

A Comparative Study on Effect of Suryanamaskar and Aerobic Dance on Physical Fitness

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Abstract: *This study assesses and compares the effect of Aerobic dance and Suryanamaskar on three aspects of physical fitness, flexibility, cardiovascular endurance, static and dynamic balance, by using the outcome measures, modified sit and reach test, one leg stance test, step test and star excursion balance test respectively. Two different groups were formulated, 30 participants were taken in suryanamaskar and aerobic dance group, 15 participants in each group, put through four weeks protocol of suryanamaskar and aerobic dance performed on alternative days. Pre and post protocol assessment within both the groups showed significant improvement in all the outcome measures. Post protocol, on comparison between the two groups showed significant improvement in modified sit and reach test (p value= 0.0163), in Aerobic Dance group, whereas rest of the outcome measures did not show any significant improvement between the two groups comparatively. The findings suggest a significant improvement in flexibility, balance and cardiovascular endurance, pre and post protocol within both the groups. On comparing post protocol between the two groups, modified sit and reach test showed significant improvement in Aerobic Dance group suggesting it being more effective in improving flexibility, rest of the outcome measures did not show any significant improvement.*

Keywords: Aerobic Dance, Suryanamaskar, Flexibility, Balance, Cardiovascular Endurance

1. Introduction

One of the factors that make it possible to maintain good health is physical activity. Low physical activity increases the risk of obesity, ischemic heart disease, increased content of triacylglycerols and low-density lipoproteins in the blood (LDL), arterial hypertension, cerebral stroke, post-meal postprandial hyperinsulinemia and carbohydrate intolerance, type-two diabetes, osteoporosis, malignant neoplasms (colon, prostate, lung, breast), depression and others [5]. Being physically fit has been characterized as the capacity to complete everyday tasks with life and readiness, without undue fatigue and with plentiful vitality to appreciate relaxation time interests and to meet unforeseen crisis [3]. Undergraduate physiotherapy students represent a group of young-adults expected to have a good working knowledge of physical activity and related health benefits. They are expected to promote and prescribe exercise to patients and the general public. It is estimated that nearly one-fifth of the world's population is physically inactive [10]. The demands of physiotherapy practice are diverse and require practitioners to demonstrate an optimal level of fitness to be able to deliver quality service to their clients and patients. The physical tasks involve safe handling and moving of patients, gait training and using body segments to provide support and resistance during treatment sessions [13].

Components of fitness include:

Cardiorespiratory endurance - is the ability to perform large muscle dynamic exercise, such as walking, swimming, and/or biking for long periods of time. [7]

Flexibility - is the ability to bend and move a single joint or series of joints smoothly and easily through an unrestricted, pain free range of motion. [7]

Balance - it is a generic term used to describe the dynamic process by which the body's position is maintained in

equilibrium. [7]

Body composition-a ratio of amount of fat on the body versus other tissues such as muscle, bones and skin. [12]

Muscular strength- is the greatest measurable force that can be exerted by a muscle or a muscle group to overcome resistance during a single maximum effort. [7]

Muscular endurance - is the ability of a muscle to contract repeatedly against a resistance, generate and sustain tension, and resist fatigue over an extended period of time. [7]

Aerobic Dance has become a popular mode of exercise especially among women due to its fun nature. With a catchy music background and joyful dance steps, aerobic dancers would be able to have fun while sweating out. Depending on its level of aggressiveness, aerobic may also improve and maintain cardiorespiratory fitness other than being a great tool for weight loss. [3]

Surya Namaskar, is a series of 12 physical postures made up of a variety of forward and backward bends. The series of movements stretch the spinal column and upper and lower body through their full range of motion, massaging, toning and stimulating vital organs by alternately flexing the body forwards and backwards[2]. It has been suggested that Suryanamaskar at different speeds provides different benefits and that when it is done rapidly it warms up the body and acts as a cardiotonic, whereas when done slowly it strengthens and tones the musculature and enhances functioning of internal organs.[11]. There are many ways to achieve fitness by using, aerobic methods, weight training, pilates, different form of martial arts, however there is a paucity of literature regarding comparison Of Surya Namaskar Yoga and Aerobic Dance in improvising fitness of healthy young physiotherapy students. Hence this study was undertaken.

