Suryanadi Pranayama on Physiological Indices among Smokers

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**Abstract**

Smoking causes important structural and functional alterations to the respiratory epithelium. Breathing exercise is the best practice to prevent the smoking associated diseases especially respiratory illnesses and death. Pranayama is a method of breathing and chest expansion exercise which improves the ventilatory functioning and overall capacity of lungs. Hence, the study was conducted with the aim to evaluate the effectiveness of Suryanadi Pranayama on physiological indices among smokers. The pre-experimental research design was conducted with 30 samples which matched with the inclusion criteria. Suryanadi Pranayama was administered for 30 days. The primary outcome of the research was respiratory rate, pulse rate, peak expiratory flow rate and oxygen saturation which was measured before and after the intervention and was compared by using SPSS package. The study finding reveal that there was a highly significant changes was found in respiratory rate, pulse rate, peak flow expiratory rate and oxygen saturation at the level of p<0.001. It is concluded that Suryanadi Pranayama is safe and effective breathing exercise yoga and suggested replicating the similar study on larger samples for wider understanding the mechanisms involved.

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**Introduction**

Cigarette smoking is one of the biggest public health threat and also leading cause of preventable disease and death. Cigarette smoke contains more than 4000 noxious components, including gas and particulate substances such as asacrolein, formaldehyde, carbon monoxide, nicotine, cotinine; acetaldehyde, phenol and potassium cyanide (Environmental Protection Agency, 1993). Also a considerable lot of these segments are provenly poisonous to the respiratory epithelium (Dalhamn, 1970). Smoking causes malignant growth, coronary illness, stroke, lung problems, diabetes, and chronic obstructive pulmonary disease (COPD), which incorporates emphysema and ongoing bronchitis (U.S. Department of Health and Human Services, 2014). Tobacco use causes in excess of 7 million deaths for each year internationally (World Health Organization, 2017) and all things considered; smokers pass on 10 years sooner than nonsmokers (World Health Organization, 2011). In excess of 8 million individuals a year will kick the bucket from illnesses identified with tobacco use by 2030 if smoking example everywhere on the globe doesn't change (Jha et al., 2013). It additionally causes significant basic and utilitarian modifications to the respiratory epithelium. Various examinations have demonstrated that Cigarette smoking is related with significant changes in mucous creation components causes a decrease in cell capability, enlistment of apoptosis in respiratory hair cells (Lan, 2007) and debilita-
tion on epithelial recovery upon injury (Winkle et al., 2001). Ongoing presentation to this smoke causes metaplastic changes to the respiratory mucosa with an expansion in the number and size of chalis cells and resulting increment in upper aviation route emission (Mullen et al., 1987; Wright et al., 1984). Breathing exercise is the best practice to prevent the smoking associated diseases especially respiratory illnesses and death.

Many earlier studies have been well documented that yogic breathing exercise upgrades the respiratory proficiency by expanding the strength of stomach and intercostal muscles, and by expanding the quantity of alveoli and indispensable limit. Pranayama is a strategy for breathing and chest development practice which improves respiratory breathing limit by expanding chest divider extension and constrained expiratory lung volumes (Chanavirut et al., 2006). Pranayama (prana = energy + yama = control) is a type of meditation technique that involves various ways of controlling the breathing invented by Indian monk from ancient time. Pranayama made from prana (life force) + Yama (control) that would signify “breath-control” or the “breath-limit” or it can likewise be perceived as “pranayama” that would mean “opportunity of breath” or “breath freedom”.

Prana is the conscious energy that essentially means that the Nadis of our body also transmit consciousness there are 72,000 Nadis. These Nadis are channels or pathways of prana in the system. The positive impact of pranayama in the body system is well reported with sound scientific basis. Savitripiranayam produced a significant increase in respiratory pressures and respiratory endurance and also suggested that different kinds of Pranayama show significant physiological responses in normal young volunteers (Madanmohan et al., 2005). Nadi-shodhana Pranayama training programme suggested improving vital capacity and control heart rate and blood pressure and may contribute to enhance health status and wellness (Singh, 2011).

The regular slow practice of breathing exercise improve the autonomic function by increases para sympathetic activity and decreases sympathetic activity (Pal, 2004), elucidates the role of cardiovascular and respiratory functions (Jerath et al., 2006). The first change of reduction in sympathetic tone is appeared within a week due to the regular practice of pranayama (Shankarappa et al., 2012). Pranayama can be used as a lung strengthening tool to treat many lung diseases like asthma, allergic bronchitis, post pneumonia and tuberculosis recoveries, and many occupational diseases (Turankar et al., 2013). Pranayama gradually improves the ventilatory functioning and overall capacity of lungs thereby vital energy flows to maintain the normal homeostasis of the body and thus it helps for prevention, control and rehabilitation of many respiratory diseases (Manaspure et al., 2011). Suryanadi or Surya Bhedan is a type of pranayama in which Surya implies the Sun and as indicated by Yoga, the Surya Nadi is the correct nostril. In this pranayama, utilize the correct nostril or Pingala for inward breath and the left or Ida one for exhalation. Right nostril is Pingala Nadi, which speaks to the physical energy of a body.

