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RESEARCH ARTICLE

# Effect of seasonal variation on respiratory dynamics in normal individuals

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## ABSTRACT

**Background:** Recently, manifestation of global environmental changes is important. Environmental changes temperature and humidity may affect on respiratory dynamics. **Aims and Objectives:** The aim of this study is to identify the outcomes of seasonal effect on pulmonary function. **Materials and Methods:** This was a cross-sectional study based on the seasons using result from spirometry, questionnaires to investigate the participants' respiratory system, sedentary and smoking habit, etc. Anthropometric parameter has been taken. All participants are performed spirometry. Spirometry values were tabulated with mean, median, and coefficient of variation. **Results:** The spirometry assessment, based on the seasons was significant. Forced vital capacity (FVC), forced expiratory volume in 1-s ($FEV_1$), and peak expiratory flow rate values were significantly increase in winter, but $FEV_1$/FVC and forced expiratory flow between 25% and 75% decrease with increasing environmental temperature. **Conclusion:** Respiratory rate and capacity change with seasons.

**KEY WORDS:** Spirometry; Forced Vital Capacity; Season; Summer; Winter

## INTRODUCTION

Nowadays, due to global warming worldwide, environmental changes are evident. The sudden temperature changes and humidity may affect on cardiorespiratory system. Therefore, the study of seasonal changes is important. It is acknowledged that the system of external respiration, regular changes related to the seasonal dynamics of climatic factors occur during the year.[1] Many studies recorded seasonal changes in the intensity of energy processes in body and the volume of pulmonary ventilation[2-6]. Forced expiratory volume in 1-s ($FEV_1$) is a measure of primarily proximal airway status and is dependent on vigorous and rapid exhalation. A good evaluation of $FEV_1$/forced vital capacity (FVC) is dependent on complete exhalation.[7,8]

In winter, the resistance of airways increases.[9,10] There are data on an increase in the air content of the lungs.[9,11] It is also known that the direction and extent of manifestation of functional changes depend on the severity of the climate at the site of the human residence.[12]

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## MATERIALS AND METHODS

The cross-sectional study was carried out at the Department of Physiology, ESI-Post Graduate Institute of Medical Science and Research and ESIC Medical College, Kolkata. The study protocol was approved by the Institutional Ethics Committee. A total of 203 subjects both male and female with the age group of 20–50 years were recruited as the subjects. Subjects had completed questionnaires with personal information including health history and physical activity habits and smoking habits, etc. Before testing, the subjects with recent history of any acute/chronic respiratory disease at the time were excluded from the study. The anthropometry including height, weight, and body mass index (BMI) was measured. Spirometry was done with FEV, $FEV_1$, $FEV_1/FVC$, forced expiratory flow between 25% and 75% ($FEF_{25-75}$), and peak expiratory flow rate (PEFR) values.

Spirometry had been recorded in two pick seasons, i.e., winter and summer. Record had been taken at sitting position after at least 10 min of rest. Data were analyzed using appropriate statistical tests, using frequencies and percentages for categorical variables and central tendency and dispersion measures (standard deviation) for quantitative variables. All statistical parameters were done using statistical software STATA and Microsoft Office Excel®. $P < 0.05$ was considered to be statistically significant.

## RESULTS

Respiratory parameters changed significantly by two different seasons. FVC, $FEV_1$, and PEFR values were significantly increase in winter [Figure 1], but $FEV_1/FVC$ and $FEF_{25-75}$ decrease with increasing environmental temperature [Figure 2]. The mean for anthropometric parameters including height and weight was significantly greater in men than in women [Table 1]. The value for FVC, $FEV_1$, $FEF_{25-75}$, and PEFR was highly significant when comparisons by seasons; nevertheless, the values for $FEV_1/FVC$ are not significant [Table 2].

## DISCUSSION

The study demonstrated that increased environmental temperature and humidity increases respiratory rate, although FVC correlated negatively with respiratory rate. FVC also increases.FVC increases with decreasing environmental temperature and humidity. On other sites, it decreases in summer. The maximum seasonal variation was found in the FVC and PEFR.

Breathing frequency was proportional to body temperature and was articulated in winter. A sudden decrease in temperature and humidity could be related to altered airways function.[13] Consistent evidence demonstrates that wintertime cold temperatures increase respiratory morbidity and mortality.[14-16]

