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Impact of Chronic Air Conditioner usage on Pulmonary Function Tests using Computerised Spirometry in Healthy Males in Coimbatore.

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Abstract

Background: Nowadays, Air conditioners are one of the most luxurious needs of human beings and their use has been increasing day by day. According to recent studies, inhalation of cold dry air leads to alteration in pulmonary functions. The present study was aimed at considering whether intensive use of air conditioner affected pulmonary functions.

Materials and Method: 25 male subjects having age group of 18-25 years and using air conditioners for more than 6 months and for a minimum duration of 6 hours per day were selected for the study. 25 males of same age group who never use air conditioners were taken as control. In all the subjects, computerized spirometric parameters were measured by SPIRO EXCEL. The parameters between both the groups were compared by applying unpaired 't' test. P value less than 0.05 was taken as statistically significant.

Results: There was statistically significant reduction in FVC (Forced Vital Capacity), FEV1(Forced Expiratory Volume in first second), FEV1/FVC Ratio, PEFR (Peak Expiratory Flow Rate), FEF25 (Forced Expiratory Flow at 25% of Forced Vital Capacity), FEF50 (Forced Expiratory Flow at 50% of Forced Vital Capacity), FEF25-75(Mid Expiratory Flow Rate), and MVV (Maximum Voluntary Ventilation) in air conditioner users as compared to that in non air conditioner users.

Discussion: The decreased values of lung functions may indicate underlying lung dysfunction due to exposure to AC environment. Due to cold air inhalation, airway becomes hyper -responsive. Bronchoconstriction occurs and it increases resistance of airways. The mechanism causing bronchoconstriction is vagal mediated nervous reflex. Cold dry air is inhaled through AC's and hence the alterations in pulmonary functions may be stimulated in AC users. The results of present study are also indicating towards early stages of airflow limitation

Conclusion: Intensive use of air conditioners may predispose to respiratory disorders in the form of early small airway diseases.

Keywords: Air conditioner users, Pulmonary function tests, Computerised Spirometer.

Introduction

Air conditioners(ACs) are one of the luxurious needs of human beings in the twenty first century, which is used in hospitals, banks, colleges, offices, cinema theatres, vehicles, railways, shopping malls, etc.[1]

Inhalation of cold dry air for long period makes the airway smooth muscles more sensitive, thereby leading to alteration of pulmonary functions. [2].Intensive use of air conditioner also increases the risk of atopic sensitization [3,4]. Increased prevalence of IgG induced sensitization and hypersensitivity pneumonitis was reported in persons exposed to aerosol contaminated air conditioners[5, 6].

A previous study done on young healthy subjects using ACs in their cars for atleast 1 hour daily for duration of 6 months, showed a reduction in lung functions[7]. Another study done on bank employees working in AC room, for a duration of 6 months to 5 years, showed that a significant reduction in FEV1, FEF25-75%, and PEFR values, and in [8].

AC makes the air cool and dry**.** It is this cool and dry air which can cause bronchoconstriction and increase airway resistance. Increased airway resistance is detrimental to the air movement through the respiratory passages and affects respiration .This is reflected as decreased pulmonary function tests (especially FEV1, PEFR, FEF25-75%) .

The present study was conducted to evaluate the spirometry parameters in AC users with exposure to AC over a long period. Computerized spirometry was used as it is a simple and useful test to identify and monitor respiratory impairment.

Materials and Methods

The study was conducted among the general population, Peelameduarea, Coimbatore, Tamilnadu.

Group I subjects(AC users):

Inclusion Criteria

1. 25 healthy males
2. Age group 18-25 years
3. Healthy males using AC for six hours per day, for more than six months.

Exclusion Criteria:

Any acute respiratory disorders like URI,LRI.

Any chronic respiratory disorder like tuberculosis.

Systemic illness like hypertension, diabetes mellitus.

Those who are suffering from occupational lung diseases.

Smokers.

Group II subjects(Non AC users): Healthy males who used AC daily for less than one hour or those who never use AC.

Anthropometric measurements like height, weight were recorded. A detailed history taking and preliminary clinica examination was done on the subjects to rule out any medical problems.

