

Comparison of Elastic Resistance Band Exercises and Yoga in Physiotherapy Students with Chronic Non-Specific Low Back Pain: A Randomized Clinical Trial

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Abstract

Objectives: To study and compare the effectiveness of elastic resistance band exercises and yoga in physiotherapy students with chronic non-specific low back pain

Design: Randomized clinical trial

Participants: 40 physiotherapy students, 20 in each group.

Interventions: Group A received elastic band exercises and group B received yoga for 10 days i.e. 5days/week.

Measurements: VAS, Pressure biofeedback, MODQ, lumbar ROM.

Results: Elastic resistance band exercises resulted in significant improvement in pain reduction (mean change 4.3, $p = 0.001$), Core strength (mean change 3.2, $p = 0.001$), flexibility (mean change extension 0.9 and flexion 1, $p = 0.001$ for both flex and extension) and functional disability (mean change 11.1, $p = 0.001$) than yoga at 10th day of intervention.

Limitations: small sample size, no follow up and less duration of intervention

Conclusions: Though the study showed beneficial results in both groups, results reflected that 10 sessions of elastic resistance band exercises showed better improvement than the Yoga postures in physiotherapy students with chronic NSLBP.

Keywords: Non-specific low back pain; Elastic resistance band; Yoga; Pressure biofeedback; Core muscle

Introduction

Low back pain (LBP) is a problem worldwide with a lifetime prevalence reported to be as high as 84%. The lifetime prevalence of low back pain is reported to be as high as 84%, and the prevalence of chronic low back pain is about 23%, with 11–12% of the population being disabled by low back pain [1]. LBP is defined as pain experienced between the twelfth rib and the inferior gluteal fold, with or without associated leg pain [2]. Based on the etiology LBP is classified as Specific Low Back Pain and Non-specific Low Back Pain. Of all the LBP patients 10% are attributed to Specific and 90% are attributed to Non-Specific Low Back Pain (NSLBP) [3]. Specific LBP are those back pains which have specific etiology causes like Spondylolisthesis, Spondylosis, Ankylosing Spondylitis, Prolapsed disc etc.

Non-specific low back pain has become a major public health problem worldwide. NSLBP is defined as low back pain not attributable to a recognizable, known specific pathology. This is a health problem on rise in younger patients [3]. Non Specific pain in general refers to any type of back pain that is caused by placing abnormal stress and strain on muscles of the vertebral column. It is called nonspecific because it is usually not clear what is actually causing the pain. There is no specific problem or disease that can be identified as the cause of the pain [4]. NSLBP is typically associated with pain, soreness and/or stiffness in the lower back region, functional disability for which it is not possible to identify a specific cause of the pain. Non-specific low back pain typically results due to poor posture, poorly-designed seating, and incorrect bending and lifting motions as required in various occupations [5]. Conventionally according to the duration of back pain, low back pain is categorized according to its duration as acute (<6 weeks), sub-acute (6 weeks - 12 weeks) and chronic (>12 weeks) [4].

Occupational health hazards are on rise due to promotion of industrial life, leading to marked increase in prevalence of work related musculoskeletal disorders (WRMSDs) [6,7]. Not only the industrial workers are at risk of low back pain but also are the health professionals who deal with patients in awkward postures for long duration. Prevalence of various work related musculoskeletal problems (neck pain, back pain, shoulder pain, headache etc.) have been studied in various health professionals such as nurses, surgeons, dentists and physiotherapists which show the most common complaint being low back and neck pain [8-13]. Many studies have indicated that physiotherapists are at risk of work related musculoskeletal disorders. The reason is associated with physiotherapists whose nature of job includes treating the patients, lifting the body part of the patients, awkward posture and who may have to sit/stand for prolonged period to treat the patients [14].

Studies show that the common factor in most cases of non-specific low back pain (NSLBP) is weakness of the core muscles. Weak core muscles result in loss of the appropriate lumbar curve and poor posture. Multifidi have been found to atrophy in people with

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chronic low back pain. Hence, weakness of core muscles leads to decrease in overall functional strength and spinal instability [15-17]. Spinal instability is considered to be one of the important causes of low back pain but is poorly defined [18]. Core muscles are referred as spinal stabilizers. The normal function of the stabilizing system is to provide sufficient stability to the spine to match the instantaneously varying stability demands due to changes in spinal posture, static and dynamic loads. Hence, weakness of core muscles leads to decrease in overall functional strength leading to low back pain [19-21]. Core muscle strength can be assessed using different methods like Electro Myo Graphy, Ultrasonography, and pressure biofeedback unit. The pressure biofeedback unit is found to meet the need for quantification of the abdominal draw in action. This unit has shown to be applicable for indirect assessment of core strength hence, a reliable outcome measure [22,23].

