

A Study on the Effect of Surya Namaskar on Flexibility Levels among School Girls

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Abstract— Flexibility is an essential component of all types of physical fitness, which can help improve posture, enhance athletic performance, and prevent injuries and disease. It is essential for school-going girls to engage in regular physical activity for healthy growth and development. The traditional yoga practice Surya Namaskar consists of twelve postures, which are performed in a succession along with breathing. Surya Namaskar is known to improve flexibility, muscle strength, balance, and mental health, and has become a popular exercise worldwide. This quantitative research investigated the impact of a structured Surya Namaskar program on the flexibility of school girls. Sixty girls aged 12 to 16 years were selected and randomly assigned into two groups. One group did a Surya Namaskar program for 8 weeks, five days a week, and the other group continued with their normal school activities. The Sit-and-Reach Test was used to assess flexibility pre- and post-program. The data were analyzed using paired and independent t-tests at the 0.05 level. The data, recorded after eight weeks, confirmed that the experimental group that did Surya Namaskar was fitter than the control group. The study concludes that doing Surya Namaskar regularly is a good, cheap, and practical way of improving the flexibility of school girls. The inclusion of Surya Namaskar in school physical education can improve students' fitness and health.

Keywords— Surya Namaskar, Flexibility, School Girls, Yoga, Physical Fitness, Sit-and-Reach Test, Physical Education, Exercise Intervention, Health, Adolescent Girls.

I. INTRODUCTION

Physical fitness plays a vital role in health, the functioning of the body and the feelings of someone in life. It aids in the physical, mental, emotional and social development of an individual. Due to advances in technology as well as changes in lifestyle, kids and teenagers are not moving around as much as you used to. They spend on TV, computers, video games, and mobiles more hours. Overall fitness has decreased especially in flexibility, muscle strength, endurance and cardio-respiratory fitness. Flexibility is a unique and essential element of fitness. Flexibility is the ability of a joint to perform its full range of movement without pain. It is dependent on the flexibility and sturdiness of the muscles, tendons, and other connective tissues. Good flexibility assists in moving easily, a good posture, better performance at sports and reduces injury chances. Being too stiff can result in issues such as tight muscles, limited range of motion, poor posture, discomfort, and increased risk of injury. The school-age period is significant for physical growth, improvement of movement skills and development of healthy habits for life. The constant physical and hormonal changes in the body at the teen years, affect an individual's physical movement and performance. Thus it is necessary to have physical activities which help to improve flexibility along with the fitness. Though conventional PE exercise classes allow students to exercise, they do not hold the interest of the students in the long run due to dull activities and not focusing on overall health. Popularly supported fitness and

overall well-being are the reasons why people do yoga.

Yoga has its origins in ancient India and encompasses physical postures, breathing, meditation and relaxation. Yoga helps in improving mental and emotional health which is not generally happened in many exercises. Numerous studies have proven that engaging in yoga on a regular basis results in improved flexibility, increased strength of muscles, enhanced balance and coordination, improved functioning of the heart and lungs, stress management, and better mental health. Surya Namaskar or Sun Salutation is one of the most practiced yoga. It is a set of twelve connected postures done in a rhythmic way with controlled breathing. Every exercise in this dynamic routine enhances and elongates various areas of the body while working almost all the important muscle groups and joints. The series of exercises includes forward bends, backward bends, lunges, planks, and inversions. This aids in increasing the movement of the spine apart from the flexibility of the joint, endurance of muscles, balance, and blood circulation. The breathing part also improves the use of oxygen, body efficiency and focus. Surya Namaskar is a full-body exercise because it helps with stretching, strength, endurance, flexibility, balance, and breathing. Rather than stretching one area, Surya Namaskar works the entire body. Doing it regularly stretches the spine, shoulders, chest, belly, hips, hamstrings, quads, calves and ankles, which help joints move and muscles stretch. You should be flexible if you're a schoolgirl as you go through puberty. Having good flexibility can help with posture and movement skills, better participation in sports and play, less tiredness and fewer sports injuries. It also helps improve other fitness areas, such as speed, agility, balance, and strength. Fostering flexibility during the teenage years lays down a strong foundation for life and good movement habits. Schools world over are realising the advantages of introducing yoga in their

curriculum.

