

Effect of Slow and Fast Surya namaskar on Peak expiratory flow rate, Blood Pressure, and Physical Fitness index among Pharmacy Students.

Dr. Deepti Wadhwa¹, Dr. Amrit Kaur², Naman Shah³, Amruta Dhande⁴
(Associate Professor¹, MVP's College of Physiotherapy, Nashik, India, Professor², MVP's College of Physiotherapy
Intern³, Intern⁴, MVP's College of Physiotherapy, Nashik, India)

Abstract:

Background: There is an increase in the demand of pharmacists in India as the pharmacy profession is evolving due to industrialization since the last decade. The Surya Namaskar is performed usually early in the morning facing the morning rising sun. Each step has its own pose (including position and form) with its own breathing pattern (inhalation or exhalation) and its own mantra. Surya namaskar in a slow manner is in tune with slow breathing, while the rapid method of performing multiple rounds in a fast manner is similar to physical exercise.

Materials and Methods: In this comparative study, 80 subjects from MVP's samaj's college of pharmacy, belonging to the age group of 17 – 25 years were allocated into 2 groups of 40 subjects each. Group A – Slow Surya namaskar and Group B – Fast Surya namaskar. Group A received Slow Surya namaskar training, in which each of the 12 postures were held for 30 seconds, each round was completed within 6 mins and 5 rounds were conducted. Group B received training in Fast Surya namaskar, in which each of the 12 postures were held for 10 seconds, each round was completed within 2 mins and 5 rounds were conducted. The duration of this study was 4 weeks. The values of PEFr, BP, and Physical fitness index using the modified Harvard step test was taken before commencing the study and 4 weeks after. These parameters were also compared between the two groups.

Result: The result of this research showed that there was a significant effect of SSN and FSN on PEFr and Physical fitness index ($p < 0.0001$). The intergroup comparison showed the increase in PEFr values in the SSN group was significantly more than in the FSN group. The study also revealed that SSN produced a significant decrease in Diastolic Pressure ($p < 0.0001$). Inter-group comparison of the physical fitness index using the modified Harvard step test shows that the increase in the FSN group was significantly more than SSN group.

Conclusion: This study concluded that Slow and Fast Surya Namaskar influences improving Peak expiratory Flow Rate Blood Pressure, and Physical fitness index.

Keyword: Slow Surya namaskar, Fast Surya namaskar, PEFr, Blood pressure, Physical fitness index, Modified Harvard step test.

I. Introduction

Over the past decade in India, pharmacy profession has been evolving steadily and pharmacy comprises of the third largest healthcare profession in the world ⁽¹⁾. Today, pharmacists have expanded their role from dispensing to pharmaceutical care by maximizing the benefits of medications ⁽²⁾. There is an increase in the demand of pharmacists in India as the pharmacy profession is evolving due to industrialization since the last decade ⁽³⁾.

Yoga means union, union of mind, body, and spirit the union between us and the intelligent cosmic spirit of creation 'the oneness of all things' ⁽⁴⁾. Yoga is popular in the world, for the restless it is a solace, for the sick it is a boon. For the common man it is a fashion to keep him fit and beautiful ⁽⁵⁾. Yoga is a science practiced in India over thousands of years. It produces consistent physiological changes and has a sound scientific basis. Yoga claims to increase longevity, it has therapeutic and rehabilitative effect ⁽⁶⁾.

Yoga is a mind body technique, which includes set of physical exercises (asana) in sync with breathing techniques, relaxation and meditation ⁽⁷⁾. It has been found that yoga results in improving lipid profiles ⁽⁸⁾, heart rate variability ⁽⁹⁾, decrease in blood pressure ⁽¹⁰⁾ and even decrease of atherosclerosis when combined with dietary and other lifestyle modifications ^(11,12). The five principles of yoga are relaxation, exercise (asanas), pranayama (breathing control), nourishing diet, and positive thinking and meditation. Pranayama is breathing techniques that increase the capacity of lungs ⁽⁴⁾.

Surya namaskar was developed by ancient Hindus who worshipped the sun (Surya) as the creator of all things. The Surya namaskar is performed usually early in the morning.

Each step having its own pose (including position and form) with its own breathing pattern (inhalation or exhalation), and its own mantra. Its versatility makes it one of the most useful methods to induce a healthy, vigorous and active life. Surya namaskar is a series of twelve physical poses. These alternating asanas flex and stretch spinal column and limbs through their maximum range. In Surya namaskara deep rhythmic breathing process is synchronized with each movement, which empties the lungs more vigorously and refills them with oxygenated air⁽¹³⁾.

It is based on three elements: rhythm, energy and form. Surya namaskar can be done in slow, medium and fast pace.

Slow pace helps to increase body flexibility

Medium pace helps in muscle toning

Fast pace is an excellent aerobic workout and helps in weight loss⁽¹⁴⁾

During Surya

namaskar, muscles of entire body experience stretch and pressure alternately and therefore it gives more benefits with less expenditure of time. Surya namaskar practice gives benefits of asana and pranayama and improves general health and fitness⁽¹⁵⁾.

