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## Effect of alternate nostril breathing on peak expiratory flow rate (PEFR) in second trimester of pregnancy at the end of 4 weeks: A pre and post experimental study

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### Abstract

**Aim:** This study evaluated effect of alternate nostril breathing on peak expiratory flow rate (PEFR) in second trimester of pregnancy at the end of 4 weeks. In this study the focus was made on the effect of alternate nostril breathing in improving peak expiratory flow rate. Peak Expiratory Flow Rate (PEFR) is the highest flow that can be achieved during a forced expiration from full inspiration. Peak flow measures the ease with which the lungs are ventilated and reflects resistance in large airways, expiratory muscle strength and effort. Peak expiratory flow rate gets reduced in second trimester of pregnancy due to enlarged gravid uterus, lesser force of contraction of main expiratory muscles like 'anterior abdominal' and 'internal intercostal muscles', vertical dimension is reduced limiting movement of diaphragm.

**Methodology:** 60 subjects were selected for the purpose of study from gynaecological hospitals in and around Pune city. Data was collected and peak expiratory flow rate was measured by using Mini wright peak flow meter.

**Procedure:** 60 females who were in second trimester of pregnancy within the age group of 20-35 years having normal pre-pregnancy BMI were selected and peak expiratory flow rate was measured. The left nostril initiated alternate nostril breathing was performed for 15 minutes in the morning every day of the week for the period of 4 weeks.

**Statistical tool:** Paired t-test was used for the pre and post data analysis of the group.

**Conclusion:** This study concludes that alternate nostril breathing technique is effective in improving peak expiratory flow rate (PEFR) in second trimester of pregnancy with women having normal pre-pregnancy BMI at the end of 4 weeks.

**Keywords:** PEFR, second trimester, experimental

### Introduction

Peak Expiratory Flow or Peak Expiratory Flow Rate (PEFR) is the highest flow that can be achieved during a forced expiration from full inspiration <sup>[1]</sup>.

Peak flow measures the ease with which the lungs are ventilated and reflects resistance in large airways, expiratory muscle strength and effort <sup>[1]</sup>.

Measured in L/min. Normal value is 300-600 L/min <sup>[1]</sup>.

Pregnancy is a remarkable state of physiological adaptation in which profound alterations in the functioning of all systems of mother occur to accommodate the needs of developing foetus. It is divided into 3 trimesters. Several changes are reported in the maternal pulmonary function (i.e. respiratory system).

Weeks	Length (cm)	Weight (g)
12	9	
16	16	
20	21	500
28	35	1250

1st trimester = 1st day of last period-13 weeks

2nd trimester = 14-28 weeks

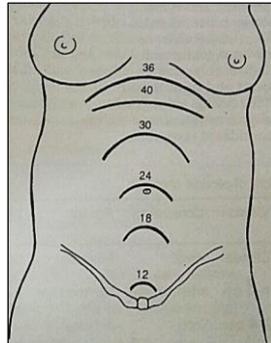
3rd trimester = 29-40 weeks

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Increased circulating progesterone levels of pregnancy further sensitize the respiratory centre in medulla to CO<sub>2</sub>, this and increasing demand for O<sub>2</sub> acts as a mild stimulants to ventilation [2].

Resting respiratory rate goes up a little from 15 to about 18 breaths/min, there is lowering by some 25% of maternal blood CO<sub>2</sub> tension which leads to hyperventilation [2].

Enlarging uterus increasingly impedes the descent of diaphragm [2].



**Fig 1:** Fundal heights in relation to gestation in weeks

Diaphragm displaces upwards if foetus is large and/or abdominal component of torso is short. Upward pressure of foetus affects the ribs causing them to flare [2].

During active forceful expiration, the intra-abdominal pressure increases which exerts pressure on diaphragm cranially giving a passive stretch on costal fibres of diaphragm [3].

Enlarging uterus increases the end-expiratory abdominal pressure, increases negative pleural pressure and there is early closure of airways [3].

There is less force of contraction of expiratory muscles i.e. anterior abdominals and internal intercostals. Hence there is significant decrease in PEFR especially in 2nd trimester as forceful expiration is quite difficult [3].