The increasing popularity and endorsing of yoga are identified through International yoga Day which is vital for education and health. The Surya Namaskar is especially good for schools as it requires little equipment, takes up little space, is inexpensive and is something that students of any age and fitness levels can do safely. Due to its simplicity, easy accessibility and general benefits of mobility, it is good alternative to be added to the school physical education program. Surya Namaskar participation in schools may not be new. However, there aren't many studies that back its efficacy. While many studies talk about the general health benefits of yoga, there is not much research on how structured Surya Namaskar practice affects flexibility in schoolgirls. As adolescence is a crucial period for the development of fitness, it is essential to find out whether regular practice of Surya Namaskar can enhance the flexibility of the adolescents significantly. This information may help make yoga a regular part of physical education at school and assist in adopting a healthier lifestyle.

A. Historical Perspective

Yoga is one of the oldest practices to strengthen our body, mind, and (and/or) spirit. Its origins can be traced back over 5,000 years to the Indus Valley Civilization. Ancient paintings, such as seals depicting people calmly sitting with crossed legs, suggest the practice of yoga occurred long before it was ever penned into ancient religious scriptures. Yoga finds its earliest references in the Vedas, the sacred texts of Hinduism: Rig Veda, Yajur Veda, Sama Veda, and Atharva Veda. These writings refer to subjugating the body, creating discipline and controlling the balance between the body and mind. These concepts were further developed in the later Upanishads, philosophical scriptures with deeper spiritual overtones that explore the nature of the mind, health, and growth. Around 200 BCE, one of the major milestones in the history of yoga occurred when Patanjali penned the Yoga Sutras. He brought

yoga into eight segments — Ashtanga Yoga — and this clarified the method for nurturing both body and mind. These eight steps are Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana, and Samadhi. Surya Namaskara is a sacred part of yoga. These were essentially a group of movements performed to pay tribute to the Sun, which has always held a very special place in Indian culture, often referred to as the source of life force, energy, and health. Ancient texts also characterize the Sun as a representation of power, knowledge, and spiritual light. During the late 1800s and early 1900s, Surya Namaskar gained popularity. Yoga instructors and sports trainers considered it a whole exercise routine. This sequence is a series of 12 poses, performed rhythmically with a single breath. These poses are designed to open your whole body and improve blood flow/flexibility and strength. Yoga began traveling west with the first yogis in the early 1900s, making its mark across the globe. Research conducted outside of India began to demonstrate the physiological and psychological benefits that yoga appeared to provide. In this moment, yoga is found all around the world and is perceived as not only highly beneficial for staying fit but also for being happy.

To recognize the worldwide importance of yoga, the United Nations proclaimed June 21 as the International Day of Yoga in 2014. Today, yoga has been placed at the forefront of arts-to-fitness trends by schools, colleges, sports teams, and hospitals. Surya Namaskar is one of the easiest and great ways for students to develop flexibility as well as fitness among all the practices of yoga.

B. Surya Namaskar and Flexibility

Surya Namaskar (Sun Salutation) is a dynamic yogic sequence in which twelve postures are performed with rhythmic breathing. It incorporates forward bends, backward bends, stretches, and balancing movements, involving almost every major muscle group and joint in the body. Surya Namaskara is a complete exercise that benefits mental concentration

and overall health, as well as physical fitness. Flexibility, the capacity of a joint or group of joints to move through an unrestricted full range of motion without discomfort, is one important aspect of physical fitness. It aids in achieving correct posture, enhancing performance during sports or any athletic activity, facilitating functional movement of the body and minimizing musculoskeletal injury risk.

The regular practice of Surya Namaskar increases flexibility, strengthens and stretches muscles, tendons, and ligaments, while improving the elasticity of joints and the muscular system. The sequence is an ideal way to improve blood circulation and loosen muscles from top to bottom by mobilizing your spine, shoulders, hips, hamstrings, and calves. Scientific research has proven that regular practice considerably improves flexibility in school pupils, athletes, and adults. The current study uses Surya Namaskar as an organized yoga-based exercise program.

