



PHYSIOLOGY

EFFECTS OF SURYANAMASKAR ON CARDIO VASCULAR AND RESPIRATORY PARAMETERS IN SCHOOL STUDENTS

Sasi Kumar A^{1*}, Sivapriya D V², Shyamala Thirumeni³

¹Tutor, Department of Physiology, Tagore Medical College & Hospital, Rathinamangalam, Chennai- 600048, Tamilnadu, India

²Assistant Professor, Department of Physiology, Saveetha Medical College & Hospital, Saveetha University, Saveetha nagar, Thandalam, Chennai- 602 105, Tamilnadu, India

³Professor and Head, Department of Physiology, Saveetha Medical College & Hospital, Saveetha University, Saveetha nagar, Thandalam, Chennai- 602 105, Tamilnadu, India

Abstract

Back ground: Modern medical science has started to study the effects of suryanamaskar and yogic techniques. With increasing scientific research in suryanamaskar and yoga, its therapeutic aspects are explored in wide angle. In yoga the sun is represented by surya nadi, the pranic channel which carries the vital life- giving force. Suryanamaskar is the combination of asana and pranayama. Suryanamaskar has been integrated into physical education in many public and private schools across the country. The ultimate goal is to improve the physical health and increase the quantity of sportsmen with effective cardio-respiratory efficiency. **Methods :** This study was designed to evaluate the effects of a 45 days daily practice of suryanamaskar on blood pressure(BP), heart rate(HR), respiratory rate (RR), forced vital capacity(FVC) and peak expiratory flow rate (PEFR) in school students of both sexes. 115 school students aged 10 to 14 years were recruited for the study. The participants were trained to perform suryanamaskar for 45 days study period. The cardio vascular and respiratory parameters BP, HR, RR, FVC and PEFR were measured before and after practice of suryanamaskar. **Results:** The results showed that the Systolic blood pressure, PEFR and FVC increased significantly and RR, HR and diastolic blood pressure decreased significantly after the practice of suryanamaskar. **Conclusion:** The beneficial effects of suryanamaskar can be applied to all schools to improve the physical health and sports activities of the students.

Keywords: Suryanamaskar, blood pressure (BP), heart rate (HR), respiratory rate (RR), forced vital capacity (FVC) and peak expiratory flow rate (PEFR)

Introduction

Good health and freedom from disease is the best achievement of life. Modern medicine has made tremendous progress in recent years. Modern medicine as well as yoga has scientific basis and universal outlook. It is gratifying that science has started studying the effects of yogic techniques, while yoga has started using modern technology and scientific methods.

Scientific research has shown that yogic techniques produce consistent and beneficial physiological changes. A few weeks of disciplined yoga practice can lead to improvement in many physiological and psychological functions. Practice of asana and pranayamas results in an overall improvement in cardio-respiratory functions and physical fitness which improves one's tolerance to stressors [1].

Suryanamaskar

The basic translation of Suryanamaskar is salutations to the sun. It is a very ancient tradition which has been in existence since the Vedic age.

The physical basis of the practice links together twelve asanas in a dynamically performed series.

These asanas are ordered so that they alternately stretch the spine backwards and forwards. When performed in the usual way, each asana is moved into with alternate inhalation and exhalation [1, 2].

A full round of Suryanamaskar is considered to be two sets of the twelve poses with a change in the second set to moving the opposite leg first through the series [3].

With increasing scientific research in yoga, its therapeutic aspects are also being explored. Suryanamaskar gives more benefits with less expenditure of time [3]. It is claimed that suryanamaskar practice improves general health and fitness. Hence, the present study was undertaken to study the effects of suryanamaskar practice on cardio-respiratory fitness parameters in young. It Improves pulmonary functions, cardiovascular endurance and strengthens the abdominal muscles.

Suryanamaskar is considered as the best exercise as it consists of important Yogasanas and Pranayamas [4,5]. The Pranayama and its advantages are skillfully incorporated in Suryanamaskar, so Suryanamaskar is an appreciated exercise among all ages from kids to

* Corresponding Author, Email: simmamsasi@gmail.com

old age people. Suryanamaskar or Sun Salutation is the best way to burn the calories and reduce weight. It is often recommended for obesity. It is recommended by various authors and proved to be effective in children.

