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Seasonal Variations in the Pulmonary Function Tests of Young Individuals in Kodagu District

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Abstract
The impact of sudden changes in climate on the respiratory function of young healthy individuals have often been underestimated and ignored. Spirometry is a simple and non invasive method to analyse the pulmonary function. To study the seasonal variations in pulmonary functions among young individuals. Using a computerized spirometer, the study was conducted on 150 subjects of age 18-25 years consisting of 78 males and 72 females. Pulmonary function tests namely RR, FEV1,FVC, PEFR and MVV were assessed. The FEV1, FVC, PEFR and MVV were significantly lower in the winter season when compared to the summer season. With change in season, Pulmonary function changes significantly in young healthy individuals.

INTRODUCTION

Sudden temperature changes and humidity may have an impact on cardiorespiratory system. Therefore, the study of seasonal changes in pulmonary function is important. Forced expiratory volume in 1-s (FEV1) is a measure of primarily proximal airway status and is dependent on vigorous and rapid exhalation. In winter, the resistance of airways increases[1].

The overall prevalence of chronic bronchitis in young adults was 5.5%, with similar estimates in males and females. The group of cases with chronic bronchitis had more self-reported respiratory infections and emergency department visits compared to the group of subjects without chronic bronchitis[2]

Increasing attention is being given to the effects of weather exposure in the context of climate change. Extremes of temperature such as heat waves, hot weather and extended periods of cold may negatively affect lung function and symptom burden in COPD. In fact, COPD patients often report susceptibility to temperature and weather changes. Both summer heat and winter cold have been associated with increased COPD hospitalisations and symptom burden.

Lower outdoor temperature exposure was associated with worsening bronchitis symptoms (cough, sputum colour and sputum amount), regardless of season[3].

The importance of spirometry for proper diagnosis of COPD has to be emphasized

It is also important to note that spirometry results are not pathognomonic of any particular disease; rather, they provide a pattern of physiological abnormality that can be obstructive, restrictive, or mixed.

Since seasonal changes have got an impact on the Respiratory system and there is not much of a study on this, we have taken up this topic.

MATERIALS AND METHODS

Type of Study: This is a comparative cross-sectional study for a duration of one year, conducted at Madikeri, Karnataka

Study Population: comprises of 150 healthy subjects of both sex in the age group of 18-25 years.

Inclusion Criteria: The study group consists of both males and females with no previous history of any long term Respiratory illness or allergy.

Exclusion Criteria: The subjects who are obese and those with skeletal deformity were excluded from the study.

Study Design: The study was performed after obtaining ethical clearance from institutional ethical committee and after receiving informed and written consent from all the participants.

All data were collected at a fixed time of the day between 2pm-4pm, in the months of March, July and December

Parameters such as Forced Expiratory Volume in 1 sec (FEV1), Forced Vital Capacity (FVC), FEV1/FVC ratio, Peak Expiratory Flow rate (PEFR), Maximal Voluntary Ventilation (MVV) and Respiratory rate (RR) were assessed.

FVC, FEV1, MVV and PEFR were recorded using computerised spirometer-RMS Medspiror Helios 702. All the subjects were made acquainted with spirometer before actual recording.

For recording FVC, FVC test was done on medspiror. The procedure was explained to subject before carrying the test. They were asked to practice the procedure. The subjects were asked to begin relaxed tidal breathing through the mouth piece fixed over the transducer and then to take a deep breath in and blow out as hard and fast as possible and continue blowing until no more air can be exhaled, then to take another deep breath back in, with mouth piece still in the mouth until lungs are full. It was ensured that a tight seal was maintained between lips and mouth piece of spirometer, nose clip was applied to close the nostrils. Three readings were taken and then highest reading of these was taken as final one.

For recording MVV the subjects were asked to breathe and quickly for 15 seconds through mouth piece of spirometer. Nose clip was applied to prevent air leak through nostrils. Three readings were taken and best was considered as final one.

The RR was recorded by observing the abdominal movements and counting the movements for 1 minute after asking the subject to rest.

Statistical Method: Mean and Standard deviation of all parameters were calculated. An Independent-Samples "t" test procedure was applied to compare the groups. Statistical analysis was carried out. $P<0.05$ was considered as statistically significant.

