



# EFFECT OF SURYANAMASKAR ON PEFR AND UPPER BODY MUSCLE ENDURANCE AMONG PHYSIOTHERAPY STUDENTS

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## Abstract

### Background

Suryanamaskar is a popular traditional Indian yoga practice also known as 'Sun Salutation'. It includes practice of dynamic postures which involves alternative backward bending and forward bending poses. During Suryanamaskar, muscles of the entire body experience contraction and relaxation alternately and therefore it gives more benefits with less expenditure of time. Suryanamaskar has impact on optimal stress on cardio-respiratory system. It increases the movement of diaphragm and abdominal breathing leading to better oxygenation and a lower respiratory rate.

### Aim

To study the effect of suryanamaskar on Peak Expiratory Flow Rate (PEFR) and upper body muscle endurance among physiotherapy students.

### Methods

In this study, 35 physiotherapy students on the basis of inclusion and exclusion criteria were recruited from M.V.P'Samaj College Of Physiotherapy. Their ages ranged from 18-26 years. The subjects underwent Suryanamaskar practice 6 days per week for 2 weeks with each session of 20 minutes. Peak flow meter was used to measure Peak Expiratory Flow Rate and Modified Push Up Test was used to measure upper body muscle endurance. The pre and post test data was collected.

### Result

The result of this study showed that there is an effect of Suryanamaskar on Peak Expiratory Flow Rate (PEFR) and upper body muscle endurance in physiotherapy students. As the P value regarding pre and post treatment for both Peak Expiratory Flow Rate (PEFR) and Modified Push Up Test was <0.0001. The study proved to be extremely statistically significant in improving peak expiratory flow rate in physiotherapy students.

### Conclusion

The study concluded that suryanamaskar has an effect on improving peak expiratory flow rate and upper body muscle endurance among physiotherapy students.

**Key words** Suryanamaskar, peak expiratory flow rate, upper body muscle endurance.

## INTRODUCTION

Physiotherapists are desired to have a good level of physical fitness to meet their job demands. The physiotherapy profession which demands good amount of strength, endurance and flexibility. This requires good cardiorespiratory and muscular endurance as well as body composition. <sup>(1)</sup>

Recent studies have shown that yoga poses and techniques produce consistent and beneficial physiological changes. <sup>(2)</sup> With increasing scientific research, its other effect on body are also being explored. <sup>(3)</sup> The effects of short term yoga practice on ventilatory function tests are significant. It improves ventilatory functions in the form of increase in Forced Expiratory Volume (FEV), FEV in one second and Peak Expiratory Flow Rate. <sup>(4)</sup> It can be stated that yogic

training is beneficial for the better maintenance of body functions, particularly pulmonary functions, even in normal healthy subjects.<sup>(5)</sup>

Suryanamaskar is a series of 12 dynamic postures performed in synchronization with the breath.<sup>(6)</sup> The sequence of asanas is such that each asana is complimentary to the next. It is a series of variety of forward and backward bends.<sup>(7)</sup> The deep breathing performed with each posture also renders some benefits of breathing exercise.<sup>(8)</sup> It is characterized by slow and deep inhalation and exhalation. The stress is more on prolonged expiration and efficient use of abdominal and diaphragmatic muscles.<sup>(9)</sup>

Suryanamaskar's relevance and versatility make it among the most useful and complete methods to bring about health while the same time preparing an adeptness for the deeper processes of yoga.<sup>(10)</sup> It is a very powerful practice.<sup>(11)</sup> During Suryanamaskar, the muscles of entire body experience contraction and relaxation alternately and therefore it is said to give more benefits in a shorter duration.<sup>(12)</sup> There is stretching and contraction of the muscles in a systematic manner leading to increased flexibility and strength of muscles.<sup>(13)</sup> It is claimed that suryanamaskar practice gives benefits of both asana and pranayama and improves general health and fitness.<sup>(14)</sup>

Peak Expiratory Flow Rate is defined as the largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration, expressed in litres/minutes.<sup>(15,16)</sup> Suryanamaskar has an effect on breathing controlling musculature; including the muscle of the abdomen, diaphragm and the intercostal muscles of the thorax and function of lung themselves. Improvement of the volume of inhalation can be obtained through the use of basic breathing control. The peak expiratory flow rate (PEFR) measurement is a simple and reliable way of judging the degree of airway obstruction in various obstructive lung diseases.<sup>(17)</sup> PEFR is preferred among other pulmonary function tests because of the advantages like inexpensive, easy to perform the procedure, easy to use and handle, and easy to take the reading.<sup>(18)</sup>