In fast Surya namaskar the 12 poses should be completed in 2 minutes and each pose should be held for 10 seconds. In slow Surya namaskar 12 poses should be held for a duration of 30 seconds, each round takes approximately 6 minutes to complete. Surya namaskar in a slow pattern is in tune with slow and shallow breathing, while rapid method of performing multiple rounds in a fast manner is similar to physical exercise⁽¹⁶⁾.

Practice of asana and pranayama results in an overall improvement in cardio-respiratory functions and physical fitness which improves one's tolerance to stressors. It is observed that regular yogic practices reduce basal metabolic rate and resting oxygen consumption⁽¹⁷⁾. It is reported that regular Surya namaskar practice improves cardiovascular and respiratory efficiency in healthy adolescents, reduces resting heart rate in both males and females⁽¹⁸⁾. A study shows that after yoga training a given level of exercise produces a much less cardiovascular response, suggesting improved exercise tolerance. Regular practice of Surya namaskar has shown to lower heart rate and blood pressure⁽¹⁹⁾.

Peak Expiratory Flow Rate (PEFR) is defined as the largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration, expressed in l/min⁽²⁰⁾. Surya namaskar helps in functioning of the lungs, it improves strength of intercostal muscles, trapezius which leads to increase in vital capacity and expansion of lungs and thus improve the health of lungs. It increases maximum inspiratory and expiratory pressure and it is a good breath coordination performance done in steps⁽²¹⁾. Surya namaskar increases the excursions of diaphragm and lungs as well as thoracic compliance and decreases airway resistance⁽¹⁵⁾.

Yoga strengthens the respiratory musculature due to which chest and lungs inflate and deflate to fullest possible extent and muscles are made.

The HST was developed by the professors at Harvard university as a means of assessing the aerobic capacity of young athletes attending that university⁽²⁴⁾. Harvard step test is a type of cardiopulmonary test for detecting and diagnosing cardiovascular diseases. It is a measurement of fitness and a person's ability to recover after strenuous exercise. The quicker heart rate returns to resting, the person is considered to be more fit. In modified Harvard step test, the platform of a height of 33 cm wooden box is used, with 5 min duration or until exhaustion. Physical fitness index is assessed with the help of this test⁽²⁵⁾.

Thus, this study focuses on effect of Slow and fast Surya namaskar on PEFR, BP and Physical fitness index among Pharmacy students.

II. Materials and Methodology

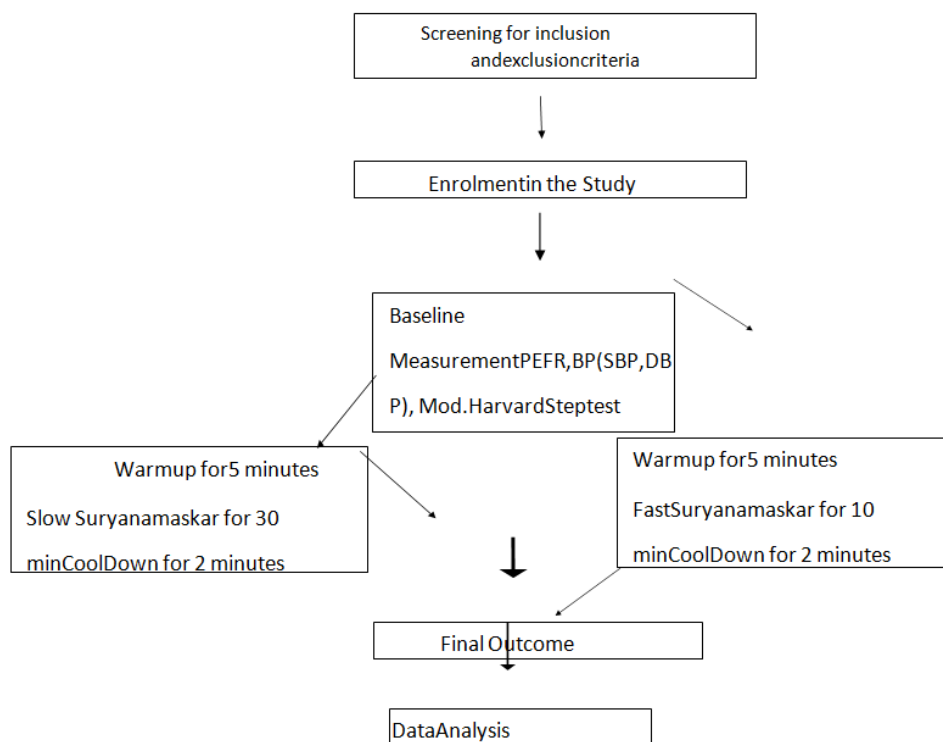
It was a comparative study design and a convenience sampling method was used. 80 Pharmacy students were recruited. Each group consisted of 40 subjects. Group A was for Slow Suryanamaskar, and group B was for Fast Surya namaskar. Study was conducted that consisted subjects of both genders between the age group of 17-25, who were willing to participate, ready to give informed consent and demonstrated capability to co-operate. Subjects who have already undergone yoga training, smokers and alcoholics, Subjects with the history of major medical illness such as TB, Hypertension, DM and bronchial asthma, spinal deformity, Hernia and back pain, those who have undergone recent injury or immobilization, lack of interest, those who were on drugs acting on CNS such as Anti-psychotics, Anti-Depressants, Sedatives-Hypnotics were excluded from the study.