The pulmonary function tests were carried out using Power lab 8/30 series with dual bio Amp/stimulator, manufactured by AD instruments, Australia. The protocol was explained to the subjects and informed consent was obtained from each of the participant. All pulmonary function tests were done on the subjects comfortably seated in an upright position. The subject was connected to the mouthpiece and was asked to breathe in order to familiarize himself with the equipment. During the test the subject was adequately encouraged to perform at their optimum level and also a nose clip was applied during the entire maneuver. Test was repeated at least 3 times and the best matching results were considered for analysis. Residual volume, Functional residual capacity, Total lung capacity, airway resistance and compliance are derived values, rest all are measured by the machine. The algorithms used for calculation have been validated for Indian populations.

Statistical Analysis

All data is expressed as a mean ± SD for each of the parameter. The two groups were compared by applying unpaired 't' test and P value of less than 0.05 was considered as significant.

RESULTS

Table 1: Anthropometric parameters

	AC users (Mean+/- SD)	Non AC Users (Mean+/- SD)	P value
Age	23.04+/-1.3	24.24+/-0.92	0.072*
Height	155.96+/-3	155.24+/-2.57	0.068*
Weight	59.68+/-4.67	59.20+/-4.06	0.075*

*P Value- Not Significant

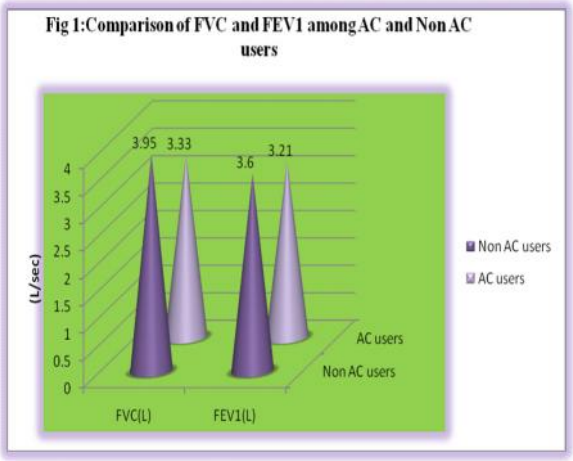
In the present study, the anthropometric parameters did not show any statistical significance between the two groups

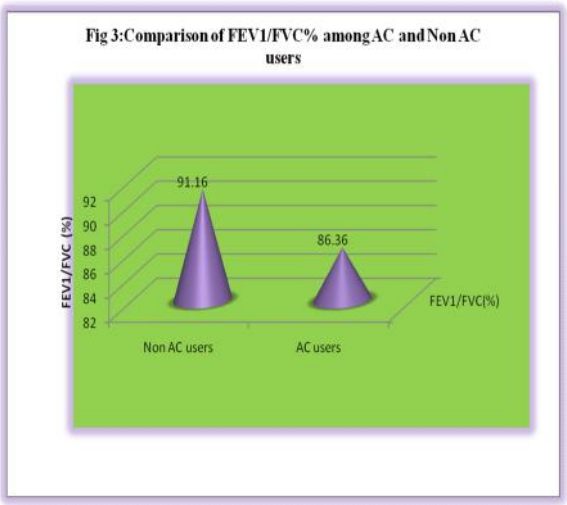
Table 2: Computerised spirometric parameters

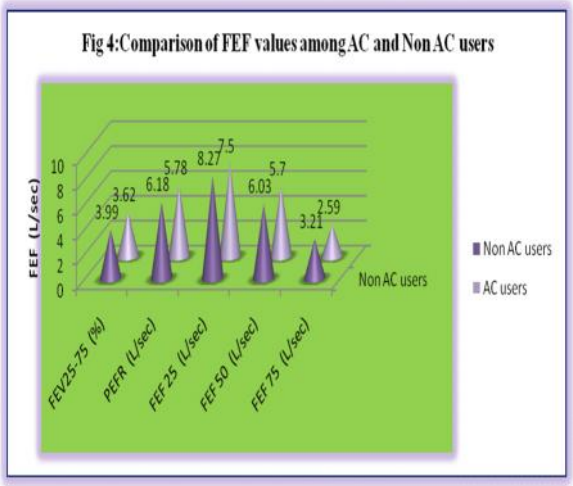
Parameters	Non AC users (Mean+/- SD)	AC users (Mean+/-SD)	P Value
FVC(L)	3.95+/-0.18	3.33+/-0.27	<0.001*
FEV1(L)	3.6+/-0.14	3.21+/-0.17	<0.01*
FEV1/FVC (%)	91.16+/-1.21	86.36+/-1.77	<0.001*
FEF 25-75%	3.99+/-0.13	3.62+/-0.15	<0.0001*
PEFR	6.18+/-0.2	5.78+/-0.11	<0.0001*
FEF25	8.27+/-0.18	7.50+/-0.25	<0.001*
FEF50	6.03+/-0.13	5.70+/-0.16	<0.0001*
FEF75	3.21+/-0.16	2.59+/-0.13	<0.001*
MMV	143.2+/-12.05	126.36+/-17.95	<0.001*

*-P Value- Significant.