Regular practice of Suryanamaskar significantly show reduction in pulse rate, attributed to increased vagal tone and decreased sympathetic activity^[6,7]. Decreased sympathetic activity in turn reduces catecholamine secretion and also leads to vasodilation leading to improvement in peripheral circulation. It is also observed that regular yogic practices reduce basal metabolic rate and resting oxygen consumption. All these may be responsible for reduction in resting pulse rate

Yogic practices alter the hypothalamic discharges leading to decrease in sympathetic tone and peripheral resistance and hence the diastolic blood pressure^[7].

Regular yogic practices strengthen the respiratory muscles; increase the excursions of diaphragm and lungs as well as thoracic compliance^[8,9]. Also yoga practices decrease airway resistance. All these factors contribute to improvement in the various lung function tests after regular practice of suryanamaskar.

Methods

115 healthy school students aged 8 to 14 years of both sexes were selected by Random sampling - lottery method. After getting the consent from their parents or guardian, they were involved in the study. A health check up was conducted for all the participants before the start of the study.

Inclusion criteria

Healthy participants aged 8-14 years.

Exclusion criteria

Participants with Congenital heart disease, Respiratory disease, Epilepsy, Recent injury or immobilization, Mentally challenged, Physically challenged, Spinal deformity, History of active sports training, Previous experience of yoga

Withdrawal criteria

Participants with Acute illness, Lack of interest, and Absenteeism during the training period were with drawn from the study.

Prior to the study the base line data were collected from all the participants. It includes the following parameters - name, age, sex, resting pulse, blood pressure, forced vital capacity using Spiro meter, Peak expiratory flow rate using Mini-Wright peak flow meter and resting respiratory rate by manual method.

Instruments used to measure the parameters were portable and could be efficiently used. Mini wrights peak flow meter is feasible and useful to measure

PEFR in pre school children^[10]. Wrights peak flow meter is often used instrument by researchers like MilnerPulickal, as it was effective and flow rates could be obtained over the age of three^[11,12].

Reproducible curves can be produced in children. Technically acceptable and graphically producible curves were obtained in children of 3 to 6 years ^[13]. Bhattacharya had done a study to find vital capacity in children and young adults of India^[14]. The final outcome of the studies done by Turner and Necati Akugun showed that spirometry can be effectively used to know the pulmonary function in children^[15,16].

Udupa et al had done a research and proved that yoga training decreases systolic blood pressure & diastolic blood pressure where as suryanamaskar increases the SBP and decreases DBP^[17].

Dr. Madhanmohan has done a research to find the effect of yoga training on cardio-respiratory system in school children for 6 months and the parameters are reassessed^[18]. Result showed significant increase in the respiratory parameters in all groups. Cardio-vascular parameters like the basal heart rate were decreased. Results confirm that yoga decreases blood pressure whereas suryanamaskar increases systolic and decreases diastolic blood pressure.

Sphygmomanometer was used to measure the systolic & diastolic blood pressure. The participants were seated comfortably, and the children BP cuff was tied. The systolic BP was measured first by palpatory method then by auscultatory method the systolic and diastolic BP was measured.

Peak Expiratory Flow Meter- Mini- Wright's Peak Expiratory Flow Meter was used to measure the peak expiratory flow rate. The participants were made to sit comfortably and taught how to blow through the peak flow meter. Three values were taken and the maximum out of three was noted.

FVC - Digital Spiro meter was used. The participants were made to sit comfortably and taught how to blow through the Spiro meter probe. Disposable children mouth piece was used. The procedure was repeated with rest period until reproducible curves were obtained

Steps in Suryanamaskar^[19,5]

The participants were trained to perform suryanamaskar in a slow manner so that each of the 12 poses were held for a duration of 30 seconds. Each round took 6 minutes to complete and 5 rounds were performed in 30-40 minutes. Suryanamaskar pre training was given for seven days by a yoga trainer and the performance of suryanamaskar was analyzed using performance chart. Practice started at (6.30 am) on an empty stomach in a clean, ventilated, quiet, and pleasant room.

Position 1

Inhale and maintain it in standing position with hands joined together near chest, feet together and toes touching each other.

Position 2

Exhale and bend forward at the waist till palms touch the ground in line with the toes. Don't bend knees while performing.

Position 3

Inhale and take the left leg back with left toes on the floor, press the waist downwards and raise the neck, stretch the chest forward and push shoulders backwards. Keep the right leg and both the hands in the same position. Keep the right leg folded.