2. Methodology

Aim and Objective of the study were:

To study and compare the effects of suryanamaskar and aerobic dance protocol on flexibility, cardiorespiratory endurance and balance on undergraduate students.

To Assess the Pre and Post Protocol:

- Flexibility
- Cardiorespiratory Endurance
- Balance

In the suryanamaskar group and aerobic dance group

To Compare the Effects of Post Protocol:

- Flexibility
- Cardiorespiratory Endurance
- Balance

Between the suryanamaskar group and aerobic dance group.

Type of study: Interventional and Comparative.

Sample Size: 30 physiotherapy students. (15 students in each group).

Inclusion Criteria: Healthy, female, undergraduate /postgraduate students (Age 18-30).

Exclusion Criteria: Any conditions affecting cardiovascular, pulmonary, musculoskeletal, neurological, immunological systems, diagnosed psychiatric affection, subjects exercising regularly. Prior written consent was taken from the subjects (with a full detailed explanation being given about the tests and protocol that was conducted over a span of 4 Weeks (3 days a week, alternate days). A data record sheet was filled in which subjects age, and their outcome measures (Modified Sit and Reach Test for flexibility, One Leg Stance Test for static balance, Star Excursion Balance Test for dynamic balance, Harvard Step Test for endurance) were assessed before the start of the study.

RPE (Rate of Perceived Exertion) according to Borg's scale was recorded for both the groups after end of each session to maintain equal intensity of the protocol for both the groups at each level of progression.

The students were divided in 2 groups of - Suryanamaskar And Aerobic Dance, 15 students each group:

• Surya Namaskar group:

Consisting of warm up, Surya Namaskar and cool down. Warm up consists of active movements at all joints of the body [1]. For Fast Suryanamaskar, the subjects were trained to perform Suryanamaskar in a rapid manner so that all 12 postures were completed in 2 minutes. For Slow Suryanamaskar, the subjects were trained to perform suryanamaskar in a slow manner so that each of the 12 postures was held for 30 seconds, fifteen rounds were performed in 30-40 minute. [11], performed for a span of four weeks, alternative days, 3 days a week.



Figure 1: Subjects performing Suryanamaskar



Figure 2: Subjects performing Suryanamaskar

• Aerobic Dance group:

Consisting of warm up, dance and cool down. Warm up consisted of active movements of all body joints followed [1]. Aerobic Dance consisted of one choreography sequence of aerobic training consisted of dance elements and structures. A total of 20 choreographed sequences were performed. One choreographed sequence consisted of "four eights". "One eight" consisted of eight movements and motions. The entire choreographed sequence consisted of 32 movements and motions. There were combinations with jumps and more intense arm and body movements. 20 choreographed sequences consisting of march (walk), step touch, double step touch, side to side, leg curl, double leg curl, knee up, double knee up, grapevine, mambo, cha-cha-cha, V step, squat, hop, jump, turn. Total duration of 35 minutes, performed for a span of four weeks, alternative days, 3 days a week. [9]

Cool down consists of active movements done slowly. [1]



Figure 3: Subjects performing Aerobic Dance



Figure 4: Subjects performing Aerobic Dance

At the end of four weeks outcomes measures were assessed. Students were asked to wear loose clothes to prevent restriction of movements.

Outcome Measures

Modified Sit and Reach Test



Figure 5: Subject performing Modified Sit and Reach Test.

In this test subject sits on the floor with buttocks, shoulders, and head in contact with the wall; extends the knees; and places the soles of the feet against the box. A ruler is placed on top of the box with the zero end toward the subject. Keeping the head and shoulders in contact with the wall, the subject reaches forward with one hand on top of the other, and the ruler is positioned so that it touches the fingertips. This procedure establishes the relative zero point for each subject. As you firmly hold the ruler in place, the subject reaches forward slowly, sliding the fingers along the top of the ruler (Figure 5). The score is the most distant point on the ruler contacted by the fingertips [5]. Hold the full reach position for 2 seconds and score was recorded.