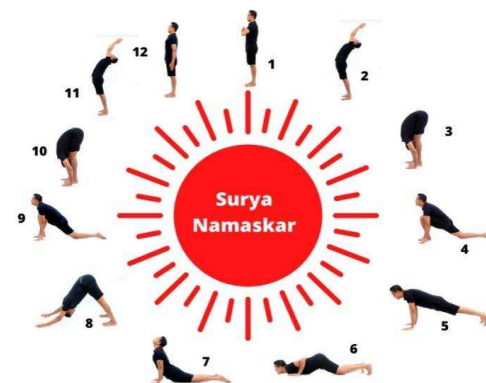


Fig. 1. Twelve-posture sequence of Surya Namaskar

II. RELATED WORK

This paper considers different authors research work that is shown as below:

TABLE I
SUMMARY OF RELATED WORK

Sr. No.	Author(s) & Year	Technique Used	Major Results
1	Apesh Singh Deora & Sisodiya (2025)	Surya Namaskar intervention on school softball players	Improved strength, endurance, flexibility, and agility.

Sr. No.	Author(s) & Year	Technique Used	Major Results
2	Suwannakul et al. (2025)	8-week Surya Namaskar training for overweight female students	Significant improvement in flexibility, muscle strength, VO ₂ max, BMI, and stress reduction.
3	Pal et al. (2024)	6-week Surya Namaskar (12 rounds/day)	Improved flexibility, hand grip strength, cardiovascular function, and body composition.
4	Belladon, Siva & Reddy (2023)	Review of Yoga (Asana, Pranayama, Meditation, Surya Namaskar)	Reported improvements in flexibility, strength, balance, and overall health.
5	Dixit et al. (2022)	6-week Surya Namaskar vs. Zumba (ANCOVA)	Surya Namaskar significantly improved agility and balance.
6	Gayathri & Sarojini (2022)	8-week Surya Namaskar and Pranayama training	Improved vital capacity and overall physical fitness.
7	Prasanna & Vandhana (2022)	Systematic review	Concluded that Surya Namaskar enhances flexibility, strength, cardiovascular health, and mental well-being.
8	Debabrata Sarkar (2022)	6-week Surya Namaskar programme	Significant improvement in flexibility and cardiovascular endurance.
9	Bintari, Anita & Sulistyarto (2021)	Quasi-experimental (Hatha Yoga vs. Surya Namaskar)	Surya Namaskar increased flexibility (7%) and balance (19%).
10	Kaur (2021)	6-week repeated measures design	Significant improvement in strength, speed, endurance, flexibility, and coordination.
11	Chu Gotink et al. (2016)	Systematic review & meta-analysis	Yoga significantly improved cardiovascular and metabolic health indicators.
12	Juliana Costa Shiraishi et al. (2017)	12-week Hatha Yoga programme	Improved hamstring flexibility, abdominal endurance, and reduced body fat.
13	Bhavanani (2014)	Review study	Yoga promotes physical, mental, and therapeutic health benefits.

Sr. No.	Author(s) & Year	Technique Used	Major Results
14	Pal et al. (2013)	Experimental yoga training	Improved muscular strength, anaerobic power, and physiological efficiency.
15	Shirley Telles et al. (2013)	Comparative study (Yoga vs. Physical Exercise)	Yoga improved physical fitness, balance, attention, and self-esteem.
16	Javadekar & Manjunath (2012)	Experimental study on school children	Surya Namaskar improved attention more effectively than physical exercise.
17	Ankad et al. (2011)	Pranayama and meditation intervention	Improved cardiovascular function and autonomic balance.
18	Bhavanani et al. (2011)	Comparative study (Slow vs. Fast Surya Namaskar)	Fast practice improved fitness; slow practice enhanced flexibility and relaxation.
19	Choudhary (2010)	Dynamic Surya Namaskar training	Significant improvement in flexibility among university students.
20	Rajeev Choudhary (2010)	Repeated measures experimental design	Dynamic Surya Namaskar significantly enhanced flexibility.
21	Tran et al. (2001)	8-week Hatha Yoga programme	Improved muscular strength, endurance, flexibility, and aerobic fitness.
22	Gobel et al. (1978)	Clinical exercise study	Established Rate-Pressure Product as an indicator of myocardial oxygen consumption during exercise

III. METHODOLOGY & PROCEDURE

Methodology is an important part of any research study as it provides a systematic procedure for conducting the investigation. It explains the research design, selection of subjects, collection of data, tools used, administration of tests and statistical techniques employed for the analysis of data.

