International Journal of Physical Education, Sports and Health 2023; 10(3): 333-341

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (RJIF): 5.38
IJPESH 2023; 10(3): 333-341

www.kheljournal.com
Received: 25-02-2023
Accepted: 31-03-2023

Dr. Shruti Sandeep Bhambore
MPT, PES Modern College of Physiotherpy, Pune, Maharashtra, India

Dr. Sucheta Golhar
Principal of PES Modern College of Physiotherpy, Pune, Maharashtra, India

Corresponding Author:
Dr. Shruti Sandeep Bhambore
MPT, PES Modern College of Physiotherpy, Pune, Maharashtra, India

Effectiveness of core muscle stabilisation exercises vs core muscle stabilisation exercises along with stretching of back extensor on pain and lumbar spine range of motion in bharatanatyam dancers with mechanical low back pain: Comparative study

Dr. Shruti Sandeep Bhambore and Dr. Sucheta Golhar

Abstract
Background: Dance involves body, emotion and mind: it is both a physical activity and a means of expression and communication. Bharatanatyam is distinguished by its grace and style, it includes traditional poses, rhythmic foot stamping, jumps, pirouettes, and positions where the knees are in contact with the floor. The most common site of pain in both genders across different dance forms and levels of training was the back (42.5%), followed by the knee (28.3%) and ankle (18.63%). The basic posture of Bharatanatyam is called 'Araimandi' which involves the dancer to assume a position of half-squat with hips externally rotated and knees flexed. It has been concluded in a previous study that the lumbar lordosis angle and the pelvic inclination angle in bharatnatyam dancers is more than the non-dancers. The theoretical findings show that deviations in the lumbar lordosis are contributing factor to low back pain. Back pain in bharatnatyam dancers has been associated with the increased lumbar lordosis and anterior tilting of pelvis. The resulting hyperlordosis elongates the abdominal muscles, making them prone to weakness, whereas the erector spinae and hip flexor muscles remain shortened. The aim of this study was to compare effect of core muscle stabilisation exercises vs core muscle stabilisation exercises along with stretching of back extensor on pain and lumbar spine range of motion in bharatanatyam dancers with mechanical low back pain within 6 weeks.
Subjects: This study included 64 bharatnatyam dancers with mechanical low back pain selected using inclusion and exclusion criteria.
Methods: The written consent of all the participants and Ethical clearance from the institutional committee was taken. Sampling of population was done by Simple Random Sampling. Subjects in group A (N = 32) received core muscle stabilisation exercises and subjects in group B (N = 32) received Core muscle stabilisation exercises along with stretching of back extensor exercises for duration of 6weeks for 4times per week. Pre and Post assessment was done by using NPRS for pain, Modified Modified Schober's test for lumbar spine range of motion. Further data was analysed by using the appropriate statistical analysis and a result was obtained.
Results: After 6 weeks of core muscle stabilisation exercises and core muscle stabilisation along with stretching of back extensor exercises, post values of Pain, lumbar spine range of motion showed extremely significant improvement with p-value of 0.0001.
Conclusion: The current study proves that there was significant improvement in pain and lumbar range of motion in core muscle stabilisation and core muscle stabilisation along with back extensor muscle stretching groups respectively. However core muscle stabilisation alonhg with back extensor stretching showed superior significance.

Keywords: Bharatnatyam dancers, Mechanical low back pain, Core muscle stabilisation, Back extensor stretching, Numerating pain rating scale, Modified-Modified schober's test

Introduction
Dance involves body, emotion and mind: it is both a physical activity and a means of expression and communication. Dance is a conscious effort to create visual designs in space by continuously moving the body through a series of poses and pattern training. The movements must be in symmetric and should follow a particular rhythm [2]. Indian traditional dance encompasses various indigenous dance styles across India that originate from temple dancing.

They are categorized into seven major kinds, namely Bharatnatyam, Kathak, Manipuri, Kathakali, Odissi, Kuchupudi, and Mohiniattam. All Indian classical dances are rooted in Natyashastras (Indian treatise on performing arts) in varying proportions, therefore, share common features such as mudras (gestures made with hands or fingers), body positions, and inclusion of dramatic or expressive acting, or abhinaya. Bharatanatyam is one of the most sublime and ancient of Indian classical dances; it originated in Tanjore, a town of Tamil Nadu in Southern India. This dance form lays its foundation on the aesthetic beauty of angles and lines formed by various positions of different body parts. Bharatanatyam is distinguished by its grace and style, it includes traditional poses, rhythmic foot stamping, jumps, pirouettes, and positions where the knees are in contact with the floor [1]. The basic posture of Bharatanatyam is called 'Araimandi' which involves the dancer to assume a position of half-squat with hips externally rotated and knees flexed. This helps lower the body and Bharatanatyam makes use of this principle to provide the dancer with increased stability [12].

In a previous study, it was found that during repeated 'Araimandi' and 'Muzhumandi' positions in Bharatanatyam, there is shortening of iliacus and psoas major muscles resulting in anterior pelvic tilt and imbalances in trunk flexors and extensors which places more stress on the back resulting in increasing lordotic curve in later stages. In case of faulty postures during practice for prolong period can result in permanent structural change [5]. Their training requires more strength, flexibility, stamina, grace, passion and emotion. When there is lack of flexibility, which is an essential component of normal biomechanical functioning, it can cause early muscle fatigue or altered biomechanics of movement. Lack of stretches and muscle tightness may lead to overuse injury or even produce early wear and tear changes in the weight bearing joints [12]. The most common site of pain in both genders across different dance forms and levels of training was the back (42.5%), followed by the knee (28.3%) and ankle (18.63%) [1].

The conditions apart from low back pain in bharatnatyam dancers studies found change in foot posture, decreased flexibility, decreased strength, hypermobility of knee joint, loss of proprioception in ankle joint, decreased sway velocity in unilateral stance (decreased balance), etc.

