Original Article

Pulmonary Function Tests in Air Conditioner Users

Physiology Section

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ABSTRACT

Objective: The present study was aimed at the measurement of the pulmonary function tests in healthy air conditioner users at its comparison with that of non air conditioner(AC) users and at considering whether air conditioner usage affected pulmonary functions.

Study method: The study group comprised of 50 healthy males between the ages of 25-50 years, who were working in air conditioned rooms. 50 age and sex matched controls were chosen and their pulmonary functions were compared by using a computerized spirometer, SPIROBANK-G.

Results: There was a significant decrease in Forced Expiratory Volume in first second[FEV_1], Forced Expiratory Flow at 25-75 percent of lung volume [FEF_{25-75}], Peak Expiratory Flow Rate [PEFR] and a significant increase in the respiratory rate.

Conclusion: There is a significant decrease in the pulmonary functions in air conditioner users.

Key Words: Pulmonary functions, Air conditioner, Respiratory rate, Chest expansion

INTRODUCTION

Modern styles of living in urban areas have been considered to be potentially responsible for the development of airway problems and for the reduction in the pulmonary functional capacities. One of the components of the modern life style is the intensive use of air conditioners, which has caused the increased inhalation of cold dry air ultimately leading to an alteration in the pulmonary functions. The inhalation of cold dry air for long periods makes the airway smooth muscle more sensitive. Abrupt changes in the air temperature may induce rhinitis even in the absence of the usual triggering allergy. This study was aimed at the measurement of the pulmonary function tests in healthy air conditioner users and its comparison with that of non air conditioner users and at considering whether air conditioner usage affected the pulmonary functions.

MATERIALS AND METHODS

Fifty male subjects between the age group of 25-50 years were chosen for the study. The subjects worked in banks which were provided with air conditioners which maintained the room temperature at 18-22°C. Fifty male subjects who were working outside the air conditioned cabins in the bank were chosen as the controls. The present study was planned to assess the effect of the air conditioners on the pulmonary functions in young, healthy, non-smoking males of the age group of 25-50 years. The PFTs (Pulmonary Function Tests) of FEV_1, FEF_{25-75} and PEFR were assessed by using a computerized spirometer, SPIROBANK-G and the values were compared with those of the control group. Healthy subjects of the age group of 25-50 years who were exposed to the air conditioner for a duration of at least 6 months to five years were included. Subjects with smoking habits, allergy, wheezing/bronchial asthma, skin diseases, past H/O tuberculosis, any chronic drug intake, myocardial infarction, breathlessness and cough with expectoration were excluded.

SPIROMETER

A computerized spirometer by the name of Spirobank – G, which is based on a turbine sensor which works on the infrared interruption principle, made by MIR Medical International Research – Roma-Italy was used for this study.

RESULTS

On the comparison of the FEV_1, FEF_{25-75} and PEFR values of the male controls with the subjects who were exposed to the air conditioner in the age group of 25-50 years, it was found that there was a significant decrease in the FEV_1, FEF_{25-75} and PEFR values and a significant increase in the respiratory rate but a decrease in chest expansion was nonsignificant [Table/Fig: 1-4].

Statistical analysis was done by using the Students 't' test. The significance was drawn at a P (Probability) value of 0.05.