A. Design of the Study

The present study adopted an experimental one-group pre-test and post-test design. The flexibility levels of the selected subjects were measured before the commencement of the training programme and again after the completion of the Surya Namaskar

training programme. The difference between the pre-test and post-test scores was used to determine the effect of the training programme.

TABLE II
EXPERIMENTAL DESIGN

Group	Pre-Test	Treatment	Post-Test
Experimental Group (N=30)	O ₁	X	O ₂

Where: O₁ = Pre-Test; X = Surya Namaskar Training Programme; and O₂ = Post-Test.

B. Selection of Subjects

Thirty (30) school students aged between 16 and 18 years were selected as subjects for the study. The selected students were physically fit and free from any medical condition that could restrict their participation in physical activity. Prior permission was obtained from the school authorities before conducting the study.

TABLE III
DISTRIBUTION OF SUBJECTS

Particulars	Number
School Students	30
Age Group	12–16 Years
School Selected	One
Total Subjects	30

C. Eligibility Criteria

1) Inclusion Criteria:

1. Students aged between 16 and 18 years.
2. Regularly enrolled school students.
3. Physically fit and medically healthy.
4. Willing to participate in the study.

2) Exclusion Criteria:

1. Students suffering from injury or illness.
2. Students absent during training or testing.
3. Students undergoing any specialized fitness training programme.

D. Selection of Variable

The present study consisted of the following variable:

Independent Variable— Surya Namaskar Training Programme

Dependent Variable— Flexibility

E. Source of Data

The data for the present investigation were collected from school students studying in a selected school. The subjects belonged to the age group of 16–18 years and were enrolled as regular students of the school during the period of investigation.

F. Sampling Method

The subjects were selected through the purposive sampling method. This method was considered appropriate because the participants were selected according to the specific requirements of the study, such as age, availability, willingness to participate and suitability for the training programme.

G. Collection of Data

The data were collected in two phases:

1) Pre-Test: Before the commencement of the training programme, all subjects were tested for flexibility using the Sit and Reach Test. The scores obtained were recorded as pre-test scores.

2) Post-Test: After the completion of the Surya Namaskar training programme, the same test was administered again under similar conditions. The scores obtained were recorded as post-test scores.

H. Surya Namaskar Training Programme

The selected subjects participated in a structured Surya Namaskar training programme conducted under the supervision of the researcher.

TABLE IV
TRAINING PROGRAMME SCHEDULE

Particulars	Description
Training Method	Surya Namaskar
Duration of Programme	8 Weeks
Days per Week	5 Days
Session Duration	30 Minutes
Total Subjects	30
Age Group	12–16 Years

TABLE V
STRUCTURE OF TRAINING SESSION

Activity	Duration
Warm-up Exercises	5 Minutes
Surya Namaskar Practice	20 Minutes
Cool-down Exercises	5 Minutes
Total Duration	30 Minutes

The participants practiced Surya Namaskar regularly under proper guidance. The number of rounds was gradually increased based on students' adaptation and fitness levels. Emphasis was placed on correct posture, breathing coordination and smooth execution of movements.

I. Data Recording and Verification

All observations and test scores obtained during the pre-test and post-test were carefully recorded on specially prepared recording sheets. The collected data were checked and verified to ensure accuracy and reliability. Any errors in recording were corrected before statistical analysis.

J. Tools and Techniques

The following tools and techniques were used for collecting data:

1) Flexibility (Sit and Reach Test):

Purpose— The Sit and Reach Test was administered to measure the flexibility of the lower back and hamstring muscles of the subjects.

Equipment— A sit-and-reach box, measuring scale, recording sheet and stationery were used for conducting the test.

