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# Determining the impact of 12 weeks intervention of hatha yoga practices on range of motion of trunk lateral flexion and thoracolumbar spine trunk rotation in college men

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## Abstract

**Purpose:** yoga has many uses in rehabilitation in addition to its health benefits for managing and preventing disease (rehabilitare, from the Latin, means to restore). Rehabilitation comes in a variety of forms, including social, psychological, and physical. As a way of life, yoga has assisted people with physical ailments in regaining their health. Hatha yoga practices are an effective means to improve the flexibility in college students. The Purpose of this investigation was to study benefits of hatha yoga practices on range of motion of trunk lateral flexion and thoracolumbar spine trunk rotation in college men.

**Material & Methods:** thirty untrained college students were randomly assigned to Hatha Yoga Practice group (HYP) (n=15) (Age: 19.1±0.9, Height: 171.7±2.5, Weight: 63.9±2.4) and control group (CG) (n=15) (Age: 19.1±0.8, Height: 171.2±2.6, Weight: 63.9±1.8) and their ranged from 18 to 23 years. The HYP group performed their respective training, three times per week for twelve weeks. Prior to and after the training, TLF, and TSTR were evaluated using standardized tests. The dependent 't' ratio was used to analyze pre- and post-intervention data.

**Results:** the results showed that the HYP group significantly (p=0.00) improved in TLF and TSTR compared to the control group.

**Conclusion:** the twelve weeks of Hatha yoga training produced better improvement over TLF and TSTR in college men.

**Keywords:** Hatha Yoga, Rehabilitation, Trunk lateral flexion, and Thoracolumbar spine trunk rotation.

## Introduction

Living a sedentary lifestyle affects a large percentage of people in society, which is an undesirable trait. Because of computerization in the workplace, prolonged sitting has gradually come to be accepted as the standard. With rates of obesity, diabetes, and cardiovascular disease on the rise, these developments are not only harmful to physiological health and well-being but also to musculoskeletal health. Long periods of sitting (more than eight hours per day) have been linked to an increase in neck, shoulder, and low back pain, according to recent studies. This explains why posture is such a popular topic in today's world.

Flexibility is part of the body's health-related component. The characteristic of the musculoskeletal system that establishes the range of motion that can be attained without endangering the joints is called flexibility. Flexibility is defined as "freedom of movement" and refers to a body part's capacity to carry out a variety of tasks quickly and at the appropriate pace (Alter, 2004). People of all ages, including children, teenagers, adults, and the elderly, should perform the mobility exercise movement. Strength training is recommended by the World

Health Organisation to target large muscle groups twice a week (WHO, 2010). Engaging in activities that promote flexibility is also advised by the American Heart Association (AHA) and the American College of Sports Medicine (ACSM). Exercises for flexibility should be done on two or three days a week, utilizing the main muscles and maintaining a position for at least sixty seconds (Garber et al., 2011).

Exercises for flexibility may help preserve musculoskeletal integrity and lower the risk of orthopaedic complications in later life. The main effects of these types of workouts are a temporary increase in the length of the musculotendon due to relaxation of the actin-myosin complex and a permanent increase brought about by changes in the extracellular matrix surrounding the muscle (Pollock et al., 1998). Sustaining ideal flexibility may be crucial for maintaining proper posture and removing the root causes of various disabilities (Alter, 2004).

Daily life seldom requires extremes of lateral-flexion range of motion (Mellin, 1985). Thoracic spine mobility is the first thing that comes to mind when addressing posture. A fairly rigid thoracic spine may result from sedentary behaviour, which can exacerbate dysfunction in the nearby spinal regions. One region of the spine that frequently experiences decreased flexibility and stiffness is the thoracic or mid-spine. Since mobility in the thoracic spine accounts for up to 80% of total back rotation, mobility, especially rotation is crucial.

