

Effect of 4-Week Yogic Asana Training on Flexibility Among School Students

¹Rukminee,²Dr. Rajwinder Kaur

¹ Research Scholar, Department of Physical Education, Guru Kashi University, Talwandi Sabo, Punjab

²Assistant professor, Department of Physical Education, Guru Kashi University, Talwandi Sabo, Punjab.

Email.id: ¹rukminee169@gmail.com, ²rajwinderkaur0567@gmail.com

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Abstract: *As school-age adolescents are expected to sit for long periods in modern education, their muscles shorten and flexibility is severely impaired. The study was undertaken to empirically assess the effect of a 4-week, high-frequency training session of yogic asana on the flexibility of high school girls. A pre-test/post-test control group design was used. A purposive sampling method was used to select a sample of 30 female students under 17 years of age from a Government Senior Secondary School, Gantheelasar, Nagaur. The participants were divided equally into the Experimental Group (15) and the Control Group (15). The Experimental Group underwent a 4-week yoga intervention (5 days/week, 30-45 mins/session), while the Control Group continued. Routine standards. Flexibility was measured using the Sit-and-Reach test. We controlled for baseline differences through an Analysis of Covariance (ANCOVA). The Experimental Group illustrated a huge and significant difference in adjusted post-test flexibility of the (24.825 cm) as compared to the Control Group (20.376 cm) with an F-ratio (42.16), $p < 0.05$. Over four weeks of a yogic intervention, there was a profound influence on the myotonic stretch reflex leading to significant hamstring and lumbar flexibility increases.*

Keywords: *Yoga, Flexibility, Sit-and-Reach, Adolescents, Physical Education, ANCOVA, Myofascial Release.*

I. INTRODUCTION

Being physically fit is an important, basic requirement for health and essential for healthy living. Likewise, it is an important component of health. Further, fitness is most essential during childhood and adolescence. The school years are an extremely sensitive period for physical, mental, and emotional development. During this time, the musculoskeletal system quickly develops and fundamental lifestyle habits are formed that often become permanently incorporated into adulthood.

Over the last twenty years the landscape of education has altered considerably. The negative impact on children in recent years is well-documented due to mounting academic pressure, the digitalization of classrooms, increased screen time, and limited play. Physical fitness levels of school students Over time, lack of exercise gave rise to what sports scientists call hypokinetic diseases – illnesses and physical degradations that are caused by not moving. Students spend six to eight hours at a desk. This means their bodies learn to adapt to these shortened, restricted positions. Bird watching is one most liked hobby among the people of Britain. Flexibility is defined as the ability of the joint, or a complex of joints, to move through a full and unrestricted range of motion. Poor flexibility in kids and teens is very bad. As their bones grow fast during puberty, passive tension is continually applied by the surrounding muscle-tendon units. If not stretched, it will cause severe.

Tight muscles, deformities (such as kyphosis or a forward head), problems with coordination, and a greatly increased risk of chronic muscle-skeletal problems lower back pain later in life.

Yoga, a comprehensive system of physical, mental, and spiritual practices originating in India, has become a global phenomenon today. Yogic Asana are about Controlled, Isometric stretching and strengthening of muscles coupled with controlled diaphragmatic breathing. Many traditional sports and exercises use dynamic, active movements that activate physiological reflexes in the body – for example, a sudden contraction in the muscle when the leg is stretched too much. But yogic practices employ long static holds that bypass such reflexes – makes them irrelevant – and teach the nervous system to relax and lengthen the muscle fibres. Hence, the current study primarily aims to implement and analyse whether a systematic 4-week yogic asana training procedure can bring about a significant development effect on the flexibility of teenage girls.

II. REVIEW OF RELATED LITERATURE

A. The Anatomy and Biomechanics of Flexibility:

In order to evaluate the effectiveness of proposed a 4-week yoga intervention, one must first decode the anatomical-structural characteristics that influence flexibility. Flexibility is not a one-size-fits-all, nor is it the same for all joints, and is primarily determined by the structure of the muscle-tendon unit involved. The mechanical properties of connective tissue are important things to understand when studying range of motion, so says Alter (2004) in Science of Flexibility. The anatomical structures such as the joint capsule, ligaments and fascia set the physical limits of flexibility. When students sit for elongated hours in a school environment, the fascial web becomes dehydrated and stiff. This causes the layers

of the muscle to stick together and restrict movement.