The series of poses stretch the entire body through their full range of motion, massaging, toning and stimulating vital organs by alternately flexing the body forwards and backwards. It builds upper body strength through the inherent weight bearing positions, especially in the arms and shoulders, throughout the series.<sup>(19)</sup> This simulated push-up movement and upper body weight bearing position in the series may help to develop muscular strength and endurance in the pectoral, triceps, as well as the muscles of the trunk.<sup>(20)</sup>

Muscle performance encompasses both strength and endurance. Muscle strength is the amount of tension or force that muscle or muscle group can voluntarily exert in one maximal effort under prescribed conditions. Muscle endurance is ability of muscle to perform repeated contractions at a certain output (dynamic endurance) or to sustain a contraction over time at a certain level (static endurance).<sup>(21)</sup>

A number of measurable components contribute to physical fitness. The health-related components are (a) cardiorespiratory endurance, (b) muscular endurance, (c) muscular strength, (d) body composition and (e) flexibility.

<sup>(22)</sup> It has been found that a lower level of aerobic capacity is associated with low level of physical activity. Also, poor engagement in exercise is associated with low level of oxygen consumption. As it is evident that Suryanamaskar has a favourable effect on the skeletal muscular system, it is an ideal form of exercise.<sup>(7)</sup> So, the study was chosen to observe the effects of Suryanamaskar on PEFR and upper body muscle endurance among physiotherapy students.

**PURPOSE OF STUDY** To study the effect of Suryanamaskar on Peak Expiratory Flow Rate (PEFR) and upper body muscle endurance among Physiotherapy students.

### AIM OF THE STUDY

To determine the effect of Suryanamaskar on PEFR and upper body muscle endurance among physiotherapy students.

### OBJECTIVES OF THE STUDY

- To study the effect of Suryanamaskar on PEFR among physiotherapy students
- To study the effect of Suryanamaskar on upper body muscle endurance among physiotherapy students
- To study the effect of Suryanamaskar on PEFR and upper body muscle endurance among physiotherapy students

### HYPOTHESIS

Suryanamaskar has an effect on PEFR and upper body muscle endurance among physiotherapy students.

### NULL HYPOTHESIS

Suryanamaskar does not have any effect on PEFR and upper body muscle endurance among physiotherapy students.

### RESEARCH METHODOLOGY

- **Type of study:** quasi experimental study
- **Sampling method:** Convenient sampling
- **Sample size:** 35
- **Study setting:** M.V.P Samaj College of Physiotherapy
- **Study duration:** 6 months

### Inclusion criteria:

- Age between 18-26 years
- Both genders
- BMI of 18.5-22.9 {Asian classification}
- Undergraduate and Postgraduate physiotherapy students

### Exclusion criteria:

- Students who are practicing any other exercise/sports activity for at least 3 months.
- Orthopaedic problems (low back pain, repetitive stress injuries, fractures etc)

- Neurological condition (vertigo, epilepsy etc)
- Major medical illness such as bronchial asthma
- Major surgery in previous year

### **MATERIAL REQUIRED:**

- Pen
- Paper
- Consent form
- Assessment form
- Yoga mat
- Peak flow meter
- Mouthpiece
- Stop watch

### **OUTCOME MEASURES:**

#### **1. Peak Expiratory Flow Rate (PEFR)** <sup>(27,28,29)</sup>

- Peak flow meter was used to measure PEFR.
- Subject was asked to be seated comfortably on a chair.
- The subject was asked to take a deep breath and placed the mouthpiece in the mouth, between the teeth. The lips were closed around it, taking care that a tight seal was maintained between the lips and the mouthpiece.
- The subject was then asked to inhale deeply and to blow out hard and fast in a single blow.
- The number was noted down.
- Three readings were taken and the average value was calculated.



**Fig 1. Measuring Peak Expiratory Flow (PEFR)**

#### **2. Push Up Test** <sup>(25)</sup>

- Upper body muscle endurance particularly that of the triceps, anterior deltoid, and pectoralis was measured by a standard push up test where the number of correctly performed push ups was counted until the subject could not perform any more push ups in a rhythmic pattern.
- The females performed modified push-ups.

**Modified Push-ups:** The subject was asked to place the knees on the floor, placing the palms on the floor directly below the shoulders and cross her feet at the ankles.

