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Original Research Article

THE EFFECT OF AIR CONDITIONERS (AC) ON PULMONARY FUNCTIONS IN YOUNG ADULTS

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ABSTRACT

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. The existence of bronchospasm in response to nasal inhalation of cold and/or dry air may be considered as a protective mechanism that tends to reduce the airflow rate in the upper airways and cervical trachea and limits the penetration of insufficiently conditioned inspired air into the lungs. Cold dry air challenge test is the test by which bronchial responsiveness is measured by applying physical stimuli like hyperventilation of cold and dry air. It has been observed that hyperventilation of cold dry air causes bronchoconstriction, and eupnoeic inhalation of cold, dry air increases airway resistance in asthmatic patients in AC environment, the current study was carried out on young adults using air condition and non-air condition, 66 subjects between the age group of 25-50 years chosen for the study, the subjects was then divided into two groups viz, group A & group B. The subjects of both the groups then examined for their FVC, FEV1 and PEFR values FVC and FEV1 ratio was also documented for each subjects. The best of the three readings was recorded and finally the data was analyzed using standard deviation and't' test. There was a difference in the data after the analysis of standard deviation and 't' test hence it was found that FVC, FEV1 and FEV1/FVC is higher in Non-air conditioner users compare to air conditioner users. But there is no significant difference between the PEFR level between Air conditioner and non-air conditioner users. Hence it can be concluded that non air conditioner users have higher pulmonary function when compared to air conditioner users.

KEYWORDS: AC users, PFT, PEFR, FEF25–75% and FEV1.

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BACKGROUND

Industrialization and Development of IT companies made migration and modern styles of living in urban areas. Air conditioners (AC's) are extensively used these days in IT companies, home as well as while traveling. The term air conditioning commonly refers to the cooling and dehumidification of indoor air for thermal comfort. The reduction in the humidity of the air being cooled is due to the condensation of water vapour [1]. Thus, cold dry air is what we inhale while using AC's. It has been observed that

hyperventilation of cold dry air causes broncho-constriction in asthmatic patients [2].

It has been suggested that changing the concentration of the water in inspired air has a greater effect on airway response and it is the osmotic effect than cooling effect that is more important in determining exercise induced asthma [3].

According to air conditioning and refrigeration institute there are over 60 million AC's using fluorocarbons in US alone. These 'Freons' primarily serve as propellants and used in cooling system and have been shown to result in widespread toxicity after accidental or intentional inhalation[1]. Modern styles of living in urban areas have been considered potentially responsible for the development of airway allergic diseases due to proliferating house dust mites & increasing concentration of indoor air pollutants, which lead to the elevation of serum Ig E levels or the enhancement of eosinophil activity [4-6]. One of the component in modern lifestyle is intensive use of AC's, which has increased the risk of atopic sensitization [7,8]. While the absence of air conditioners and use of hot water heating systems is also reported to have a negative relationship with FEV1 [9].

Air conditioners' purpose is to provide comfort during either hot or cold weather. However, air conditioning is not only destructive to the environment, but also harmful to health. We use air conditioning to cool our little microenvi ronment, house, car, office, whatever it may be, but in so doing, we pump out heat and harmful gases into the external environment, thus contributing to global warming [10].

Hyperventilation in cold air induces bronchoconstriction which may be as a result of repetitive dehydration of small airway when large volume of cold air is inhaled [11,12].

Increased prevalence of IgG induced sensitization and hypersensitivity pneumonitis is reported in persons exposed to aerosols of contaminated AC's[13]. While fluorinated hydrocarbons collectively referred as freon's have been shown to result in widespread toxicity after accidental or intentional inhalation. Freon inhalations may lead to the production of cardiac arrhythmias. Freon's primarily serve as propellants and are widely used in cooling systems [14].

Exacerbation of Allergic rhinitis and Bronchial asthma after the use of automobile air conditioner has been demonstrated. Contamination of home and office air conditioner with species of thermophilic actinomycetes may cause hypesensitivity pneumonitis. Other illnesses such as Legionnaire's disease, invasive aspergillosis and systemic acinetobacter infections have also been traced to the contamination of AC's and humidifier system [15-18]. The above studies indicate a link between the use of AC's and various cardiorespiratory functions. To the best of our knowledge there is no study showing the effect of AC's on various pulmonary functions. Therefore the present study was planned to evaluate the lung function tests of young healthy non-smokers adults using AC's.