Treatment of chronic NSLBP aims at pain relief and exercise program which includes strengthening plus stretching program for para spinal and core muscles [24]. One of the most recent concepts in the management of low back pain is the utilization of core stability exercises to improve spinal stability and function while eliminating pain [25]. To achieve strengthening of these core muscles, exercise program is administered employing various equipments like Elastic Resistance, Swiss Ball, springs, sand bags etc. The use of elastic resistance products in therapeutic exercise programs has become widespread in rehabilitation and has been shown to be an effective method of resistance and improving muscle strength [26]. Elastic bands and tubing are produced by several manufactures under different product names, the most familiar of which is Thera-band, Elastic Resistance Bands and Tubing. Elastic bands are available in an assortment of grades or thicknesses. Color coding denotes the thickness of the products and grades of resistance [27]. These ERB exercises have been studied for their effectiveness to improve core muscle strength and functional ability in LBP patients [28-30].

There is a growing trend appreciated in building core strength using yoga therapy. Hatha yoga is one branch of yoga consisting of physical postures .i.e. asanas, breathing techniques pranayama, and meditation. It is believed that Yoga brings stability to the body and mind. Many Chronic low back ache patients seek relief using complementary therapies such as yoga Several studies suggest yoga to be effective for chronic low back pain [31,32].

Literature shows core muscle weakness to be major factor causing LBP. Many studies have been done to study effectiveness of strengthening of core muscles to treat NSLBP using exercising with Pilates, Swiss ball, Elastic Resistance, Yoga etc, Elastic Resistance exercises and Yoga therapy have unique approaches but target the core muscle strength. However, there are no studies that compare Elastic resistance band exercises and Yoga on NSLBP so as to find the better of the two. Although prevalence of WRMSDs has been studied, there is dearth in literature where health professional students are intervened with therapy for WRMSDs. Hence, the present study attempts to target students of Physiotherapy professionals.

The present study intended to compare Elastic Resistance Band Exercises and Yoga therapy in Physiotherapy students with chronic non-specific low back ache in terms of pain, core muscle strength, range of motion and functional disability.

Methodology

Study Design: It was a randomized clinical trial.

Setting: Physiotherapy students from KLE's Institute of Physiotherapy, Belgaum, Karnataka India.

Participants: 40 Physiotherapy students including both males and females with chronic NSLBP.

Inclusion criteria:

- Both male and female physiotherapy students of age group 18 – 25 years.
- Chronic Non-specific back pain
- Patients willing to participate in the study

Exclusion criteria:

- Back pain with trauma.
- Any neurological symptoms involving Prolapsed Intervertebral Disc, Radiculopathy
- Any systemic disease like RA, Anky losing spondylitis etc.
- History of recent abdominal, back surgeries etc.
- Any contraindication for exercises. (fever, hypotension , recent fractures etc)
- Pregnancy

For this trial ethical clearance was obtained from the institutional ethical committee. The purpose of this study was explained and a written informed consent was obtained from all the participants. Only those willing to take treatment intervention for 10 days i.e. 5 days per week were recruited for the study. The subjects were screened on the basis of inclusion and exclusion criteria and then they were requested to participate in the study. The demographic data including age, height, weight, Body Mass Index and duration of symptom were collected through data collection sheet along with initial assessment of outcome measures. Pain was assessed by Visual Analogue Scale (VAS), functional disability by a Modified Oswestry Disability Questionnaire score, lumbar stiffness through lumbar ROM using Modified Schober's for flexion and extension and core muscle strength which was assessed using Pressure Biofeedback Unit.

After this initial evaluation they were allocated into two groups, ERB group – Elastic Resistance Band group (ERB) and Yoga group (YG). Both groups received the selected treatment for 10 sessions at 5 sessions per week with warm up and cool down period. On completion of the treatment on the 10th day, post interventional assessment was done for the 4 outcome measures and documented for analysis.