The muscles of the trunk help with breathing, coughing, straining, and posture maintenance. They also stabilize the thorax, pelvis, and spine for head and extremity movements. In addition, the abdominals help maintain a regular gait, support and shield the abdominal viscera, and contract to shield the spine during lifting movements. Trunk flexion is accomplished by the erector spinae, psoas major, and abdominal muscle groups. When trunk flexion is done against resistance, like body weight, the abdominal muscles tense. Therefore, the primary muscles used when getting out of bed or rising from a supine position are the abdominal muscles. When the head is raised in the supine position, the most engaged abdominal muscle is the rectus abdominis (Carman et al., 1972) tightening to keep the thorax stable. When one is pushing, pulling, or lifting, the abdominal muscles contract isometrically and serve to stabilise the thorax and pelvis (Henmi et al., 2006).

Lateral flexion of the trunk is facilitated by the quadratus lumborum, iliopsoas, and posterolateral fibres of the external abdominal oblique, erector spinae, and intertransversarii muscles. When in an upright position, the lateral flexors contract on one side to begin movement and on the opposing side to alter it (Lindh, 1989). The erector spinae, multifidus, rotatores, and internal and external abdominal oblique muscles are the muscles that make up the trunk rotator complex. The primary rotators of the trunk are the abdominal obliques, both internal and external. During trunk rotation, the extensor muscles work to counteract the flexion torque produced by the oblique abdominal muscles (Macintosh et al., 1993).

Physical yoga, also known as hatha yoga, is one type of fitness that is characterized by mind-body exercise. The term asanas refers to the various poses and variations found in Hatha yoga. There are numerous health advantages in regular yoga practice (Grabara, 2016). It has been demonstrated that practicing yoga helps prevent chronic diseases associated with civilization, like heart disease (Hartley et al., 2014) depression (Shapiro et al, 2007), diabetes (Singh et al., 2001), and lower back pain (Williams et al., 2009; Kim et al., 2014). Frequent hatha yoga practice may also help reduce stress (Kim et al., 2014), enhancing body alignment (Grabara, 2013) and enhancing the physical fitness health-related components (Tran et al., 2001) including flexibility.

Stretching is always the primary goal of an asana in contemporary yoga practice. Because of this, it is essential that we comprehend the neurological and anatomical features of stretching. PNF puts the target muscle on stretch by having the opposing muscles contract shorter, then the target muscle contracts static. Hence, active and passive range of motion increased (Victoria et al., 2013).

*Hypothesis*

Based on study findings mentioned above, we hypothesized that participants performing 12 week Hatha yoga training will show larger improvements in selected variables (i.e., trunk lateral flexion and thoracolumbar spine trunk rotation). Of note, trunk lateral flexion and thoracolumbar spine trunk rotation are of vital importance for everyday activities, sports performance and injury prevention in college students.

## Material and methods of research

*Participants*

Thirty male college students were split into two groups at random (i.e., HYPG and GG) employing Research Randomizer, a programme available on an official website that is open to the public, their ranged from 18 to 23 years. Throughout the study, all participants were counseled against cutting back or increasing their regular activities and daily sports.

*Methods*

Group 1 underwent hatha yoga practice (HYP) and group II was the control group. The primary aim of the research as well as any associated protocols was explained to the participants. After being evaluated by a licensed medical professional, each of them was deemed healthy enough to take part in the research. Before the study started, informed consent from the participants was obtained. This study did not have any dropout rates. The Declaration of Helsinki's guidelines were closely adhered