One Leg Stance Test

Used to test static balance. It was performed only eyes closed. Subject was asked to stand barefoot. Subjects were asked to stand barefoot on the limb of their choice, with the other limb raised so that the raised foot was near but not touching the ankle of their stance limb. Prior to raising the limb, the subject was instructed to cross her arms over the chest, then instructed to shut both the eyes. Time commences when the subject raised the foot off the floor. Time ended when the subject either: used her arms (i.e., uncrossed her arms), used the raised foot (moved it towards or away from the standing limb or touched the floor), moved the weight-bearing foot to maintain her balance (i.e., rotated foot on the ground), or opened eyes. The procedure was repeated 3 times and the best of the 3 trials was considered. [6]



Figure 6: Subject performing One Leg Stance Test

Star Excursion Balance Test



Figure 7: Subject performing Star Excursion Balance Test

It is a test to check dynamic balance. [4]

The goal of the test is to maintain a single leg stance on one leg at the midpoint of intersection of all the 3 lines (anterior, posterolateral, posteromedial) while reaching as far as possible with the contralateral leg. The subjects performing the test must maintain their balance on the single stance leg of their choice, while using the other leg to reach as far as possible in 3 different directions (posterolateral, posteromedial, anterior).

The test was performed 3 times and the best out of the three results was taken. The test was nullified and had to be repeated if the subject commits any of the following errors:

- Makes a heavy touch.
- Rests the foot on the ground.
- Loses balance.
- Cannot return to the starting position under control [14]

Harvard step test



Figure 8: Subject performing Step Test

Platform height being 46 cms, subjects were asked to perform step up down at speed of 30 steps per min until not able to maintain speeds for 15 seconds Pre heart rate and blood pressure of the subject was measured and the subject was asked to perform the step up test according to the beeps of the music, subjects was asked to climb the step on one beep and to descend on the next. Time for which the subject can perform the test was noted. The time, at which the subject feels that he cannot perform the test any more was taken into consideration. This time is known as the Time of exhaustion. After the completion of the test the immediate post heart rate of the subject was noted. Then subsequent three post heart rates were measured as 1 to 1.5, 2 to 2.5, 3 to 3.5 minutes.

Formula - $T * 100 / h \times 2$, where:

T = time until exhaustion in seconds, h = total heart beats [15].

Outcome is equated as:

Table 1: Fitness Index Scoring (For Female) [16]

Rating	Fitness Index
Excellent	> 86
Above Average	76-86
Average	61-75
Low average	50-60
Poor	< 50

3. Result and Analysis

The data was analysed using Graph-Pad Instat 3.10 Pre and post protocol assessments done in Aerobic Dance and Suryanamaskar groups.

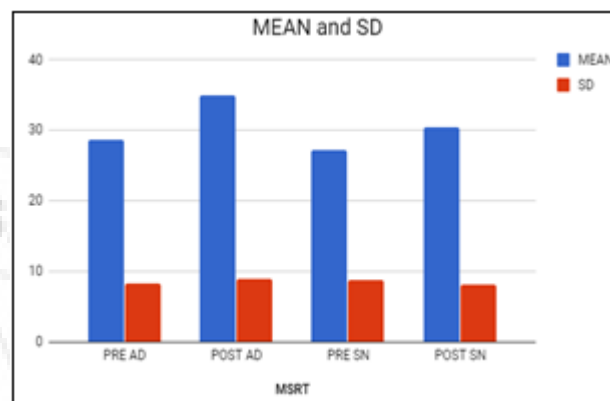
The means of the pre and post protocol, for all three outcome measures, within the respective groups were assessed using Paired T test for those data that passed the normality test and using Wilcoxon Matched Pair Signed Rank Test, for those data that did not pass the normality test.

AD: Aerobic Dance, SN: Suryanamaskar, SD: Standard Deviation, MSRT: Modified Sit and Reach Test.

Table 2: Assessment of Modified Sit and Reach Test pre and post protocol for Aerobic Dance and Suryanamaskar groups.