Low back pain (LBP) is a major health problem affecting the adult population. Postural changes are one of the risk factors. Abnormal posture makes a strain on ligaments and muscles that indirectly affects the curvature of the lumbar spine. It is known that several complex factors affect the lumbar curve, which has a role in balancing compressive forces. Various studies have examined the relationship between changes in the angle of the lumbar spine and back pain [13]. Other investigators have also shown decreased flexibility and back muscle tightness in patients with LBP.[14]Back pain is a symptom associated with many medical conditions, both mechanical and non-mechanical. Mechanical low back pain (previously called non-specific low back pain) may be defined as pain without any identifiable cause and of less than 12 weeks duration with no positive clinical findings. MLBP manifests as pain, muscle tension, or stiffness that is localized below the costal margin and above the inferior gluteal folds and is not attributed to a specific pathology with or without leg pain involvement. Common causes of mechanical back pain include strain on muscles of the vertebral column and abnormal stress. It can be caused by Lifting heavy objects, levered postures (bending forward), Static loading of the spine (prolonged sitting or standing) discogenic pain, and myofascial pain [16-18].

A study was conducted by Shraddha Pawar, *et al*. On lumbar lordosis and pelvic inclination angle in bharatnatyam dancers. 80 subjects were assessed for lumbar lordosis and pelvic inclination angle. The study concluded that the lumbar lordosis angle and the pelvic inclination angle in bharatnatyam dancers is more than the non-dancers. They also proved that there is linear correlation between the two measurements which explains the pelvic posture and the lumbar spine posture in bharatanatyam dancers. The theoretical findings that deviations in the lumbar lordosis are contributing factor to low back pain Back pain in bharatnatyam dancers has been associated with the increased lumbar lordosis and anterior tilting of pelvis. Hyperlordosis often results from an attempt to increase turnout at the hip by putting the hip joint in a position where the capsular ligaments are loosened (hip flexion, or anterior pelvic tilt), which allows the femur to rotate more in the hip socket [1]. The resulting hyperlordosis elongates the abdominal muscles, making them prone to weakness, whereas the erector spinae and hip flexor muscles remain shortened [1]. Such an imbalance in the lumbopelvic segment caused by forced turnout at the hip is likely to reinforce an exaggerated lumbar lordosis during relaxed standing [1]. Additionally, lordotic posture places more weight on the facets, which are not predominantly weight bearing joints but are sites of nociceptive tissue [1]. Excessive narrowing of the intervertebral foramen caused by approximation of the pedicles as a result of hyperlordosis compresses nerve roots and their dural sheaths, contributing to back pain [1]. Thus clinically it is of grave importance that pelvic postures and lumbar spine postures should be assessed in Bharatanatyam dancers to acknowledge their problems and correct their abnormal postures and the imbalance in the trunk flexor and extensor equilibrium [19]. The lumbar lordosis angle and the pelvic inclination angle in bharatanatyam dancers is more than the non-dancers. We also proved that there is linear correlation between the two measurements which explains the pelvic posture and the lumbar spine posture in bharatanatyam dancers [3, 19].

Core stability

Term has referred to the active component to the stabilizing system including deep/local muscles that provide segmental stability (eg transversus abdominis, lumbar multifidus) and/or the superficial/global muscles (eg rectus abdominis, erector spinae) that enable trunk movement/torque generation and also assist in stability in more physically demanding tasks [20]. The core can be described as a muscular box with the abdominals in the front, paraspinals and gluteals in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom. Within this box are 29 pairs of muscles that help to stabilize the spine, pelvis, and kinetic chain during functional movements.[11]Without these muscles, the spine would become mechanically unstable with compressive forces as little as 90 N, a load much less than the weight of the upper body (2). When the system works as it should, the result is proper force distribution and maximum force generation with minimal compressive, translational, or shearing forces at the joints of the kinetic chain. The core is particularly important in sports because it provides ''proximal stability for distal mobility'' [11].

Guidelines for stabilisation exercises and progression:

1. Begin training with awareness of safe spinal motions and

the neutral spine position or bias.
2. Have patient learn to activate the deep stabilizing musculature while in the neutral position.
3. Add extremity motions to load the superficial global musculature while maintaining a stable neutral spine position (dynamic stabilization).
4. Increase repetitions to improve holding capacity (endurance) in the stabilizing musculature; increase load (change lever arm or add resistance) to improve strength while maintaining a stable neutral spine position.
5. Use alternating isometric contractions and rhythmic stabilization techniques to enhance stabilization and balance with fluctuating loads.
6. Progress to movement from one position to ano ther in conjunction with extremity motions while maintaining a stable neutral spine (transitional stabilization).
7. Use unstable surfaces to improve the stabilizing response and improve balance [32].

In recent years, there has been focus on motor control exercises (MCEs) that aim to retrain or re-establish the optimal control of deep spinal muscles and maintaining the same during physical and functional tasks [5]. This exercise program was designed to improve the specific function of lumbopelvic muscles and to achieve control of posture and movement [5]. There is a sufficient evidence to suggest that motor control exercise (MCE) therapy targeting the transverse abdominis (TrA) and lumbar multifidus (LM) appears effective in enhancing segmental stability, reducing low back pain, enhancing functional ability and reducing recurrence rate of low back pain [5].

Stretching is a general term used to describe any therapeutic maneuver designed to increase the extensibility of soft tissues, thereby improving flexibility and ROM by elongating (lengthening) structures that have adaptively shortened and have become hypomobile over time [7]. Just as strength and endurance exercises are essential interventions to improve impaired muscle performance or reduce the risk of injury, stretching interventions become an integral component of an individualized rehabilitation program when restricted mobility adversely affects function and increases the risk of injury [24, 32]. Stretching exercises also are considered an important element of fitness and sport-specific conditioning programs designed to promote wellness and reduce the risk of injury or re-injury [24, 32].

Heat therapy is used for the treatment of many conditions. The application of heat to the superficial muscle reduces muscle tension and stiffness. It flushes toxins and other injury in the system by reducing inflammation and increasing blood flow. Significant therapeutic benefits in patients with acute non-specific LBP is seen, as indicated by increased pain relief and trunk flexibility, and it provided decreased muscle stiffness and disability [30].