Position 4

Hold the breath and raise the knee of left leg. Take the right leg backwards and keep it close to the left leg. Straighten both the legs and both hands. Keep the neck straight and site fixed. Keep both the toes erect. Take care that the neck, spine, thighs and the feet are in a straight line.

Position 5

Exhaling bend both the hands in elbows and touch forehead on the ground, touch the knees on the ground, keep both the elbows close to chest. The forehead, chest, both the palms, both the toes, knees should touch the ground and rest of the body not touching the floor. Since only eight parts rest on the ground , it is called 'Ashtanga' position.

Position 6

Inhale and straighten the elbows, stretch the shoulders upwards, press the waist downwards but dont bend the arms. Keep the knees and toes on the floor. Push the neck backwards and site upwards.

Position 7

Hold the breath, bend the neck downwards and press the chin to the throat, push the body backwards and touch the heels on the ground, raise the waist upwards, do not move the palms on the floor.

Position 8

Hold the breath as in position 7, bring the right leg to the front and place it in between the hands and place the left leg at the back with left knee and toes on the ground.

Position 9

Exhale and bring the left leg forwards as in the position 2 and place it in between both the arms.

Position 10

Inhaling start getting up and attain the position as in position 1.

Position 11 & Position 12

Same as position 2 and position 1
After 45 days of regular practice all the above parameters were reassessed.

Statistical Analysis

All the values obtained before and after performing Suryanamaskar were expressed as mean \pm SD. The students paired 't' test was used to compare pre and post training valued. P values of less than 0.05 was accepted as significant difference between the compared values.

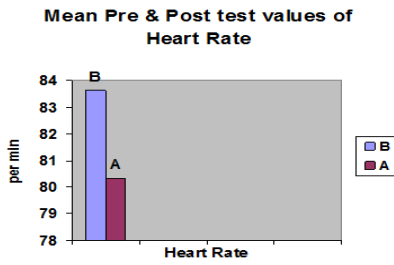
Results

Table I and fig 1,2,3 shows decrease in heart rate, and diastolic blood pressure(DBP), increase in systolic blood pressure(SBP) after suryanamaskar

Table – I: Mean pre and post test values of HR, SBP and DBP

S.No	PARAMETERS	PRE TEST VALUES	POST TEST VALUES
1	Heart Rate (Beat/Min)	83.63	80.31
2	Systolic blood pressure(mmHg)	91.23	94.54
3	Diastolic blood pressure(mmHg)	63.03	62.03

Figure 1 - Statistically significant change in the heart rate



B - Before Suryanamaskar, A - After Suryanamaskar

Figure 2 - statistically significant increase in the systolic blood pressure

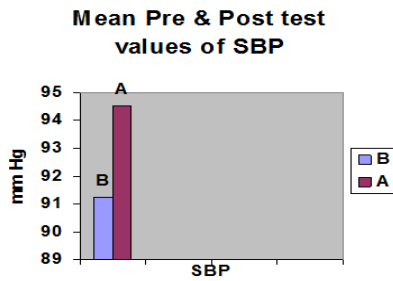


Figure 3 - statistically significant decrease in diastolic blood pressure

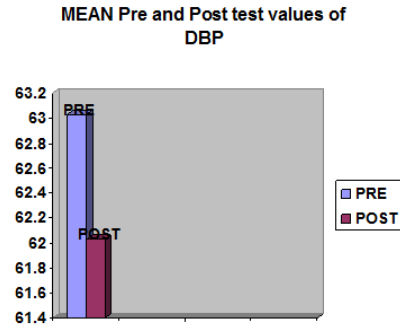
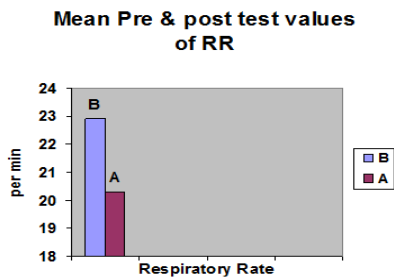


TABLE- II, fig 4,5,6 shows decrease in Respiratory rate, increase in forced vital capacity and peak expiratory flow rate.