MATERIALS AND METHODS

A total number of 66 subjects were included in this study and divided in to 2 groups. 33 Subjects who are exposed to AC's in the age group of 20-50 years, 33 subjects who are not exposed to AC's in the age group of 20-50 years belonging to Nandyal, Kurnool district in Santhiram Medical College and General hospital, Nandyal, Kurnool district.

Inclusion criteria for ac users: Individuals using AC's on regular basis for at least 5 hrs daily for the past 6 months with, No previous / present history of respiratory and cardiovascular diseases, No history of smoking, No history of allergy.

Exclusion criteria for ac users: Presence of any acute / chronic respiratory disorders, Systemic illness which directly or indirectly affects the respiratory system, History of smoking, History of allergy, Use of AC's on irregular bases or for less than 5 hrs daily or less than 6 months.

Inclusion criteria for Individuals not using AC's anywhere with: No previous / present history of respiratory and cardiovascular diseases, No history of smoking, No history of allergy.

Exclusion criteria Individuals not using AC's anywhere with: Previous / present history of respiratory and cardiovascular diseases, History of smoking, History of allergy.

Materials: Pulmonary function tests will be

carried out using 'MEDSPIROR', a computerized self-calibrating spirometer which fulfils the criteria for standardized lung function tests.

The following parameters will be recorded.

· Age

· Sex

· Height (Ht) in cms

· Weight (Wt) in Kgs

· PEFR in litre/sec

· FEF 25-75% litre/min

· FVC litre/min

· FEV_1 litre/min

· FEV_1/FVC

For Statistical analysis Mean and standard deviation (SD) will be worked out to establish the level of outcome variables in the two groups in excel spread sheet. As sample size in large, student t-test will be applied to test the significance of difference in two groups. All the tests of significance will be carried out at 5% level.

RESULTS

Table 1: Showing the AGE, HIGHT, WEIGHT, BMI's Mean, SD, and comparison in ac users and non-users.

	AC usage		Non user		p-value
	Mean	SD	Mean	SD	
Age	36.59	8.08	36.53	9.34	0.98
Hight (CM)	159.29	11.17	161.13	11.12	0.51
Weight (KG)	60.35	15.64	63.88	17.27	0.39
BMI (kg/m^2)	23.72	5.44	24.44	5.71	0.6

Table 2: Showing the FVC's Mean, SD, and comparison in ac users and non-users.

FVC	AC usage		Non user		p-value
	Mean	SD	Mean	SD	
Observed	3.4	0.82	3.48	0.76	0.69
Predicted	2.41	0.85	2.65	0.8	0.23
%Predicted	71.26	20.43	75.25	15.45	0.38

Fig. 1: Showing the FVC's Mean, SD, and comparison in ac users and non-users.

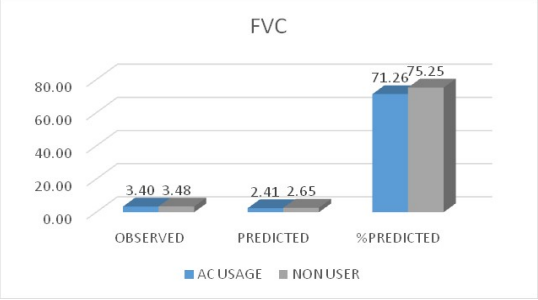


Table 3: Showing the FEV1's Mean, SD, and comparison in ac users and non-users.

FEV1	Ac usage		Non user		p-value
	Mean	SD	Mean	SD	
Observed	2.87	0.65	2.96	0.58	0.56
Predicted	1.96	0.73	2.15	0.75	0.29
%Predicted	68.35	21.31	72.69	18.76	0.38

Fig. 2: Showing the FEV1's Mean, SD, and comparison in ac users and non-users.

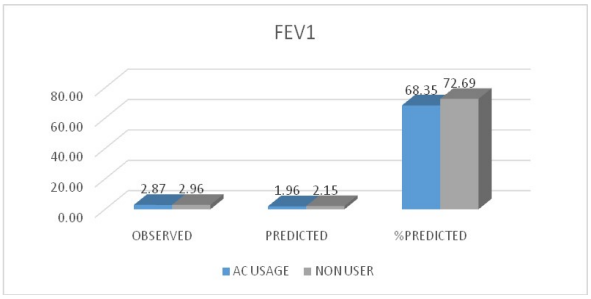


Table 4: Showing the FEV1/FVC's Mean, SD, and comparison in ac users and non-users.