All the expiratory flow rates were significantly decreased in AC users (group I)







Discussion

In the present study, the anthropometric parameters like height, weight and age did not show any statistical significance between the two groups. This shows that the anthropometric parameters did not have an influence on the pulmonary function tests. Also, there is a definite impairment in FVC, FEV1, FEV1/ FVC%, PEFR, FEF25, FEF50, FEF25-75 & MVV among AC users. Thus the results of the present study show a predisposition of air conditioner users towards respiratory dysfunction. These findings correlate well with other such studies.

The decreased values of lung functions may indicate underlying lung dysfunction due to exposure to AC environment. Due to cold air inhalation, airway becomes hyper-responsive [12]. Bronchoconstriction occurs and it increases resistance of airways. The mechanism causing bronchoconstriction is vagal mediated nervous reflex [14]. The other factor behind it is increase in the number of mast cells. They release histamine which is a known agent causing bronchoconstriction [15,16]. Cold air also causes epithelial desquamation and loss of epithelial derived relaxation factor which leads to bronchoconstriction [17]. Repeated cooling and desiccation also causes airway remodeling same as that of asthma [18,19]. It also removes the protective mucosal barrier which exposes underlying sub mucosa . This leads to inflammatory changes and increase in the number of eosinophils.

Cold dry air inhaled through AC's produce alterations in pulmonary functions in AC users. The results of present study are also indicating towards early stages of airflow limitation. [19]. Tobacco smoking and intensive use of AC's appeared to be positively related to atopic sensitization and enhanced eosinophil activity. Probably living conditions, such as indoor dampness and poor ventilation increases the exposure to indoor air pollutants[20]. Crude water extracts of contaminated AC's are the antigen-source of the hypersensitivity pneumonitis in exposed workers [5]. Moreover contamination of home, office and car air conditioners with fungi has been reported to cause hypersensitivity pneumonitis [21,22].

According to Fontanneri et al. Nasal inhalation of cold dry air causes activation of cold receptors or in the nasal mucosa and activation of these receptors induces protective bronchoconstrictor responses. According to Beasely R et al. airway epithelial damage due to cold dry air is a critical feature of airway hyper responsiveness**.** According to Barnes P J et al, inhalation of cold dry air leads to activation of parasympathetic nerves which brings about bronchoconstriction. The inhalation of cold dry air causes bronchoconstriction by local non nervous

reactions also like release of histamine and slowly reactive substance of anaphylaxis by mast cells.

Similar study was done in 2006 by Farah K et al in which the pulmonary function tests to assess parameters PEFR, FEF25-75% and FEV1 were significantly reduced in subjects using car AC's. Hiteshkumar Solanki et al in 2013 performed spirometry to observe the effect of air condition use on pulmonary functions. PEFR and FEF25-75% were significantly decreased in AC users[25].

Yelam SB et al. found statistically significant decrease in PEFR, FEF25, FEF50, FEF75, FEF25-75 and MVV among AC users as compared to non AC users.Maulikvaru et al found a significantly decrease in the values of PEFR, FEF25, FEF50, FEF25-75 and MVV.Choudry et al found a significantly reduced lung functions in air conditioned car drivers as when compared to controls.Jeelani et al showed that there was a decrease in the peak expiratory flow rate, FEF25-75% which is the flow rate over the middle half of vital capacity, as an evidence of mid airflow restriction.

Conclusion

This study has revealed that AC users had significantly reduced spirometry parameters when compared with non AC users. Hence, frequent spirometry assessment of people working in AC environment is suggested, to ensure early detection of respiratory problems and to avoid complications in future.

References

1. MaulikVaru, YogeshKacha, AnupVegad, Chinmay Shah, Hemant Mehta. A Comparative Study Of Computerized Spirometric Parameters Between Air Conditioner Users And Non Air Conditioner Users .International Journal of Basic and Applied Physiology;2(1) :163-166

2. N. Caire, A. Cartier, H. Ghezzo and J.L. Malo. Influence of the duration of inhalation of cold dry air on the resulting bronchoconstriction in asthmatic subjects. EurRespir J 1989; 2: 741-745.