Interventions

Elastic resistance band (ERB) exercises group consisted of a set of exercises which were performed with and each exercise repeated 10 times (Figure 1). Yoga regime included a set of yogic postures i.e. asanas which were performed in a cyclic format and was repeated twice. Each posture was done with 10 seconds hold. For both the groups, total duration of each session was 45 mins with 5 sessions per week for two weeks.

Elastic Resistance Band group exercises [28] (Figure 1)	Yoga therapy group – Asanas [33,34] (Figure 2)
<ol style="list-style-type: none"> 1. Thera band abdominal crunch in supine 2. Thera band abdominal oblique crunch in supine 3. Thera band abdominal crunch (lower abs) 4. Thera band trunk “Chop” 5. Thera band trunk “Lift” 6. Thera band trunk extension (in long sitting) 7. Thera band trunk Sidebend-Overhead (in standing) 8. Thera band trunk rotation (in sitting) 	<ol style="list-style-type: none"> 1. Cobra posture and variations (Bhujangasana) 2. Bridging posture and variations (Setubandhasana) 3. Dhanurasana 4. Pavanmuktasana (knee to chest and variations) 5. Cat and dog pose (Marjarasana) 6. Downward facing Dog (Parvatasana) 7. Warrior pose and variations (Virbhadradasana) 8. Reclining Cobbler 9. Child’s pose (Shashankasana) 10. Half-moon pose (Ardachandrasna)

Outcome measures

Visual Analogue Scale (VAS)

The visual analogue scale is a 10 cm straight line drawn on a paper marked with numbers 0 to 10, where 0 symbolized no pain and 10 symbolized the worst thinkable / intolerable pain and participants were asked to mark a point on this line as per the severity of his/her pain which indicates present pain level [35].

Modified Oswestry Disability Scale (MODQS)

For severity of disability due to back ache. A well validated, self-reported questionnaire designed for low back pain. It contains 10 sections. For each section the total possible score is 5. If the first statement is marked the section score is 0, if the last statement is marked the section score is 5. Total score is calculated in percentage, where better functions are indicated with lower scores [36,37].

Lumbar Range of Motion

Lumbar flexion and extension range of motion was measured by

using standard technique Modified Schober’s Test. This was done using a flexible cloth measuring inch tape. The patient stands erect, arms at side. The therapist identifies the posterior superior iliac spines (PSISs) by making an ink mark on the midline of the lumbar spines horizontal to the PSIS. Make another mark on the spinous processes 15 cm superior to the PSIS line. Align the tape measure between the two skin marks. The patient bends backward for extension and forward for flexion. The new distance between the superior and inferior skin markings is measured with the patient positioned in flexion/extension and noted. Flexion and Extension range of motion is the difference between the initial length between skin markings (15cm) and the length measured in full lumbar flexion and extension respectively [38,39].

Core Muscle Strength

Core muscle strength was measured using pressure biofeedback unit (Chttanoooga, California, USA). The device consists of three chamber pressure cells which was placed under the lumbar spine in crook lying and inflated to a base line of 40mmHg. The participants