FEV1/FVC	Ac usage		Non user		p-value
	Mean	SD	Mean	SD	
Observed	0.84	0.03	0.84	0.03	0.98
Predicted	0.8	0.13	0.81	0.11	0.88
%Predicted	96.71	13.49	95.84	12.05	0.79

Fig. 3: Showing the FEV1/FVC's Mean, SD, and comparison in ac users and non-users.

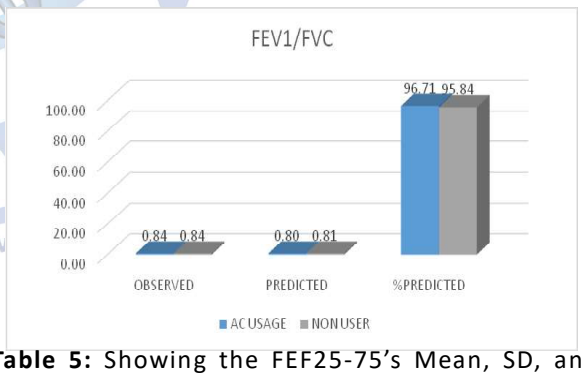


Table 5: Showing the FEF25-75's Mean, SD, and comparison in ac users and non-users.

FEF25-75	AC usage		Non user		p-value
	Mean	SD	Mean	SD	
Observed	3.39	0.63	3.48	0.57	0.55
Predicted	2.15	1.16	2.41	1.28	0.4
%Predicted	62.65	29.61	67.84	30.58	0.49

Fig. 4: Showing the FEF25-75's Mean, SD, and comparison in ac users and non-users.

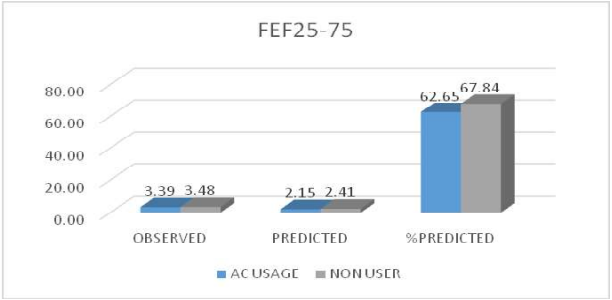
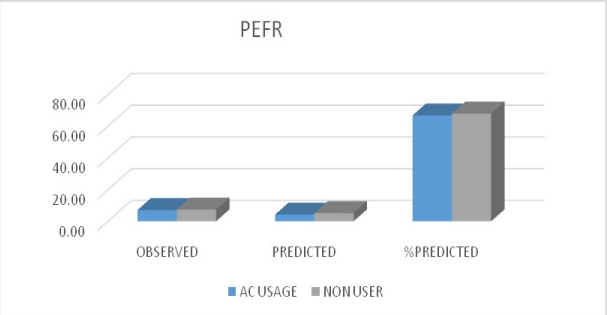


Table 6: Showing the PEFR's Mean, SD, and comparison in ac users and non-users.

PEFR	AC usage		Non user		p-value
	Mean	SD	Mean	SD	
Observed	7.12	1.68	7.44	1.3	0.39
Predicted	4.2	1.48	5.1	2.38	0.07
%Predicted	66.74	46.37	67.88	25.71	0.9

Fig. 5: Showing the PEFR's Mean, SD, and comparison in ac users and non-users.



DISCUSSION

The hypothesis that there is a difference between the PFT values in air conditioned and non-air conditioned users. Between the age group of 25-50 years can be fully accepted on the basis of findings of the study. This is supported by our primary finding which revealed that the PFT values are more in non ac users as compared to ac users. Modern living in urban areas is potentially responsible for development of various disorders and use of AC is a part of it. Tough competition between professional settings forces young adults to work for hours in central AC environment. Present study has shown that users of air conditioner environment causes impairment in respiratory functions which may lead to serious complications in future. Spirometry is a simple and useful test to identify and monitor respiratory impairment. With the proper equipment and the correct technique, maximal results can be obtained.