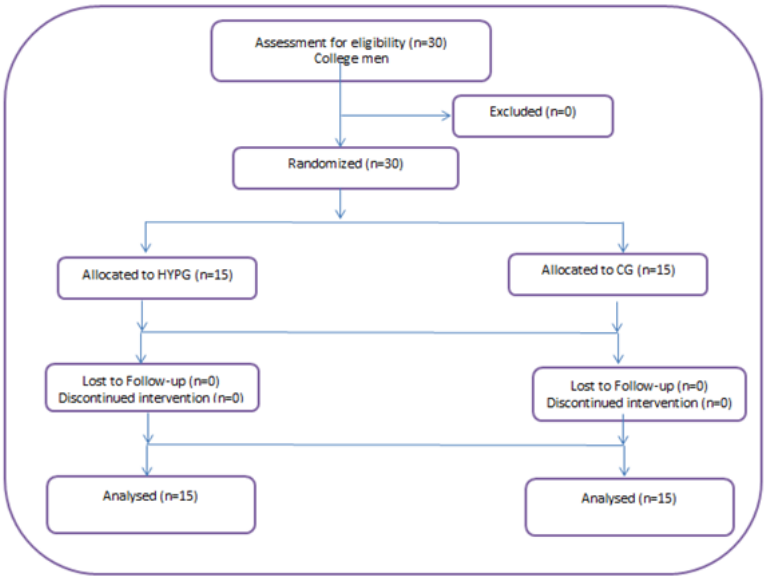


**Figure 1. Diagram showing the study's development through different stages.**

**Table 1.** Characteristics of Participants (mean ± SD)

| Group of subjects | No. of Subjects | Age (In Years) | Height (In Centimeters) | Weight (In Kilograms) |
|---|---|---|---|---|
| **Hatha Yoga training (G1)** | 15 | 19.1±0.9 | 171.7±2.5 | 63.9±2.4 |
| **Control (G2)** | 15 | 19.1±0.8 | 171.2±2.6 | 63.9±1.8 |

to in this study (World Medical Association, 2013). Each participant signed an informed consent form after being fully informed about the purpose of the study. During training programmes, participants had the option to revoke their consent if they felt uncomfortable.

*Inclusion and exclusion criteria*

Regular attendance at both measurements, a lack of injuries, and consent to participate in the study were the inclusion criteria. During the 12-week period, only one absence was allowed. The standards for exclusion were they had no history of musculoskeletal, cardiopulmonary, neurological or orthopaedic disorders and infectious diseases and disability in performing asanas, more than two sessions absence in exercises and the reluctance of subjects and parents to take part.

Our hypothesis was tested by evaluating adaptations after practicing Hatha yoga through a controlled, randomized design that comprised pre- and post-testing. The training period lasted 12 weeks to induce training-related changes in measures of trunk lateral flexion and thoracolumbar spine trunk rotation were assessed using standardized tests such as Alternate tape measurement Test for TLF (Mellin, 1986); and TSTR (Frost et al., 1982). Prior to the tests, the participants warmed up generally for ten minutes by dynamically and statically stretching their upper and lower extremities muscles and by running for five minutes at a low intensity (Yilmaz et al., 2017).

A tape measure is the cheapest and possibly most user-friendly tool for calculating spinal movement. Bilge et al. (2011) recommended in their study, utilizing a tape measure to measure the lumbar spine is an inexpensive, practical, and dependable method that can be applied in the evaluation process.

*Alternate tape measurement Test (Trunk Lateral Flexion)*

The subjects are asked to stand with their feet shoulder-width apart. The level of the middle finger tip is marked on the thigh. When executing the test movements, the subject is instructed to maintain both feet flat on the ground (Fig. 2.1 (Clarkson et al., 2013)). The individual extends their trunk laterally to its maximum range of motion. On the thigh, a second mark is made at the level of the middle finger's tip (Fig. 2.2 (Clarkson et al., 2013)).

The distance between the marks placed on the thigh at the level of the middle finger at the start position and the end position is measured with a tape measure (Fig. 2.3, (Clarkson et al., 2013)). The distance measured represents the lateral flexion ROM (Mellin, 1986).

Frost et al. (1982) described a method for measuring rotation in the thoracolumbar spine using a tape measure.