Procedure Methodology^(39,40,41)

After written informed consent was obtained, the pre-treatment values of the outcome measures, PEFR, BP and Physical fitness index using Modified Harvard step test was taken. Ethical Clearance was taken.

Two groups were formed, Group A – SSN and Group B- FSN. The protocol began with 5 mins of warm up period. Participants from Group A were taught Slow Surya Namaskar in which each of the 12 postures were held for 30 seconds. Each round took 6 minutes and 5 rounds were performed. Participants from group B were taught Fast Surya Namaskar in which each of the 12 postures were held for 10 seconds, one round took 2 minutes to complete and 5 repetition were conducted. This was followed by a cooldown period of 2 mins. This was performed 5 days a week for 4 weeks.

Flowchart Depicting Procedure



Results

1. Pranamasana (Prayer Pose)

Subjects were asked to stand erect with palms held close to chest. She was instructed to only inhale.



Fig1. Pranamasana (Prayer Pose)

2. Hastauttanasana(RaisedArmPose)

Subjects were asked to Raise both arms overhead, then tilt the head, neck and upper body gently backward while gazing up at the thumbs.



Fig 2.Hastauttanasana(RaisedArmPose)

3.HastaPadasana(HandtoFootpose)

Subjects were asked to exhale and bend forward and place the palms on the floor in the line of the toes, without bending the knees



Fig3.HastaPadasana(HandtoFootpose)

4. AshwaSanchalasana(EquestrianPose)

The subject was asked to inhale and take one leg behind, resting its knees on the floor. Then asked to raise the neck upwards



Fig4. AshwaSanchalasana(EquestrianPose)

5.Dandasana(StickPose)

The subjects were asked to hold their breath and raise both their knees off the floor, straightened the arms such that neck, spine, thighs and feet were kept in a straight slant line



Fig5.Dandasana (StickPose)

6.AshtangaNamaskara(SalutewithEightParts)

Subjects were asked to exhale and bend both the arms in the elbows and the forehead, chest, both the palms, both the knees and toes touch the floor raising the hips off the floor.



Fig6.AshtangaNamaskara(SalutewithEightParts)

7. Bhujangasana(CobraPose)

Subject was asked to Inhale, straighten the arms in the elbows, and stretch the shoulders upwards. Keeping the toes and knees resting on the floor. Keeping the arms straight, raise the chest off the floor and curved the back.



Fig7.Bhujangasana(CobraPose)

8. Parvatasana(MountainPose)

Exhaling the subjects were asked to bent the neck downward and push their body backwards and up. Positions of the toes and palms on the floor was not changed.



Fig 8. Parvatasana (Mountain Pose)

9. AshwaSanchalasana(EquestrianPose)

Subjects were then asked to Inhale and bring the right leg to the front and place it between the palms of the two arms like position 4.



Fig9. AshwaSanchalasana(EquestrianPose)

10. HastaPadasana(HandtoFootpose)

Exhaling the subjects were asked to bend forward and place their palms on the floor in line with their toes, without bending their knees



Fig10.HastaPadasana(HandtoFootpose)

11. Hastauttanasana(RaisedArmsPose)

Subjects were asked to inhale and raise both arms off the floor and overhead with palms touching while tilting the head, neck and upper body backward just like position 2.



Fig11.Hastauttanasana(RaisedArmsPose)

12. Pranamasana(PrayerPose)

subjects were asked to Exhale and bring the hands down and forward and straighten the back, taking the initial position.



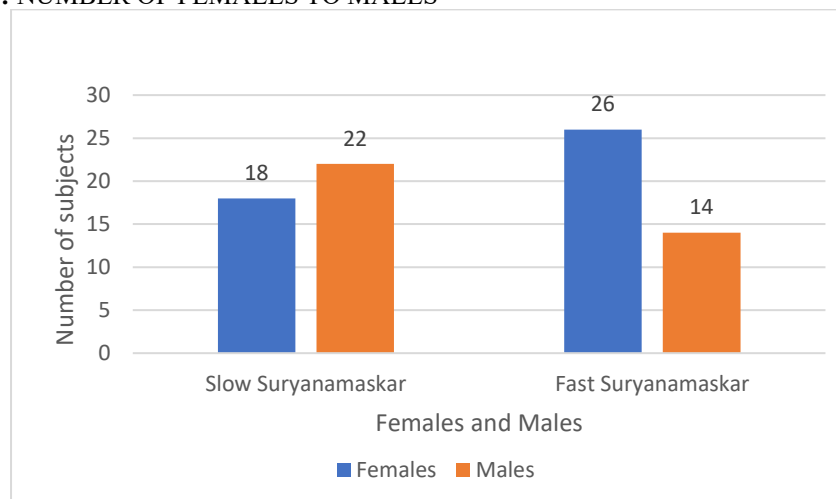
Fig12.Pranamasana(PrayerPose)