1. The aim of this study was to compare effect of core muscle stabilisation exercises vs core muscle stabilisation exercises along with stretching of back extensor on pain and lumbar spine range of motion in bharatanatyam dancers with mechanical low back pain within 6 weeks

Materials and Methodology

Study design

Comparative study

Sampling method

Simple Random sampling

Study setting

Dance institutes and studios in and around the city.

Study population

Bharatanatyam dancer with mechanical low back pain

Duration of intervention: 6 weeks
Duration of study: 1 year
Sample size: 64

Eligibility criteria

Inclusion criteria

- Willing to participate.
- Age between 18 to 30 years.
- Female Bharatanatyam dancers (maximum 5hrs or more every week)
- Dancers diagnosed with mechanical low back pain.
- NPRS rating upto 5
- MMT score more than or equal 3

Exclusion criteria

- Dancers with history of spine surgery in past
- History of recent trauma, pathological conditions of spine i.e. fracture, cancer and inflammatory disease, degenerative changes of spine, congenital abnormalities of spine, nerve root compression
- Any neurological and cardiac condition contraindicating the exercise protocol.
- Pregnant women

Withdrawal criteria

- Patients not willing to disclose data after intervention score are obtained.
- Patients who do not maintain a follow-up of exercises for more than a week
- Patients refusing to comply with instructions during examination and study protocol.

Materials used

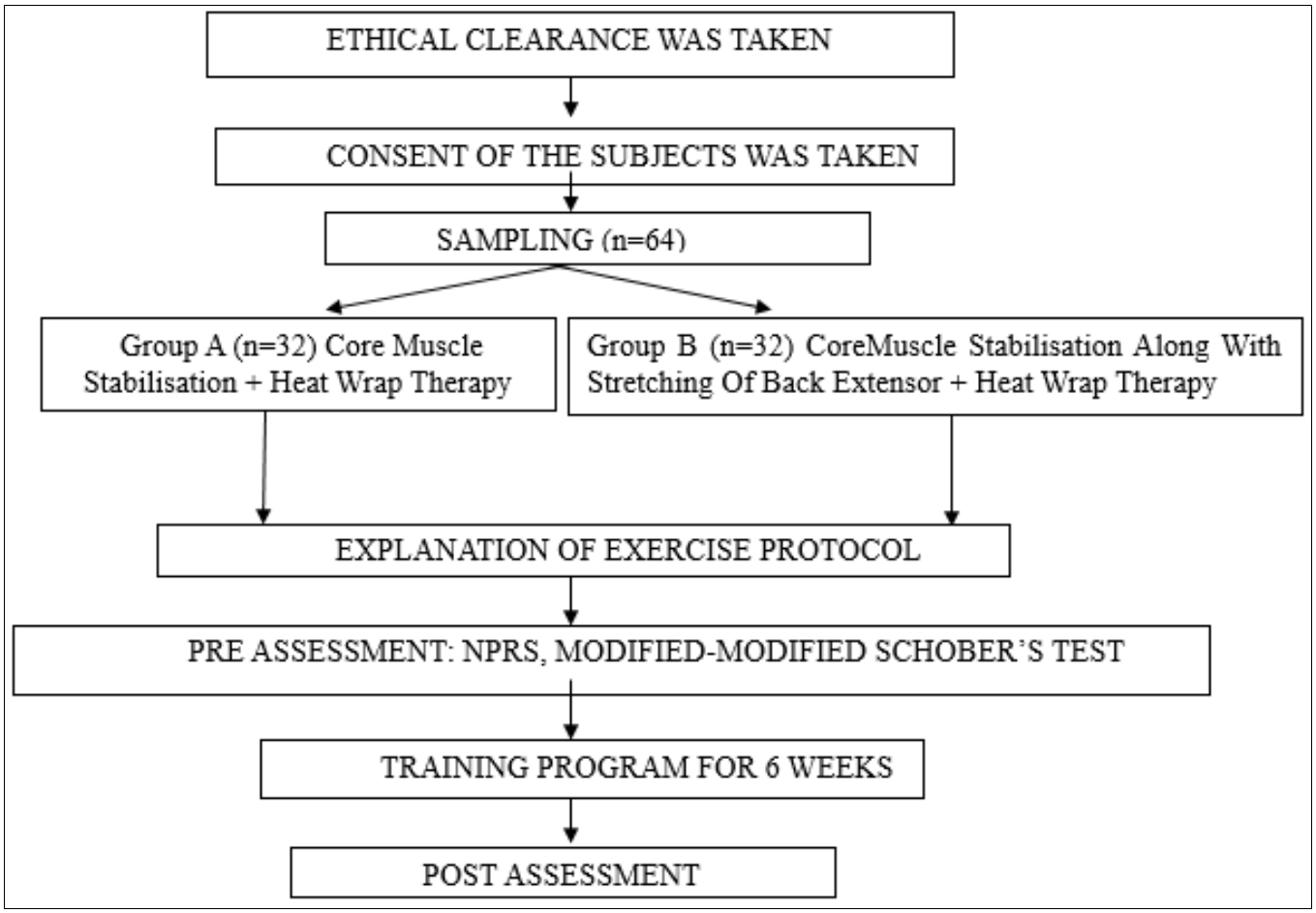
- Pen and Paper
- Numerical pain rating scale assessment scale.
- Measuring tape
- Consent letter
- Data Collection Sheets.