With their feet propped up on a stool and their arms folded across their chest, the subject is seated. On the lateral aspect of the acromion process, the subject holds the tape measure's end. With

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2.1 2.2 2.3

**Figure 2.** **Technique for measuring trunk lateral flexion.**

3.1 3.2

**Figure 3.** **The process for measuring thoracolumbar trunk spine rotation.**

the other end of the tape measure held either on the upper border of the greater trochanter or on the uppermost point of the iliac crest at the mid axillary line, the investigator can make measurements. The measurement is the distance between the uppermost point of the iliac crest at the mid-axillary line or the upper border of the greater trochanter and the lateral aspect of the acromion process. (Fig. 3.1 (Clarkson et al., 2013)).

The subject rotates the trunk to the limit of motion (Fig. 3.2 (Clarkson et al., 2013)). At the limit of rotation, the distance is measured between the lateral aspect of the acromion process and either the upper border of the greater trochanter or the uppermost point of the iliac crest at the mid axillary line. The thoracolumbar rotation range of motion (ROM) is the difference between the measurements of the start and end positions. Documentation of the surface landmarks utilized in the evaluation is necessary.

Because they are easily palpable, Clarkson et al., (2013) suggests using the uppermost point of the iliac crest and the lateral aspect of the acromion process as preferred surface landmarks. The measurements were taken both before and after the first (hatha) yoga class (pre-test and post-test). After warming up for ten minutes, they were executed. Every measurement was done twice to ensure accuracy, and the best result was noted.

For a duration of 12 weeks, the subjects were asked to attend three days a week (Monday, Wednesday, and Friday) of 90 minutes of hatha yoga (6.30 am to 8 am). The Tadasana was the asana in the hatha yoga sessions. Other postures improved flexibility, balance, muscle strength and endurance, and the mobility of the spine.

The subjects performed the following asanas: Utkatasana, Uttasana, Adho-mukha svanasana, Urdhva-mukha svanasana, Phalakasana, Caturanga Dandasana, Vasisthasana, Virabhadrasana (I, II, III), Vrksasana, Utthita trikonasana, Utthita Parśva Konasana, Parivrtta-trikonasana, Parivrtta Parsva-konasana, Salabhasana, Dhanurasana, Urdhva Dhanurasana, Bhujangasan, Ustrasana, Gomukhasana, Paschimottanasana, Parivrtta Paschimottanasana, Baddha Konasana, Halasana, Marichyasana, Ardha-matsyendrasana, Urdhva Prasarita Padasana, and Sarvangasana. The classes always ended

with the Savasana. The subjects could utilize exercise mats and straps for assistance. Meditation and pranayama practices were not included in the classes.

*Statistical Analysis*

The statistical software SPSS for Windows (SPSS, Inc., Chicago, IL, USA) was used to analyse the data. Thirty college students were split into two groups for the experiment using the pre- and post-random group design. By calculating the mean and standard deviation, the effects of 12 weeks of hatha yoga practices were examined. The "t" test was used to determine whether there had been a significant improvement. To test the significance level, a fixed 0.05 level of confidence was used.

## Results of the study

The 't' ratio between the control and experimental groups' means for the thoracolumbar trunk lateral flexion and thoracolumbar spine trunk rotation of college-aged men is calculated in Table 2. The mean values of pre and posttest on control group of TLF and TSTR were 14.6 and 14.8 and 2.27 and 2.33 respectively. At the 0.05 level of confidence, it was determined that the obtained ratios of 1.87 and 0.43 for the degrees of freedom 1 and 14 were statistically not significant because they were less than the necessary table value of 2.14.

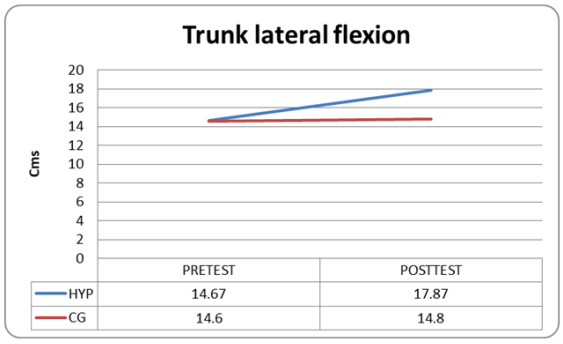


**Figure 4. Graphical representation of individual comparison between pre and post test on trunk lateral flexion of Hatha yoga practice and control group.**