MSRT	Mean	SD	P value	Significance
Pre AD	28.633	8.336	< 0.0001	Extremely Significant
Post AD	35	8.896		
Pre SN	27.167	8.805	0.0003	Extremely Significant
Post SN	30.4	8.078		

Test applied for: Aerobic Dance group- Paired T Test
Suryanamaskar group- Paired T Test



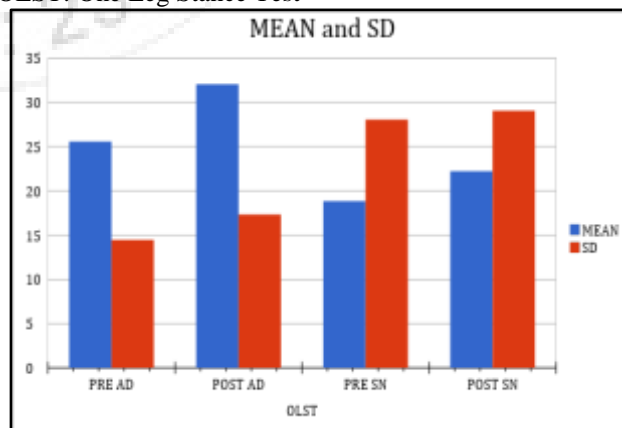
Graph 1: Significant improvement was observed in flexibility in both the group

Table 3: Assessment of One Leg Stance Test pre and post protocol for Aerobic Dance and Suryanamaskar groups

OLST	Mean	SD	P value	Significance
Pre AD	25.6	14.476	0.0068	Extremely Significant
Post AD	32.067	17.327		
Pre SN	18.867	28.086	< 0.0001	Extremely Significant
Post SN	22.233	29.065		

Test applied for: Aerobic Dance group - Paired T Test
Suryanamaskar group-Wilcoxon Matched Pair Signed Rank.

OLST: One Leg Stance Test

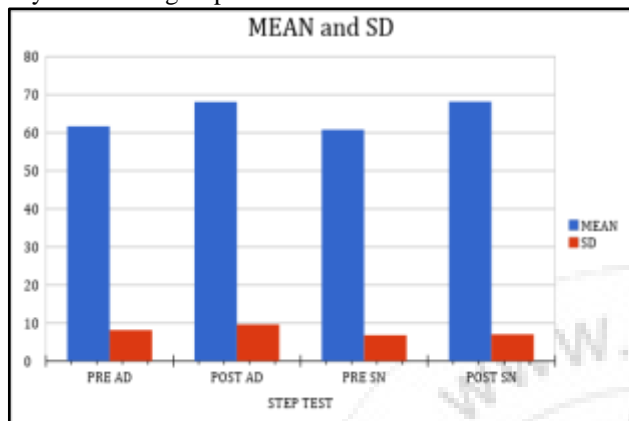


Graph 2: Significant improvement was observed in one leg stance test in both the groups

Table 4: Assessment of Step Test pre and post protocol for Aerobic Dance and Suryanamaskar groups.

Step Test	Mean	SD	P value	Significance
Pre AD	61.66	8.135	< 0.0001	Extremely Significant
Post AD	68.099	9.6		
Pre SN	60.807	6.77	< 0.0001	Extremely Significant
Post SN	68.176	7.015		

Test applied for: Aerobic Dance group - Wilcoxon Matched Pair Signed Rank Test
 Suryanamaskar group- Paired T Test

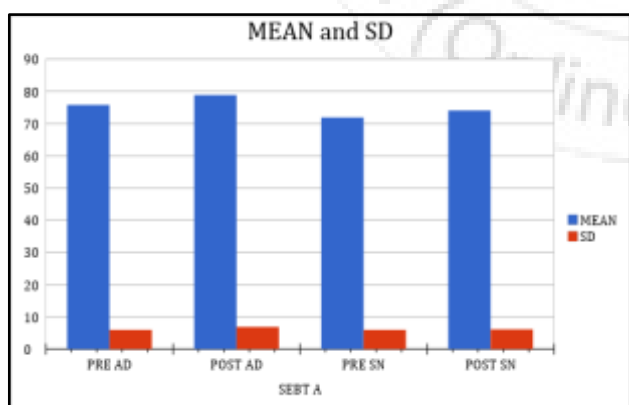


Graph 3: Significant improvement was observed in Step Test in both the groups

Table 5: Assessment of Star Excursion Balance Test in Anterior Direction pre and post protocol for Aerobic Dance and Suryanamaskar groups

SEBT A	Mean	SD	P value	Significance
Pre AD	75.8	6.014	0.0004	Extremely Significant
Post AD	78.933	6.912		
Pre SN	71.933	6.009	< 0.0001	Extremely Significant
Post SN	74.067	6.147		