Procedure—The subject was instructed to remove their shoes and sit on the floor with both legs fully extended and their feet placed firmly against the sit-and-reach box. The knees were kept straight throughout the test. The subject placed both hands together with the fingertips aligned at the edge of the measuring scale positioned on the top of the testing box. On the command, the subject slowly bent forward from the hip joint and reached forward as far as possible along the measuring scale without making any jerky or bouncing movements. An

assistant ensured that the knees remained fully extended during the performance. The subject was asked to hold the farthest-reached position for at least 1 second. Three trials were administered to each subject and adequate rest was provided between trials to avoid fatigue.

Scoring— The best performance out of the three trials was recorded to the nearest centimeter. The recorded distance reached by the subject on the measuring scale was noted and 12.93 centimeters (equivalent to 9 inches) were subtracted from the recorded value to obtain the final flexibility score. The resulting value represented the flexibility level of the subject and was used for statistical analysis.

K. Method of Presentation

The collected data were systematically organized, classified and tabulated for analysis. The results were presented through tables showing the pre-test and post-test scores of flexibilities. Appropriate interpretation was made on the basis of statistical findings.

L. Statistical Tools

The collected data were organized, tabulated and analyzed using appropriate statistical techniques. Mean and Standard Deviation were calculated to determine the average performance and variability of the flexibility scores. To assess the effect of the Surya Namaskar training programme on flexibility levels among school students, the Paired Sample t-test was applied to compare the pre-test and post-test scores. The level of significance was set at 0.05 for testing the study's hypothesis.

IV. ANALYSIS OF DATA & RESULTS

Analysis, Interpretation & Discussion of Data Collected for Study entitled Effect of Surya Namaskar on Flexibility Levels among School Girls. Data collection: - Data were collected from thirty school girls aged 12-16 years before and after the administration of Surya Namaskar training programme.

In order to fulfill the study aim, the data collected were analyzed with suitable statistical methods. Descriptive statistics were calculated for the data, including Mean and SD, while factorial ANOVA was performed to assess the significance of differences between pre-test and post-test scores for flexibility.

The following tables present the results systematically and are interpreted with respect to the study's aim and hypothesis. They provide an analysis of the efficacy of a Surya Namaskar training program in improving flexibility levels among school girls. The results from the statistical analysis are presented in the following sections.

A. Analysis of Data

This post is based on an article in the International Journal of Innovative Research and Development (IJIRD), called Effect of Surya Namaskar Training Program on Flexibility Levels Among School Girls: A Study. The flexibility scores during the pre-test and post-test were analyzed statistically.

The mean and Standard Deviation were computed as descriptive statistics to describe the data. Paired Sample t-test was used to find out the difference between pre-test and post-test in the case of flexibility. They used 0.05 (rather low value) as a level of significance

It consists of the analyzed data, followed by their interpretation and discussion. Analysis findings were tested to arrive at results therefore verifying the hypothesis that Surya Namaskar influenced flexibility levels among school girls.

TABLE VI
MEAN AND STANDARD DEVIATION OF
PRE-TEST AND POST-TEST FLEXIBILITY
SCORES

Variable	N	Mean	Standard Deviation
Pre-test Flexibility	30	10.12	1.53
Post-test Flexibility	30	13.54	1.33

Table VI presents the Mean and Standard Deviation of the pre-test and post-test flexibility scores of school girls. The mean pre-test flexibility score was 10.12 cm with a Standard Deviation of 1.53, whereas the mean post-test flexibility score was 13.54 cm with a Standard Deviation of 1.33. The increase in the mean score from 10.12 cm to 13.54 cm indicates an improvement in the flexibility levels of the subjects after participation in the Surya Namaskar training programme. The lower Standard Deviation in the post-test suggests that the performance of the subjects became more consistent following the training.

The significance of the improvement was further tested through the Paired Sample t-test. The obtained t-value (22.52) was found to be greater than the table value (2.045) at the 0.05 level of significance with 29 degrees of freedom. Therefore, the difference between the pre-test and post-test flexibility scores was found to be statistically significant ($p < 0.05$).