Respiratory excursion is limited at lung bases and greater movement is in mid costal and apical regions [2].

Shortness of breath due to increased congestion of capillaries and increased respiratory centre sensitivity due to increased demand. Breathing is more diaphragmatic than costal.

Muscle weakness or fatigue can also cause dyspnoea.

Also there is inverse correlation of weight and PEFR i.e. weight is inversely proportional to PEFR (if weight increases PEFR decreases) [4].

Pranayama is an important component of yoga training. It is derived from 2 Sanskrit words “Prana” -vital force or life energy, “Ayama”-to prolong. It provides concentration and de-stress the person [5].

The basic activity of bulbo pontine complex is modified; to slow down its rhythm thus the lungs to work to their maximal extent to take O<sub>2</sub> and expire CO<sub>2</sub> maximally leading to decrease in respiratory rate. Sensitivity of respiratory centre to CO<sub>2</sub> is reduced [5].

Slow deep and full inhalation and exhalation as in Anulom-Vilom improves respiratory muscle strength. In yogic system of breathing the right nostril dominance corresponds to activation of ‘Pingala’ subtle energy channel related to sympathetic arousal. Left nostril to ‘Ida’ subtle energy channel corresponds to parasympathetic activation [5].

## Need of Study

PEFR is significantly reduced in second trimester of pregnancy. There are several reasons for it [6].

During 2nd trimester of pregnancy there is mechanical pressure of enlarging gravid uterus [6,7,8].

Elevation of diaphragm and restricting movements of lungs, thus hampering forceful expiration. It may be due to bronchoconstrictor effect of decrease alveolar PCO<sub>2</sub> on bronchial smooth muscles. PEFR is more sensitive to muscular element in respiration and as anaemia produces muscle weakness reflecting lower PEFR [6].

Lesser force of contraction of main expiratory muscles like ‘anterior abdominals’ and ‘internal intercostal muscles’ [6,8].

Due to enlarged gravid uterus, vertical dimension is reduced limiting movement of diaphragm [6,8].

So, in previous studies effect of yoga on respiration in women has been studied. But effect of alternate nostril breathing on PEFR in women with 2nd trimester of pregnancy has not been done. So in this present study we will see effect of alternate nostril breathing on PEFR in 2nd trimester of pregnancy.

## AIM

Effect of Alternate Nostril Breathing on Peak Expiratory Flow Rate (PEFR) in second trimester of pregnancy at the end of 4 weeks.

## Objective

To measure effectiveness of Alternate Nostril Breathing on Peak Expiratory Flow Rate (PEFR) in second trimester of pregnancy at the end of 4 weeks.

## Review of Literature

- Radhika Banka, Ashna Mangharam, Lancelot Pinto European respiratory journal.2017 use of mini wright peak flow meter as a point of care screening tool for obstructive airway disease in resource limited settings mini wright peak flow meter is a sensitive tool for screening of PEFR (r=0.94).
- Nehal S. Patel, Betsy Johnson, Varsha S Joshi; Effect of yoga on respiration in women; Int. J Basic Appl. Physiol. 2017 study was done to see effect of yoga on RR, breath holding time and expiratory pressure done for 16 weeks. There was decrease in RR and increase in BHT in working and non-working women.
- Vinnakota Sriprakash; Prevalence and clinical features of nasal septum deviation: a study in urban centre, International Journal of Otorhinolaryngology and Head and Neck Surgery; October-December 2017; aim is to investigate the prevalence of nasal septum deviation in geographical area. Age group of 16-35years was taken as study population. Nasal obstruction was a predominant symptom followed by rhinitis and oral discharge. Results were 16-25 years -43% 26-35 years-26%
- Andrea Carla Brandao da Costa Santos Alex Sandro Rolland Souza Jousilene de Sales Tavares Melania Maria Ramos Amorim; Evaluation of Pulmonary function and body composition in pregnant women International Archives of medicine obstetrics and gynecology.2016, To compare pulmonary function and the body composition between trimesters of pregnancy and to determine the variables correlated to peak expiratory flow and expiratory flow between 25% to

75% of vital capacity. Result was PEFr, VC, FEV1 decreased with progression of pregnancy.