Test applied for: Aerobic Dance group - Paired T Test,
 Suryanamaskar group - Paired T Test
 SEBT: Star Excursion Balance Test, A: Anterior

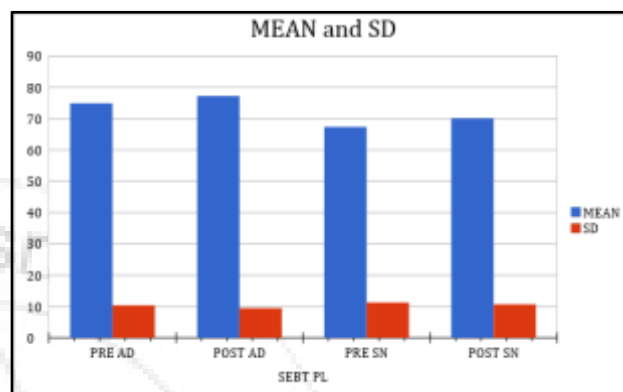


Graph 4: Significant improvement was observed in Star Excursion Balance Test in anterior direction in both the groups.

Table 6: Assessment of Star Excursion Balance Test in Posterolateral Direction pre and post protocol for Aerobic Dance and Suryanamaskar groups

SEBT PL	Mean	SD	P value	Significance
Pre AD	74.9	10.403	0.0001	Extremely Significant
Post AD	77.2	9.466		
Pre SN	67.367	11.251	0.0003	Extremely Significant
Post SN	70.1	10.734		

Test applied for: Aerobic Dance group - Wilcoxon Matched Pair Signed Rank Test
 Suryanamaskar group- Paired T Test
 PL: Posterolateral

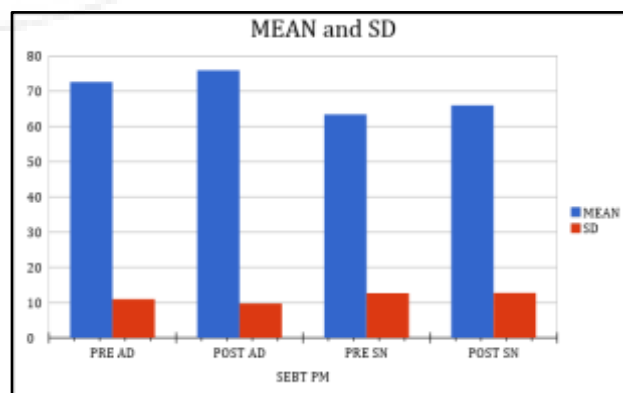


Graph 5: Significant improvement was observed in Star Excursion Balance Test in Posterolateral direction in both the groups

Table 7: Assessment of Star Excursion Balance Test in Posteromedial Direction pre and post protocol for Aerobic Dance and Suryanamaskar groups

SEBT PM	Mean	SD	P value	Significance
Pre AD	72.633	10.981	0.0001	Extremely Significant
Post AD	75.933	9.699		
Pre SN	63.433	12.65	0.0008	Extremely Significant
Post SN	66	12.722		

Test applied for: Aerobic Dance group - Wilcoxon Matched Pair Signed Rank Test
 Suryanamaskar group- Paired T Test
 PM- Posteromedial



Graph 6: Significant changes were observed in Star Excursion Balance Test in posteromedial direction in both the groups

Comparing the effects of post protocol respective parameters of suryanamaskar and aerobic dance.

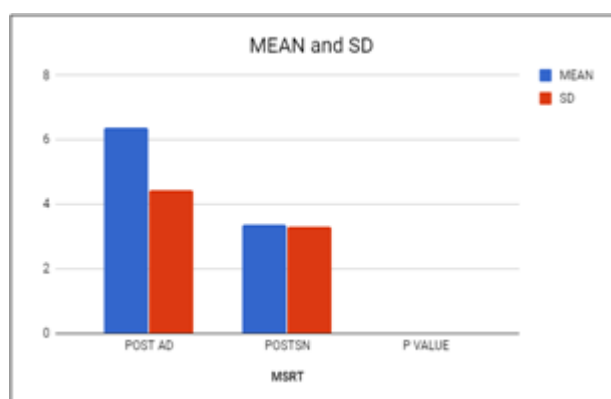
The means of all the three outcome measures, of both the groups, post protocol, was compared using Mann Whitney test and Unpaired T Test.