Outcome measures

- **Pain:** Numerical Pain Rating Scale
- **Lumbar range of motion:** Modified-Modified Schober's test

Procedure

The flowchart below is the diagrammatic representation of the methodology followed



Core muscle stabilisation exercises	
First 2 weeks: (basic lumbar stabilization; emphasis on abdominalis)	**Prone lying**
1. Draw in and hold for 10 seconds.	1. Extend one LE
2. Opoosite LE on mat, bent leg fall out	2. Extend both LE
3. Opposite LE on table	3. Lift head, arms and lower extremity
4. Hold opposite LE @ 90 degrees of hip flexion with UE	Progression
5. Hold opposite LE @ 90 degrees of hip flexion (no UE assistance)	Alternating LE with the modified bicycle
6. Bilateral LE movement	5. Reciprocal and alternating patterns using the UE and LE simultaneously
Third and fourth weeks (basic lumbar stabilization; emphasis on trunk muscles)	**Crunches**
1. Flexes one UE	1. Crunch with both the hands forward:
2. Extends one lower extremity along the exercise mat	2. Crunch with crossed hands:
3. Extends one lower extremity and lifts 6-8 inches off the mat.	3. Crunch with hands behind:
4. Flex one UE and extend contralateral LE.	**Planks**
	1. Normal plank
	2. Side plank:

Back extensor stretching exercises
1. Quadratus Lumborum Stretch
2. Lions Stretch
3. Erector Spinae Stretch

Core Muscle Stabilisation	Back Extensor Stretching
Frequency: 4 Days/Week	**Frequency:** 4 Days/Week
Duration: 45 Min/Day	**Hold Time:** 10-20 sec
Repetitions: 10 Reps	**Set:** 2
Sets: 3	**Repetitions:** 3
Rest interval: 2 Min	**Duration:**15 Min
	Rest interval: 30 Sec

Data analysis and interpretation

- The data was entered using Excel sheet and was analysed using SPSS.
- The data on categorical variables is shown as n (% of individuals) and continuous variables are presented as Mean and Standard Deviation (SD) across two study groups.
- Demographic data of age distribution according to group is given.
- The data was analysed using parametric tests.

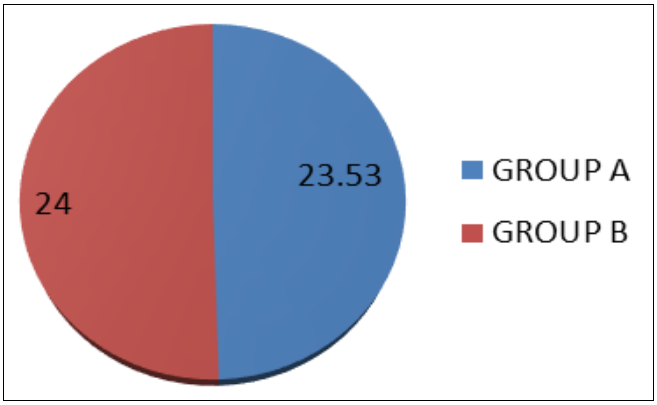
Following statistical test of significance were used:

a) Paired t test was used within groups to find out if there was any difference between pre and post values of Group A and Group B
b) Unpaired t test was used between group to find out if there were any difference in post values of group A and B
c) P value less than 0.05 was considered statistically significant.

Results and Tables

Table 1: Age distribution of the sample

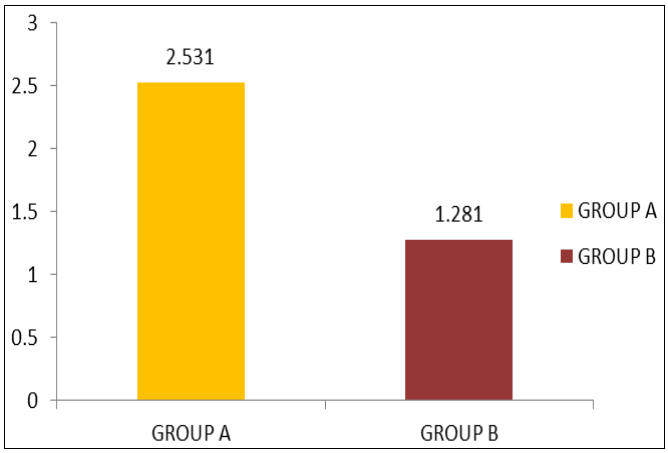
Age	Group A	Group B
N (Sample)	32	32
Mean Age	23.53	24
Stdv	3.16	3.01



Graph 1: Mean age distribution

Table 2: NPRS between group: Unpaired test

Group	Mean	STDV	P Value	T Value
A (Post)	2.51	0.949	P Value is	T = 6.350 with 62
B (Post)	1.28	0.581	< 0.0001	degrees of freedom



Graph 2: Between Group A and Group B

Graphical interpretation

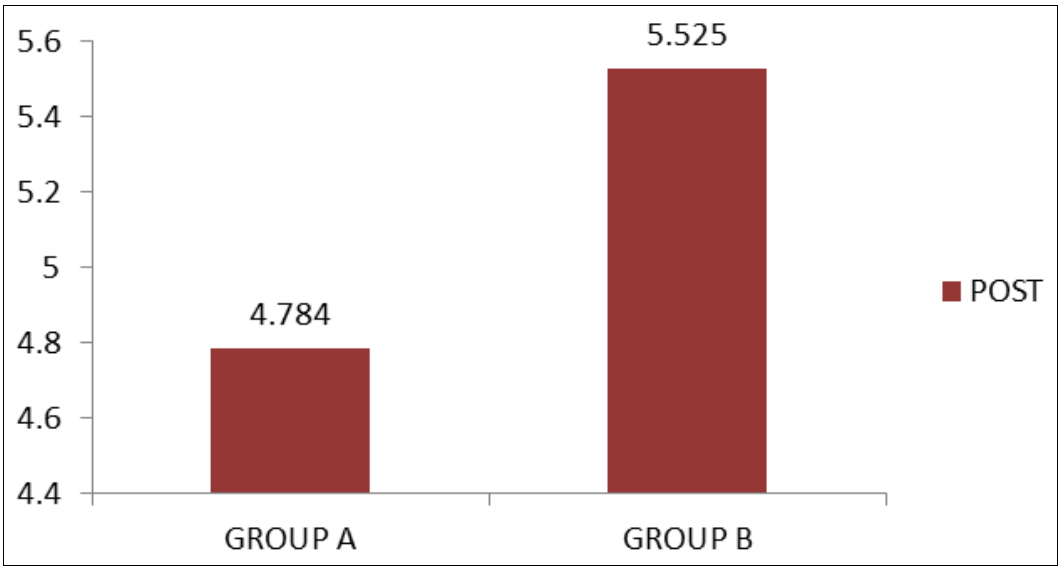
This graph shows comparison of changes in post values in NPRS of group A and group B. Y axis shows difference in Pain by NPRS and X-axis shows post values.