Table II - Mean values of respiratory parameters before and after suryanamaskar

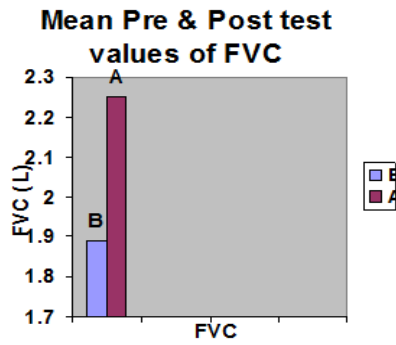
S.No	PARAMETERS	PRE TEST VALUES	POST TEST VALUES
1	RESPIRATORY RATE(MIN)	22.91	20.29
2	FORCED VITAL CAPACITY(L)	1.8913	2.2515
3	PEAKEXPIRATORY FLOW RATE(L/Min)	247.22	268.52

Figure 4 - statistically significant decrease in respiratory rate



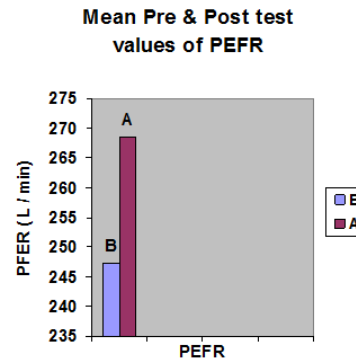
B - Before Suryanamaskar, A - After Suryanamaskar

Figure 5 - statistically significant increase in forced vital capacity



B - Before Suryanamaskar, A - After Suryanamaskar

Figure 6 - statistically significant increase in peak expiratory flow rate



B - Before Suryanamaskar, A - After Suryanamaskar

Table 3 shows the overall effect of suryanamaskar on cardio- respiratory parameters

S.No	Parameters	Before suryanamaskar	After suryanamaskar	Mean difference	't' value
1	Heart rate (beat/min)	83.63±2.57	80.31±2.07	3.32	15.9432***
2	Systolic blood pressure(mmHg)	91.23± 4.09	94.54± 2.65	-3.30	10.6741***
3	Diastolic blood pressure(mmHg)	63.03± 1.66	62.03± 2.67	1.00	3.8730***
4	Respiratory rate(/min)	22.91± 2.20	20.29 ±1.57	2.63	14.2550***
5	Forced vital capacity(L)	1.8913± .28	2.2515± .28	-3.602	29.5626***
6	Peak Expiratory Flow Rate (L/min)	247.22± 19.71	268.52± 21.41	-21.30	16.8714***

*** p < 0.0001,

Discussion

The present study showed that the cardio respiratory parameters significantly change after the practice of Suryanamaskar. In general, yogic practices have been proposed to reduce resting heart rate and blood pressure.

Telles and Prathima found a reduction in the resting heart rate when a yoga training program was implemented^[20,21]. A decline in the heart rate was also found in current study.

Madhanmohan 2002 in his study showed that the Basal HR in yoga group was 85.32 beats/min before the yoga training^[18]. After six months of yoga training it decreased to 82.42 beats. In our study the HR decreased from 83.63 to 80.31 which is statistically significant.

This finding is consistent with Udupa et al (1975) who have also reported that the the resting HR decreases after six months of yoga training^[17] and also with Bowman who revealed that heart rate decreased following yoga but not significantly after aerobic training^[22]. This shows the beneficial effect of yoga on heart.

In the current study - systolic BP showed significant increased from 91.23 to 94.54 mm Hg and diastolic decreased from 63.03 to 62.03 mm Hg, in

relation to Madhanmohan's study in 2002 where the SBP increased and DBP decreased from after six months practice of suryanamaskar^[18].

Udupa et al proved that yoga training decreases systolic blood pressure & diastolic blood pressure whereas suryanamaskar increases the same^[17]. Our results confirm that Suryanamaskar will increase the SBP and decrease the DBP. Six months of suryanamaskar practice decreases resting pulse rate and blood pressure –Prathima^[21].

Respiratory rate in the current study is decreased significantly from 22.91 to 20.29 with 45 days of suryanamaskar. Makwana also showed the short term effect of yoga in ventilatory function^[8].

The PEFR showed significant increase from 247.22 to 268.52 in consistence with Madhanmahon^[18].

FVC also increased after training period of 45 days. The mean value increased from 1.89 to 2.25 which is consistent with the study of Makwana^[8].

Hence the current study proves that even a period of 45 days Suryanamaskar training can show significant change in the cardio and respiratory parameters. The physical efficiency of the children improved after the practice in correlation with the study of Nayar^[9].