Statistical Analysis

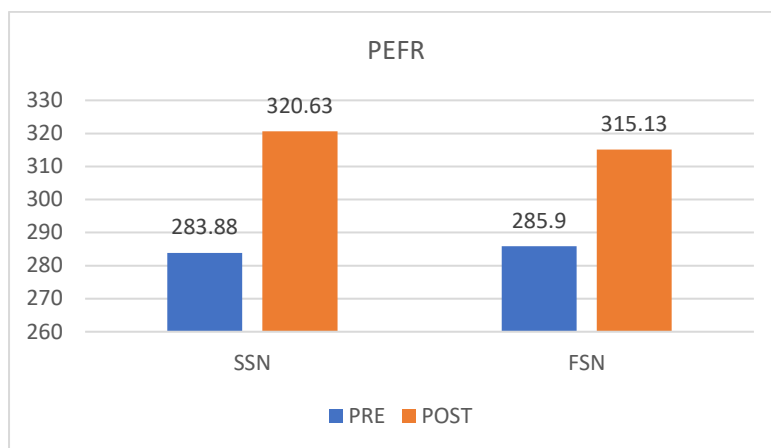
The peak expiratory flow rate was analysed using a mini wright peak flow meter. Blood pressure was assessed using an electro-sphygmomanometer. And fitness was assessed using the modified Harvard step test and co-related it with the physical fitness index. The Data was prepared in excel spreadsheet. Paired t-test for pre and post treatment value was done. Unpaired t-test was done to compare between Group A and Group B.

III. RESULT

GRAPH 1: NUMBER OF FEMALES TO MALES



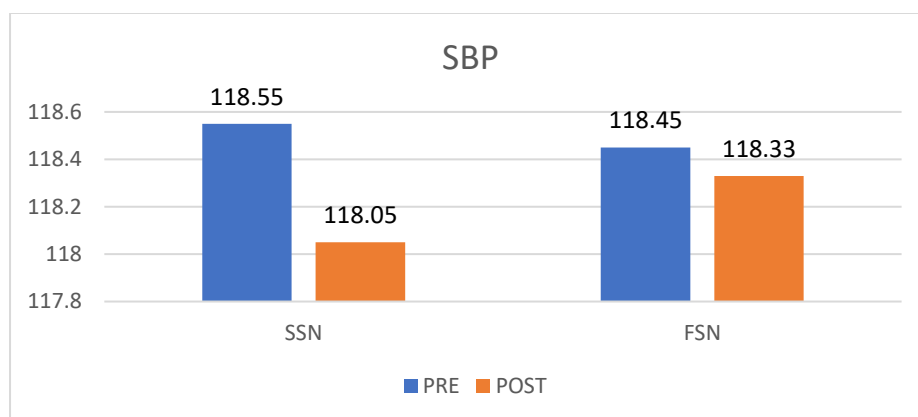
GRAPH 2: COMPARISON OF PRE AND POST MEAN TREATMENT SCORES OF PEFR IN SLOW AND FAST SURYANAMASKAR USING PAIRED T TEST



The mean value of PEFR in SSN was 283.88 before the treatment and 320.63 after the treatment. P-value $i < 0.0001$ and the result is extremely statistically significant.

The mean value of PEFR in FSN was 285.90 before the treatment and 315.13 after the treatment. P value is < 0.0001 and the result is extremely significant.

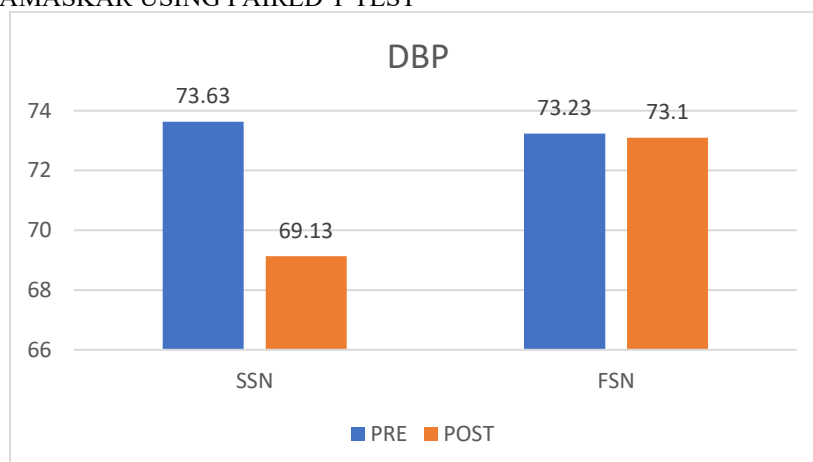
GRAPH 3: COMPARISON OF PRE AND POST MEAN TREATMENT SCORES OF SBP IN SLOW AND FAST SURYANAMASKAR USING PAIRED T TEST



The mean value of Systolic blood pressure in Slow Surya namaskar was 118.55 before the treatment and 118.05 after the treatment. P value is 0.0648 and the result is not statistically significant.

The mean value of Systolic blood pressure in Fast suryanamaskar was 118.45 before the treatment and 118.33 after the treatment. P value is 0.9076 and result is not statistically significant.