Graphical result

The result obtained for Unpaired t test for NPRS suggests considered extremely significant improvement in 'p' value obtained (p<0.0001) for both groups statistically. But group B (mean 1.28) suggests more significance and decrease in pain more than Group A (mean 2.531).

Table 3: MMST Flexon between group: Unpaired test

Group	Mean	St dv	P Value	T Value
Post (A)	4.784	0.304	< 0.0001	T = 9.120 with 62 degrees of freedom.
Post (B)	5.525	0.343		



Graph 3: Between group A and B flexion

Graphical interpretation

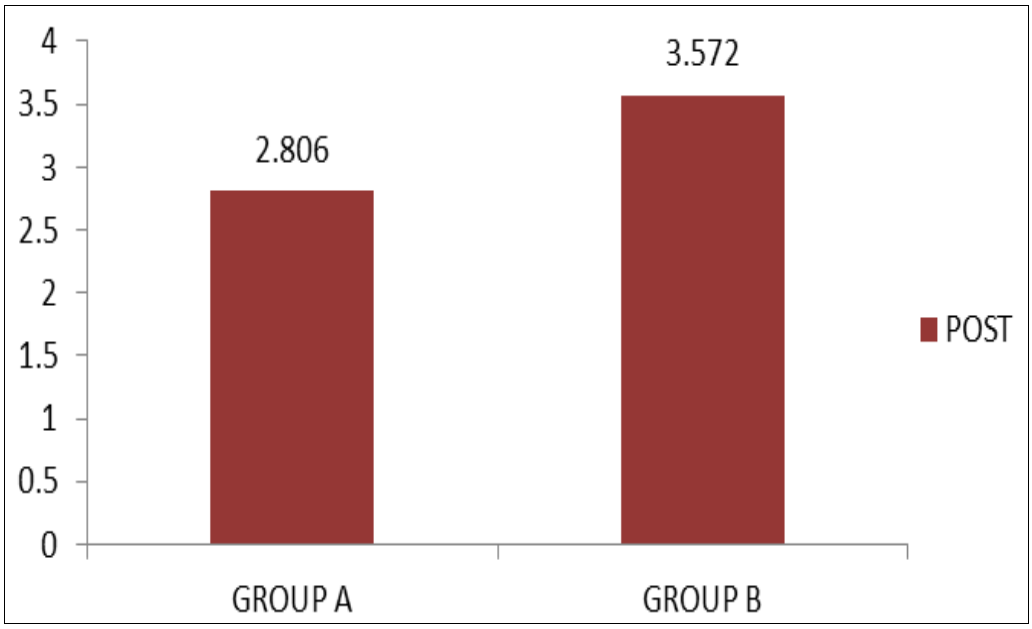
This graph shows changes in MMST post values of group A and group B. Y axis shows difference in Flexion range of motion by MMST and X-axis shows post values.

Graphical result

The result obtained for Unpaired t test for MMST suggests considered extremely significant improvement in 'p' value obtained (p<0.0001) for both groups statistically. But mean difference of group B (5.25) suggests more significant and increase in flexion range of motion more than group A (4.78).

Table 4: MMST Extension between groups unpaired T test

Group	Mean	St dv	P Value	T Value
Post (A)	2.084	0.209	<	T = 9.099 with 62 degrees
Post (B)	3.572	0.374	0.0001	of freedom.



Group 4: Within group comparion MMST extension

Graphical interpretation

This graph shows changes in MMST extension post values of group A and group B. Y axis shows difference in Extension range of motion by MMST and X-axis shows post values.

Graphical result

The result obtained for Unpaired t test for MMST suggests considered extremely significant improvement in 'p' value obtained (p<0.0001) for both groups statistically. But mean difference of group B (3.572) is more significant and increase in extension range of motion more than Group A (2.806).

Discussion

The aim of this study was to compare effect of core muscle stabilisation exercises vs core muscle stabilisation exercises along with stretching of back extensor on pain and lumbar spine range of motion in bharatanatyam dancers with mechanical low back pain after 6weeks. Study was conducted on total (n=64) bharatnatyam dancers having mechanical low back pain. Study included individuals aged between 18-30 years. Pain was assessed on numerating pain rating scale (NPRS) and lumbar range of motion was assessed using modified-modified schooner's test (MMST). All the participants in the study were assessed for core strength rating 3 or more for MMT and pain rating 5 or less. The intervention was given for 6weeks. Participants were divided into two groups: Group A received core muscle stabilisation exercises for 4days per 6weeks while Group B received core muscle stabilisation exercises along with stretching of back extensor muscles.

The result of the current study showed that, Pain was statistically significant (p<0.0001) in both Group A and Group B post 6 weeks by NPRS. But when compared with their mean difference, Group B (2.81) is more significant than Group A (1.191) in reducing mechanical low back pain in bharatnatyam dancers. The result shows, statistically significant (p<0.0001) in MMST Flexion between both Group A and Group B post 6 weeks. But when compared with their mean difference, Group B (5.525) is more significant than Group A (4.784) in increased flexion range of motion. Also, result shows, statistically significant (p<0.0001) in MMST Extension between both Group A and Group B post 6 weeks. But when compared with their mean difference, Group B (3.572) is more significant than Group A (2.084) in increased extension range of motion.

Core Muscle Stabilisation (Group A)

As evident from table 3, 5, 7 there is significant difference in pain and lumbar range of, motion post 6-week intervention of core muscle stabilisation exercises given to individuals with mechanical low back pain.

