



TO COMPARE THE EFFECTIVENESS OF AEROBICS V/S SURYANAMASKAR ON CARDIOPULMONARY ENDURANCE OF COLLEGE STUDENTS WITH INACTIVE LIFESTYLE BY USING THE HARVARD STEP TEST.

An Experimental Study

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Abstract: Physical exercise is a bodily activity which involves body calorie burn and which maintains overall health and wellness. Yoga is the spiritual concept but nowadays it is becoming a very popular form of physical exercise. Suryanamaskar consists of 12 postures, chanted in a particular arrangement with a particular breathing pattern. Aerobic exercise training is an Augmentation of the energy utilization of the muscle by means of an exercise program. The need of the study is to compare the effectiveness of Suryanamaskar v/s Aerobics on the cardiopulmonary endurance of college students with inactive lifestyle so that a best exercise schedule can be followed by them to prevent the onset of the above mentioned diseases at an early age.

Method – Approval from Ethical committee was taken. Students were divided into two groups A and B. Both the groups performed Harvard step test before the exercise protocol and the results were recorded. Group A performed Suryanamaskar and Group B performed Aerobics for 4 weeks under my observation. Harvard step test was performed after the 4 week protocol and the results were recorded. The results were compared by proper statistical analysis.

Result – On comparison there is a significant improvement in the cardiopulmonary endurance of group B students who performed aerobics as compared to group A who performed Suryanamaskar.

Conclusion - This study showed that there is significant improvement in the fitness index of both the groups after performing Aerobics and Suryanamaskar for 4 weeks respectively. On analysis of the post fitness indexes

of Aerobics and Suryanamaskar, Aerobics was found to be clinically more effective than Suryanamaskar for improving cardiopulmonary endurance of college students with inactive lifestyle.

Index Terms - Suryanamaskar, Aerobics, Cardiopulmonary endurance, Inactive lifestyle, Harvard step test.

I. INTRODUCTION

Physical exercise is a bodily activity which involves body calorie burn and that maintains physical fitness and overall health and wellness. Individuals are engaged in physical exercise for various reasons, such as to increase growth and development, strengthen muscles and to develop cardiovascular endurance, athletic skills, weight loss or management and also enjoyment.^[1]

Yoga is the spiritual concept but nowadays it is becoming a very popular form of physical exercise. The major health problems in modern society are obesity, hypertension, diabetes, stroke which occur due to sedentary life style. The cardiovascular endurance is the ability of the heart, lungs and blood vessels to supply a sufficient amount of oxygen and nutrients to the cells to meet demands of daily activities. The beneficial effects of physical exercise on the cardiovascular system are well documented. There is a direct relationship between physical inactivity and cardiovascular efficiency. Regular physical exercise has also shown a beneficial effect on VO₂ max.^[1]

A lack of physical activity causes approximately 6% of the burden of disease from coronary heart disease, 7% of type 2 diabetes, 10% of breast cancer and 10% of colon cancer worldwide and, overall, physical inactivity causes 9% of premature mortality worldwide.^[1]

Most research studies these days use the term inactive to describe people who are performing insufficient amounts of moderate- and vigorous-intensity activity. Adults aged 18–64 years should do at least 150 min of moderate-intensity aerobic physical activity throughout the week, or do at least 75 min of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate and vigorous-intensity activity.^{[2][3]}

Yoga is essentially a spiritual discipline based on an extremely subtle science, which focuses on bringing harmony between mind, soul and body. The word 'Yoga' is derived from the Sanskrit root 'Yuj', which means 'to join' or 'to yoke' or 'to unite'. Yoga includes various Pranayam, Asanas, Suryanamaskar and Meditation.^[4]

Suryanamaskar consists of 12 postures chanted in a particular arrangement with a particular breathing pattern. Suryanamaskar is a beautiful attitude in its basic and every cycle would take only 30-40 seconds to complete with 2 minutes of relaxation. Surya means the 'Sun' and namaskar means 'Salute'. It includes bending down with proper forms with proper breathing technique.^[4]

Aerobic exercise training or Cardiorespiratory endurance training is an augmentation of the energy utilization of the muscle by means of an exercise program.^[5]

The physiological response to Aerobic Exercise includes:

1. Cardiac Effects: Increased frequency of SA node depolarization, increased cardiac output, Increased systolic BP, Reduction in total peripheral resistance.
2. Respiratory Effects: increased gas exchange, Increased muscle metabolism during exercise results in more O₂ extraction from arterial blood, resulting in increased venous P_{co2} and H⁺, increased body temperature, increased epinephrine and increased stimulation of receptors of the joints and muscles. Minute ventilation increases as respiratory frequency and tidal volume increases. Alveolar ventilation increases 10 to 20-fold during heavy exercise.^[5]

