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Effect of surya namaskar and aerobic exercise on cardiovascular endurance among students

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Abstract
Background: Cardio respiratory endurance is defined as the capacity of both blood and respiratory system to deliver oxygen to the skeletal muscles during prolonged performance of physical activities. [4] Current studies shows that aerobic exercise could improve the inhibitory control in healthy children, adolescents, and adults. Scientific studies have proven that Surya namaskar has a beneficial impact on the general integrated model functional capability of the heart, lungs and the blood system, which contributes to physical health and performance, and cardiac autonomic functions affecting heart rate variability control. [2]
Purpose of the study: This study is aimed to compare the effects of Surya namaskar and aerobic exercise on cardiovascular endurance on individuals preferably NIEPMD college students
Methodology: After obtaining informed consent, a baseline assessment was conducted. Subject will be checked for the inclusion criteria, exclusion criteria and were randomly allotted to Group1 in which the subjects were trained to perform Surya Namaskar or Group 2 in which they performed Aerobic exercises like Treadmill walking and Static cycling along with Surya Namaskar.
Result: 6-minute walk test was taken as the outcome measure to check the effectiveness of the exercises. The 6 Minute Walk Test is a sub-maximal exercise test used to assess aerobic capacity and endurance. Data analysis revealed significant improvements in cardiovascular endurance among Group 2 students.
Conclusion: From this study it has been concluded that Surya Namaskar exercise along with aerobic exercises showed significant improvement in cardiovascular endurance than Surya Namaskar exercises alone, in college students.

Keywords: Surya namaskar, aerobic exercises, cardiovascular endurance, 6-minute walk test

Introduction

Cardio respiratory endurance is defined as the capacity of both blood and respiratory system to deliver oxygen to the skeletal muscles during prolonged performance of physical activities. [4] The major role of the cardiovascular system in exercise with large volume of exertion is to supply oxygen and other substrates to the active skeletal muscles and to the removal of metabolic waste sloughed off by the active muscles.

In addition to these, at least two more changes occur in the cardiovascular response to aerobic exercise: maximal cardiac output and stroke volume increase, while resting heart rate decreases, further, the muscle fibre capillary density also increases because of aerobic training. Central cardiovascular function enhancement accounts for one of the major mechanisms that increase maximal oxygen uptake. The normal discharge rate of the sinoatrial (SA) node is between 60 and 80 Bpm. With aerobic training, there is a significant delay in the discharging rate because of increased inhibition by parasympathetic nervous activity. So, heart rate during rest is also in part determined by increased stroke volume causing a lower rate.

The connection between the sympathetic nervous system (SNS) and heart disease is beyond doubt. Sympathetic tone elevation is a feature of the pathophysiology of primary hypertension, atrial fibrillation, and congestive heart failure. In contrast, we see a wide consensus of the literature regarding the highly protective effects of physical exercise. Some biological mechanisms responsible for these positive effects have been put forward, such as decreased metabolic work of the myocardium and better electrical stability, both of which are related to the autonomic nervous system. This implies that perhaps one of the ways by which exercise achieves its protective effect against heart diseases is through a reduction in SNS activity. [12]

Scientific studies have proven that Surya namaskar has a beneficial impact on the general integrated model functional capability of the heart, lungs and the blood system, which contributes to physical health and performance, and cardiac autonomic functions affecting heart rate variability control. [2] The most favourable time of practicing Surya Namaskar is at dawn, being the most quiet period of the day.

In all outdoor practice, it is recommended to face the sun as it rises in the east. Another good moment for practice is twilight. Surya Namaskar, however, can be practiced at any time except when the stomach is full.