- Antonella LoMauro, Andrea Aliverti ERS publications.2015. respiratory physiology of pregnancy
- Ananda Balayogi Bhavanani, Meena Ramanathan, Madanmohan; Online International Interdisciplinary Research Journal, ISSN 2249-9598, Vol-IV, Jan 2014; this study evaluated immediate effects of 27 rounds of left nostril initiated alternate nostril breathing (ANB) technique of nadi shuddi (NS) and right nostril initiated ANB of aloma viloma (AV) pranayama on cardiovascular (CV) parameters and reaction time (RT) in a trained population. Result obtained was heart rate, systolic and diastolic blood pressure reduced significantly after NS and these parameters increased after AV. Left nostril initiated breathing induces relaxation/balance and right nostril initiated breathing induces autonomic arousal.
- Sushma Jadhav, VB Dudhamal, SS Karadkhedkar, Sayeeda Afroz, NA Razvi Comparative study of pulmonary function tests on different trimesters of pregnancy IJCRR. 2013. This study was conducted on normal pregnant women age group of 16-30 years. Readings were recorded and PEFr was decreased in 1st trimester.
- Dr Monika Bansal Dr Manoj Goyal Dr Jasjeet Kaur Dhillon, Dr Parmjit Kaur Longitudinal study of PEFr in pregnant women; NJIRM. 2012. This study included pregnant and non-pregnant female controls. Effect of age and height was noted which showed increase in PEFr post-partum i.e. mean PEFr increased with increase in age and had highly significant positive correlation with height in all the three trimesters of pregnancy.
- Lori Thein Broody and Carrie M. Therapeutic Exercise, 3rd Edition, Philadelphia, 2011.
- K Upadhyay Dhungel, V Malhotra, D Sarkar and R Prajapati Effect of alternate nostril breathing on cardiorespiratory functions. Nepal Med Coll J 2008. The response of alternate nostril breathing on cardiorespiratory functions in young adults. Performed 15mins of session early morning for 4 wks. so increase in PEFr, PR, RR was noted.
- Sunyal DK, Amin MR, Ahmed A, Begum S, Begum M, Rahman N; Peak Expiratory Flow Rate in Pregnant women; J Bangladesh Soc. Physiol. 2007 PEFr was estimated in different trimesters PEFr was significantly reduced in 2nd and 3rd trimester so PEFr decreased throughout the pregnancy due to mechanical effects of increasing uterus.
- Nidhi Jain, R D Shrivastava and Anil Singhal Indian J Physiol Pharmacol 2005; 49(4):469-474 Effect of right and left nostril breathing on cardiorespiratory and autonomic parameters. The study was done on males and females of age group 17-22 years, there was reduction in RR and BP, rise in PEFr was noted. There were no sharp distinctions between effects of right and left nostril breathing.
- Physiotherapy in respiratory care Alexander Hough 2001. Third edition.
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pregnant women showed lower PEFr when compared with non-anaemic pregnant women.

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- Nidhi Jain, R D Shrivastava and Anil Singhal Indian J Physiol Pharmacol 2005; 49(4):469-474 Effect of right and left nostril breathing on cardiorespiratory and autonomic parameters. The study was done on males and females of age group 17-22 years, there was reduction in RR and BP, rise in PEFr was noted. There were no sharp distinctions between effects of right and left nostril breathing.

### Methodology

- **Study type:** Experimental study
- **Study design:** Pre and post experimental study
- **Sample size:** 60
- **Sampling method:** Convenient sampling
- **Study population:** Women in second trimester of pregnancy in and around city
- **Study setting:** Referred patients from gynaecological hospitals in and around city
- **Treatment duration:** 4 weeks

### Inclusion Criterion

- Women in second trimester of pregnancy
- Age-20-35 years
- Pre-pregnancy BMI-normal i.e. 18.5-24.9 (11)

### Exclusion criterion

- History of cardiovascular or respiratory diseases
- bony deformity or any fracture of thoracic cage
- Gestational diabetes mellitus [12]
- Hyperthyroidism [10]
- Nasal septum Deviation [13]

### Materials and Tools

- Pen
- Paper
- Consent form
- Mini wright peak flow meter

Mini wright peak flow meter is a simple, handheld device that measures Peak Expiratory Flow Rate (PEFR).