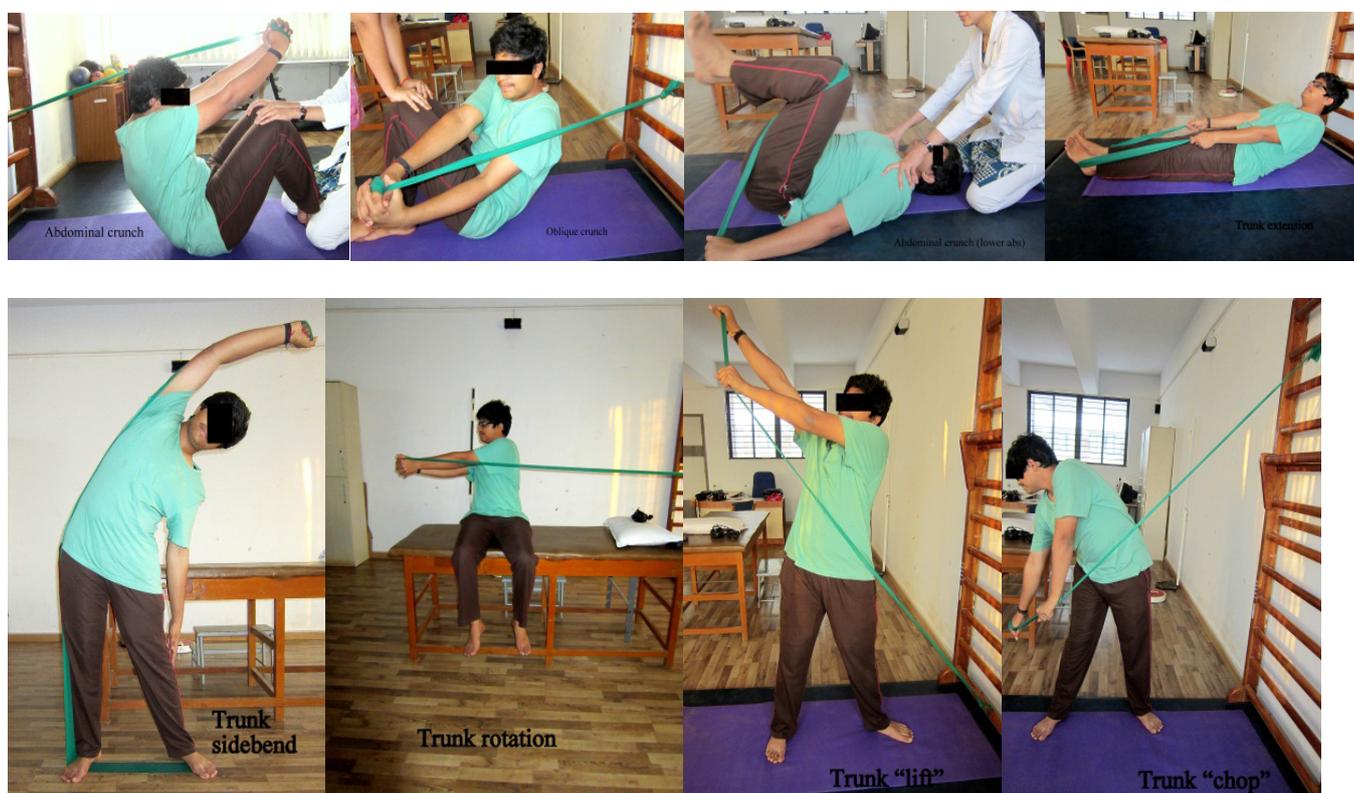


Figure 1: Elastic Resistance Band Exercises.