The findings of this study are in accordance with findings of Pavana, Amrutha SV who conducted a study on Effectiveness of Lumbar Motor Control Exercises in Improving Lumbar Stability among Bharatanatyam Dancers and concluded that there is a positive effect on improving the activity of core muscles (p<0.001) and there is significant improvement in functional activities and reduction of pain (p<0.001) among the Bharatanatyam dancers. Thus, the study concludes that there is a significant effect of Lumbar motor control exercises in improving lumbar instability among Bharatanatyam dancers. In present study similar effects of core muscle stabilisation exercises was seen for pain. Typically, during the performance of a specific stabilization exercise, patients learn how to recruit the deep muscles of the spine and gradually reduce undesirable excessive activity of other muscles.[36] Another benefit of the core exercise program is the restoration of coordination and control of the trunk muscles to improve control of the lumbar spine and pelvis.[36] According to the biomechanical model theory, weakened muscles cause mechanical irritation in the lumbar spine, thereby causing pain by stimulating pain-sensitive structures, It is assumed that the CORE exercise program can restore the function of weakened muscles in CLBP patients and augment the ability to support and control the spine and pelvis, thereby alleviating mechanical irritation and pain, ultimately reducing spasm in the low back region [36].

Another study done by Arsalan Ghorbanpour *et al*. (2018) [46] on effects of McGill stabilization exercises and conventional physiotherapy on pain, functional disability and active back range of motion in patients with chronic non-specific low back pain. The study concluded that McGill stabilization exercises and conventional physiotherapy provide approximately similar improvement in pain, functional disability, and active back range of motion in patients with CNSLBP. However, it appears that McGill stabilization

exercises provide an additional benefit to patients with CNSLBP, especially in pain and functional disability improvement.

Similarly, Javadian Y *et al*. conducted a study on influence of core stability exercise on lumbar vertebral instability in patients presented with chronic low back pain: A randomized clinical trial. In concluded, the results of the study indicate that in patients with NSCLBP, the application of core stability exercises combined with general exercises is more effective than general exercises-alone in improving lumbar segmental instability.

Core stability involves the lumbo–pelvic–hip complex and is defined as the capacity to maintain equilibrium of the vertebral column within its physiologic limits by reducing displacement from perturbations and maintaining structural integrity. For example, Hodges and Richardson20 examined the sequence of muscle activation during whole-body movements and found that some of the core stabilizers (ie, transverses abdominals, multifidus, rectus abdominals, and oblique abdominals) were consistently activated before any limb movements. These findings support the theory that movement control and stability are developed in a core-to-extremity (proximal–distal) and a cephalocaudal progression (head-to-toe). Core stability exercises are implemented according to the theoretical framework that dysfunction in core musculature is related to (musculoskeletal) injury; therefore, exercises that restore and enhance core stability are related to injury prevention and rehabilitation. (The Effect of Core Stability Training on Functional Movement Patterns in College Athletes)

Core muscle stabilisation along with Back muscle stretching

As evident from table 3, 5, 7 there is significant difference in pain and lumbar range of motion post 6-week intervention of core muscle stabilisation exercises along with stretching of back muscles given to individuals with mechanical low back pain.

The findings of this study are in accordance with findings of Akhlaq Ahmed *et al*. who conducted a study on effectiveness of Core Muscle Stabilization Exercises with and without Lumbar Stretching in Non-Specific Low Back Pain. The study concluded that the core muscle stabilization with lumbar stretching were more effective than core muscle stabilization exercises alone for the management of non-specific low back pain. In current study we have found same superior effects in the group B where core muscle stabilisation with back muscle stretching was given. The reason for improvement in lumbar flexibility could be due to the exercises that were included in this study. The stretching exercises reduced spinal viscosity (internal resistance and friction) and floss the nerve roots at the outlet of each lumbar level, and other flexibility exercises were lion's stretch, quadratus lomborum stretch, all these exercises created a stretch in the lumbar muscles, which could be a reason for improving the flexibility [34]. Connective tissue deformation (stretch) occurs to different degrees at different intensities of force. It requires breaking of collagen bonds and realignment of the fibres for there to be permanent elongation or increased flexibility [34].

Similarly, T. Kumar *et al*. conducted a study on "Efficacy of core muscle strengthening exercise in chronic low back pain patients" This study concludes that core muscle strengthening exercise along with lumbar flexibility and gluteus Maximus strengthening is an effective rehabilitation technique for all chronic low back pain patients irrespective of duration (less than one year and more than one year) of their pain.

Heat therapy for both the groups

Thermotherapy consists of application of heat for the purpose of changing the cutaneous, intra-articular and core temperature of soft tissue with the intention of improving the symptoms of certain conditions [27, 30].

Physiological effects of heat therapy are: increases the temperature of the skin/soft tissue, the blood flow increases by vasodilatation, the metabolic rate and the tissue extensibility will also increase, heat increases oxygen uptake and accelerates tissue healing, it also increases the activity of destructive enzymes, such as collagenase, and increases the catabolic rate.

In our study the reason for decrease in pain and flexibility in bharatnatyam dancers could be the prior heat therapy treatment given to both the groups. The therapeutic effects of topical heat treatment are mediated via neurologic, vascular, and biopsychosocial mechanisms. Topical heat increases small non-myelinated C-fiber activity that inhibits nociceptive signals in the spinal cord and increases proprioception. Heat therapy may also stimulate various regions of the brain, supporting psychosomatic effects. The benefit of the heat wrap is thus indirectly mediated in the brain via skin warming, combined with the physical support of body regions affected with pain. Additionally, the psychologic effects of comfort and relaxation have been associated with topical heat therapy, mitigating central integration and coherence of the pain experience. Relaxation of the muscles cause lengthening of the muscles thereby increasing the flexibility.

The findings of our study are in correlation with Scott F. Nadler *et al*. who conducted a study on "Continuous Low-Level Heat wrap Therapy for Treating Acute Nonspecific Low Back Pain" concluded significant therapeutic benefits in patients with acute non-specific LBP, as indicated by increased pain relief and trunk flexibility, and it provided decreased muscle stiffness and disability.

Core muscle stabilisation v/s core muscle stabilisation along with back muscle stretching (Between Groups)

There is statistically significant difference within the group, however from the statistics we can infer that core muscle stabilisation exercises along with back extensor muscle stretching is better than core muscle stabilisation exercises in individuals with mechanical low back pain. (Table no. 4, 6, 8)

The probable cause of this could be the increased strength associated with biofeedback a result of both motor unit firing rate and recruitment patterns. Thus after intervention the recruitment order of muscles were corrected and the compressive load from spine decreased, consequently producing stabilization of spine which might be the reason for reduced pain and symptoms. Stretching exercises were used to eliminate impaired flexibility and restore normal trunk range of motion.