AD: Aerobic Dance, SN: Surya Namaskar, SD: Standard Deviation, MSRT: Modified Sit and Reach Test.

Table 8: Comparison of Modified Sit and Reach Test, post protocol between Aerobic Dance and Suryanamaskar groups.

Modified Sit and Reach Test	Post AD	Post SN	P value	Significance
Mean	6.367	3.367	0.0163	Significant
SD	4.43	3.289		

Test used: Mann -Whitney



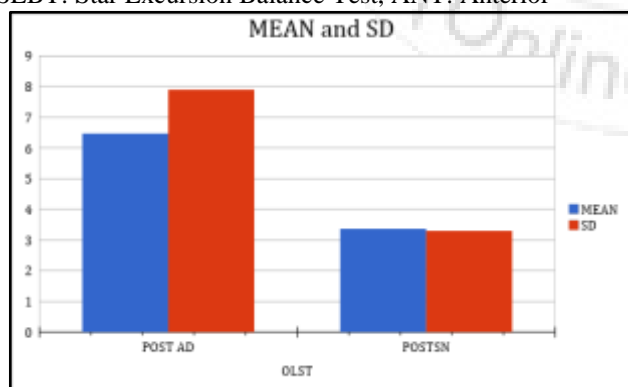
Graph 7: Significant improvement was observed in flexibility between both the groups out of which mean value of Aerobic dance showed better improvement.

Table 9: Comparison of One Leg Stance Test, post protocol between Aerobic Dance and Suryanamaskar groups.

OLST	Post AD	Post SN	P value	Significance
Mean	6.467	3.367	0.2637	Not Significant
SD	7.9	3.289		

Test used: Mann -Whitney

SEBT: Star Excursion Balance Test, ANT: Anterior

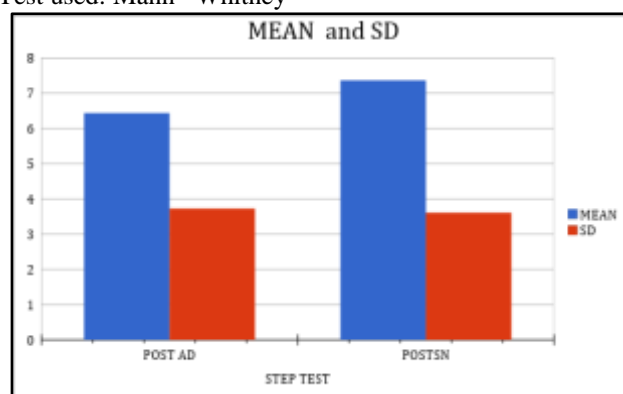


Graph 8: No significant improvement was observed in One Leg Stance Test between the two groups

Table 10: Comparison of Step Test, post protocol between Aerobic Dance and Suryanamaskar groups.

SEBT Test	Post AD	Post SN	P value	Significance
Mean	6.439	7.369	0.7244	Not Significant
SD	3.728	3.609		

Test used: Mann –Whitney



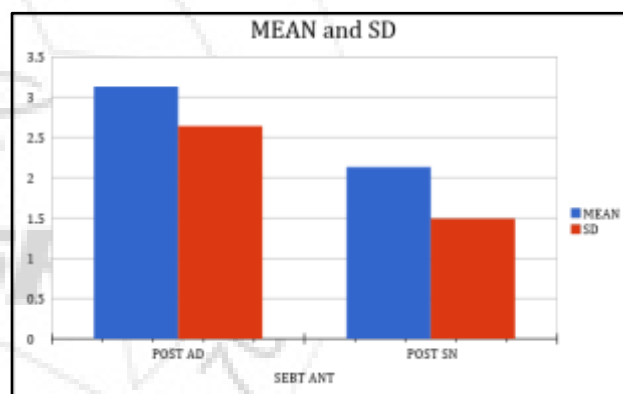
Graph 9: No significant improvement was observed in Step Test between the two groups.