Keeping her back straight, she was then instructed to start bending the elbows until her chest almost touched the floor. Returning to the starting position, she was to then repeat lowering and raising at a steady pace.



**Fig 2. Modified Push Ups**

### **PROCEDURE** <sup>(30,31,32,33)</sup>

- 35 participants were selected according to inclusion and exclusion criteria. They were explained about the procedure and a consent form was signed from all the participants.
- The protocol began with 5 minutes of warm-up period.
- The subjects then performed 10 suryanamaskars. Each Suryanamaskar pose was held for 5 seconds. Hence one cycle lasted for 60 seconds.
- This was followed by a cool-down period of 5 minutes (Shavasana).
- The complete protocol duration was 2 weeks.

#### **1. Pranamasana (Prayer Pose)**

The subject was asked to stand erect with palms held close to the chest in prayer pose. She was instructed to only inhale, without making any other movement of the body.



**1Fig 3. Pranamasana (Prayer Pose)**

## 2. Hastauttanasana (Raised Arm Pose)

The subject was asked to raise both arms overhead, and then tilt the head, neck and upper body gently backward while gazing up at the thumbs. Then the subject was asked to exhale the breath completely.



Fig 4. Hastauttanasana (Raised Arm Pose)

## 3. Hasta Padasana (Hand to Foot Pose)

The subject was asked to inhale and bend forward in the waist and place the palms on the floor in the line of the toes, without bending the legs in the knees.



Fig 5. Hasta Padasana (Hand to Foot Pose)

## 4. Ashwa Sanchalanasana (Equestrian Pose)

The subject was asked to exhale completely and take one leg behind, resting its knee on the floor. Then asked to press the waist downwards and raised the neck upwards.



Fig 6. Ashwa Sanchalanasana (Equestrian Pose)

## 5. Dandasana (Stick Pose)

The subject was then asked to inhale and raise the knee off the floor. Taking the other leg behind, she then straightened both the legs and the arms. The neck, spine, thighs and feet were kept in a straight slant line.



Fig 7. Dandasana (Stick Pose)

## 6. Ashtanga Namaskara (Salute with Eight Parts)

The subject was asked to exhale, and bent both the arms in the elbow and the forehead, chest, both the palms, both the knees and toes touched the floor raising the hips off the floor.



Fig 8. Ashtanga Namaskara (Salute with Eight Parts)

## 7. Bhujangasana (Cobra Pose)

The subject was asked to inhale and straightened the elbows, stretching the shoulders upwards. The toes and knees rested on the floor. Keeping the arms straight, and was asked to raise the chest off the floor and curved her back.



Fig 9. Bhujangasana (Cobra Pose)

## 8. Parvatasana (Mountain Pose)

Exhaling subject was asked to bent the neck downward and pushed the body backwards and up. The positions of the toes and palms on the floor was not changed.



**Fig 10. Parvatasana (Mountain Pose)**

### 9. AshwaSanchalanasana (Equestrian Pose)

The subject was asked to inhale and bring one leg to the front and place it between the palms of the two arms.



**Fig 11. Ashwa Sanchalanasana (Equestrian Pose)**

### 10. Hasta Padasana (Hand to Foot pose)

Exhaling subject was asked to start bending forward in the waist, placing the palms on the floor in the line of the toes, without bending the legs in the knees.



**Fig 12. Hasta Padasana (Hand to Foot pose)**

### 11. Hastauttanasana (Raised Arms Pose)

While inhaling subject was asked to raise both arms off the floor and overhead while tilting the head, neck and upper body backward just like position 2.