Conclusion

Scientific research has shown that yogic techniques produce consistent and beneficial physiological changes. A few weeks of disciplined yoga practice can lead to improvement in many physiological and psychological functions. It is claimed that suryanamaskar practice improves general health and fitness. It improves pulmonary, cardiovascular function.

Suryanamaskar is the combination of asana and Pranayama and it is simple to practice, consumes only less time so that children can practice it every day. Yoga develops many wonderful qualities, and makes the children healthy for their future life. It also sharpens the ability to focus, self-confidence, and helps to develop self-discipline. We therefore conclude that suryanamaskar should be practised by children every day to get these beneficial effects.

Bibliography

1. K K, Gharote MS. Yoga for your heart 1985; 3rd edition Mumbai ; pg:11- 15.
2. Swaminathan S, Venkatesan P, Mukunthan R. Peak expiratory flow rate in south Indian children. *Indian Pediatrics*;(30):207-211,1993.
3. Vishwas Mandlik. Yog Shikshan Mala, Yog Parichay: 2001 6th edition Nashik;pg 36-45
4. Sparrow L. Hugh Lauter Levin A Yoga journal book 2004: Westport; pg:3
5. Swami sathyananda saraswati. Yoga for children 2006; 4th edition Bihar; pg:20-26
6. Vempati RP, Telles S. Yoga-based guided relaxation reduces sympathetic activity judged from baseline levels *Psycho. Rep*, (90): 487-494,2002
7. Wenger M.A. and Bagchi B.K. Studies of autonomic functions in practitioners of yoga in India. *Behavioral science*, 312-323, 1961
8. Makwana K, Khirwadkar N, Gupta HC. Effect of short term yoga practice on ventilator function tests. *Indian J Physiol Pharmacol* (32): 202-207,1988.
9. Nayar H.S., Mathur R.M. Effects of yogic exercises on human physical efficiency. *Indian journal of medical research*,(24) 1369-1375, 1975
10. Pandae A.H prediction of peak expiratory flow rate from height and weight.*Indian journal of paediatrics* 53 (4) 521 -523,1986.
11. D.Milner A D,Ingram D. Peak expiratory flow rate in children under 5 years of age. *Archives of disease in childhood*. 45(244), 780 – 782, 1970.
12. Pulickal AS, Fernandez GV. Peak expiratory flow rate in healthy rural south Indian school children predicted from body height. *Indian J Public Health* (51):117-119, 2007.
13. Howard eigen,Harvey bieler,debra grant,Kathy christoph,delana Terrill,douglas k. heilman, walter T. Ambrosius, Robert S.Tepper. spirometric pulmonary function in healthy preschool children. *American journal of respiratory and critical care medicine*.163 (3) 619 – 623,2001.
14. Bhattachary A K, Banerjee. S. Vital Capacity in children and young adults of India. *Indian journal. Medical Research* 54-62,1966
15. Turner J A, Mc Lean.R.L Spirometric measurement of lung function in healthy children .*Pediatrics*. 7,360,1951.
16. Necati Akgun and Hamit Ozgonut. Spirometric studies on normal Turkish subjects aged 8 to 20 years.*thorax*. 24, 714-721;1969.
17. Udupa KN, Singh H, Settiwar RM. Physiological and biochemical studies on the effect of yogic and certain other exercises. *Indian J Med Res* (63) 620-624, 1975.
18. Madan Mohan, Gopal krishna pal Effects of yoga training on cardio- respiratory function in school children of pondicherry. Submitted to Department of Science and Technology Pondicherry 1 – 32,2002.
19. Saraswathi S, Suryanamaskar-A technique of solar vitalization; 2nd edition Bihar;pg:3-5,12,18.
20. Telles s, Joshi M, Dash M, Raguraj P, Naveen K, and Nagendra H. An evaluation of the ability to voluntarily reduce the heart rate after a month of yoga practice. *Integral physiological and behavioural science* 39(2)119- 125,2004 .
21. Pratima M. Bhutkar, Milind V. Bhutkar, Govind B.Taware,Vinayak Doijad.Effect of suryanamaskar on cardio- respiratory fitness parameters. *Al Ameen J Med Science* 1(2), 126-129,2008
22. Bowman A J, Clayton R H, A. Murray, J.W Leed, G.A. Ford. Effect of Aerobic Training and Yoga on Baro reflex.*European Journal of clinical investigation*.27(5)443-449,1997.