It is a custom of times immemorial, enduring since Vedic times. The physical basis of the practice joins 12 asanas in a dynamically performed series. These asanas are ordered so that they stretch the spine in alternate directions: back and forward. It is important to note that when asanas are performed, inhalation and exhalation are alternately involved when the body shifts from one posture into the other. One round of Surya Namaskar is understood as two cycles of 12 postures, performing again the same second round, starting with a different leg. With growing scientific

scrutiny of yoga practice its therapeutic benefits are also coming to the fore which makes Surya Namaskar more beneficial to its practitioners. Surya Namaskar practice develops health and fitness, it is said. [4]

These days there are a lot of modern scientific studies on the practice of hardly complex yoga techniques referred to as Surya Namaskar. The term 'Surya namaskar' itself refers to sun salutation in English originating from the two words Surya meaning sun and namaskar meaning bending in respectful manner. For many people, limited range of asanas helps enhance all the movements of the body, so individual characteristics combine in one system. This effect produces a wave-like feeling throughout. Because people are too busy in our modern-day fast era, this practice may take little time but still be highly effective for oneself. On the other hand, it has also been suggested that practicing Surya namaskar achieves the combined benefits found in both asana and pranayama thus improving cardiovascular endurance, physical, psychological, and spiritual well-being of an individual. [3]

The aerobic exercise period is the training part of the exercise program. Attention to the determinants of frequency, intensity, time and type of the program has an impact on the effectiveness of the program. The main consideration when choosing a specific method of training is that the intensity be great enough to stimulate an increase in the stroke volume and cardiac output and to enhance local circulation and aerobic metabolism in the appropriate muscle group.

Aerobic exercise can be defined as any physical activity that depends primarily on the aerobic energy generating process, on the condition that it is off sufficient intensity to maintain or improve physical fitness or to improve cardiovascular endurance.

Undergraduate medical students have high stress levels related to school and work simultaneously throughout their day-to-day activities compared to people around the globe. The link between acquired obesity due to stress is quite blurred as well.

Current studies show that aerobic exercise could improve the inhibitory control in healthy children, adolescents, and adults.

This study is aimed to compare the effects of Surya namaskar and aerobic exercise on cardiovascular endurance on individuals preferably NIEPMD college students. The level of cardiovascular endurance can be measure using 6 minutes walk test. To achieve that, it was decided to find the outcome of Surya namaskar and Surya namaskar along with aerobic exercises on cardiovascular endurance, and then compare the effects of both type of exercise on the level of cardiovascular endurance and to know which is better in improving the cardiovascular endurance among NIEPMD students.

Methodology

Trial designs and participants

The quasi- experimental study was conducted at College of Physiotherapy, NIEPMD (D), Muttukadu, Tamil Nadu, India. Students of both genders in age group between 18 to 25 years were included in the study.20 students from NIEPMD (D) were randomly allocated to Group 1 or Group 2.

Intervention

Students in Group 1 were trained to perform Surya Namaskar. Each of the 12 poses was held for duration of 20 seconds. Each round took 4 minutes to complete and total 3 rounds were performed in 12 minutes. Totally each student performed the Surya Namaskr exercise 15 times a week for 4 weeks.

Students in Group 2 were also trained to perform Surya Namaskar along with aerobic exercises such as treadmill walking and static cycling. In this study students were allowed to perform the static cycling for 15 min and their heart rate, pulse rate and the blood pressure are measured before and after the activity in order to calculate the effectiveness of the activity to increase the cardiovascular endurance. After warming up, Group 2 performed exercise on treadmill. Subjects were asked to walk on the treadmill for 15 min with their normal speed (3.5 m/s). And to report if they feel any discomfort like nausea, chest pain, headache, excessive sweating etc. during the procedure .Subjects should hold the treadmill bar and asked to walk with erect posture.

Outcome Measure

The main outcome measure was 6-minute walk test (6 MWT) – for measuring the cardiovascular endurance among NIEPMD college students. The 6 Minute Walk Test is a sub-maximal exercise test used to assess aerobic capacity and endurance. The distance covered over a time of 6 minutes is used as the outcome to compare changes in performance capacity.

Results

Table 1: The table shows the standard deviation, standard mean of post and pre-test values of both groups in 6 Minute walk tests.