Table 11: Comparison of Star Excursion Balance Test in anterior direction, post protocol between Aerobic Dance and Suryanamaskar groups

SEBT ANT	Post AD	Post SN	P value	Significance
Mean	3.133	2.133	0.2399	Not Significant
SD	2.642	1.494		

Test used: Mann -Whitney

SEBT: Star Excursion Balance Test, ANT: Anterior



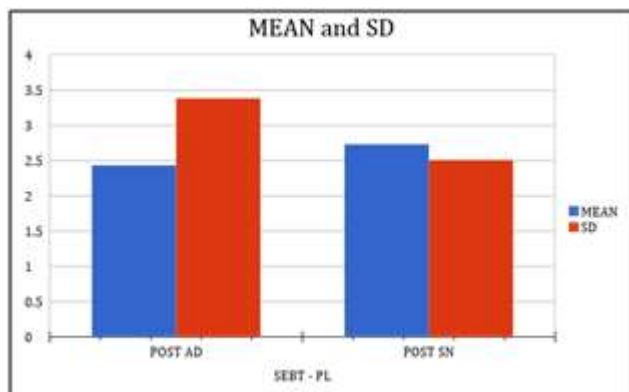
Graph 10: No significant improvement was observed in Star Excursion Balance Test in Anterior direction between both the groups.

Table 12: Comparison of Star Excursion Balance Test in posterolateral direction, post protocol between Aerobic Dance and Suryanamaskar groups

SEBT PL	Post AD	Post SN	P value	Significance
Mean	2.433	2.733	0.3079	Not Significant
SD	3.385	2.51		

Test used: Mann -Whitney

PL: Posterolateral

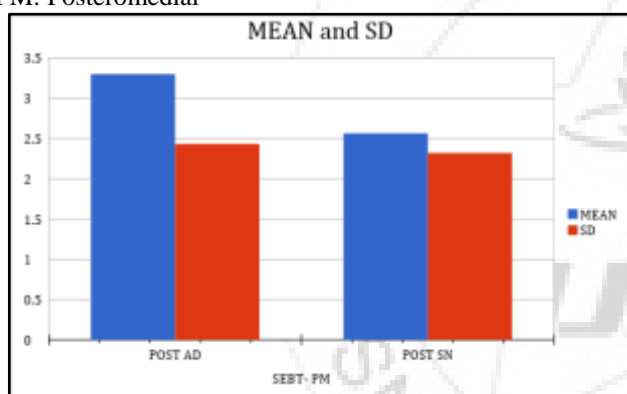


Graph 11: No significant improvement was observed in Star Excursion Balance Test in Posterolateral direction between both the groups

Table 13: Comparison of Star Excursion Balance Test in posteromedial direction, post protocol between Aerobic Dance and Suryanamaskar groups

SEBT PM	Post AD	Post SN	P value	Significance
Mean	3.3	2.567	0.4055	Not Significant
SD	2.433	2.321		

Test used: Unpaired T Test
PM: Posteromedial



Graph 12: No Significant improvement was observed in Star Excursion Balance Test in Posteromedial direction between both the groups

4. Discussion

It was observed that there was an extremely significant change in the flexibility within the two groups. As seen from the Modified Sit and Reach Test, there was an increase in the reach of the subjects in both Suryanamaskar and Aerobic Dance group following the intervention suggesting an increase in the length of hamstrings and back extensor muscle groups.

Determinants of stretching are: [7]

- Alignment
- Stabilization
- Intensity of Stretch
- Duration of Stretch
- Speed of Stretch
- Frequency of Stretch
- Mode of Stretch

In Suryanamaskar, in postures Dakashinpad Prasarnasan, DwipadPrasarana, Saashtang Namaskarasan, again

Dakashinpad Prasarnasan, Padahastasana, Sthiti, [8], various groups of muscles such as hip flexors, hamstrings, back extensors and plantar flexors were stretched.

In Aerobic Dance, steps like choreographed sequences consisting of the following elements: march (walk), step touch, double step touch, side to side, leg curl, double leg curl, knee up, double knee up, grapevine, mambo, cha-cha-cha, V step, squat, hop, jump, turn. [9] hip flexors, hamstrings, back extensors, plantar extensors were stretched.

