.2 | 3.30 | 0.43 |
| | Control | 7.46 | 3.46 | |
| NPRS | Intervention | 3.84 | 1.31 | 0.26 |
| | Control | 3.46 | 1.10 | |
| TAMPA | Intervention | 6.56 | 5.88 | 0.71 |
| | Control | 5.96 | 5.77 | |

**Between group analysis:**

Between-group analysis is illustrated in Table:5. The p value comparison of ODI between the group was 0.43 which is not statistically significant. The p value comparison of NPRS between the group was 0.26 which is not significant statistically and p value comparison of TAMPA between the group was 0.71 which is also not statistically significant. When lumbar segmental stabilization group compared to conventional groups in terms of pain, disability and kinesiophobia there was no statistical significance observed i.e. p >0.05, this shows that both the groups are equal.

## DISCUSSION

In our study we found the lumbar segmental stabilisation exercise and general exercise have similar effects in terms of pain with the help of NPRS, disability score with the help of Oswestry Disability Index(ODI) and kinesiophobia with the help of TAMPA scale. Here, in our study we found that more the disability participants are prone to have kinesiophobia(fear of avoidance).

Participants in interventional group were given lumbar stabilization exercises the fact

that strengthening of the lumbar multifidus (LM) and TrA muscles might reduce pain by reducing forces on the spine and increase stability by co-contraction of these muscles. Similar studies like in order to reduce compressive stresses on spinal tissues, Richardson et al. [13,15] proposed that both muscles serve as the lumbar segment's major stabilizers. Supporting that According to Snijders et al. [14], the co-contraction of the TrA and LM muscles provides the basis for the lumbo-sacral biomechanical stability, which reduces compressive overloads and reduces or eliminates pain perception.

McGill et al. and Richardson et al. [13] believed that muscle endurance is more essential than muscle power in the protection of lumbar segmental stability. Both mitochondria and the rate at which oxygen is absorbed by muscle cells decreased and resulted in reduction in activity level, hypomobility, and functional abnormalities in adults with persistent low back ache. The cross sectional area of local stabilizer muscles especially multifidus decreased, as it can be followed by muscle atrophy and a decreased amount of type I muscle fibers and oxygen. A key component in developing and maintaining the stability of the lumbar vertebral segments is muscle endurance.

Our study illustrated in table no.4 for disability evaluation with the help of ODI which was statistical significance in the Control group as well. Participants had performed stretching exercise, flexion exercises and strengthening of core muscle which is mentioned in methodology showed reduction in disability by finding that major cause of NLBP is biomechanical abnormal posture, pelvic tilting, increased lordotic curvature which lead to flexion posture or lower cross syndrome in which individuals are prone to develop restricted spine mobility, muscle weakness and muscle tightness, so focusing on strength and flexibility, protocol was design in such a manner that aims on stretches of back extensors, hip extensors and strengthen the abdominal muscles which ultimately reduce the compressive force on spine, improve muscle endurance and reduce pain and disability by improve mobility of lumbar spine.

Nava-Bringas et.al.2022[16] had carried out prospective, longitudinal and comparative study. in which 21 CLBP and degenerative spondylolisthesis over the age of 50 were included and divided into 2 groups- spine stabilization exercises and flexion exercises. The author did not find that statistical difference between the two exercise programs, all patients presented significant changes in the thickness of the multifidus muscle. So, the author concludes that there is no difference between spine stabilization exercises and flexion exercises in terms of changes in muscle thickness as measured by ultrasonography.

As mentioned in table no. 3 NPRS score for pain is reduced in interventional group post treatment which is highly statistically significant. The core of the lumbo-sacral biomechanic stability is the co-contraction of the TrA and LM muscles, which are improved by lumbar segmental stabilization exercises. These muscles function by lowering compressive overloads and minimizing or eliminating pain perception.[17]

Different models of pain propose that pain-related fear plays a pivotal role in the onset and perpetuation of chronic pain and disability. In patients with chronic MSK, greater levels of fear-avoidance attitudes were substantially correlated with higher pain intensity levels.