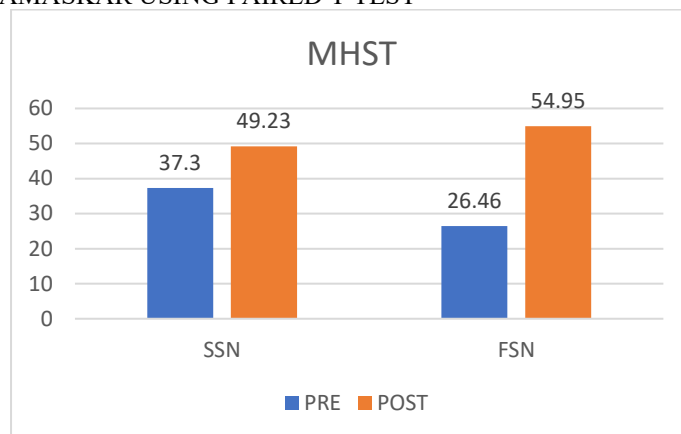
GRAPH 4: COMPARISON OF PRE AND POST MEAN TREATMENT SCORES OF DBP IN SLOW AND FAST SURYANAMASKAR USING PAIRED T TEST



The mean value of DBP in SSN was 73.63 before the treatment and 69.13 after the treatment. P value is <0.0001 and result is extremely significant.

The mean value of DBP in FSN was 73.23 before the treatment and 73.10 after the treatment. P value is 0.8345 and the result is not statistically significant.

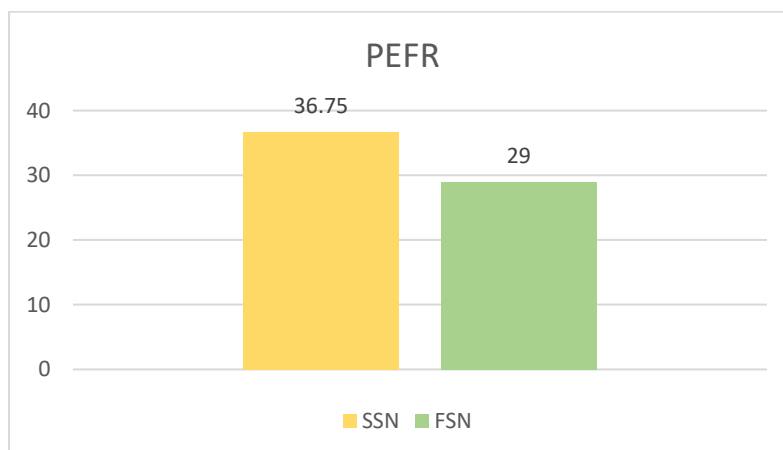
GRAPH 5: COMPARISON OF PRE AND POST MEAN TREATMENT SCORES OF MHST IN SLOW AND FAST SURYANAMASKAR USING PAIRED T TEST



The mean value of MHST in SSN was 37.30 before the treatment and 49.23 after the treatment. Pvalue is <0.0001 and the result is extremely statistically significant

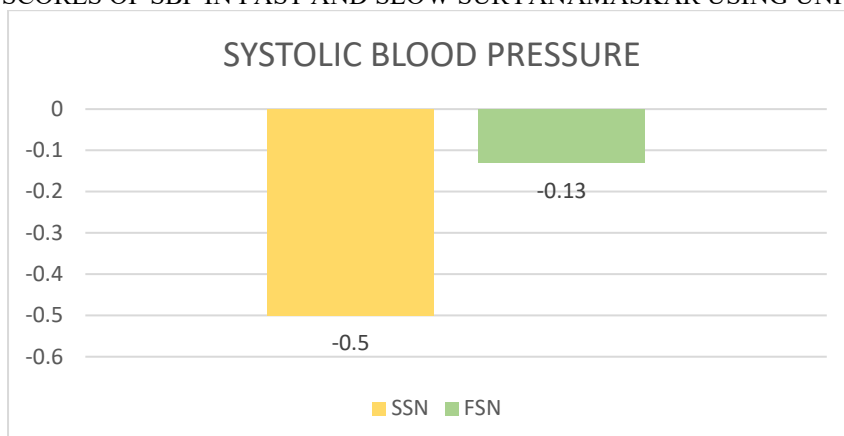
The mean value of MHST in FSN was 26.46 before the treatment and 54.95 after the treatment. P value is <0.0001 and the result is extremely statistically significant

GRAPH 6: COMPARISON OF MEAN VALUES OF DIFFERENCE BETWEEN PRE AND POST TREATMENT SCORES OF PEFR IN FAST AND SLOW SURYANAMASKAR USING UNPAIRED T TEST



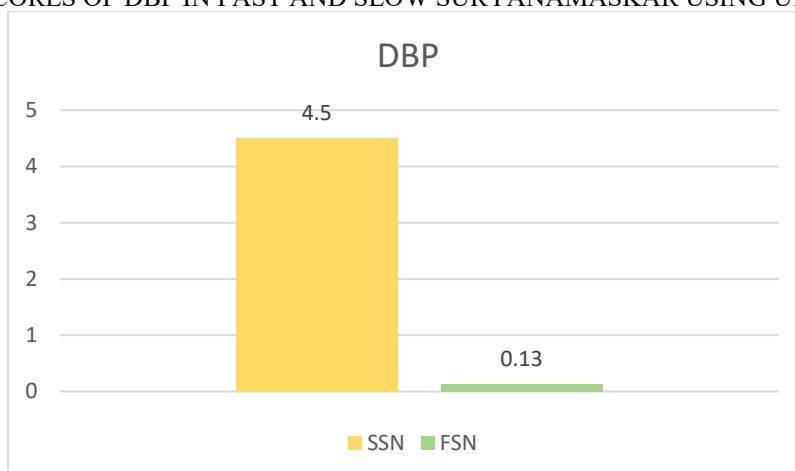
The mean value of PEFR in FSN was 29.00 and for SSN was 36.75. P value is <0.0001 and the result is extremely statistically significant