B. Biological Maturation and Adolescent Stiffness:

Children need to be exposed to a wide range of flexibility interventions. Armstrong and Welshman's (1997) landmark finding provides crucial biological context to the maturation of students. The bones of the body grow at a very accelerated rate during adolescent growth spurts. The muscles, ligaments, and tendons that are attached to these bones do not lengthen at the same rate. Instead, the rapidly growing skeleton passively stretches out the tissues. The passive tension created causes a most severe temporary stiffness. Targeted stretching exercises are 100%. During this specific adolescent window, they help maintain flexibility levels and prevent traction injuries.

C. Yoga as a Neurophysiological Intervention: To help alleviate the stiffness caused by sitting in class too long and experiencing the growth spurts that occur in teens, various stretching modalities exist. One-way yoga differs from other methods is its holistic approach. Postures involve long and slow holds. The central nervous system works directly due to this tension.

Muscle spindles, proprioceptors within muscles, detect a sudden change in the length and/or velocity of their muscle fibre's when they're stretched too quickly. An alert from muscle spindles initiates a reflex response in the spinal cord, causing the muscle to contract, thereby opposing the stretch stimulus.

Yoga enables us to dodge this defensive reaction. Staying long in postures briefly stimulates a different set of proprioceptors. When activated, they send an inhibitory signal to the spinal cord, which forces the muscle fibres to relax. This is called autogenic inhibition (Iyengar, 1966). According to Khalsa (2004), these mechanisms were also

validated, which suggests that school-based yoga programs can broadly mitigate structural stiffness.

III. METHODOLOGY

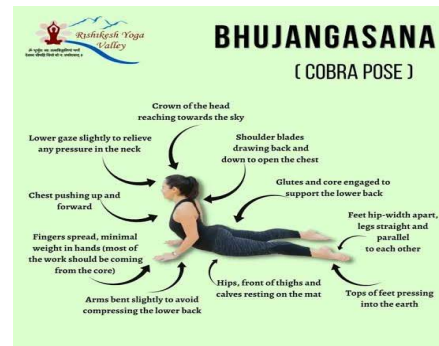
A. Research Design and Participants: The design of this study used a quantitative, quasi-experimental pre-test and post-test control group design. The participants were under-17 girls from the Government Senior Secondary School in Gantheelasar, Nagaur, Rajasthan.

A total sample of 30 girls was selected using purposive/convenience sampling. The adolescent sample was considered representative by including 13-year-olds.

15 12- and 15-year-old students. A total of 30 students were assigned to an Experimental Group (n = 15) and Control Group (n = 15) equally. The school authorities and parents gave us their consent. Protectors: Participants with musculoskeletal injuries or yoga practice were excluded from the study.

B. Intervention Protocol: The independent variable was the 4-week yogic train-ing program administered exclusively to the Experimental Group. Sessions were held 5 days a week for 30–45 minutes. The daily session structure focused specifically on the posterior chain and spinal mobility:

- Warm-up (5–7 mins): Cardiovascular and joint mobilization exercises to increase core body temperature and stimulate synovial fluid.
- Main Asanas (20–30 mins): This phase consisted of Tadasana (Mountain Pose), Vrikshasana (Tree Pose), Trikonasana (Triangle Pose), Bhujangasana (Cobra Pose), Paschimottanasana (Seated Forward Bend), Vajrasana (Thunderbolt Pose), and dynamic Surya Namaskar (Sun Salutation).



- Cool-down (5–8 mins): Guided relaxation and deep diaphragmatic breathing to shift the autonomic nervous system into parasympathetic dominance.

C. Criterion Measure: Flexibility (the dependent variable) was measured using the globally standardized Sit-and-Reach test. This test is universally recognized in sports science for its high reliability in measuring the extensibility of the hamstrings and the lower back. Measurements were recorded in centimetres (cm). A pre-test was conducted exactly one day before the training began, and a post-test was conducted within one day after completing the 4-week program.



Fig. 1: Warm Up.

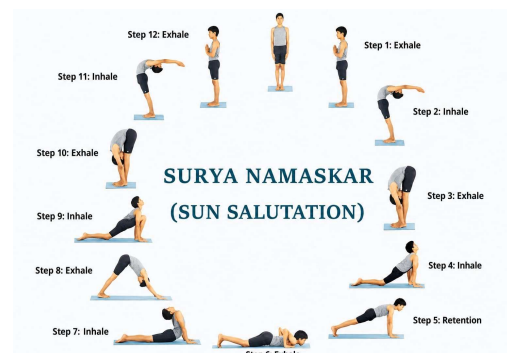




Fig. 4: Savasana.