PEFR is noted by instructing the patient to hold the mouthpiece in her mouth then to perform full inspiration and then forced expiration into the flow meter [1].

It is measured in L/min.

Value of  $r = 0.94$  [8]



### Procedure

- Ethical clearance was obtained from ethical committee of P.E.S. Modern College of Physiotherapy, Pune.
- Patients were selected as per the inclusion and exclusion criteria.
- The patient's consent was taken about the treatment and the procedure will be explained.
- The pre-treatment PEFR was noted by instructing the patient to hold the mouthpiece in her mouth then to perform full inspiration and then forced expiration into the flow meter.
- Total 3 readings were taken and mean of 3 readings were considered as the PEFR value.
- She was directed to sit in an easy and steady posture i.e. a comfortable sitting posture keeping the head neck and trunk erect and in a straight line.
- She should keep the body still during practice of Alternate Nostril Breathing in a calm and quiet room. Practise of alternate nostril breathing was performed in following steps:
  - **Step 1:** She was asked to close her right nostril by her thumb and slowly breathe in upto maximum, through left nostril.
  - **Step 2:** She was then asked to close her other i.e. left nostril by her ring finger and open the right nostril to exhale slowly upto maximum.
  - **Step 3:** Now, she was instructed to inhale through same right nostril (with left nostril closed) and then to open left nostril and exhale as stated above.
- These three steps completed one cycle of Nadi Shuddhi.
- Each session of alternate nostril breathing consist of 15 minutes in the morning every day of the week for 4 weeks.
- In that 15 minutes, rest interval can be taken as per the comfort of the patient. Frequency is dependent upon the patient's comfort in the 15 minutes.
- It is done for 4 weeks of period. The post treatment values were to be taken in the same manner with mini wright peak flow meter at the end of 4 weeks.
- After the post-treatment values were taken in same way at the end of 4 weeks the data is to be analysed statistically.



### Data Analysis

The level of significance for PEFR was calculated by paired t test.

The data was analyzed using PRIMER version 7.

$p < 0.0001$  (statistically significant)

$t = -26.734$  with 55 degrees of freedom

### Statistical Analysis

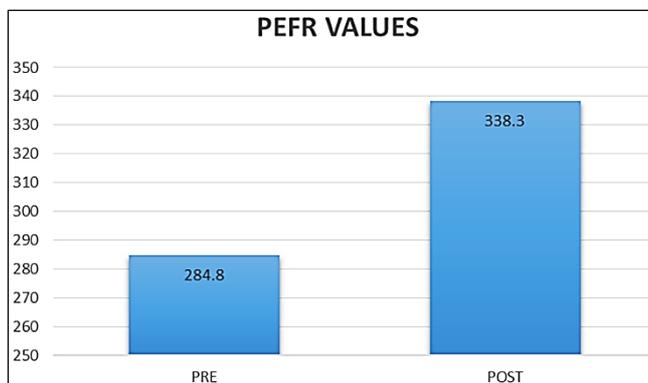
The PEFR values were improved with pretest mean of 284.8 to 338.3 with SD 35.23 to 29.67

$p < 0.0001$  (statistically significant)

$t = -26.734$  with 55 degrees of freedom

The following table and graph shows pre and post values of PEFR

PEFR	Mean	SD
Pre	284.8	35.23
Post	338.3	29.67
Difference	53.45	14.96



### Result

The PEFR values were improved with pretest mean of 284.8 to 338.3 with SD 35.23 to 29.67.

The findings of this study revealed a significant improvement in post intervention peak expiratory flow rate (PEFR) values at the end of 4 weeks.