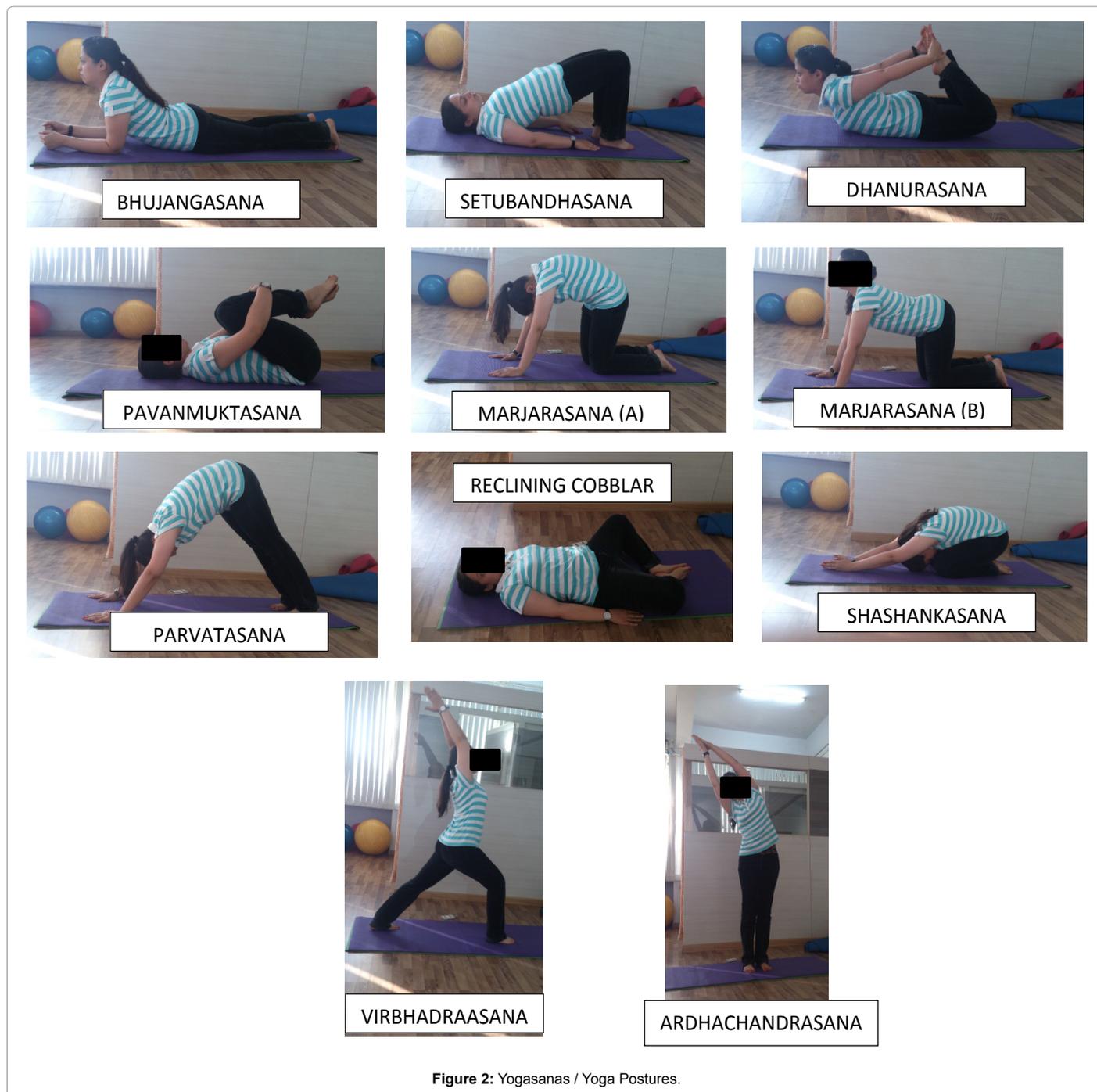


Figure 2: Yogasanas / Yoga Postures.

were asked to draw in the abdominal wall without moving the spine or pelvis. Pressure should remain at 40mmHg. Participants were instructed to hold it for 10 seconds, breathe normally. The difference of the actual pressure to 40mmHg was noted down [22,23].

Statistical analysis was done by the SPSS version 14. Statistical measures such as independent “t” and paired “t” tests were used to analyze the data for between and within group difference. The p value of <0.05 was considered to be statistically significant improvement. The results were analyzed in terms of decrease in pain, functional disability, increase in core strength and lumbar range of motion for flexion and extension.

Results

The results of the study showed statistically significant improvement in both groups when compared pre and post intervention. However, ERB group showed more decrease in pain, improvement in function, increase in ROM and increased muscle strength than that of YG group.

Demographic profile

Each group had 20 participants. The mean age of participants in ERB group was 19.5 years ± 1.76, the mean age of participants in YG group was 21.9 years ± 1.25. The p value by paired t test was found to

be <0.001 which is significant. Participants belonging to YG group were 2years elder than that of ERB group which is statistically significant but clinically not significant as the target population was students of physiotherapy. The mean BMI of participants in ERB group was 21.4 ± 4.35 , the mean BMI of participants in YG group was 21.8 ± 3.34 . The difference in mean BMI in ERB group and YG was statistically not significant ($p=0.735$). There was no difference in BMI and sex ratio of two groups (Graph1).

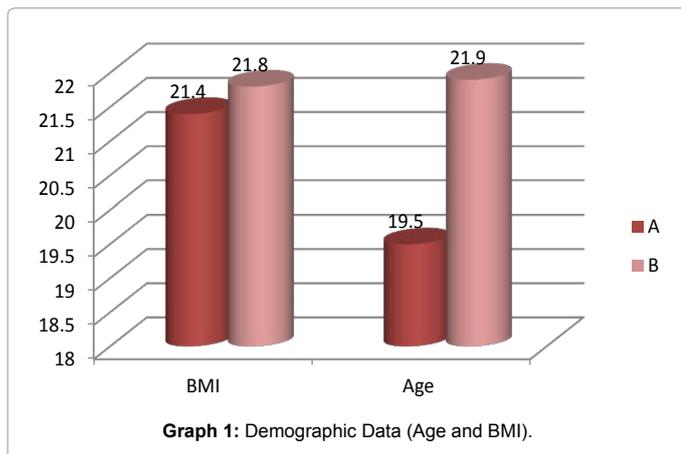
Clinical parameters

The participants treated within group showed a statistically significant decrease in pain and functional disability and increase in core strength and flexibility.