DISCUSSION

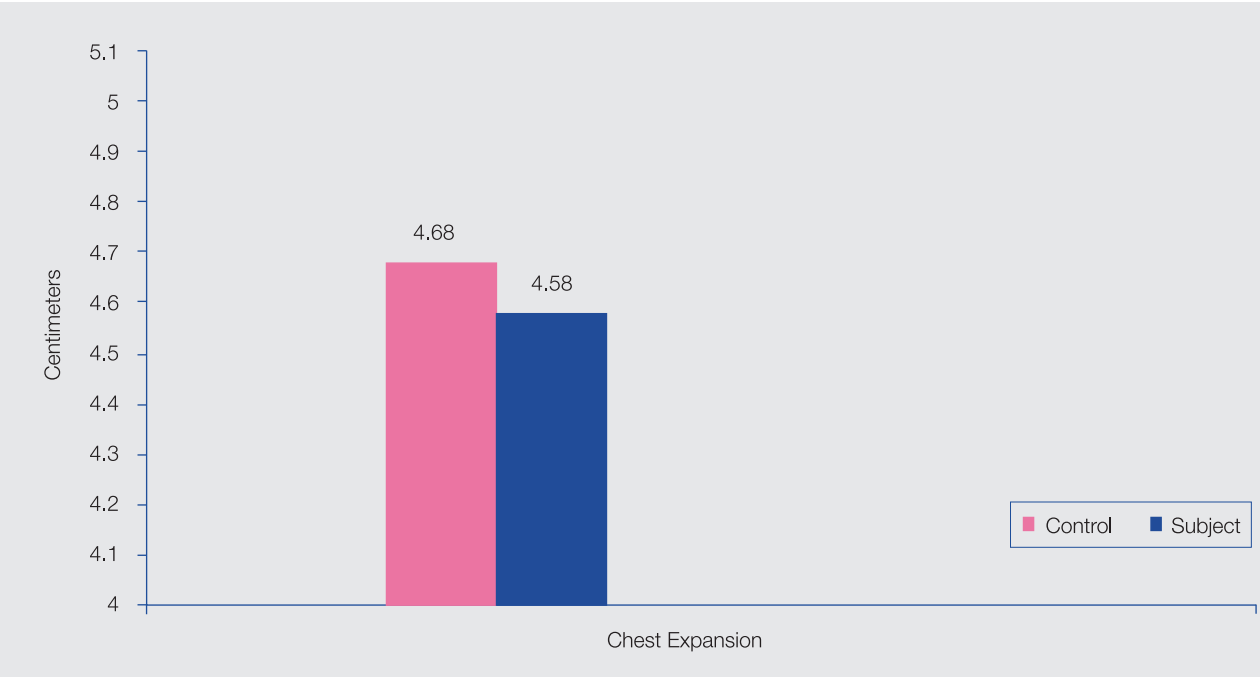
In this computerised twenty first century, the use of air conditioners is unavoidable in working places like IT centers, banks, etc. Till recently, it was thought that working in an air conditioned environment was pleasant. But the people working in such an environment are facing its adverse effects also. The inhalation of cold, dry air affects the lung functions. This study was aimed at evaluating the effect of the air conditioner exposure on the lung functions tests such as FEV_1, FEF_{25-75}, PEFR.

1. Timed vital capacity (FEV_1): This is also called as forced expiratory volume in the first second (FEV_1). It is one of the most useful tests to detect generalized airway obstruction. It is most widely used to measure the airway responsiveness. Crapo Ro, Lockey J, Aldrich V, Jenson R.L., Ellcot C.G [1].
2. Maximum Mid Expiratory Flow Rate (FEF_{25-75}): This indicates the patency of small airways.
3. Peak expiratory Flow Rate (PEFR): It is the maximum velocity in liters per minute with which air is forced out of the lungs.

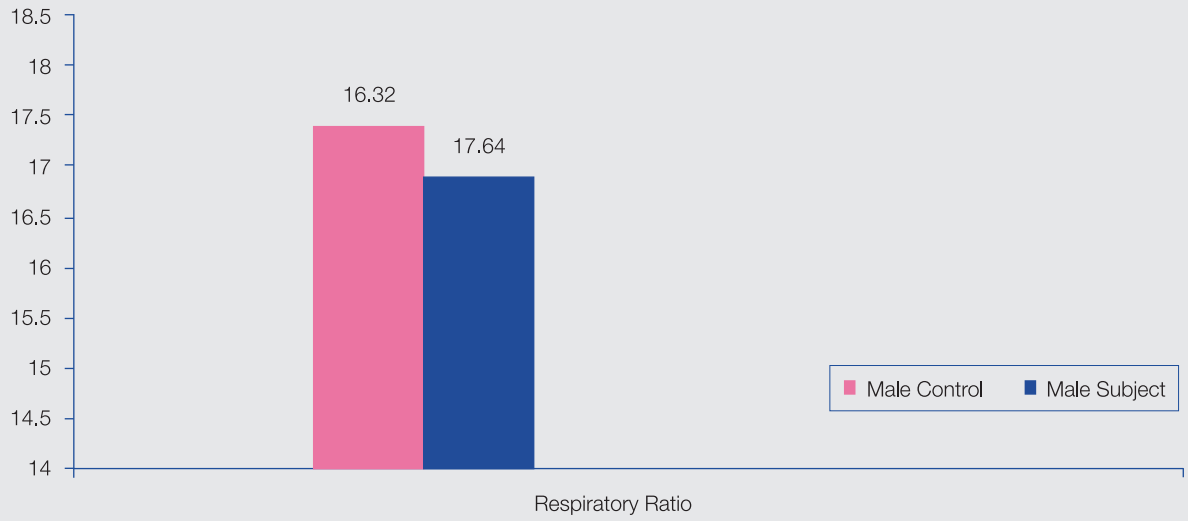
Parameters	Control					Subject				
	FEV_1	FEF_{25-75}	PEFR	Chest expansion	RR	FEV_1	FEF_{25-75}	PEFR	Chest expansion	RR
Numbers	50	50	50	50	50	50	50	50	50	50
Mean	3.28	3.49	6.07	4.68	16.32	3.01	3.22	5.59	4.58	17.64
SD	0.14	0.13	0.42	0.71	1.10	0.22	0.22	0.42	0.64	1.35
"t"	5.32	5.33	4.07	0.52	3.81					
P	< 0.05	< 0.05	<0.05	> 0.05	< 0.05					