GRAPH 7: COMPARISON OF MEAN VALUES OF DIFFERENCE BETWEEN PRE AND POST TREATMENT SCORES OF SBP IN FAST AND SLOW SURYANAMASKAR USING UNPAIRED T TEST



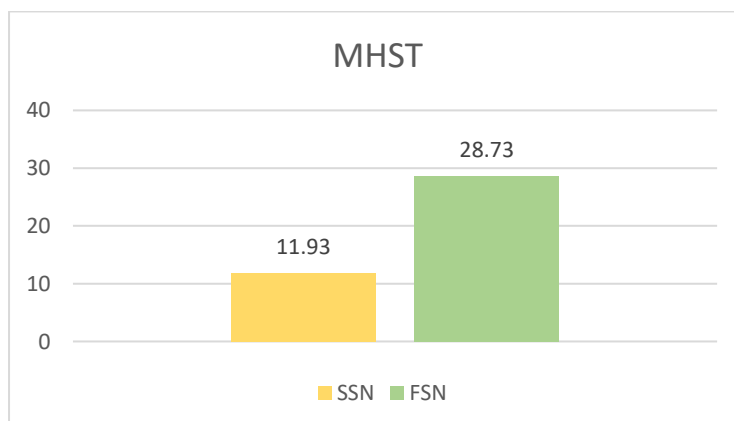
The mean value of Systolic blood pressure in slow suryanamaskar was -0.5 and for fast suryanamaskar was -0.13. P value is 0.7345 and the result is not statistically significant.

GRAPH 8: COMPARISON OF MEAN VALUES OF DIFFERENCE BETWEEN PRE AND POST TREATMENT SCORES OF DBP IN FAST AND SLOW SURYANAMASKAR USING UNPAIRED T TEST



The mean value of DBP in FSN was 0.13 and for SSN was 4.50. P value is <0.0001 and the result is extremely statistically significant

GRAPH 9: COMPARISON OF MEAN VALUES OF DIFFERENCE BETWEEN PRE AND POST TREATMENT SCORES OF MHST IN FAST AND SLOW SURYANAMASKAR USING UNPAIRED T TEST



The mean value of MHST in FSN was 28.73 and for SSN was 11.93. P value is <0.0001 and the result is extremely statistically significant.

IV. Discussion

The purpose of this study was to determine and compare the effects of Slow and Fast Surya namaskar on PEFr, BP, and Modified Harvard Step test. In this study 80 subjects were assigned; group A was taught Slow Surya namaskar and Group B was taught fast Surya namaskar. The duration of the study was 4 weeks.

In slow Surya namaskar, each of the 12 poses were held for 30 secs and 5 rounds were performed. In Fast Surya namaskar each pose was held for 10 secs. Our study showed a significant increase in PEFr values in individuals performing Slow ($p < 0.0001$) and fast ($p < 0.001$) Surya namaskar. The mean value of PEFr in FSN was 29.00 and for SSN was 36.75. P-value is < 0.0001 and the result is extremely statistically significant. The reason can be that each pose is subjecting the muscle to stretch. This reduces the stiffness of the intercostal muscles and leads to an increase in respiratory muscle endurance. Thus, improving lung compliance. This goes according to Author Rafaela Barros dr Sa et al. who demonstrated that simple exercise for respiratory muscles stretching produces benefits in the chest wall kinetics, kinematics and respiratory patterns⁽⁴²⁾.

Slow Surya namaskar produces an insignificant effect on systolic pressure with two-tailed ($p = 0.0648$), not statistically significant. Whereas Diastolic pressure decreases significantly ($p < 0.0001$). The decrease in diastolic pressure can be explained on the basis of the reduction in sympathetic activity and increase in vagal tone. This goes according to author H S Nayar, N T Joseph and S Joseph who concluded that Yogic Practice causes a shift of the autonomic equilibrium leading to parasympathodominance and reduction in sympathetic activity⁽⁴³⁾.

Fast Surya namaskar produces an insignificant effect on Systolic Pressure. This goes according to a study conducted by Kristine M. Fondran at Cleveland State University, who concluded that A decrease in Systolic Blood pressure is less likely to occur in normal individuals and would require a compromised Cardiovascular system to produce a significant effect. It was also mentioned that the little to no effect of Suryanamaskar is not surprising as what is considered to be the normal range of Systolic Blood Pressure cannot be altered to be more normal⁽⁴⁴⁾.

The effect of SSN and FSN on the modified Harvard step test was statistically significant ($p < 0.0001$). The effect of regular exercise is known to have beneficial effects on health. The current study showed that the physical fitness among pharmacy students was poor according to the physical fitness index. The mean value of MHST in FSN was 28.73 and for SSN was 11.93. P-value is < 0.0001 and the result is extremely statistically significant. This signifies that the improvement in the physical fitness is comparatively more in group B which performed Fast suryanamaskar than Group A. The effects of fast suryanamaskar are similar to those of physical aerobic exercise with increased muscular endurance and power. It involves movements of large muscle groups that are subjected to rhythmic contraction and relaxation.