In ERB group, the mean Visual Analogue Scale (VAS) score on pre-treatment was 7.7 ± 1.07 which was reduced to 3.4 ± 1.49 at the end of the treatment. The mean difference of pre and post treatment scores in ERB group was about 4.3 ± 1.35 . In YG group, the mean Visual Analogue Scale (VAS) score was on pre-treatment 7.3 ± 1.15 which was reduced to 5.7 ± 1.23 . The mean difference in YG group was about 1.6 ± 0.79 . The p value found out with independent t test was <0.001 which is highly significant. There was more reduction of pain seen in ERB group when compared to YG group (Table 1).

In ERB group, the mean MODQ score on pre-treatment was 24.7 ± 2.85 which was reduced to 13.6 ± 3.56 at the end of the treatment. In YG group, the mean MODQ score on pre-treatment was 24.5 ± 2.89 which was reduced to 19.5 ± 2.23 and mean difference was about 5 ± 1.37 . The p value found out with independent t test was <0.001 which is highly significant (Table 2).

There was significant improvement in flexion ROM in both the groups. 1 ± 0.67 was mean difference of pre and post scores in ERB group. In YG group, the mean flexion score on pre-treatment was 4.5 ± 0.29 which was increased to 4.8 ± 0.27 ; mean difference was about 0.3 ± 0.25 . The p value found out with independent t test was <0.001 which is highly significant. Mean extension score on pre-treatment in



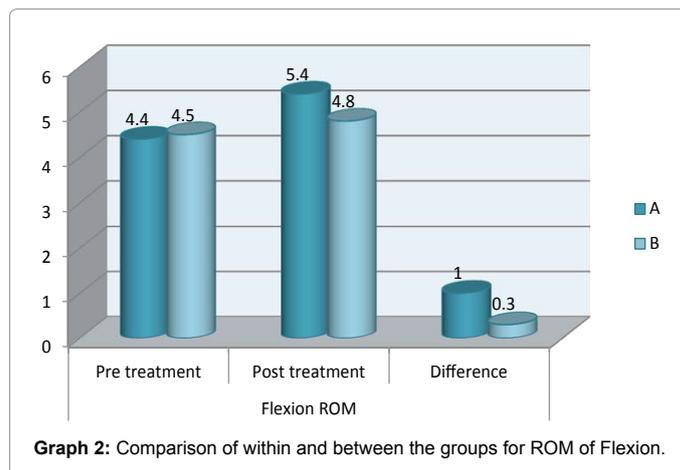
Graph 1: Demographic Data (Age and BMI).

Groups	Pre-treatment		Post-treatment		Difference	
	Mean	SD	Mean	SD	Mean	SD
A (Elastic Resistance Band)	7.7	1.07	3.4	1.49	4.3	1.35
B (Yoga)	7.3	1.15	5.7	1.23	1.6	0.79
t	1.194		5.486		7.969	
p	0.240		<0.001		<0.001	

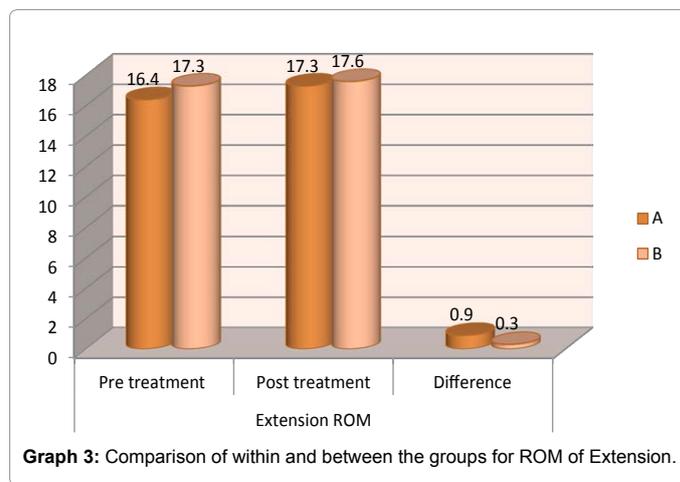
Table 1: Comparison of within and between groups for Pain (VAS) Score.