An essential reason for the correct nostril breathing is to expand the pranic energy, physical energy and to renew the body, supports the sensory system, particularly the thoughtful sensory system and builds the proficiency of the stomach related framework and significant for some significant metabolic cycles (Ankad et al., 2011). Past investigations have recommended that selective right uni-nostril breathing known as suryanadi pranayama has sympathomimetic impacts remembering increment for digestion, gauge oxygen utilization, systolic weight and pulse (Raghuraj and Telles, 2003). Hence Considering the potential beneficial effects and well documented previous research report, the present study was designed to test the hypothesis that the suryanadi pranayama have an effect on physiological indices among smokers.

MATERIALS AND METHODS

Quantitative approach with pre-experimental research design was adopted to conduct the study with 30 samples in a selected village of Thiruvallur district from April 2020 to May 2020 after obtaining approval from Institutional Scientific Review Board of Saveetha College of Nursing. Samples who matched with the inclusion criteria were selected by purposive sampling technique. The inclusion criteria were smokers with the age group between 18 and 40 years and willing to sign an informed consent to participate in the study.

Smokers with hypertension, respiratory disease, chest wall injuries, congestive cardiac failure, orthopedic problems, having a regular practice of yoga and not able to follow the instruction were excluded from the study. The demographic questionnaire was completed at the beginning of the study. The primary outcome of the study was ventilatory volume and capacities such as respiratory rate, pulse rate, peak expiratory flow rate, and oxygen saturation. Pretest assessment was done using pulse oximeter.
Table 1: Frequency and percentage distribution of demographic variables among smokers.

| S No | Demographic Variables | Study Group | Frequency | Percentage |
|------|-----------------------|-------------|-----------|------------|
| 1    | Age in Years          |             |           |            |
|      | a. 18-25 years        | 07          | 23.3%     |
|      | b. 26-30 years        | 09          | 30%       |
|      | c. 31-35 years        | 07          | 23.3%     |
|      | d. 36-40 years        | 07          | 23.3%     |
| 2    | Education             |             |           |            |
|      | a. Illiterate         | 03          | 10%       |
|      | b. Primary            | 09          | 30%       |
|      | c. Secondary          | 13          | 43.3%     |
|      | d. Graduate           | 05          | 16.7%     |
| 3    | Occupation            |             |           |            |
|      | a. Unemployed         | 02          | 6.7%      |
|      | b. Business           | 05          | 16.7%     |
|      | c. Technical worker   | 12          | 40%       |
|      | d. Daily wages        | 11          | 36.6%     |
| 4    | No of Cigarettes per day |           |           |            |
|      | a. 1 per day          | 02          | 6.7%      |
|      | b. 2-5 per day        | 11          | 36.7%     |
|      | c. 5-10 per day       | 10          | 33.3%     |
|      | d. More than 10 per day | 07          | 23.3%     |

and peak flow meter after standardizing an instrument. Pre demonstration on suryanadi pranayama yoga was demonstrated prior to initiate the intervention among participants. Participants were instructed to continue the suryanadi yoga daily in the morning for 30 days under the direct supervision of investigator. The duration of each session was 15 minutes. Participants were monitored the vital signs such as respiratory rate, hear rate before and after the yoga and informed them to report any discomfort like dyspnea, dizziness, and palpitation. It was performed in a vajrasana sitting position. Post-test was conducted at the end of one month using the same tool. Confidentiality was maintained throughout the procedure. Effectiveness of suryanadi pranayama on pulmonary function was determined in the study group was SPSS package. The data were expressed as Mean ± SE and as frequency distribution and paired ‘t’ test was used for the comparison of means. A probability of 0.05 or less was taken as statistically significant.

**Steps of Suryanadi Pranayama**

Participants were instructed to kneel on the floor by using a yoga mat for comfort. Instructed to sit in Vajrasana and pull the knees and ankles together and point the feet in line with legs. The bottoms of feet should face upward with big toes touching. Instructed to exhale as sit back on legs and buttocks will rest on heels and thighs will rest on calves. Put the hands on thighs and adjust pelvis slightly backward and forward until feel comfortable. Perform Nausicaa Mudra (i.e. fold index and middle finger) and with the right hand, close left nostril with ring finger. Then, instructed the participants to inhale slowly through right nostril by counting 1-6 over a period of six seconds. Now exhale slowly up to maximum over a period of six seconds through the right nostril. Continue the suryanadi pranayama of 6 cycles/min for 10 minutes.