The outcomes made it abundantly evident that the trunk lateral flexion and thoracolumbar spine trunk rotation of experimental group improved due to the influence of twelve weeks of hatha asana practices. The experimental group's mean scores on the TLF and TSTR pre- and posttests were, respectively, 14.67 and 17.87, 2.33 and 3.80. At the 0.05 level of confidence, the obtained "t" ratios of 22.11 and 11 were found to be statistically significant for the degrees of freedom 1 and 14, as they exceeded the required table value of 2.14.

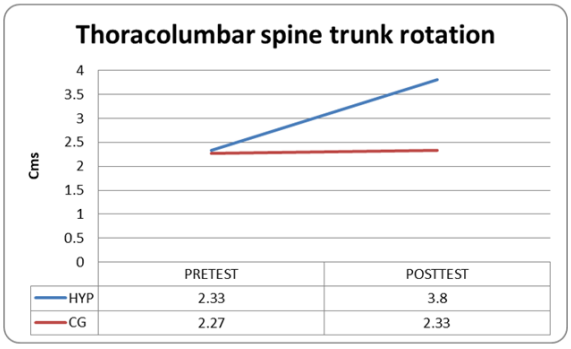


**Figure 5. Graphical representation of individual comparison between pre and post test on Thoracolumbar spine trunk rotation of Hatha yoga practice and control group.**

## Discussion

Finding out the advantages of hatha yoga practises on college men's trunk rotation and lateral flexion range of motion was the main goal of this study. The findings showed an increase in the range of motion as a result of hatha yoga exercises.

Humans go through several predictable phases of body control and movement as they grow from tiny, mostly immobile newborns to fully formed, remarkably mobile adults. These patterns can be characterized as reflexive and intentional movements in motor development, both of which are developmental benchmarks (Cech and Martin, 2002). Precise evaluation of range of motion is an essential component of both injury assessment and performance-enhancement screening initiatives, as it aids in determining the required interventions. Furthermore, ROM changes can offer insight into the efficacy of an intervention. Clinically proven techniques measure cervical (Audette et al., 2010) lumbar spine (Olson and Goehring, 2009) excursion in rotation, lateral flexion and flexion-extension. Additionally, clinical methods for accurately measuring thoracic spine flexion and extension have been established (Mannion et al.,

**Table 2.** The mean and "t" test summary for the pre- and post-tests on TLF and TSE of control and experimental groups

| Variables | Group | Test | Mean ± SD | 't' ratio | p-value |
|---|---|---|---|---|---|
| TLF | CON | Pre | 14.6±0.83 | 1.87 | 0.82 |
| | | Post | 14.8±0.77 | | |
| | EXP | Pre | 14.67±0.82 | 22.11 | 0.00 |
| | | Post | 17.87±0.74 | | |
| TSTR | CON | Pre | 2.27±0.46 | 0.43 | 0.67 |
| | | Post | 2.33±0.49 | | |
| | EXP | Pre | 2.33±0.49 | 11 | 0.00 |
| | | Post | 3.80±0.41 | | |

*Significant at 0.05 level of confidence (2.14)

2004) and bending sideward (Klein et al., 1991).

The thoracolumbar spine's coordinated upper and lower segment motion is a component of trunk rotation movement (Klein et al., 1991). Thoracolumbar rotation is significantly influenced by posture (Edmondston, 2007). To avoid musculoskeletal pain, it's critical to measure and enhance the axial thoracolumbar rotation angle (Edmondston, 2007). Viitanen (Edmondston, 2007) assesses thoracolumbar level's axial rotation while the subject was seated. Johnson et al. (2012) measured while sitting and partially kneeling, taking the axial-thoracolumbar rotation. A verbal remark was utilized in earlier research to avoid compensating for lumbo-pelvic rotation, which can flex and extend during axis-thoracolumbar rotation.