Groups	Pre-treatment		Post-treatment		Difference	
	Mean	SD	Mean	SD	Mean	SD
A (Elastic Resistance Band)	24.7	2.85	13.6	3.56	11.1	4.02
B (Yoga)	24.5	2.89	19.5	2.23	5	1.37
T	0.220		6.239		6.413	
P	0.827		<0.001		<0.001	

Table 2: Comparison of within and between groups for Functional Score (MODQ).



Graph 2: Comparison of within and between the groups for ROM of Flexion.



Graph 3: Comparison of within and between the groups for ROM of Extension.

ERB group was 16.4 ± 0.87 which was increased to 17.3 ± 0.36 . Mean difference was about 0.9 ± 0.59 . In YG group, the mean extension score was 17.3 ± 0.36 which was increased to 17.6 ± 0.28 ; mean difference was about 0.3 ± 0.17 . The p value found out with independent t test was <0.001 which is highly significant (Graph 2).

There was significant improvement in muscle strength as on PBF in both the groups. Mean PBF score on pre-session in ERB group was 3.4 ± 0.99 which was improved to 6.6 ± 0.99 ; mean difference was about 3.2 ± 0.95 . In YG group mean PBF score on pre-session was 3.5 ± 1.09 which was increased to 4.7 ± 1.30 . 1.2 ± 0.58 was the mean difference seen in YG group. The p value found out with independent t test was <0.001 which is highly significant (Graph 3).

Discussion

The present study showed significant improvement in elastic resistance band exercise group than Yoga group when compared to

their baseline values in terms of pain, function, strength and flexibility in physiotherapy students with chronic non-specific low back pain. The outcome measures i.e. VAS, lumbar ROM, core strength measured by PBF and MODQ were used to assess the physiotherapy students with chronic NSLBA of both elastic resistance band exercises and yoga group were compared. Intervention was given for 10 days i.e. 5days/week and the results concluded that the resistance band group showed better results than yoga. As the elastic band group had benefit of an added resistance to the muscles, it showed a significant improvement in terms of core strength measured post-session when compared to pre-session whereas yoga group showed significant increase in flexibility. Hence, both the groups can be effective and will give good results in patients suffering from low back ache.

A study done by Joshua, Johnson in the year 2012 proposed that core stabilization exercises are effective in treating low back pain due to spinal instability and other clinical diagnoses to restore function and pain free movement in athletes. The purpose of the study was to evaluate exercise as a treatment for low back pain with a specific emphasis on core stabilization and provide an outline of exercises and progression to help guide clinicians in treating the athlete with low back pain [40]. In the present study, intervention of both the groups focused on core muscle strengthening which were proved to reduce low back pain, increase flexibility and improve function of the subjects.

Elastic resistance is a unique type of resistance training compared to other traditional forms, such as isotonic or isokinetic resistances. The resistance provided by elastic bands or tubing is based on the amount that the band or tubing is stretched. This resistance can be measured in pounds of force depending on the percentage the band or tubing is stretched from its resting length; this is known as "force-elongation". Regardless of how long the band or tubing is before it's stretched, the force produced at its stretched length depends on the percent elongation. When applied as an exercise, elastic resistance offers a strength curve (torque) similar to human strength curves and isotonic resistance exercises (a bell-shaped curve). This is because of the angle created between the elastic resistance and the lever-arm, the "Force Angle" [28]. The benefit provided by the fact that elastic resistance does not rely on gravity and that it provides continuous tension to the muscles being trained. Another unique benefit of elastic resistance is that it offers linear variable resistance. This means that, as the range of motion of the exercise increases, the resistance provided by the elastic equipment increases i.e. the number of muscle fibers that are being used in the exercising muscle increase. More the muscle fibers used, the greater the adaptations in muscle strength that can be achieved with the training program. These changes can be presumably associated with the strength gains and benefits in pain reduction in the present study. The elastic resistance band exercise which was included in the present study was based on force elongation and resistance provided which has proven to be effective in increasing core strength. Similar findings were noted in a non-published thesis was done by Varun Naik on athletes with low back pain which showed significant improvement in core strength with elastic band exercises in athletes with low back pain [30].