Other studies like Picavet et al. (2002) showed that in patients with persistent low back pain who reported weekly physical activity, the association between pain and disability was explained by greater catastrophizing scores, fear, and depression in addition to the role of catastrophizing as a mediator. According to two prospective investigations [18], early alterations in catastrophizing following an injury or after consulting a doctor for musculoskeletal

discomfort fails to indicate changes in anxiety, disability, or depression.

Similarly other studies like Zale *et al* [19] showed that 46 cross-sectional studies involving 9,579 adults, adolescents, and children with acute or chronic pain were analyzed. The development of chronicity is favored by pain-related fear, which is linked to greater disability in several acute and chronic pain syndromes. Fear avoidance was identified to predict a delayed recovery in both acute and subacute low back ache.

Kinesiophobia is known to be a barrier to rehabilitation adherence in different chronic pain conditions. As our study illustrated that as the pain severity increases it will increase fear of movement associated with severe disability given in table 3 and 4. Fear of pain is associated with disability, and this relationship is mediated by avoidance/escape behaviors as well as hypervigilance. A person's muscular system and fitness may gradually deteriorate as a result of multiple, long-term avoidance of daily activities and the development of functional disability.

In present study table no. 4 illustrate that in the control group there is kinesiophobia documented with the help of TAMPA scale in which individuals were having fear of motion at initials and after the treatment it significantly reduced due to improvement in disability severity. Supporting study by De Moraes Vieira *et al* [20] observed that a positive and significant correlation between kinesiophobia and moderate-to-severe disability, but not a significant correlation at moderate disability levels. They also stated that men showed greater fear avoidance belief scores than women, and no between-gender differences observed in context to the self-efficacy scores. According to these authors, when a person has a high level of self-efficacy, even heightened pain-related fear does not result in an increase in impairment since they believe they are capable of performing tasks. However, heightened fear most likely increases the risk of disability when self-efficacy is low (Woby et al., 2007) [21].

Whereas in our study both interventional and control group had seen equally effective in terms of kinesiophobia.it is due to variation in the duration of episodes, fluctuations of pain intensity, severity of pain and the presence of social and contextual factors may be involved in the maintenance of chronic low back ache [22].Furthermore, the biopsychosocial model suggested by the guidelines (Airaksinen et al., 2006; Bekkering et al., 2003; Dagenais et al., 2010; Dellito et al., 2012; Philadelphia Panel, 2001; van Middelkoop et al., 2011), A multidisciplinary approach should be used to treat CLBP, taking into account both biological and psychosocial aspects. The main limitation of the present study was the small sample size and no follow-up period. Inadequate proportion of the number of female participants to the males. This factor could make judgments difficult for generalizability of the results. Future studies with larger sample sizes and long-term follow-ups and should aim objective markers for assessing disability or segmental stability.

## CONCLUSION

Present study concludes that by comparing conventional exercises versus Lumbar segmental stabilisation exercises both are equally effective to reduce kinesiophobia along with pain and disability by strengthening the core muscles individually in patients with non-specific LBP. Conventional exercises can compete with segmental exercises to narrow down the pain, disability and kinesiophobia in NSLBP. If severity of disability is higher than individual is more prone to develop kinesiophobia (fear of avoidance).

The long-term exercise impact is an additional benefit of the segmental stabilization exercise. There is a notably low recurrence rate, according to earlier research. However, prior research on strengthening exercise revealed that if patients stop exercising, the benefits of the exercise tend to decrease.

## *Declaration by Authors*

**Ethical Approval:** Approved by Institutional Ethical Committee.

**Acknowledgement:** The author deeply acknowledges to K.M Patel Institute of Physiotherapy, Bhaikaka University for providing Platform for this work. Also, they really appreciated the patients participating in this study

**Source of Funding:** None

**Conflict of Interest:** The authors declare no conflict of interest.

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How to cite this article: Sanket Parekh, Daxa Mishra, Lata Purohit. Comparison of lumbar segmental stabilisation and general exercises on pain, functional disability and kinesiophobia in patients with low back pain: a randomised control trial. *Int J Health Sci Res.* 2024; 14(4):23-34. DOI: *10.52403/ijhsr.20240405*

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