### Discussion

The present study was done to see the effect of alternate nostril breathing on PEFR in 2<sup>nd</sup> trimester of pregnancy at the end of 4 weeks. For the study 60 subjects in 2<sup>nd</sup> trimester of pregnancy were collected out of which there were 4 drop outs in the study.

Pretreatment data was collected using mini wright peak flow meter. The treatment protocol was given for 4 weeks and post treatment same measures were recorded and results were drawn out.

According to the results Alternate Nostril Breathing was effective in improving peak expiratory flow rate in 2<sup>nd</sup> trimester of pregnancy at the end of 4 weeks. ( $p < 0.0001$ ).

K Upadhyay Dhungel in there study states the effect of alternate nostril breathing on cardiorespiratory functions in young adults. The study shows improvement in the cardiorespiratory functions.

Nidhi Jain, R D Shrivastava and Anil Singhal in there study shows effectiveness of right and left nostril breathing on cardiorespiratory and autonomic parameters performed in age group of 17-22 yrs.

During active forceful expiration intra-abdominal pressure increases which exerts pressure on diaphragm cranially giving a passive stretch on costal fibers of diaphragm.

During active forceful expiration intra-abdominal pressure increases which exerts pressure on diaphragm cranially giving a passive stretch on costal fibers of diaphragm.

Enlarging uterus increases end expiratory pressure increases negative pleural pressure and there is early closure of airways due to which the abdominals and expiratory muscles cannot contract to their fullest. Excursion is limited at the basal level.

Therefore the breathing exercise was aimed at full contraction of abdominals, expansion at basal levels and increasing muscle strength.

Performing alternate nostril breathing there is slow deep and full inhalation and exhalation which improves muscle strength.

K Upadhyay Dhungel in there study states the changes occurring in respiratory dynamics i.e. there is efficient use of diaphragmatic and abdominal muscles thereby emptying and filling the respiratory apparatus more efficiently and completely which improves peak expiratory flow rate.

There is enhancement of respiratory muscle efficiency, rise in thoracic-pulmonary lung compliance and broncodilation. Stimulation of pulmonary stretch receptors by inflation of the lung reflexly relaxes smooth muscles of larynx and tracheobronchial tree probably reduces airway resistance which helps in improving PEFR.

This acts as a physiological stimuli for release of lung surfactant and prostaglandins into alveolar spaces which increases the lung compliance.

As there is activation of parasympathetic system reduction in heart rate and respiratory rate occurs which will inhibit hyperventilation leading to improvement in expansion at basal spaces and decrease in oxygen consumption which helps in improving PEFR.

Nidhi Jain, RD Shrivastava and Anil Singhal in there study states that right nostril breathing corresponds to activation of sympathetic arousal and left nostril breathing was mediated by parasympathetic alteration because parasympathetic activation is anabolic in nature and decreases oxygen consumption. There is greater compliance of thoracic cage and lungs over basal levels which helps in improving PEFR. The relaxing effect inhibiting the constrictor tone to bronchial smooth muscle.

Study done by Ananda Balayogi Bhavanani, Meena Ramanathan, Madanmohan states that left nostril initiated breathing shows induction of a more relaxed state of parasympathetic dominance. Mechanical receptors in the nasal mucosa register flow of air across membranes (unilaterally) and transmit this signal ipsilaterally to hypothalamus the highest centre for autonomic regulation. Initiating with left nostril breathing activates parasympathetic system which significantly reduces heart rate, systolic and diastolic blood pressure.

Initiating with right nostril breathing activates sympathetic system which significantly increases heart rate, systolic and diastolic blood pressure.

Thus left initiated nostril breathing helps in relaxation and eventually helps in improving PEFR.

### Conclusion

This study concludes that alternate nostril breathing technique is effective in improving peak expiratory flow rate (PEFR) in 2<sup>nd</sup> trimester of pregnancy with women having normal pre-pregnancy BMI at the end of 4 weeks.

**Limitations**

- The study was performed with a small sample size.

**Future scope**

- This technique could be performed on women having higher pre-pregnancy BMI i.e. obese women.
- This study could include other lung function test.

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