The protocol consisted of user of air condition and non-air condition young adults in Nandyal rural. 66 subjects between the age group of 25-50 years chosen for the study, the subjects was then divided into two groups viz, group A & group B. A group consisted users of an air condition environment for a minimum of one year while group B which was the control group consisted of a non-air condition environment the subjects of both the groups then examined for their FVC, FEV1 and PEFR values FVC and FEV1 ratio was also documented for each subjects. The best of the three readings was recorded and finally the data was analyzed using the 't' test. FVC (Forced Vital Capacity) is the volume of air which can be forcibly and maximally exhaled out of the lungs until no more can be expired. FVC is usually expressed in units called liters. This PFT value is critically important in the diagnosis of obstructive and restrictive diseases.

FEV1 (Forced Expiratory Volume in One Second) is the volume of air which can be forcibly exhaled from the lungs in the first second of a forced expiratory manuever. It is expressed as liters. This PFT value is critically important in the diagnosis of obstructive and restrictive diseases. FEV1/FVC This number is the ratio of FEV1 to FVC - it indicates what percentage of the total FVC was expelled from the lungs during the first second of forced exhalation this number is called FEV1%, %FEV1 or FEV1/FVC ratio. This PFT value is critically important in the diagnosis of obstructive and restrictive diseases.

PEFR (Peak Expiratory Flow Rate) is maximum flow rate achieved by the patient during the forced vital capacity maneuver beginning after full inspiration and starting and ending with maximal expiration - it can either be measured in L/sec or L/min - this is a useful measure to see if the treatment is improving obstructive diseases like bronchoconstriction secondary to asthma.

The result of the current study reveals that the PFT values are more in non AC users as compared to non AC users. The probable reason behind this finding can be that nasal inhalation of cold dry air causes activation of cold receptors or osmoreceptors in the nasal mucosa and activation of these receptors induces protective bronchoconstrictor responses [19]. Cold and dry air causes the release of inflammatory mediators possibly associated with mast cells and causes bronchospasm [20]. Nasal cold air provocation causes mast cell activation and sensory nerve stimulation [21]. Histamine released by the mast cells causes bronchospasm, increases airway resistance and decreases dynamic compliance [22]. Respiratory tract of the subject exposed to AC environment is hyper responsive and the patency of the airways is decreased [23]. Therefore probable reason for the findings of

the present study is hyper responsive airways, inflammation and mast cell activation due to cold injury which leads to bronchoconstriction and decreases dynamic compliance. Cold dry air challenge test is used to measure bronchial responsiveness by applying physical stimuli like hyperventilation of cold and dry air .Result of the test shows that hyperventilation of cold and dry air causes bronchoconstriction, and eupnoeic inhalation of cold and dry air increases airway resistance in asthmatic patients. During working in AC environment workers inhale cooled and dehumidified that is cold and dry air which might be affecting their airways and altering pulmonary functions.

Intensive use of air conditioners in modern living has increased the risk of atopic sensitization and eosinophil activity [24,25]. Increased prevalence of IgG induced sensitization and hypersensitivity pneumonitis was reported in persons exposed to aerosol contaminated air conditioners [26]. Hypersensitivity pneumonitis caused by bacteria, fungi and molds contaminating air conditioning systems had been also reported [27]. Conditions favorable to the growth of micro-organisms are sometimes found in air conditioning system. While such micro-organisms are potentially pathogenic or allergenic, it can lead to human respiratory ailments and thus result in a decline in pulmonary functions.

Limitations of study:

The limitation of procedure is that it depends on co-operation of subject. The spirometric maneuver is repeated several times to ensure accuracy and consiste-ncy of the data. The subject needs to understand the procedure detailed by the therapist and follow all instructions. The procedure cannot be performed on subjects who are unable to exhale forcefully into the Spirometer. The procedure cannot be performed on subjects with oral infection

CONCLUSION

Hence it can be concluded that non air conditioner users have higher FVC, FEV1 and FEV1/FVC when compared to air conditioner users. But there is no significant difference between the PEFR level between Air conditioner and non-air conditioner user.

REFERENCES

[1]. Khaliq F, Sharma S, Tandon OP. Pumonary functions in air conditioner users. Indian J Physiol Pharmacol 2006;50(1):67-72.

[2]. Malo JL, Cartier A, E Archeveque J, Ghezzo H, Martin RR. Cold air inhalation has a cumulative bronchospastic effect when inhaled in consecutive doses for progressively increasing degrees of ventilation. Am Rev Respir Dis 1986;134:990-3.