In conclusion, the current study proves that there was significant improvement in pain and lumbar range of motion in core muscle stabilisation and core muscle stabilisation along with back extensor muscle stretching groups respectively. However core muscle stabilisation along with back extensor stretching showed superior significance.

Conclusion

The present study concluded that

1. Core muscle stabilisation exercise can be used to improve

pain and lumbar range of motion in bharatnatyam dancers with mechanical low back pain.
2. Core muscle stabilisation exercise along with back muscle stretching can be used to improve pain and lumbar range of motion in bharatnatyam dancers with mechanical low back pain.
3. However, Core muscle stabilisation exercise along with back muscle stretching is better as compared to Core muscle stabilisation exercise in bharatnatyam dancers with mechanical low back pain.

Clinical implication

- The results of this study can be used to make a good treatment program for bharatnatyam dancers with mechanical low back pain
- Core muscle stabilisation exercise along with back muscle stretching can be incorporated as an intervention plan for all bharatnatyam dancers with MLBP so it will help in enhancing the flexibility and strength resulting in better biomechanics.

Limitation

Limitations of the present study were

a) Core strength was not measured post session.
b) Follow up effect of the intervention was not assessed.

Future scope

- This study can be replicated on large population.
- This study can be done on different population
- This study can be performed on patients with moderate to severe symptoms.

References

1. Shruti Prabhakaran Nair, Shruti Kotian *et al*. Survey of Musculoskeletal Disorders among Indian Dancers in Mumbai and Mangalore, Journal of Dance Medicine & Science. 2018;22:2-7.
2. Anbarasi V, David V Rajan, Adalarasu K. Analysis of Lower Extremity Muscle Flexibility among Indian Classical Bharathnatyam Dancers. International Journal of Medical, Health, Biomedical, Bioengineering and Pharmaceutical Engineering. 2012;6:6.
3. ShradhaPawar and Unnati Pandit study of lumbar lordosis and pelvic position in bharatanatyam dancers. Indian J Sci. Res. 2015;6(2):125-130.
4. Sohana Khandekar, Shrikant Mhase. To study the effect of Pilates exercises on low back pain in female Bharatnatyam dancers undergoing training, International Journal of Applied Research. 2018;4(4):389-393.
5. Pavana AS. Effectiveness of Lumbar Motor Control Exercises in Improving Lumbar Stability among Bharatanatyam Dancers. Editorial Advisory Board. 2021 Jul;15(3):160.
6. Rafiq Ahmed, Syed Shakil-ur-Rehman, *et al*., Comparison between specific lumber mobilization and core-stability exercises with core-stability exercises alone in mechanical low back pain Pak J Med Sci. 2014;30:1.
7. Hamidie Ronald Daniel Ray, *et al*. The Effect of Static and dynamic stretching techniques to increase spine range of movement (Rom) on low back pain (LBP) Patients. Journal of Engineering Science and Technology. 2017, 10.
8. Jason Brumitt. Core Stabilization Exercise Prescription, Part I: Current Concepts in Assessment and Intervention. Sports Physical Therapy. 2013;5:6.
9. Wen-Dien Chang. Core strength training for patients with chronic low back pain J Phys. Ther. Sci. 2015;27:3.
10. Venu Akuthota. Core Stability Exercise Principles' Curr. Sports Med. Rep. 2008;7(1):39Y44.
11. Komal Malik, *et al*. Normative Values of Modified - Modified Schober Test in Measuring Lumbar Flexion and Extension: A Cross- Sectional Study. International Journal of Health Sciences and Research. 2016 July 6, 7.
12. Andhare N, Yeole U, Tannu MM. Effect of Intrinsic Muscle Training on Balance in Bharatanatyam Dancers: Randomized Control Trial.
13. Deniz Evcik Æ Aylin Yucel. Lumbar lordosis in acute and chronic low back pain patients" Rheumatol Int. 2003;23:163-165.
14. Nourbakhsh MR, Arab AM. Relationship between mechanical factors and incidence of low back pain. Journal of Orthopaedic & Sports Physical Therapy. 2002 Sep;32(9):447-60.
15. Chidozie Emmanuel Mbada, *et al*. Rehabilitation of Back Extensor Muscles' Inhibition in Patients with Long-Term Mechanical Low-Back Pain" ISRN Rehabilitation. 2013.
16. James J Chien, *et al*. What is mechanical back pain and how best to treat It? Current Pain and Headache Reports. 2008;12:406-411.
17. Will JS, Bury DC, Miller JA. Mechanical low back pain. American family physician. 2018 Oct 1;98(7):421-8.
18. Chien JJ, Bajwa ZH. What is mechanical back pain and how best to treat it? Current pain and headache reports. 2008 Dec;12(6):406-11.
19. Arshad R, Pan F, Reitmaier S, Schmidt H. Effect of age and sex on lumbar lordosis and the range of motion. A systematic review and meta-analysis. Journal of biomechanics. 2019 Jan 3;82:1-9.
20. Jin ZH, Kibler WB, Press J, Sciascia A. The role of core stability in athletic function. Journal of Beijing Sport University. 2008;12:039.
21. Dr. Vijay Vasant Nemade, *et al*. Rationality and outcome of activity related treatment approach in the management of non-specific low back pain in young adults. National Journal of Clinical Orthopaedics. 2018;2(3):113-116.
22. OzgurKarcioglu, *et al*. A Systemic Review of the pain scales in Adults: Which to use? American Journal of Emergency Medicine. 2018;36:707-714.
23. Aliaa A, *et al*. Lumbar Lordosis rehabilitation for pain and segmental motion in mechanical chronic low back Pain: A Randomized Trial. Journal of Manipulative and Physiological Therapeutics. 2012;35:4.
24. Khwairakpam Zhimina Devi, *et al*. Effectiveness of muscle stretching in occupation related chronic mechanical low back pain in community nurses: A single blind study. International Journal of Physiotherapy and Research. 2014;2(1):403-10.
25. Mohammad Reza Nourbakhsh, *et al*. Relationship Between Mechanical Factors and Incidence of Low Back Pain. Journal of Orthopaedic & Sports Physical Therapy 2002 Sep;32:9.
26. Raghav S, *et al*. Role of Swiss ball exercises in reducing pain, disability and improving muscle endurance in patients with mechanical low back ache. International Journal of Physiotherapy and Research. 2017;5(2):1966-70.
27. Scott F Nadler, *et al*. The Physiologic Basis and Clinical Applications of Cryotherapy and Thermotherapy for the Pain Practitioner. Pain Physician. 2004;7:3.
28. Jyothi S, Sujaya B. Assessment of muscle strength in