It was observed that there was an extremely significant change in the cardiorespiratory endurance within the two groups. As seen from the step test there was increase in the physical index of the participants in both Suryanamaskar and Aerobic Dance group following the intervention suggesting an increase in cardiorespiratory endurance. Aerobic dance can be helpful to develop cardiovascular endurance because oxygen is delivered around the body through the bloodstream and pumped by the heart. The aerobic system can only work when the energy demand is low intensity for the heart to provide the muscles with satisfactory supply of oxygen. In aerobic exercise, the body is operating at a level in which the supply of oxygen is sufficient to the body's requests for oxygen. [3] In Suryanamaskar, performing the fast suryanamaskar is similar to performing aerobic exercise as it involves stretching and dynamic movements with optimal stress on cardio- respiratory system. The effects of fast suryanamaskar are similar to those of physical aerobic exercise with increased muscular endurance and power [11].

There is significant change in balance within both the groups. Maintaining balance requires coordination of input from multiple sensory systems including the vestibular, somatosensory and visual systems. [17]

Vestibular system: It provides information about the position and movement of the head with respect to gravity and internal forces. Receptors in the semicircular canals detect angular acceleration of the head, whereas the receptors in otoliths (utricle and saccule) detect the linear acceleration and head position with respect to gravity. [7]

Somatosensory system: It provides information about the position and motion of the body and body parts relative to each other and the support system. Muscle proprioceptors including muscle spindle and golgi tendon organs and skin mechanoreceptors are the dominant sensory inputs for maintaining balance when the support system firm, flat and fixed. [7]

Visual system: It provides information regarding the position of the head relative to the environment, the orientation of head to maintain level gaze, the direction and speed of head movements, because as our head moves, surrounding objects move in opposite direction. [7]

In slow suryanamaskar each posture held for 2 minutes improved the balance. At the same time in aerobic dance steps which include kicks jumps, v step performed repeatedly helped in improving both static and dynamic balance.

Significant changes were observed in flexibility between both the groups out of which mean values of Aerobic dance group (6.367) showed better change as compared to mean value of (3.367) Suryanamaskar group and P value at 0.0163, test used was Mann Whitney. The aerobic dance involved repeated steps of jumps and high kicks which were performed at higher intensity compared to that of suryanamaskar group, resulting in dynamic stretching of hamstrings and plantar flexors which improved the Modified Sit and Reach Test post protocol.

No Significant change was seen in endurance and balance between the two groups. This could be due to similar level of intensity and muscle groups being targeted in both the groups.

E.g. Dwipad Prasarnasan [8], in Suryanamaskar targeted the core muscles as well the trunk muscles in that group and in the Aerobic Dance group, the students were made to do planks which targeted the same muscle.

5. Conclusion

The following conclusions were derived from the study:

Pre and Post protocol flexibility, balance and cardiorespiratory endurance within both, the Suryanamaskar and Aerobic Dance group showed significant improvement.

Post - protocol flexibility showed significant improvement in the Aerobic Dance group as compared to the Suryanamaskar group whereas cardiorespiratory endurance and balance between the Suryanamaskar and Aerobic Dance group showed no significant improvement.

6. Future Scope

Limitation: Sample Size was small.

Suggestion: Longer duration of protocol.

Aerobic Dance and Suryanamaskar shows same level of improvement in static and dynamic balance, cardiorespiratory endurance hence according to the individual's interest they can go for either of the protocol. Patients who are not well versed with Aerobic Dance can take up Suryanamaskar to improve fitness. Also, individuals who enjoy Aerobic Dance can take up this protocol as a form of exercise to improve fitness. To improve flexibility individuals should go for Aerobic Dance as it shows better improvement seen from the higher mean value of Aerobic Dance group compared to that of Suryanamaskar group.

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Suggesting a higher percentage of participants were 'inactive', in spite of belonging to a group which is presumed to be knowledgeable regarding the benefits of physical activity. A significant negative attitude towards physical activity was observed in this cohort of young-adults. This seems to stem from earlier in life, due to lack of support and motivation for physical exercise and sports, received during primary and secondary schooling. This negative attitude has become a significant 'internal' barrier, which has not been changed in spite of their education.



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Volume 7 Issue 5, May 2018

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