It is clear from this study that both Slow and fast Surya namaskar have a significant effect on the health and fitness of an individual. Practicing Surya namaskar not only improves lung compliance and capacity but also helps in building vascular tone, muscle strength, and endurance.

V. Conclusion

The study concluded that Slow and Fast Surya Namaskar has a significant effect on Peak expiratory flow rate, and Physical fitness index. Slow surya namaskar shows effect on diastolic blood pressure whereas Fast Surya namaskar shows no statistical significance on Systolic and diastolic blood pressure.

References

- [1]. Nicole H. The global pharmacy workforce: Systematic review of the literature. Human resource for health. 2009;7(48): 1478–4491.
- [2]. Kumar AY, Kumar RV, Ahmad A, Mohanta GP, Manna PK. Pharmacists interventions and pharmaceutical care in an indian teaching hospital: A prospective study. Int J Adv Res Pharm Bio. 2012; 1: 386–96
- [3]. Akram Ahmad, Suleman Atique, Rajesh Balkrishnan and Isha Patel. Pharmacy profession in India: Current scenario and Recommendations. Indian Journal of Pharmaceutical Education and Research | Vol 48 | Issue 3 | July–Sep, 2014
- [4]. P Shyam Karthik, Kuthiboyina Chandrasekhar, Kondam Ambareesha, CNikhil. Effect of Pranayama and Suryanamaskar on Pulmonary Functions in Medical Students. December 2014; Journal of Clinical and Diagnostic Research 8(12): BC04-6
- [5]. Naragatti Siddhappa. The Study of Yoga Effect on Health. International Journal of Innovative Medicine and Health Science, volume 12, 2020, 9 8-110.
- [6]. Jyotsana R. Bharghankar, Rajay N. Bharghankar, Vijaykumar N. Deshpande, Shobha B. Kaore and Geeta B. Gosavi. Effect of Yoga on Cardiovascular system in subjects above 40 years. Indian J physiol Pharmacol 2003; 47(2):202-206, 2001
- [7]. Bandi Hari Krishna, Pravati Pal, Pal G.K., Balachander J., Jayasettiaseelon E. Effect of Yoga Therapy on Heart Rate, Blood Pressure and Cardiac Autonomic Function in Heart Failure. Journal of clinical and Diagnosis Research. 2014 Jan, vol-8(1):14-16
- [8]. Mahajan AS, Reddy KS, Sachdev U. Lipid profile of coronary risk subjects following yogic lifestyle intervention. Indian Heart J. 1999; 51 (1) : 39-40
- [9]. Patil S, Telles, Shirley. Effects of two yoga based relaxation techniques on heart rate variability (HRV). Int J Stress Manag. 2006;13(4): 460-75
- [10]. lakshmi kantan C, Alagsan R, Thanikachalam S, et.al. Long term effects of yoga on hypertension and/or coronary artery disease. J Assoc Physicians india. 1979; 27(12): 1055-8
- [11]. Ornish D. Can lifestyle changes reverse heart disease? World Rev Nutr Diet. 1993;72 :38-48
- [12]. Ornish D, Scherwitz LW, Doody RS, et.al. Effects of stress management training and dietary change in treating ischemic heart