Formal aerobics classes are divided into different levels of intensity and complexity and will have five components: warm-up (5–10 minutes), cardiovascular conditioning (25–30 minutes), cool-down (5–8 minutes) and stretching and flexibility (5–8 minutes).^[6]

Cardiovascular endurance is the organism's ability to persist exertion while attaining energy from the aerobic system used to supply body with energy.^[7]

II. METHODOLOGY

This experimental study is conducted on 36 subjects with inactive lifestyle age 18-25 years old at LSFPEFS COP Nigdi. Ethical committee clearance was obtained and permission was taken from the department. Written consent was taken from the subjects who fulfil the inclusion criteria and exclusion criteria. The subjects were informed about the Harvard Step Test and Intervention. The Harvard Step test was performed. The Suryanamaskar and Aerobics protocol was followed for 4 weeks. Post intervention Harvard Step Test values were noted and statistical analysis and interpretation was done.

II. A INCLUSION CRITERIA

- Both genders will be included in study
- Age 18-25 years old
- College going students with inactive lifestyle (1.5-3 MET)
- Recent unhealed fracture (less than 3 months)

II.B EXCLUSION CRITERIA

- Students who exercise regularly (Do moderate or vigorous physical activity more than 3 MET)
- History of recent surgery (less than 3 months)

II.C OUTCOME MEASURES

HARVARD STEP TEST ^[8]

The student steps up and down on step at a rate of 30 steps per minute for 5 minutes or until exhaustion. Exhaustion is defined as when the student cannot maintain the stepping rate for 15 seconds. The student immediately sits down on completion of the test, and the total numbers of heart beats are counted between 1 to 1.5 minutes, between 2 to 2.5 minutes, and between 3 to 3.5 minutes is counted.

$$\text{Fitness Index} = \frac{\text{Duration of Exercise in seconds} \times 100}{2 \times \text{sum of three } \frac{1}{2} \text{ minute pulse counts}}$$



Fig 1



Fig 2

II.D INTERVENTION PROTOCOL

- Consent was taken from the subjects who fulfilled the inclusion criteria and who were interested to participate in the study.
- These students were divided into two groups, Group A and Group B.
- Individuals from both the groups performed Harvard step test before the exercise protocol and results were recorded.
- Group A performed Aerobics and Group B performed Suryanamaskar under my observation for 4 weeks (3 sessions per week).
- Individuals again performed Harvard step test after completing the 4 week protocol and the results were recorded.

Group A	Group B
Warmup	Warmup
Suryanamaskar	Aerobics
Cool down	Cool down



Fig 3 (Suryanamaskar)



Fig 4(Aerobics)

III. STATISTICAL ANALYSIS

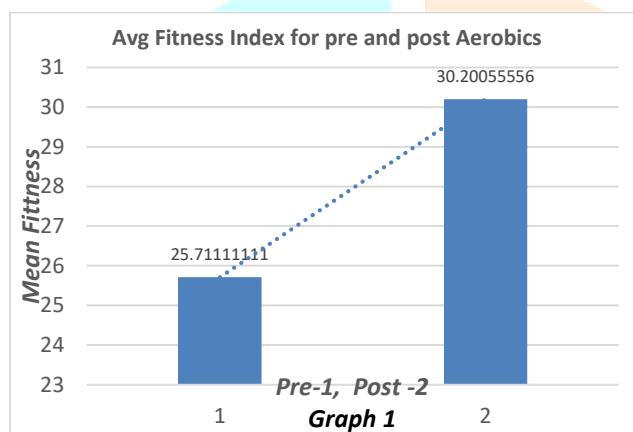
- Data was collected and analysed by using proper statistical tests.
- To compare the pre and post results of Aerobic Exercises, Paired t test was used.
- To compare the pre and post results of Suryanamaskar, Paired t test was used.
- To compare the mean of post exercise results (for both Aerobics and Suryanamaskar) Unpaired t test was used.