female Bharatanatyam dancers. International Journal of Physiology, Nutrition and Physical Education. 2018;3(2):621-625.
29. Lumbar/Core Strength and Stability Exercises. Athletic Medicine.
30. Scott F Nadler, *et al*. Continuous Low-Level Heatwrap Therapy for Treating Acute Nonspecific Low Back Pain. Arch Phys Med Rehabil; c2003 Mar. p. 84.
31. Raoul Gelabert. Dancers' Spinal Syndromes. 1986;7:4.
32. Kisner, *et al*. Therapeutic exercises sixth edition Jaypee Brothers; c2013.
33. Penkar L, Sadhale A. Balance in Bharatanatyam dancers and non-dancers: A comparative study. Journal of Society of Indian Physiotherapists. 2020;4(2):92-96.
34. Kumar T, Kumar S, Nezamuddin M, Sharma VP. Efficacy of core muscle strengthening exercise in chronic low back pain patients. Journal of back and musculoskeletal rehabilitation. 2015 Jan 1;28(4):699-707.
35. Ahmed A, Waqas MS, Ijaz MJ, Adeel M, Haider R, Ahmed MI. Effectiveness of Core Muscle Stabilization Exercises with and without Lumbar Stretching in Non-Specific Low Back Pain. Annals of King Edward Medical University. 2017 Dec 5;23:3.
36. Cho HY, Kim EH, Kim J. Effects of the core exercise program on pain and active range of motion in patients with chronic low back pain. Journal of Physical Therapy Science. 2014;26(8):1237-40.
37. Javadian Y, Akbari M, Talebi G, Taghipour-Darzi M, Janmohammadi N. Influence of core stability exercise on lumbar vertebral instability in patients presented with chronic low back pain: A randomized clinical trial. Caspian Journal of Internal Medicine. 2015;6(2):98.
38. Kato S, Demura S, Kurokawa Y, Takahashi N, Shinmura K, Yokogawa N, *et al.* Efficacy and safety of abdominal trunk muscle strengthening using an innovative device in elderly patients with chronic low back pain: a pilot study. Annals of Rehabilitation Medicine. 2020 Jun;44(3):246.
39. França FR, Burke TN, Caffaro RR, Ramos LA, Marques AP. Effects of muscular stretching and segmental stabilization on functional disability and pain in patients with chronic low back pain: a randomized, controlled trial. Journal of Manipulative and Physiological Therapeutics. 2012 May 1;35(4):279-85.
40. Battaglia G, Bellafiore M, Caramazza G, Paoli A, Bianco A, Palma A. Changes in spinal range of motion after a flexibility training program in elderly women. Clinical Interventions in Aging. 2014;9:653.
41. Sharma M, Nuhmani S, Wardhan D, Muaidi QI. Comparison of Lower Extremity Muscle Flexibility in Amateur and Trained Bharatanatyam Dancers and Nondancers. Medical Problems of Performing Artists. 2018 Mar 1;33(1):20-5.
42. Shin HJ, Jung JH, Kim SH, Hahm SC, Cho HY. A Comparison of the Transient Effect of complex and core stability exercises on static balance ability and muscle activation during static standing in healthy male adults in Health care 2020 Dec;8(4):375. Multidisciplinary Digital Publishing Institute.
43. Niederer D, Engel T, Vogt L, Arampatzis A, Banzer W, Beck H, *et al*. Motor control stabilisation exercise for patients with non-specific low back pain: a prospective meta-analysis with multilevel meta-regressions on intervention effects. Journal of Clinical Medicine. 2020 Sep;9(9):3058.
44. Masaki M, Aoyama T, Murakami T, Yanase K, Ji X, Tateuchi H, Ichihashi N. Association of low back pain with muscle stiffness and muscle mass of the lumbar back muscles, and sagittal spinal alignment in young and middle-aged medical workers. Clinical Biomechanics. 2017 Nov 1;49:128-33.
45. Sadler SG, Spink MJ, Ho A, De Jonge XJ, Chuter VH. Restriction in lateral bending range of motion, lumbar lordosis, and hamstring flexibility predicts the development of low back pain: a systematic review of prospective cohort studies. BMC Musculoskeletal Disorders. 2017 Dec;18(1):1-5.
46. Ghorbanpour A, Azghani MR, Taghipour M, Salahzadeh Z, Ghaderi F, Oskouei AE. Effects of McGill stabilization exercises and conventional physiotherapy on pain, functional disability and active back range of motion in patients with chronic non-specific low back pain. Journal of Physical Therapy Science. 2018;30(4):481-5.
47. Muhammad Waseem A, Hossein K, Syed Amir G. Effectiveness of core stabilization exercises and routine exercise therapy in management of pain in chronic nonspecific low back pain: A randomized controlled clinical trial.
48. Nemade VV, Patil AA. Rationality and outcome of activity related treatment approach in the management of non-specific low back pain in young adults.
49. Jagadeeswari S. Comparative study on flexibility among yoga and Bharatanatyam practicing student. Int J Phys Educ Sport Heal. 2017;4(4):1-4.
50. Bagherian S, Ghasempoor K, Rahnama N, Wikstrom EA. The effect of core stability training on functional movement patterns in college athletes. Journal of sport rehabilitation. 2019 Jul 1;28(5):444-9.