Triber FA et al (1998) conducted a study to determine the effect of a 4- week isotonic resistance training program using Thera band elastic tubing and light weighted dumbbells on concentric shoulder rotator strength or velocity of serve or both in a group of elite-level tennis players. 22 male and female varsity college tennis players were randomly assigned to control ERB group and experimental group for 4 week training. The experimental group exhibited significant gains in internal rotation torque at both slow and fast speeds & also in external

rotation torque at fast speed. Thereby, they concluded that resistance training using Theraband and lightweight dumbbells have beneficial effects on strength and functional performance in college level tennis players, the results of the present study was consistent with the results of Triber FA in increased strength of core muscles by use of thera bands [41]. Similar findings were noted in a non-published thesis was done by Varun Naik on athletes with low back pain which showed significant improvement in core strength with elastic band exercises in athletes with low back pain [30]. There is scarcity of literature on effectiveness of elastic resistance band on core muscles. However, the present study shows the use and its effect of elastic resistance band to increase core strength and proved beneficial for the physiotherapy students in terms of strength and pain.

Yoga is much more than a few floor exercises. It is a holistic approach that utilizes both physical and psychological practices in an effort to decrease mental, emotional and physical stress. Yoga can be highly effective for low back pain because it can help improve posture, increase strength and flexibility, and provide an overall state of relaxation. The yoga based relaxation techniques, stretching and strengthening exercises are effective because the mind is focused in a meditative way on the movements, skin, muscles sensation and relaxed breathing. Mind and body work together, creating a physiological and psychological environment that optimizes the potential for healing. Yoga is generally believed to improve flexibility, strength, balance, and agility. For patients with LBP, yoga appears to address imbalances in the musculoskeletal system affecting spinal alignment and posture [42,43]. A study by Sherman and colleagues conducted a randomized controlled trial in 2005 comparing the effects of yoga classes to conventional exercise classes and a self-care book in patients with LBP. One hundred and one subjects with nonspecific LBP of at least 12 weeks duration were randomly assigned to one of the three interventions including 36 participants to the yoga class, 35 to the conventional exercise class, and 30 to the self-care book. The Vini Yoga style of yoga was chosen with each class using a core of 17 postures specifically geared for patients with LBP. The authors concluded that yoga was more effective than conventional exercises and self-care book in reducing pain and improving functional status in patients with CLBP [34]. In 2004, Jacobs et al. conducted a feasibility study exploring an Iyengar yoga intervention for CLBP. Fifty two Participants were randomly assigned to one of the two groups including 28 to the yoga group and 24 to the wait-list control group. The authors proposed primary and secondary outcome measures that would be assessed at baseline and 1, 3, and 6 month follow-ups, outcome were measured in terms of VAS. Jacobs's studies provide published concept validity for the use of yoga in the management of CLBP [33].

In the present study subjects were on a trial for Hatha yoga style using a core of ten postures which was conducted for 10 sessions i.e. 5 days/week. However, no follow up was done. Twenty subjects were on the trial group of yoga which showed increased flexibility, reduction in pain and improvement in function but not as significant as ERB group (elastic resistance band exercises), which may be due to shorter time duration and no follow ups.

Limitations of the study were: small sample size, single centric trial, lack of controlled group, follows up was not done. Future trials should incorporate larger sample sizes with a control group and longer follow up period to obtain more power for statistical significance and to determine long term benefits of these interventions. Different clinical arms with different patient population should be employed. Comparisons can be done between different interventions for

example, yoga or Pilates or Swiss ball exercises, mat exercises, physical therapy.

The present study concluded that elastic resistance band exercise group is better than yoga group for physiotherapy students with chronic NSLBP although both interventions proved to be beneficial. The results outlined in this research are an important start in the evaluation of how elastic resistance band exercises and yoga are helpful in managing physiotherapy students with chronic NSLBP in terms of pain, function, flexibility and strength. This study may be of significance for the health care providers who treat LBP and consider recommending Elastic resistance band exercises and/or yoga to these group of patients.

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