IV. RESULTS

Aerobics	Mean	Standard Deviation	Mean Difference	p-value	t-value (obs)	t-value (Critical)
Pre Fitness Index	25.71	12.71				
Post Fitness Index	30.20	14.86	4.48	0.0000134	6.03	2.10

Table 1

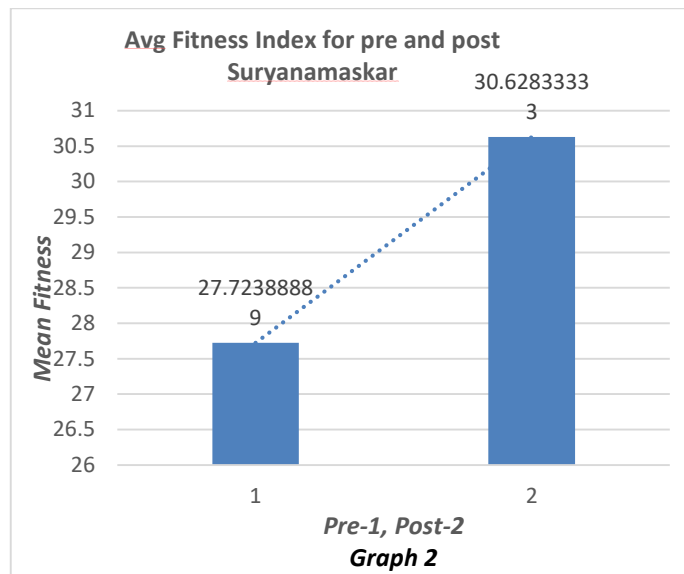
This table shows Paired t test for pre and post fitness index results for Aerobics. This table interprets that there is significant improvement in Fitness Index after performing Aerobics for 4 weeks (p value less than 0.005).



Graph 1: This shows that there is significant improvement in the pre and post fitness index after performing Aerobics for 4 weeks.

Suryanamaskar	Mean	Standard Deviation	Mean Difference	p-value	t-value(obs)	t-value(Critical)
Pre-Fitness Index	27.72	12.04				
Post-Fitness Index	30.62	13.16	2.90	0.00001045	6.16	2.109815577

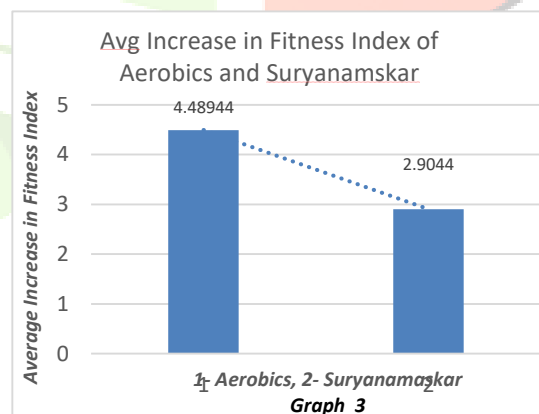
Table 2: This table shows Paired t test for pre and post fitness index results for Suryanamaskar. This table interprets that there is significant improvement in Fitness Index after performing Suryanamaskar for 4 weeks (p value less than 0.005).



Graph 2: This shows that there is significant improvement in the pre and post fitness index after performing Suryanamaskar for 4 weeks.

Methods	Mean	Standard Deviation	Mean Difference	p-value	t-value (obs)	t-value (Critical)
Aerobics	4.48	3.15	1.58	0.040	1.799	1.69
Suryanamaskar	2.90	1.99				

Table 3: Shows the Unpaired t test between the mean values of Aerobics and Suryanamaskar. In this table it can be seen that the p value is more than 0.005. This means that the difference is not statistically significant.



Graph 3: This shows that comparative result between Aerobics and Suryanamaskar is clinically significant.

V. DISCUSSION

Surya Namaskar, a traditional Indian Yogic practice, involves performing twelve physical postures with alternate forward and backward bending. Practicing twelve physical postures of SN constitute one round of its practice. Each forward bending posture is practiced with exhalation to residual volume and backward bending posture with inhalation to total lung capacity (TLC). The practice of SN has become very popular amongst people since its practice gives the benefit of aerobic exercise along with stretching of muscles. The deep breathing performed with each posture also renders some benefits of

breathing exercise. Bicycle exercise, Treadmill and Stepping, are very popular form of aerobic exercise and people practice in gym or at home.

In this study, 36 inactive individuals, between the age group 18-25 years were included. They were divided into two groups, group A and group B. Group A performed Aerobics in progression which included static cycling, treadmill and stepping for 4 weeks. Group B performed Suryanamaskar in progression for 4 weeks. The pre and post Fitness Index of each individual performing Aerobics and Suryanamaskar was calculated by using Harvard step test. The results of both the groups were compared.