**RESULTS AND DISCUSSION**

The present study findings observed that the age of participants ranged from 18 to 40 years with mean age of 31.56 ± 6.75. The highest percentage (40%) of participants was having the habit of smokes 2-5 cigarettes per day as shown in Table 1. Out of 30 samples, 5(17%) of them were in the normal range (18-20 breaths/min) of respiratory rate, 25(83%) had tachypnea (>20 breaths/min) and none of them shown bradypnea (<18 breaths/min). Regarding pulse rate of 22(73%) had normal range (78-86 beats/min) and 8(27%) had tachycardia (<86 beats min). In Peak expiratory flow rate 16(53%) had normal range of 400-600 Lit/min and 14(47%) were in
Table 2: Pretest and Post-test score of physiological indices among Smokers

| Physiological Indices | Normal | Tachypnea | Bradypnea |
|-----------------------|--------|-----------|-----------|
| Respiratory Rate      |        |           |           |
| Pre-test              | 05 (17%) | 25 (83%) | -         |
| Post-test             | 18 (60%) | 12 (40%) | -         |
| Pulse Rate            |        |           |           |
| Pre-test              | 22 (73%) | 08 (17%) | -         |
| Post-test             | 27 (90%) | 03 (10%) | -         |

| Normal (400-600 Lit/min) | Increased (>600 Lit/min) | Decreased (<400 Lit/min) |
|--------------------------|--------------------------|--------------------------|
| Peak Expiratory Flow Rate|                          |                          |
| Pre-test                 | 16 (53%)                 | -                        |
| Post-test                | 24 (80%)                 | -                        |
|                          | 99-100%                  | 98-99%                   |
| Oxygen Saturation        |                          |                          |
| Pre-test                 | 14 (47%)                 | -                        |
| Post-test                | 26 (86%)                 | -                        |

Table 3: Comparison of pre-test and post-test score of physiological indices among smokers.

| Variables               | Test     | Mean   | SD      | Paired ‘t’ Test Value |
|-------------------------|----------|--------|---------|-----------------------|
| Respiratory rate        | Pretest  | 22.86  | 1.87    | t = 13.000            |
|                         | Post-test| 18.66  | 1.09    | p = 0.0001            |
|                         |          |        |         | df = 29               |
|                         |          |        |         | S***                  |
| Pulse rate              | Pretest  | 85.06  | 2.86    | t = 16.389            |
|                         | Post-test| 79.2   | 1.44    | p < 0.0001            |
|                         |          |        |         | df = 29               |
|                         |          |        |         | S***                  |
| Peak expiratory flow rate| Pretest | 395    | 58.29   | t = 16.426            |
|                         | Post-test| 468.6  | 63.39   | p < 0.0001            |
|                         |          |        |         | df = 29               |
|                         |          |        |         | S***                  |
| Oxygen saturation       | Pretest  | 97.6   | 0.89    | t = 12.042            |
|                         | Post-test| 98.9   | 0.73    | p < 0.0001            |
|                         |          |        |         | df = 29               |
|                         |          |        |         | S***                  |

***p<0.001, S - Significant, df- Degrees of freedom.

the range of 400-300 Lit/min. 14(47%) had normal range of 99-100% oxygen saturation, and 16(53%) had the range of 98-97%. Whereas in post-test 18 (60%), 27(90%), 24(80%) and 26(86%) had normal range of respiratory rate, pulse rate, peak expiratory flow rate and oxygen saturation respectively as depicted in Table 2. When considering the effect of suryanadi pranayama on physiological indices, the summary of all findings of respiratory rate, pulse rate, peak expiratory flow rate and oxygen saturation were shown in Table 3. The pretest and post-test mean and standard deviation of respiratory rate was 22.86 ± 1.87 and 18.66 ± 1.09. The calculated paired t value of t= 13.00 was found to be statistically significant at the level of P<0.001, which indicates that there was highly significant difference in the level of respiratory rate. Regarding the effectiveness of pulse rate, paired t-test revealed that there was a difference in the pretest (85.06±2.86) and post-test (79.2±1.44) mean value in the study group and found statistically significant at the level of p<0.001 revealing that the intervention is effective in pulse rate within clinical range. The effectiveness of suryanadi pranayama was analyzed by paired ‘t’ test revealed that there is significant difference in the mean value of pretest (395±58.29) and post-test (468.6±63.39) and found statistically significant at the level of p<0.001 revealing that the intervention was found effective in improving the
peak expiratory flow rate. The pretest and post-test mean and standard deviation of oxygen saturation was 98.9±0.89 and 99.6 ±0.73. The calculated paired t value of t= 12.04 was found to be statistically significant at the level of P<0.001, which proves that there was highly significant improvement in the level of oxygen saturation. Smokers increases the risk of lung diseases and directly responsible for almost 90% of lung cancer and chronic obstructive pulmonary diseases deaths (U.S. Department of Health and Human Services, 2014, 2010).