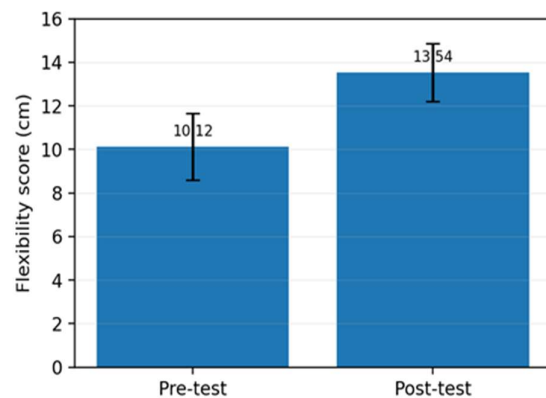


Fig. 2. Comparison of mean pre-test and post-test flexibility scores of school girls.

TABLE VII
PAIRED-SAMPLE T-TEST SHOWING THE
EFFECT OF SURYA NAMASKAR ON
FLEXIBILITY

Variable	Mean Difference	SD of Difference	t-value
Flexibility	3.42	0.83	22.52

Table Value of t (0.05 level, $df = 29$) = 2.045

Table VII presents a comparison of the pre-test and

post-test flexibility scores of school girls. The mean difference was 3.42 cm, with a Standard Deviation of Difference of 0.83. The calculated t-value (22.52) exceeded the critical value (2.045) at the 0.05 level of significance.

Since the calculated t-value was greater than the table value, a significant improvement in flexibility was observed after the Surya Namaskar training programme. Therefore, it may be concluded that the Surya Namaskar training programme had a significant effect on the flexibility levels of school girls.

B. Discussion of Hypothesis

The study aimed to find out how the Surya Namaskar training program affected the flexibility of school girls. The idea was that there would be no big change in their flexibility because of this program. The results showed that the average flexibility score went up from 10.12 cm before the training to 13.54 cm after the training. A t-value of 22.52 was found, which is higher than the t-value of 2.045 at the 0.05 level. This means the result is statistically significant, so the original idea that there would be no change was not correct. The study shows that taking part in the Surya Namaskar program had a real impact on the girls' flexibility. So, it can be said that Surya Namaskar is a good yoga practice for improving flexibility in school girls.

V. SUMMARY

The present study, entitled Effect of Surya Namaskar on Flexibility Levels amongst School Girls, was undertaken to examine the effect of a structured Surya Namaskar regimen on flexibility in school girls aged 16-18 years. This was a one-group pre-test and post-test study. Purposive sampling was used to select thirty girls from one school. All the girls who performed the Sit-and-Reach Test to measure flexibility before beginning the program. Subsequently, they engaged in an eight-week Surya Namaskar program — five times a week for 30 minutes each under the supervision of the research

group. After the program, participants took the test again to see how much more flexible they had become. Data were compiled and analyzed using the mean, standard deviation, and paired-samples t-test. Findings indicated that the mean flexibility score increased significantly from 10.12 cm (pre-program) to 13.54 cm (post-program). The improvement was statistically significant ($t = 22.52$, $p < 0.05$). The findings show that Surya Namaskar interventions have a tremendous impact on flexibility. Conclusions: Surya Namaskar is a simple, low-cost, and effective yoga exercise that could be used to increase flexibility in school girls, as per the findings of this study.

VI. CONCLUSION

Results and conclusions: Statistical analysis and interpretation of the collected data revealed that the Surya Namaskar training program had a significant positive effect on flexibility among school girls. The substantial improvement in post-test flexibility scores compared with pre-test scores supports the conclusion that systematic, regular practice of Surya Namaskar improves flexibility, particularly joint mobility and muscle elasticity. Surya Namaskar is beneficial for any age group; our results further validate this for school girls and demonstrate that it is feasible for them. Key message: The hypothesis was accepted as Surya Namaskar had a significant effect on flexibility among school girls. Thus, Surya Namaskar should be considered an ideal component of school physical education programs because it is a simple and inexpensive form of exercise that provides all-round health benefits. Regular Surya Namaskar practice for a week as part of school activities may help in overall physical fitness, aid in healthy lifestyles, and improve the physical status of adolescent girls.

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