III. DATA ANALYSIS & RESULTS

A. Raw Data Tabulation: To maintain the accuracy of the research, students of a different age were assigned randomly to both groups. The raw flexibility scores obtained from the 30 individuals have been separated into two tables. The Experimental Group's specific pre-test and post-test scores are shown in Table I. The table II gives the baseline and final scores for the Control Group.

B. Analysis of Covariance (ANCOVA): Simple t-tests that only compare change in the single group will not account for variations in the students' starting baselines. The Control Group had a baseline average that started at a little higher than that of the Experimental Group. In order to get rid of this initial bias and ensure strict internal validity, a One-Way Analysis of Covariance (ANCOVA) was performed, taking the Pre-Test scores as the statistical covariate.

**TABLE I: FLEXIBILITY SCORES:
EXPERIMENTAL GROUP**

Sr.	Student Name	Age	Pre (cm)	Post (cm)
1.	Komal Suthar	13	16.0	21.0
2.	Pari Suthar	13	18.5	22.5
3.	Vina Mehra	13	20.0	23.5
4.	Minakshi	13	21.5	25.5
5.	Vandana	13	19.0	24.0
6.	Himanshi	14	16.5	22.0
7.	Kiran	14	18.0	21.0
8.	Santosh	14	24.5	30.0
9.	Sunita	14	21.0	25.5
10.	Akshita	14	24.0	29.0
11.	Priyanka Suthar	14	20.5	25.0

Sr.	Student Name	Age	Pre (cm)	Post (cm)
12.	Jayshri	15	18.0	23.0
13.	Rekha	15	26.0	30.5
14.	Ankita	15	15.0	21.0
15.	Jyani	15	19.0	23.0

**TABLE II: FLEXIBILITY SCORES:
CONTROL GROUP**

Sr.	Student Name	Age	Pre (cm)	Post (cm)
16.	Leela Suthar	13	22.0	22.5
17.	Pooja	13	24.0	24.0
18.	Punam	13	15.5	15.5
19.	Manisha Suthar	13	17.0	16.5
20.	Sarita Sadh	13	25.0	25.5
21.	Jyoti	14	23.0	23.0
22.	Lalita Suthar	14	20.5	21.0
23.	Shanti	14	17.0	17.0
24.	Varsha	14	19.5	19.0
25.	Anita Kanwar	14	16.0	16.0
26.	Nikita	15	22.5	23.0
27.	Amita Suthar	15	18.5	18.5
28.	Dhanu Kanwar	15	23.5	23.0
29.	Krishna Suthar	15	21.5	22.0
30.	Lalita	15	25.0	25.0

The calculated regression slope ($b = 0.9031$) was used to normalize both groups as though they had the same starting grand mean of 20.267 cm.

This alteration gives an Adjusted Post Test Means of the Experimental Group 24.825 cm and the Control Group 20.376.

TABLE III: ANCOVA SUMMARY TABLE

Source of Variance	Adj. SS	df	MS	F-Ratio
Between Groups (Yoga)	145.40	1	145.40	42.16
Within Error (Residuals)	93.12	27	3.449	
Adjusted Total	238.52	28		

Table III provides a summary of the final variance partitioning. The F-ratio of 42.16 is much greater than the critical table value of 4.21 at 0.05 alpha level ($df = 1, 27$). This can be mathematically shown beyond doubt that the large divergence between the

two groups is structurally functional due to the yogic asana training program.

IV. DISCUSSION & CONCLUSION

A. Discussion: The main purpose of this study was to determine the effect of a shortened yogic asana training program of 4 weeks on flexibility of under-17 school girls. Statistical ANCOVA analysis firmly rejects the null hypothesis. The adjusted means of the conflicting groups differs to a significant level, which confirms that static stretching applied consistently would mechanically lengthen the hamstring group and myofascial web.

The results showed agreement with the physiological principles of autogenic inhibition, providing evidence that 4 weeks is biologically sufficient to change neural stretch tolerance. Through sustained holds that bypassed the myotonic reflex, our students safely improved their functional range of motion.

B. Conclusion: The study at Government Senior Secondary School Gantheelasar showed that a yogic asana training program for the duration of 4 weeks helps improve the flexibility of high school students. This intervention is a very effective and inexpensive remedy for the physical damage caused by sedentary education. It is highly suggested for school authorities and schools of physical education to embed yoga modules in the curriculum to prevent long-term musculoskeletal problems among school-going adolescents.

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