Many people continue to smoke or start to smoke every year. Chemical substances in the smoke cause damage throughout the respiratory tree from the main airways of bronchi to the peripheral airways bronchioles, terminal alveoli, as well as to the immune system. Breathing exercise is one of the effective measures to improve the lung capacity by filling the lungs with oxygen and improve internal respiration. Yoga is the ancient science which makes use of voluntary regulation of breathing to make respiration rhythmic, calm the mind to reach the ultimate goal (Dhunegel et al., 2008). Pranayama can improve lung health and capacity because using more of lungs during practicing yoga (Subbalakshmi et al., 2005).

In the present study, physiological indices in terms of respiratory rate, pulse rate, peak flow expiratory rate and oxygen saturation was assessed among smokers. The highest percentage of smokers ranged with the 26-30 years which was matched with earlier report pointed out by Creamer MR et al. (Creamer et al., 2019) that by current cigarette smoking was highest among people aged 25–44 years and lowest among people aged 18-24 years. The findings observed the physiological changes in the respiratory system such as tachypnea, tachycardia and decreased expiratory flow rate as an impact of cigarette smoking. The present study also intensively analyzes the effect of suryanadi pranayama and found highly significant improvement in respiratory rate, pulse rate, peak flow expiratory rate and oxygen saturation.

These findings are in accordance with earlier findings of Shravaya Keerthi G et al. (Keerthi et al., 2013) who reported that the increase in PEFR, vital capacities and flow rates by suryanadi pranayama practice obviously offers an increment in respiratory efficiency. This finding supported by Dinesh et al (Gaur et al., 2015) who demonstrated the effects of 12 week training in slow and fast Pranayama on pulmonary function test and revealed that slow Pranayama group, PEFR and FEV25 improved significantly. In another study by Puja Dulloet al (Dullo et al., 2008), who proven that regularly practicing a part of pranayama of alternative nostril breathing could cause positive improvement in pulmonary functions.

This finding is in line with previous study by Nidhi Jain, et al. (Jain et al., 2005), who revealed that both left and right nostril breathing evoked the general parasympathetic dominance and PEFR rose significantly only in females after 8 weeks of left nostril breathing. In the present study there was no gender differentiation because all the participants were male and suryanadi pranayama is only left nostril breathing technique. Baljinder Singh Bal (Bal, 2010) who quoted that Pranayama training programme may be recommended to improve vital capacity and maximal ventilatory volume. It is also consistent with the findings of Hakked et al. (Hakked et al., 2017), who concluded that yogic breathing practice increase the maximal voluntary ventilation, forced vital capacity thereby enhances the respiratory endurance among competitive swimmers.

In a study conducted by UpadhyayDhungel K et al. (Dhunegel et al., 2008), who found a significant increment in peak expiratory flow rate and Pulse pressure and decrease in pulse rate, respiratory rate, diastolic blood pressure after 4 weeks of regular practice of alternate nostril breathing pranayama. The present study findings is also supported by Abel AN et al. (Abel et al., 2013), who documented in a literature review that pulmonary function appears to improve with a minimum of 10 weeks of regular yoga practice. Thus, the current study finding is strongly consistent with other previous similar findings. However, there are certain limitations are present. Though it is interventional study, it does not compare with control group and the sample size was only 30.

Because this study was conducted during the COVID 19 pandemic lockdown which great strength because yogic breathing exercise is widely recommended as a preventive and promotive measures of COVID 19 because the major organ which is affected by COVID 19 is respiratory system. It also lacks in analyzing the other vial parameters such as blood pressure, pulmonary function test, X-ray findings and correlates the duration of smoking with their physiological response in respiratory system. Hence, the present study is recommended to analyze other vital parameters related to respiratory, cardiac and immune system. Thus, the positive effects of suryanadi pranayama yoga, similar study can be replicated on larger samples for wider understanding of the mechanisms involved and to generalize the findings.
CONCLUSIONS

This study finding concluded that suryanadi pranayama obviously improves the peak expiratory flow rate and oxygen saturation and the decrease in respiratory rate and pulse rate within the clinical range and can be administered as a routine practice among smokers. Thereby improve the ventilatory capacities and lung volumes and prevent respiratory illness associated with smoking such as chronic obstructive pulmonary diseases. Moreover, doing yoga changes the mind to quit from the habit of smoking. It is also safe and complementary for healthy life.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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