**Fig 13. Hastauttanasana (Raised Arms Pose)**

### 12. Pranamasana (Prayer Pose)

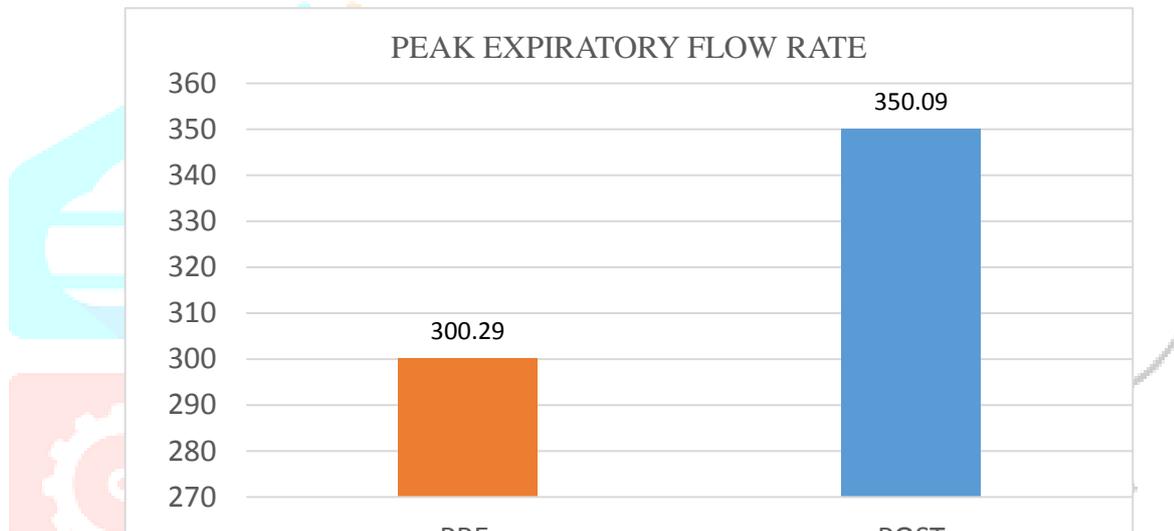
Subject was asked to exhale and bring the hands down and forward and straightened her back, taking the initial position.



**Fig 14. Pranamasana (Prayer Pose)**

**DATA ANALYSIS****TABLE NO. 1: COMPARISON OF PRE AND POST MEAN TREATMENT SCORES OF PEFR USING PAIRED T TEST**

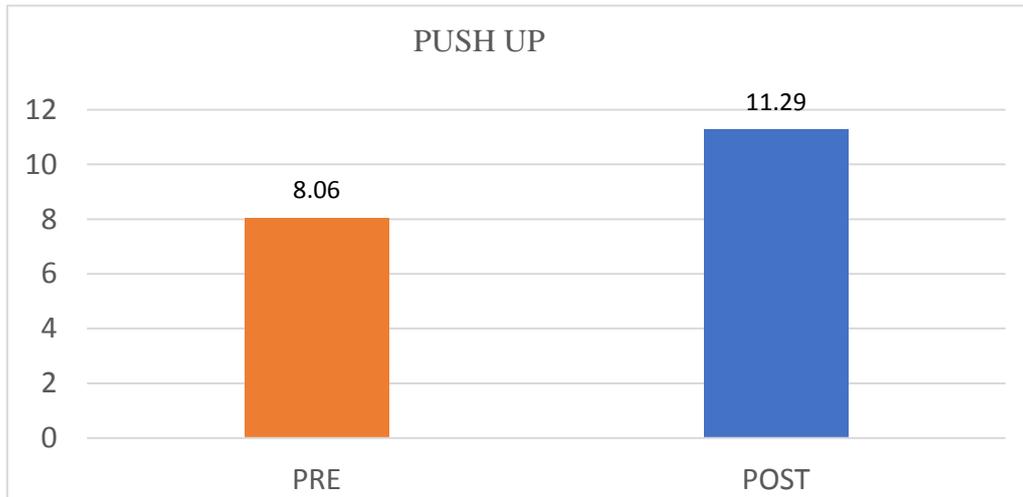
PAIRED T TEST	PEAK EXPIRATORY FLOW RATE	
	PRE	POST
MEAN	300.29	350.09
SD	43.19	46.36
P VALUE	<0.0001	
T VALUE	9.9003	
RESULT	EXTREMELY SIGNIFICANT	

**GRAPH NO. 1: COMPARISON OF PRE AND POST MEAN TREATMENT SCORE OF PEFR USING PAIRED T TEST**

**DATA INTERPRETATION:** The mean value of PEFR was 300.29 before the treatment and after the treatment the mean was 350.09 and P- value is < 0.0001 and the result is extremely statistically significant

**TABLE NO. 2: COMPARISON OF PRE AND POST TREATMENT SCORES OF PUSH UP TEST USING PAIRED T TEST**

PAIRED T TEST	PUSH UP	
	PRE	POST
MEAN	8.06	11.29
SD	2.33	3.09
P-VALUE	<0.0001	
T-VALUE	15.4194	
RESULT	EXTREMELY SIGNIFICANT	