After performing four weeks of exercise intervention, both groups showed significant improvements in their fitness index. On comparing the mean of pre and post values of Aerobics, mean for pre Fitness Index is 25.71 ± 12.71 and for post Fitness Index is 30.20 ± 14.86 . On statistical analysis significant difference was seen. ($p=0.0000134$). On comparing the mean of pre and post values of Suryanamaskar, mean for pre Fitness Index is 27.72 ± 12.04 and for post Fitness Index is 30.62 ± 13.16 . On statistical analysis significant difference was seen. ($p=0.0000104$). However, the improvements in group A, who performed Aerobics were significantly greater than those in group B who performed Suryanamaskar. On comparing the mean of difference of post values of aerobics and suryanamaskar, the mean of Aerobics was 4.48 ± 3.15 and the mean of Suryanamaskar was 2.90 ± 1.99 . On statistical analysis no significant difference was seen ($p=0.0404$)

Suryanamaskar is a sequence of yoga postures that are performed in a continuous flow, with controlled breathing. When performed regularly and correctly, it can help improve cardiovascular fitness in several ways. The sequence of postures in Suryanamaskar can help increase your heart rate, which is a key indicator of cardiovascular fitness. When your heart rate increases, the heart pumps more blood and oxygen to the muscles and organs, which improves their function and overall health. The controlled breathing techniques used in Suryanamaskar can help improve lung function and increase oxygen intake, which is essential for cardiovascular health. Suryanamaskar can help reduce stress levels, which is important for cardiovascular health. Stress can contribute to high blood pressure and heart disease, and by reducing stress, Suryanamaskar can help improve cardiovascular health.^[11] One of the studies titled "Comparison of cardiorespiratory responses between Suryanamaskar and bicycle exercise at similar energy expenditure level" by Sinha et al. (2013) aimed to compare the cardiorespiratory responses of Suryanamaskar and cycling exercises when performed at similar energy expenditure levels. This study found that cycling exercise was more effective than Suryanamaskar in improving cardiorespiratory responses even when energy expenditure was similar. The study found that although both exercises produced similar energy expenditure, cycling exercise resulted in higher oxygen consumption, heart rate, and ventilation compared to Suryanamaskar.^[12]

This study found that cycling exercise was more effective than Suryanamaskar in improving cardiorespiratory responses even when energy expenditure was similar. There are several reasons why this may be the case:

Type of exercise: Cycling requires the use of large muscle groups, such as the quadriceps, hamstrings, and glutes, and can increase heart rate and breathing rate quickly, leading to a greater demand for oxygen uptake and delivery to the working muscles.

Mode of exercise: Cycling is a continuous, rhythmic movement that allows for a sustained increase in heart rate and oxygen consumption. In contrast, Suryanamaskar involves a series of static and dynamic yoga postures that may not provide the same level of sustained aerobic exercise.

This study is in support with the present study where Aerobics (which consisted of Cycling, Treadmill and Stepping) was being compared with Suryanamaskar. In the results, Aerobics was seen to be more effective than Suryanamaskar. The reason being, Aerobic exercise increases blood flow to the muscles, providing them with more oxygen and nutrients. This helps the muscles work more efficiently and improves the muscles' ability to use oxygen to produce energy, increasing their oxidative capacity. This allows the muscles to work longer before becoming fatigued.

VI. CONCLUSION

This study showed that there is significant improvement in the fitness index of both the groups after performing Aerobics and Suryanamaskar for 4 weeks respectively. On analysis of the post fitness indexes of Aerobics and Suryanamaskar, Aerobics was found to be clinically more effective than Suryanamaskar for improving cardiopulmonary endurance of college students with inactive lifestyle.

VII. CLINICAL IMPLICATION

This study suggests that incorporating Aerobics and Suryanamaskar is a great way to improve the Cardiopulmonary Endurance of college students with inactive lifestyle. But, not all types of exercises are equally effective for improving the Cardiopulmonary Endurance. Clinicians can use this information to customize exercise programs based on the individual needs of their patients. This study can also be used to educate young population on the importance of regular physical exercise and the benefits it can have on their overall health.

VIII. LIMITATION OF STUDY

- Small population was included in the study.
- The height of the individuals included in this study was not considered. Individuals with less height faced difficulty in performing the Harvard step test as compared to tall individuals due to the height of the stepper.
- Aerobic exercises focused only on the lower extremities, whereas Suryanamaskar focused on the entire body. So, the study became biased.

IX. RECOMENDATION AND FUTURE SCOPE OF STUDY

- This study can further be continued on large sample size.
- This study can be done in women having peri menopausal symptoms by using other Exercise tolerance tests.
- Height of the individuals can be considered in the upcoming study.
- This study can also be done on sedentary population of other age groups.

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