[3]. Hahn A, Anderson SD, Morton AR, Black JL, Fitch KD. A reinterpretation of the effect of temperature and water content of the inspired air in exercise-induced asthma. Am Rev Respir Dis 1984; 130:575-9.

[4]. Van Strien RT, Gehring U, Belanger K, Triche E, Gent J, Bracken MB, et.al. The influence of air conditioning, humidity, temperature and other household characteristics on mite allergen concentrations in the northeastern United States. Allergy 2004;59(6): 645–52.

[5]. Wickman MT, Nordwall SL, Pershagen G, Sundell J, Schwarts B. House dust mite sensitization in children and residential characteristics in a temperate region. J Allergy Clin Immunol 1993;88:89–95.

[6]. Takaoka M. House dust mites in the Japanese indoor environment. Allergology 1997; 4:367–73.

[7]. De Filippis P, Spinaci A, Cola 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. Ig Sanita Pubbl 2003;59(6): 365–72.

[8]. Kuwahara Y, Kondoh J, Tatara K, Azuma E, Nakajima T, Hashimoto M, Komachi Y. Involvement of urban living environments in atopy and enhanced eosinophil activity: potential risk factors of airway allergic symptoms. Allergy 2001;56: 224–30.

[9]. Hosein HR, Corey P, Robertson J Mc D. The effect of domestic factors on respiratory symptoms andFEV1. Int J Epidemiology 1989; 18(2): 390–6.

[10]. Dhaar GM, Rabbani I. Environmental Pollution. In: Dhaar GM, Rabbani I, editors. Foundation of Community Medicine. 2 nd ed. Noida, UP: Elsevier; 2008. p. 91.

[11].Rundell KW, Jenkinson DM. Exercise induced bronchospasm in the elite athlete. Sports Med 2002;32:583-600.

[12]. Kippelen P, Caillaud C, Robert E, Connes P, et al. Effect of endurance training on lung function: A one year study. Br J Sports Med 2005;39:617-21.

[13].Baur X, Richter G, Pethran A, Czuppon AB, Schwaiblmair M. Increased prevalence of IgG induced sensitization and hypersensitivity pneumonitis (humidifier lung) in non smokers exposed to aerosols of a contaminated air conditioner. Respiration 1992; 59(4): 211–4.

[14]. William JB, Stremski E, Eljaiek L, Aufderheide TP. Freon inhalational abuse presenting with ventricular fibrillation. Am J Emerg Med 1994;12: 533–6.

[15]. Banaszak EF, Theide Wh, Fink JN. Hpersensitivity penumonitis due to contamination of an air conditioner. N Engl J Med 1970;283:271-6.
[16]. Kumar P, Marier R, Leechs H. Respiratory allergies related to automobile air conditioners. N Engl J Med 1984;311:1619-21.
[17]. Kumar P, Marier R, Leech SH. Hypersensitivity penumonitis due to contamination of a car air conditioner. N Engl J Med 1981;305:1531-2.
[18]. Kumar P, Lopez M, Fan W, Cambre K, Elston RC. Mold contamination of automobile air conditioner systems. Ann Allergy 1990; 64(2):174-7.
[19]. Pierre Fontanari, Henri Burnet, Marie Carolin Zattara-Hartmann, Yves Jammes. Changes in airway resistance induced by nasal inhalation of cold dry, dry, or moist air in normal individuals.J ApplPhysiol. 1996:81:1739-43.
[20]. Togias AG, Naclerio RM. Nasal challenge with cold, dry air results in release of inflammatory mediators. Possible mast cell involvement.J Clin Invest. 1985;76(4):1375-81.
[21]. Cruz AA, Togias A. Upper airways reactions to cold air.Curr Allergy Asthma Rep. 2008;8(2):111-7.
[22]. Benson M.K. Bronchial hyper reactivity. British Journal of Diseases of Chest.1987; 27; 254-63.
[23].R. Babitha, R. Rangarajan, M. Muhil, M.G. Basavarajaiah. Pulmonary Function Tests in Air Conditioner Users.Journal of Clinical and Diagnostic Research 2011;5(3): 532-5.
[24]. 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
[25]. 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- 30.
[26].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): 211-4.
[27]. Hoffman RE, Wood RC, Kreiss K. Building-related asthma in Denver office workers. Am J Public Health 1993;83:89-93.

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