RESULTS AND DISCUSSIONS

The present study included 150 subjects in the age group of 18-25. The mean FEV1, FEV1/FVC ratio, PEFR and MVV was significantly lower in the subjects during the winter season. The comparisons in the various seasons are shown in Table 1, 2 and 3.

The purpose of this research work was to study the seasonal variations in pulmonary function tests of young individuals. The study was conducted on 150 subjects of age 18-25. Parameters such as FEV1, FVC, MVV and PEFR were assessed among the subjects.

In this study, the Respiratory parameters were significantly lower in the winter season when

Table 1: Comparison of Summer and Rainy Season

Parameter	Season(mean±SD)		
	Summer	Rainy	p-value
RR	16.94±0.508	16.99±0.357	0.0735
FEV1/FVC	76.48±3.84	76.73±4.55	0.4745
PEFR	412.1±59.29	402.80± 58.75	2.33e-22
MVV	99.16±23.32	94.56±23.32	7.55e-18

*p value < 0.05 is statistically significant

Table 2: comparison of summer and winter seasons

Parameter	Season(mean±SD)		
	Rainy	Winter	p-value
RR	16.94±0.508	17.04±0.364	0.00357
FEV1/FVC	76.48±3.84	74.76±5.209	1.56e-05
PEFR	412.1±59.29	392.97±57.75	1.31e-47
MVV	99.16±23.32	87.92±23.217	3.60e-41

*p value < 0.05 is statistically significant

Table 3: comparison of rainy and winter season

Parameter	Season(mean±SD)		
	Rainy	Winter	p-value
RR	16.99±0.357	17.04±0.364	0.00772
FEV1/FVC	76.73±4.55	74.76±5.209	7.97e-12
PEFR	402.80± 58.75	392.97±57.75	8.87e-22
MVV	94.56±23.32	87.92±23.217	7.23e-30

*p value < 0.05 is statistically significant

compared to the other seasons. This result is consistent with Sahoo D *et al.,* In winter, the resistance of airways increases. There are data on an increase in the air content of the lungs[1].

Comparisons between seasons (Summer vs. Rainy, Summer vs. Winter, Rainy vs. Winter) suggest that there are statistically significant differences in respiratory rate across seasons, except for the comparison between Summer and Rainy, where the p-value is not significant. The significantly higher FEV/FVC ratio during Summer compared to Winter indicates better lung function in warmer months. In the prospective study of people with moderate-to-severe COPD residing in the Boston area, lower outdoor temperature exposure was associated with worsening bronchitis symptoms[11].

Similarly, the FEV/FVC ratio is higher during Rainy seasons compared to Winter. The extremely low p-values obtained for comparison between seasons highlight significant variations in PEFR across different seasons. These findings indicate that individuals experience substantial changes in expiratory flow rates throughout the year. MVV also showed a marked reduction during the winter season. In the cohort of generally healthy adults, negative relationship between temperature and lung function was steepest in the cooler temperature range (<10°C) and present during winter and spring, but not summer. People with asthma and COPD had similar associations between temperature and lung function as those without these obstructive lung diseases[12].

Initial respiratory responses to cold weather are an increase in depth and respiration rate (hyperventilation), followed by decrease in respiration (hypoventilation)., the respiration rate becomes shallow and erratic between core body temperatures of 25-30°C[13]

The average metabolic response during cold exposure, measured as the increase in kJ/min over time, was significantly higher in winter (11.5%) compared to summer (7.0%, P<.05)[14].

Studies also showed increase in bronchial responsiveness in winter months, associated with colds and low FEV1[15]

CONCLUSION

The statistically significant differences observed in lung function measurements, such as the FEV/FVC ratio, PEFR and MVV between seasons (Summer, Rainy, Winter) suggest that seasonal variations have a

notable impact on respiratory health. Specifically, the p-values obtained for FEV/FVC ratio, PEFR, and MVV are much smaller than the chosen significance level (alpha), indicating a high level of statistical significance. Thus, most lung function measurements indicate that seasonal variations may influence respiratory health. The findings suggest that individuals may experience changes in lung function across different seasons. In conclusion, this analysis provides evidence of significant associations between seasonal variations and lung function measurements among individuals in the study population.

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