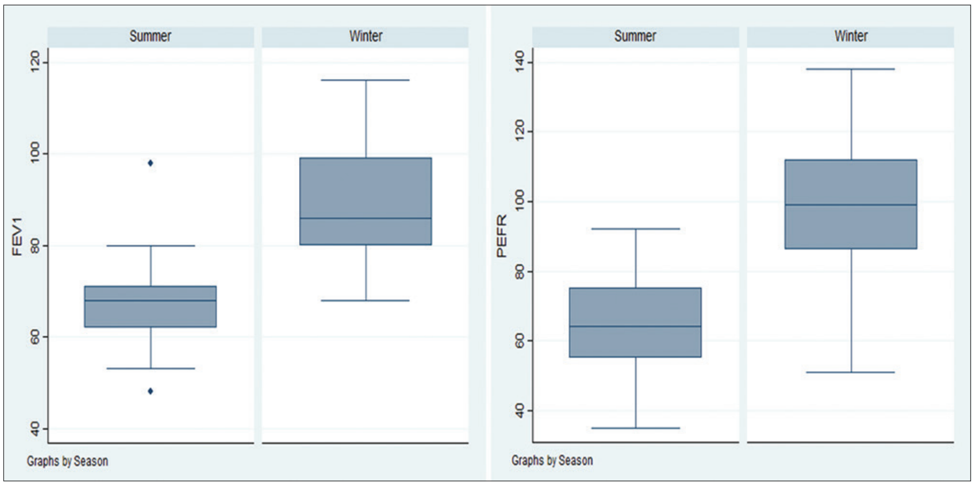


**Figure 1:** The comparison between forced expiratory volume in 1-s and peak expiratory flow rate by seasons

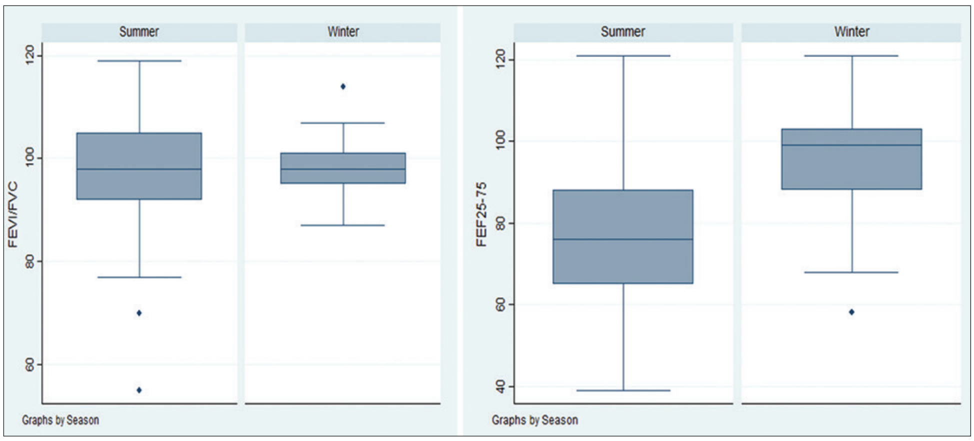


**Figure 2:** The comparison between forced expiratory volume in 1-s/forced vital capacity and forced expiratory flow between 25% and 75% by seasons

**Table 1:** Description of different physical characteristics of sample (*n*=203)

| Trait | Male (*n*=103) | Female (*n*=100) | *t*-value | *P*-value |
|---|---|---|---|---|
| Age (years) | 32.88±8.16 | 33.09±8.52 | −0.17 | 0.86 |
| Height (cm) | 170.62±6.85 | 158.88±5.99 | 12.97 | <0.01 |
| Weight (kg) | 64.02±11.02 | 57.89±9.1 | 4.31 | <0.01 |
| Body mass index (kg/m$^2$) | 22.05±3.7 | 22.91±3.38 | −1.83 | 0.06 |

**Table 2:** The effect of cold and hot seasons on respiratory parameters of subjects

| Parameters | Seasons (mean±SD) | | *P*-value |
|---|---|---|---|
| | Winter | Summer | |
| FVC | 91.79±11.14 | 68.46±7.16 | <0.01 |
| $FEV_1$ | 88.5±11.17 | 67.1±7.99 | <0.01 |
| $FEV_1$/FVC | 98.21±5.08 | 97.45±12.13 | 0.57 |
| $FEF_{25-75}$ | 96.97±12.46 | 77.07±18.48 | <0.01 |
| PEFR | 99.97±20.57 | 66.01±12.65 | <0.01 |

SD: Standard deviation, FVC: Forced vital capacity, FEV1: Forced expiratory volume in 1-s, PEFR: Peak expiratory flow rate values, $FEF_{25-75}$: Forced expiratory flow between 25% and 75%

Although the study of seasonal variation is not new, the present context throws light on the changes of environmental temperature and humidity may affect on respiratory parameters.

PEFR monitoring remains an important tool in the diagnosis and monitoring of reversible airway disease. PEFR determines to prevent conditions from worsening. Keeping continuous records of peak flow rates may also help the patient to determine whether environmental factors or certain pollutants are affecting his or her breathing. Variation of PEFR depends on such factors may include prolonged exposure of the airways and lung tissues to insults, environmental hazards, and stresses and so forth, resulting in loss of muscle elasticity, increase in body fat content in relation to protein, and increase in reaction time to stimuli and so on.[17] Some limitations are demonstrated by similar finding was that spirometry is not enough for the providing of a clinical diagnosis.[17]

## CONCLUSION

It is concluded that FVC and respiratory rate not only increase with anthropometric determinants but also increase with decreasing environmental temperature and humidity.

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