Hatha yoga can be defined as a dynamic balance between strength and flexibility, addressing the physical, mental, and emotional levels. This is based on the interpretation of the word hatha, which in Sanskrit 'ha' means the sun, male energy, strength, and 'tha' which means the moon, female energy, flexibility (Schops, 2010). We can alleviate a variety of physical ailments and increase our body's flexibility by practicing yoga. In contrast to physiotherapy techniques, yoga's static-dynamic techniques can also be considered a way for the nervous system and the joints in the spine and extremities to "self-mobilize" (Posadzki, 2009). The majority of forward-bending hatha yoga poses are best executed with an extended spine and straight knees to increase hamstring flexibility. The hamstrings' flexibility is crucial for both physical fitness and overall health. Moreover, a decrease in their suppleness may raise the possibility of harm to the musculoskeletal system (Nishikawa et al., 2015).

One of the most evident and rapidly attained benefits of consistent hatha yoga practice is improved body flexibility, which our study's findings also supported. Previous research has shown that regular yoga practice primarily benefits older adults by increasing joint mobility (Gonclaves et al., 2011). Yoga aims to provide us with a sufficient degree of flexibility so that we can use our muscles more effectively and effortlessly in our daily activities, rather than hypermobility. For this, we require the right amount of strength in the muscles that control the movement of the body's distal segments as well as the proper flexibility in the tonic muscles that sustain posture (Schneider et al., 1992).

For every participant, there was a visible increase in lateral bending. There are many postures that lengthen the spine and enhance the flexibility of the hip adductors. Asanas (poses) that lengthen the spine in the vertical axis and enhance hip joint range of motion include the Extended Triangle Pose and Extended Side Angle Pose. The only groups where a significant increase in torsional range of motion was observed were the women and the group comprising all participants. Many of the poses in Hatha yoga involve twisting the trunk. The study conducted by Grabara and Szopa (2015) and found that practicing yoga asana even once a week improved the flexibility of the hamstring muscles and increased the range of motion of the spinal joints in women aged 50-79 who took 20-week yoga classes, using the same measurement technique as the current study (Grabara, 2013).

Also, the study performed by Tran et al., (2001) involving men and women between the ages of 18 and 27 showed improvements in the participants' flexibility of the ankle and shoulder joints as well as an improvement in their range of motion when bending forward and backward. The other studies attest to the fact that people who practice yoga on a regular basis have improved flexibility (Gonclaves et al., 2011; Lau et al., 2015). Consistent with earlier research, the current findings suggest that regular yoga practice may lead to an increase in spinal flexibility.

## Conclusions

To sum up, the findings of this investigation show that both 12-week hatha yoga training significantly improved the range of motion of trunk lateral flexion and thoracolumbar spine trunk rotation in college men compared to control group.

Yoga is a practice that is worth looking into because it is low-risk and, if done correctly, can be tailored to the needs of various types of people. It is also reasonably inexpensive. Our goal is that this paper will provide fresh perspectives for the creation of innovative, well-planned research in the area of yoga and rehabilitation. It is also conclude that hatha yoga practice is a feasible and safe training method that significantly raises the range of motion in college men.

### Author's Contribution

Conceptualisation, E.B., M.R. and A.S.L.; methodology, E.B. M.R., A.S.L., and V.V.; software, E.B. and M.R.; check, E.B., M.R. and A.S.L.; formal analysis, E.B. and M.R.; investigation, E.B., M.R., A.S.L., and V.V.; resources, E.B. and M.R.; data curation, E.B. and M.R.; writing – rough preparation, E.B. and A.S.L.; writing – review and editing, E.B., M.R. and A.S.L.; visualisation, E.B., M.R. and A.S.L.; supervision, E.B., M.R., A.S.L., and V.V.; project administration, E.B.; receiving funding, E.B. and M.R. All authors have read and agreed with the published version of the manuscript.

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### Conflicts of interest

The authors declare that they have no conflicts of interest.

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