Pair	Comparison	Mean	Standard deviation
1	Group 1 (Pre vs Post)	41.80	4.57
2	|Group 2 (Pre vs Post)	76.80	7.90

Table 2: Within group analysis of Group 1:

Group 1	Pre-Test Avg	Post Test Avg	Mean Difference	Standard Deviation	T Value	P Value
	475.4	517.2	41.81	4.56	28.952	<0.01

Group 1 showed a significant and consistent improvement after the intervention**,** and the results are statistically reliable**.**

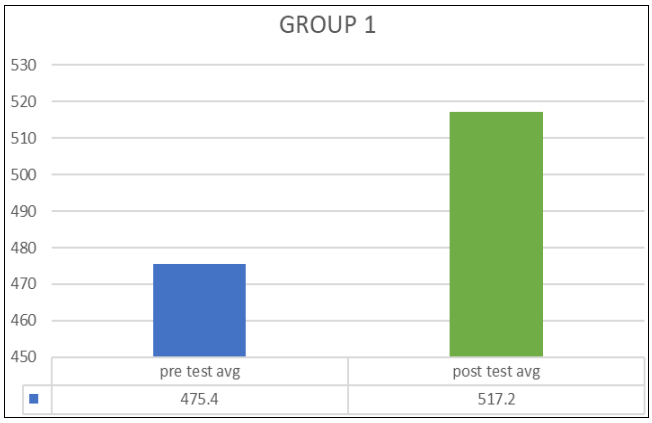

Fig 1: Within group analysis of Group 1

Table 3: Within group analysis of Group 2

Group 2	Pre-test avg	Posttest avg	Mean difference	Standard deviation	T value	P value
	488.4	565.2	76.8	7.89	30.74	<0.01

Group 2 showed a large, statistically significant improvement after treatment**,** with strong and reliable results.

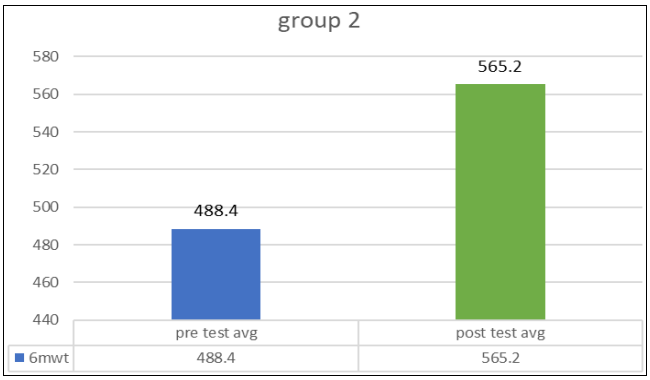

Fig 2:

Table 4:

Group	6MWT mean difference
1	41.81
2	76.80

Comparing the Mean Difference in Both the Groups, It Can Be Concluded That Group 2 Has a Higher Mean Difference than Group 1.

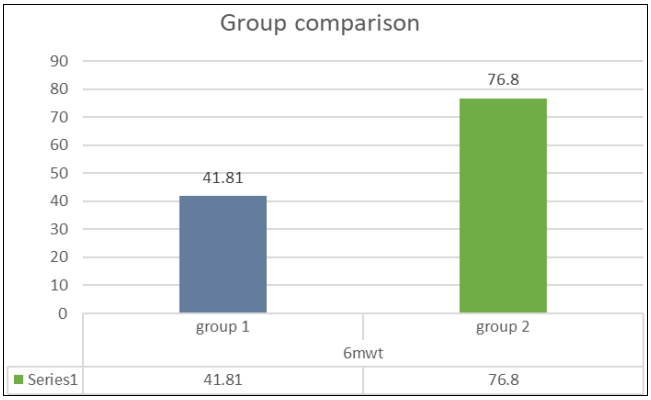

Fig 3:

Discussion

The present quasi-experimental study aimed to evaluate and compare the effectiveness of Surya Namaskar alone (Group 1) and Surya Namaskar combined with aerobic exercises (Group 2) on cardiovascular endurance among college students, using the 6-Minute Walk Test (6MWT) as the outcome measure.

The results of this study clearly demonstrate that both interventions led to significant improvements in cardiovascular endurance. However, the magnitude of improvement differed notably between the two groups.