**GRAPH NO. 2: COMPARISON OF PRE AND POST MEAN TREATMENT SCORE OF PUSH UP TEST USING PAIRED T TEST**

**DATA INTERPRETATION:** The mean value of push up test was 8.06 before the treatment and after the treatment the mean value was 11.29 and p-value is  $< 0.0001$  and the result is extremely statistically significant

## RESULT

- The result of this study showed that there is an effect of Suryanamaskar on Peak Expiratory Flow Rate (PEFR) and upper body muscle endurance in physiotherapy students.
- The mean value for PEFR was 300.29 pre study and was 350.09 post study with standard deviation of 43.19 and 46.36 respectively.
- As the P value regarding pre and post treatment for Peak Expiratory Flow Rate was  $< 0.0001$  proved to be extremely statistically significant in improving peak expiratory flow rate in physiotherapy students.
- The standard deviation was 2.33 for pre study Push Up Test and 3.09 for post study Push Up Test.
- As the P value regarding pre and post treatment for upper body muscle endurance was  $< 0.0001$  proved to be extremely statistically significant in improving upper body muscle endurance in physiotherapy students.

## DISCUSSION

The purpose of this study was to determine the effect of Suryanamaskar on Peak Expiratory Flow Rate and upper body muscle endurance in physiotherapy students.

The findings are similar to previous studies on yoga which have reported improvement in vital capacity following yoga training.<sup>(32)</sup> There is significant improvement in PEFR from mean average to which is statistically

yoga poses helps in strengthening the respiratory muscle and increases the excursion of diaphragm and lungs as well as thoracic compliance.<sup>(34)</sup> The present study focused on breath control and slow and deep respiration while performing the 12 yoga poses of Suryanamaskar. Increase in Peak Expiratory Flow Rate (P-value  $< 0.0001$ ) and upper body muscle endurance (P-value  $< 0.0001$ ).

The increase in number of push-ups by the participants after the intervention of Suryanamaskar shows that it may promote

considered extremely significant. In our study there was extremely significant

The different poses involve isometric contraction and chest wall expansion which might improve strength of the intercostal muscles. Regular efficient usage of respiratory muscles strengthens the elastic and collagen fibres and increases the extensibility of chest wall and lungs, thereby allowing the lungs to inflate and deflate to their fullest.<sup>(35)</sup> All factors contribute to improvement in various lung function.<sup>(9)</sup>

According to Author Suhas Y. Shirur et. al, the lungs inflate to the maximum while performing yoga. This results in stimulation of the stretch receptors which reflexively relaxes smooth muscles of larynx and tracheo-bronchial tree, thereby showing an effect in increasing the lung volume and capacities.<sup>(35)</sup> Holding the breath while performing each Suryanamaskar pose requires a sustained contraction of the respiratory muscles and encourages a deeper and controlled breathing pattern. This increases the capacity and strength of the respiratory musculature. As the PEFR depends on the maximal inspiratory volume and the maximal expiratory pressure generated, these factors can therefore be responsible for the increase in PEFR values.

In this study the upper body muscle endurance was assessed pre and post intervention using Push- Up Test. The number of push-ups correctly performed until the subject could not perform any more push-ups in a rhythmic pattern were counted. The muscle power improved from average mean with P-value ( $< 0.0001$ ), upper body muscle endurance. The simulated push-up portions specifically works on the triceps, serratus anterior, pectorals, deltoid and trunk muscles.<sup>(23)</sup>

The improvement in muscle power is attributed to dynamic posture assumed by the subject while performing Suryanamaskar in which muscles of the body experience stretch and contraction alternately. Many of its poses build strength because it requires sustained contractions of many muscle groups. Also, there is weight bearing on upper limb, so there is more utilization of upper body muscles.<sup>(6)</sup>

While there are significant changes in PEFr and upper body muscle endurance in this study, a daily practice of suryanamaskar may be helpful over a period of time. Suryanamaskar can be considered as an integral part of muscle strengthening and exercise protocol as it has a beneficial effect on the skeletal muscular system.<sup>(36)</sup> It can be used as an adjuvant to improve aerobic capacity and cardiovascular endurance.

The limitations of the study was no long term follow up of the subjects and small sample size.

## CONCLUSION

The study showed that Suryanamaskar has an effect on improving the Peak Expiratory Flow Rate (PEFR) and upper muscle endurance among physiotherapy students.

## SUGGESTIONS

- The study can be done in different conditionseg. hypertension, low back pain
- A comparison treatment group can be taken.

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