- disease. J Am Med Assoc. 1983; 249(1):54-9
- [13]. Dr.Vikas C.Kathane, Dr.Lalit V.Vithalani, Dr.Sanjay A.Dalvi. A comprehensive study of effect of suryanamaskar on cardio-respiratory endurance. National journal of research in ayurvedic science. Vol 1 issue 2, 2013
- [14]. DR. JP Chaudhary, Dr Kavita, Dr Anupama Pathak. Health benefits of Suryanamaskar. World Journal of Pharmaceutical and Medical Research. 2020, 6(11), 241-242
- [15]. Thirumaran M, Balaji P V. Effects of Suryanamaskar on Cardio-Respiratory and Reaction Time among Final year Medical Students. Sch. J. App. Med. Sci., 2015; 3(5A); 1842-1844
- [16]. Anand Balayogi Bhavanani, Kaviraja Udupa, Madanmohan, PNR Raviendra. A comparative study of slow and fast Suryanamaskar on physiological function. International journal of yoga 2011; 4(1): 71-76
- [17]. Sasi Kumar A, Sivapriya DV, Shyamala Thirumani. Effect of Suryanamaskar on Cardiovascular and Respiratory parameters in School Students. Recent Research in Science and Technology 2011, 3(10): 19-24
- [18]. Biswajit Sinha, Tulika Dasgupta Sinha, Anjana Pathak, Omveer Singh Tomer. Effects of Yoga training on Blood Pressure responses during Suryanamaskar following eleven months of Yoga practice in Army-men and Yoga-trained individuals. International Journal of clinical and experimental physiology, vol 1, issue 1, Jan-Mar 2014
- [19]. Karpagam S, Girwar Singh Gaur, Madanmohan Trakoo, Senthil Kumar S. Comparative Study of Effect of Slow and Fast Suryanamaskar on Work Load of Heart in Normal Human Subjects. International Journal of Physiology, July-December 2013, Vol. 1, no. 2
- [20]. Shilpa N, Veena H C, Reshma Rani Patil. Effect of Yoga on Peak Expiratory Flow Rate. National Journal of physiology, pharmacy and pharmacology. 2020 vol 10 issue 5.
- [21]. Vd. Manisha Nikam. A role of Suryanamaskar for good health. Aayushi International Interdisciplinary Research Journal, 2020, vol. 7, issue-2
- [22]. Joshi LN, Joshi VD & Gokhale LV. Effect of short term pranayama practice on breathing rate and ventilatory functions of lung
- [23]. Subbalakshmi NK, Saxena SK, Urmimala and Urban JA. D'souza: immediate effect of Nadi-shoudha pranayama on some selected parameters of cardiovascular, pulmonary and higher functions of brain.
- [24]. Brucha L. The step test, a simple method of measuring physical fitness for muscular work in young men. Res. Quart 1943; 14: 36-37
- [25]. Dr P. Amuthamozi, Dr. V. Sivachandiran. Evaluation of Physical Fitness among Student population using Modified Harvard Step Test. Paripex-Indian Journal of Research, vol-9, issue-1, Jan-2020
- [26]. G. Kirkwood, H. Rampes, V. Tuffrey, J. Richardson, K. Pilkington and S. Ramaratnam. Yoga for Anxiety; A systemic review of the research evidence. British Journal of Sports Medicine, vol-39, no-12 pp, 884-891, 2005
- [27]. K Yang. A review of Yoga programs for four leading risk factors of chronic diseases. Evidence-based Complementary and Alternative Medicine, vol. 4, no-4, pp. 487-491, 2007
- [28]. Ambareesha Kondam, M Chandrasekhar, P Punita, B Varadharaju, M Suresh, Shyam Karthik. Combined effect of Pranayama and Suryanamaskar on Dynamic Spirometric values in Normal Young Subjects. National Journal of Physiology, Pharmacy and Pharmacology. 2015; 5(2): 79-84
- [29]. Dharmesh Parmar, Nikita Modh. Study of Physical Fitness using Modified Harvard Step Test in relation with Gender in Physiotherapy Students. International Journal of Science and Research. vol 4, issue 7, July 2015
- [30]. Dr. Kanwaljeet Singh, Dr. Baljinder Singh Bal, Dr. Wilfred VAZ. The effect of Suryanamaskar Yoga on muscular endurance and flexibility among Intercollege Yoginis. Journal of Physical Education and Sport. vol 27, no. 2, June 2010
- [31]. B. Sinha, U. S. Ray, A. Pathak and W. Selvamurthy. Energy cost and cardiorespiratory changes during the practice of Suryanamaskar. Indian J Physiol Pharmacol 2004; 48(2): 184-190
- [32]. Dr. S.D. Archana, Prof. Dr. S.T. Venkateshwaran; effect of suryanamaskar on Dysmenorrhea
- [33]. Varsha SV, assistant professor, department of physiology, Sir Siddharth Institute of Medical Science and research centre, Karnataka, India; Effect of Suryanamaskar on occupational stress among IT professionals
- [34]. Chaitra B, Vijay Maitri. Effect of aerobic exercise training on PEFR: A pragmatic Randomized Controlled Trial. International Journal of Biological and Medical Research. 2011; 2(3): 789-792
- [35]. Klaita Srisingh and Chutima Phuaksaman; the reference values of peak expiratory flow rate in Thailand children; J Thorac Dis. 2021 Jan; 13(1): 31-38
- [36]. Sitalakshmi R, Poornima K N and Karthick N. The Peak expiratory Flow Rate (PEFR): the effect of stress in a Geriatric population of Chennai-A Pilot Study.
- [37]. Susan B. O'sullivan, Thomas J. Schmitz, George D. Fulk. Physical Rehabilitation Sixth Edition. Page no. 72
- [38]. K George Mathew, Praveen Aggarwal. MEDICINE Prep manual for undergraduates, sixth edition. Page no. 607
- [39]. Anagha Mangoankar, Anjali Puntambekar. Effect of Suryanamaskar VSDynamic Stretching on Hamstring Flexibility among Physiotherapy students: A Pilot Study. Int J Physiother. Vol 5(6), 202-206, 2018
- [40]. Dr. Deepti Wadhwa, Ashlesha Bhole, Sneha Waydande, et al. Effect of suryanamaskar on PEFR, and upper body muscle endurance among Physiotherapy students. International Journal of Creative Research Thoughts. 2021; 9(7): a35-a43
- [41]. Shree Vishwas V. Mandlik (2008)-YOGPRAVESH
- [42]. Rafaela Barrosa de Sa et al. Immediate effects of respiratory muscle stretching on chest wall kinematics and electromyography in COPD patients. Respiratory Physiology and Neurobiology journal. Volume 242, August 2017, Pages 1-7
- [43]. H S Nayar, N T Joseph, S Joseph. Physiological effects of yogic practice. NIMHANS Journal. 1983; 1(1): 71-80
- [44]. Fondran, Kristine Marie, "The Effect of Surya Namaskara Yoga Practice on Resting Heart Rate and Blood Pressure, Flexibility, Upper Body Muscle Endurance, and Perceived Well-Being in Healthy Adults" (2008).