3. De Filippis P, Spinaci A, Coia M, Maggi O, Pana A. Effectiveness of the maintenance operations on the air conditioning systems of a university building in relation to the microbiological quality of the air indoor. IgSanitaPubbl. 2003; 59(6): 365-72.

4. Y. Kuwahara, J. Kondoh, K. Tatara, E. Azuma, T. Nakajima, M. Hashimoto. Involvement of urban living environments in atopy and enhanced eosinophil activity: potential risk factors of airway allergic symptoms. Allergy 2001; 56: 224-230.

5. Baur X, Richter G, Pethran A, Czuppon A.B, Schwaiblmair M. Increased prevalence of IgG induced sensitization and hypersensitivity pneumonitis (humidifier lung) in nonsmokers exposed to aerosols of a contaminated air conditioner. Respiration 1992; 59 (4): 211-214.

6. Hoffman RE, Wood RC, Kreiss K. Building-related asthma in Denver office workers. Am J Public Health 1993; 83:89-93.

7. Babitha R, Rangarajan R, Muhil M, Basavarajaiah MG. Pulmonary Function Tests in Air Conditioner Users. Journal of Clinical and Diagnostic Research. 2011 June; Vol-5(3): 532-535

8. Farah Khaliq , Sharma S, Tandon OP. Pulmonary Functions In Air Conditioner Users. Indian J Physiol Pharmacol 2006; 50 (1) : 67–72

9. MalcolmJ.J.History of air conditioning. Newsweek Winter 1997;130(24):42-44.

10. FontanariP,BurnetH,Caroline M, Hartmann Z, and Jammes Y. Changes in airway resistance induced by nasal inhalation of cold dry, dry, or moist air in normal individuals. Journal of applied Physiology. October 1996 ; 81(4):1739-1743.

11. Hulke SM, Thakare A, Patil P, Shete S.A, Vaidya Y.P. Pulmonary functions in air conditioner users. Medical Journal of Dr. D.Y. PatilUniversity . January-March 2013; 6(1):21-24.

12. Beasley R Roche WR, Roberts T. Holgate ST. Cellular events in the bronchi in mild asthma and bronchial provocation.American Review of Respiratory Diseases 1989;139:806-7.

13. Benson MK. Bronchial hyperreactivity. British Journal of Diseases of chest.1987;27;254-263.

14. Koskela HO. Cold air provoked respiratory symptoms: The mechanisms and management. International Journal of Circumpolar Health.2007;66:91-100.

15. Cruz AA, TogiasA, Upper airway reactions to cold air. Curr Allergy Asthma rep.2008;8(2):111-7

16. Clark RA, Gallin JI, and Kaplan AP. The selective eosinophil chemotactic activity of histamine. Journal of Experimental medicine. 1987;142-1462.

17. Iravani J and Melville G.N. Mucociliary function in the respiratory tract as influenced by physiochemical factors. Journal of Pharmacology.1989;B.(2):471.

18. Merre CL, Isber J, Chediak A.D and .Wanner. A. Effects of Cold Dry Air Nasal Stimulation on Airway Mucosal Blood Flow in Humans.Informa Healthcare.2003; 111(4): 327-329.

19. Davis MS, Schofield B, Freed AN.Repeated peripheral airway hyperpnea causes inflammation and remodeling in dogs. Med Sci Sports Exerc; 2003 Apr;35(4):608-16.

20. Van Strien RT, Gehring U, Belanger K, Triche E, Gent J, Bracken MB, Leaderer BP. The influence of air conditioning, humidity, temperature and other household characteristics on mite allergen concentrations in the northeastern United States. Allergy 2004 June; 59(6): 645–652.

21. Kumar P, Marier R, Leech SH. Hypersensitivity pneumonitis due to contamination of a car airconditioner. *N Engl J Med* 1981; 305: 1531–1532.

22. Banaszek EF, Thiede WH, Fink JN. Hypersensitivity pnenmonitis due to contamination of an air conditioner. *N Engl J Med* 1970; 283: 271–276.

23. Barnes PJ. Neural control of human airways in health and disease. American Review of Respiratory Diseases 1998;134: 112-121

24. Barnes PJ. Muscarinic receptors in airways, Journal of Applied Physiology 1990; 68(5): 170-177

25. Solanki HK, Gojiya A.J, Dixit R and Jadeja J M. Study of pulmonary functions in air conditioner users and non users. I. J. A. B. M. S. JULY 2013.