[Table/Fig-1]: Comparison of FEV_1, FEF_{25-75}, PEFR, chest expansion and respiratory rate(RR) between control and test groups

[Table/Fig-2]: Comparison of FEV_1, FEV_{25-75}, PEFR between male controls and subjects in the age group of 25-50 years



[Table/Fig-3]: Comparison of chest expansion between control and subjects in the age group of 25-50 years



[Table/Fig-4]: Comparison of respiratory rate between control and subjects in the age group of 25-50 years

This is decreased in cases of airway obstruction. American Review of Respiratory diseases [2].

The **results, observation and analysis** of this study show that there was a

1. **Decrease in the FEV_1, FEF_{25-75}, and PEFR values in the subjects who were exposed to the AC.**

   This correlates with the study which was done by Fontanneri et al [3] on pulmonary functions in air conditioner users. The inhalation of cold dry air makes the airway hyper responsive. According to Beasely R. et al [4], Airway epithelial damage due to cold dry air is a critical feature of airway hyper responsiveness. The cold air inhalation causes inflammation. This is supported by another article by Cruz AA, Togias.A [5] which is on "Upper airway reactions to cold air". It states that air conditioning induced temperature changes can result in "an immediate nasal response consisting of significant desquamation of mucosal epithelial cells".

   The inhalation of cold, dry air leads to dehydration injury and desquamation of the the epithelial cells of the airway, which leads to the

   a) Removal of the protective mucosal barrier. Iravani J. and Melville. G.N. [6].
   b) Loss of the epithelial derived relaxant factor which leads to bronchoconstriction.
   c) Sensory nerve exposure which leads to "Nasobronchial reflex", through the maxillary afferent and the vagal efferent.
      This also leads to the activation of the parasympathetic nerves Barnes PJ [7] which bring about the broncho-constriction .
   d) Exposure of the submucosa, the mast cells and the inflammatory cells. Clark. R.A. Gallin JI and Kaplan A.P [8]
      The inhalation of cold, dry air causes bronchoconstriction by local, non nervous reactions also Barnes PJ [9]. Histamine and SRS-A which are released by the mast cells also cause bronchoconstriction. The broncho-constriction increases airway resistance Benson M.K [10] and decreases dynamic compliance which results in decreased FEV_1, FEF_{25-75} and PEFR values.

2. **Increased respiratory rate:** The stimulation of irritant receptors produces reflex tachypnoea and broncho-constriction. Mc. Donald, James S., Joann Nelson, K.A. Lenner, Melissal et al [11]

   The dynamic compliance is decreased in airway obstruction which leads to an increased respiratory rate.

   Bronchoconstriction leads to increased airway resistance which leads to an increased respiratory rate. Pierrie fontanari Henri Burnet et al [12]

3. **Decreased chest expansion:**

   Bronchoconstriction leads to decreased air entry and decreased chest expansion.

SUMMARY AND CONCLUSION

Because of the increased usage of air conditioners in the society, this study was undertaken to evaluate the effects of air conditioners on lung functions by comparing the subjects who were exposed to AC and the subjects who were not exposed to AC. The respiratory tract of the subjects who are exposed to airconditioners is hyperresponsive and the patency of the airways is decreased.

This study highlighted that:

There was a significant reduction in the FEV_1, FEF_{25-75}, and PEFR values and in the chest expansion of the subjects who were exposed to AC. There was a significant increase in the respiratory rate in the AC exposed subjects. Decreased lung functions lead to the decreased oxygenation of the whole body and thus affects the body functions.

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