In Group 1, participants who performed only Surya Namaskar showed a mean improvement of 41.81 meters in the 6MWT. This indicates that Surya Namaskar, as a structured sequence of dynamic postures, contributes positively to cardiovascular fitness. The improvement can be attributed to the rhythmic movements, coordinated breathing, and involvement of major muscle groups, which together enhance circulation and oxygen utilization.

In contrast, Group 2 exhibited a much higher mean improvement of 76.8 meters, indicating superior enhancement in cardiovascular endurance. This group combined Surya Namaskar with aerobic exercises such as treadmill walking and static cycling, both of which are well-established methods for improving aerobic capacity. The significantly higher improvement suggests a synergistic effect when combining yoga-based practices with conventional aerobic training.

The aerobic exercise period is the training part of the exercise program. Attention to the determinants of frequency, intensity, time and type of the program has an impact on the effectiveness of the program.

Aerobic exercise can be defined as any physical activity that depends primarily on the aerobic energy generating process, on the condition that it is off sufficient intensity to maintain or improve physical fitness or to improve cardiovascular endurance.

Undergraduate medical students have high stress levels related to school and work simultaneously throughout their day-to-day activities compared to people around the globe. The link between acquired obesity due to stress is quite blurred as well.

Aerobic exercise could improve the inhibitory control in healthy children, adolescents, and adults. Aerobic exercise is physical activity that uses your body's large muscle groups, is rhythmic and repetitive. Here the heart rate, pulse rate and the blood pressure are measured before and after the activity to calculate the effectiveness of the activity in increasing the cardiovascular endurance. Data analysis revealed that significant improvements in cardiovascular endurance among NIEPMD students.

Statistical Significance and Reliability

Both groups demonstrated highly significant results ($p < 0.01$), indicating that the improvements observed were not due to chance. The t-values (28.952 for Group 1 and 30.74 for Group 2) further confirm the strength and reliability of the interventions.

The standard deviation values in both groups were relatively low (4.56 in Group 1 and 7.89 in Group 2), suggesting that the improvements were consistent among participants. Although Group 2 showed slightly higher variability, it is expected due to the inclusion of multiple exercise modalities.

When comparing both groups, it is evident that Group 2 outperformed Group 1 in improving cardiovascular endurance. The difference in mean improvement (76.8 vs. 41.81) highlights the added benefit of incorporating aerobic exercises along with Surya Namaskar.

This finding supports the principle that combined training programs (yoga + aerobic exercise) are more effective than single-mode interventions. While Surya Namaskar alone provides moderate cardiovascular benefits, the addition of structured aerobic activities enhances heart rate response, oxygen uptake, and endurance capacity to a greater extent.

The observed improvements can be explained through physiological adaptations

- Surya Namaskar improves flexibility, muscular endurance, and promotes controlled breathing, which indirectly supports cardiovascular function.

- Aerobic exercises such as treadmill walking and cycling directly target the cardiovascular system by increasing heart rate, stroke volume, and oxygen consumption.
- The combination of both leads to improved cardiorespiratory efficiency, better energy utilization, and increased endurance.

The findings of this study have important implications for physiotherapy and fitness training:

- Surya Namaskar can be used as a simple, low-cost intervention to improve cardiovascular endurance in young adults.
- Combining yoga with aerobic exercises can provide maximum benefits in a shorter duration.
- This combined approach can be recommended in rehabilitation programs, fitness training, and preventive health strategies.

Conclusion

In summary, both interventions were effective in improving cardiovascular endurance, but Surya Namaskar combined with aerobic exercise was significantly more effective than Surya Namaskar alone. This highlights the importance of incorporating multi-modal exercise programs for optimal cardiovascular benefits.

Limitations of the Study

Despite the positive findings, certain limitations should be considered

- The sample size was small (n = 20)**,** which may limit generalizability.
- The study duration was only 4 weeks, which may not reflect long-term effects.
- Only one outcome measure (6MWT) was used; inclusion of additional parameters like VO_2 max could provide deeper insights.

Future Recommendations

- Future studies should include a larger sample size and longer duration.
- Inclusion of different age groups and clinical populations would enhance applicability.
- Additional physiological measures such as heart rate variability and VO_2 max should be assessed.

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