Original Article

Cool Air Inhalation And Its Effects on Respiratory Flow Rates

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ABSTRACT

Background: Today's modern lifestyle and raised global warming has led to increased use of electronic goods by common man. From fans to coolers and eventually Air conditioners popularly known as "ACs" ruling the age old gadgets by making the atmospheric temperature pleasant and comfortable. However , continuous usage of Ac',s and inhalation of cool air may have bad effects on the respiratory system and this needs to be evaluated. Hence this study was conducted to find out the effect of cool air inhalation on respiratory functions particularly flow rates.

Aim and objective: To study the effects of cool ,dry air inhalation on respiratory flow rates.

Material and Methods: The study was conducted in the Department of Physiology, Maharishi Markandeshwar Institute of Medical Sciences & Research, Mullana (Ambala). 100 healthy subjects were selected after proper consent. They were divided into two groups of 50 each as AC users (Group 1) and Non Ac users (Group 2). Their anthropometric measurements were taken. It was followed by Pulmonary function testing using computerized Spirometer. Respiratory flow rates like PEFR and FEF^{25-75} were measured. Data was analysed.

Results: Group 2 (AC users) had significantly reduced PEFR and FEF^{25-75} with P values of 0.007 and 0.001 respectively as compared to Group 1 (Non AC users)**.**

Conclusion: Since there was a significant decrease found in pulmonary flow rates post exposure to AC's , this shows a predisposition of AC users towards pulmonary dysfunction.

INTRODUCTION

Air conditioners have ousted the old world fans and coolers in our daily livelihood. Till recent times, Air conditioned environment was thought to be pleasant and harmless but many authors have observed that persons working in Air Conditioned environment are firmly related with increase in prevalance of work related headaches, fatigue and upper respiratory symptoms.[1] Less humidification as such was considered much important factor for higher prevalence of symptoms with AC user. Its relation between type of building ventilation and prevalence of symptoms have important role in public health.[2]

There is a huge effect on the level of excellence of air we breathe in due to the usage of AC's and central Ac systems. We should be very much careful about the technical, hygienic and other microbiological factors to prevent any risk of infection or damage caused because of inhalation of contaminated air while usage of AC's and thus resulting in respiratory discomfort or diseaseas.[3]

MATERIALS AND METHODS

STUDY DESIGN:
Case-Control Study

STUDY SET-UP:
The study was conducted in the Department of Physiology, Maharishi Markandeshwar Institute of Medical Sciences & Research, Mullana (Ambala).

STUDY GROUPS:
100 female subjects were selected from MMU hostels.
The selected subjects were categorized into 2 major groups:
GROUP 1(Study group) consisted of 50 healthy female students living in AC hostels(with exposure to cool air)

GROUP 2 (Control group) consisted of randomly selected 50 healthy female students living in Non AC hostels (not exposed to cool air inhalation)

All the subjects were Females between the age group of 18-28 yrs.
A detailed history and clinical examination was conducted on subjects for inclusive and exclusive criteria.
Pulmonary function testing was done two times after a 6 month's gap. First reading was taken as baseline for both groups. Consecutively the second reading was taken after 6 months in both the groups.
All the subjects who were in AC hostels used AC's for minimum of 6 hrs/day atleast 5 days a week from the past 6 months.
However the other group didn't use AC at all.
The AC temperature was between 18-22 degree centigrade as the Ac's present in the hostels were Central AC's i.e all had a similar temperature.
Those students who stayed in Non-Ac hostels were taken as controls.

Inclusive Criteria
- Study group subjects had minimum exposure of 6 hrs /day to AC for the last 6 months.
- Healthy individual without any known respiratory disease were taken.

Exclusive Criteria
- Any individual with a known General or Systemic disease.
- Any H/O of drug or any condition affecting the Pulmonary functions.
- Using AC on irregular basis.

TECHNIQUE:
The equipment used was computerized spirometer, **Spiro-Excel (Medicaid Systems Chandigarh).** It had a turbine flow meter and the range for flow measurement is 0.03 l/min. Range for volume measurement is 0-10 L. The subjects were made to sit comfortably and were told to take a deep breath in and out to familiarize with the equipment. The subject were then asked to inhale to their maximum capacity and forcefully blow into the sensor (nose clipped) as hard as possible for as long as possible. This procedure was repeated three times and the best of three readings were considered for analysis. Data was tabulated and statistically analysed.

A) ANTHROPOMETRIC PARAMETERS:-
Age, Height, Weight were documented.

B) PULMONARY FUNCTION PARAMETERS:-
1) Peak Expiratory Flow Rate
2) FEF^{25-75}

DATA ANALYSIS:

All the observations of the study were recorded and the data collected was entered in Microsoft Office Excel version 2007. It was then analyzed by SPSS computer program for windows version 20.
Mean ± SD (Standard Deviation) was calculated and "Independent sample T test" was used to obtain statistical significance (p value) between the AC groups and Non-Ac groups.
Statistical significance was determined from p value with a 'p' value of < 0.05 considered as significant and p value ≤ 0.001 considered as highly significant.

ANTHROPOMETRIC PARAMETERS:
The mean Age, Height and Weight are comparable in AC users (Group 1) and Non- Ac users (Group 2). There is no significant difference between the mean age of two groups ($p = 0.875$) as shown in table 1(a), Height ($p = 0.594$) as shown in table 1(b) and Weight($p = 0.569$) as shown in table 1(c).

A) **PULMONARY FLOW RATES:**
PEFR: It is the maximum rate of airflow observed during a sudden forced expiration, from the position of full inspiration. It is measured in liters per second. PEFR is considered the reliable method for monitoring airflow obstruction in asthmatic patients and is recommended for asthma management in international guidelines.[4,5]

AC USERS (GROUP 1) AND NON-AC USERS (GROUP 2):
Pulmonary function data for Study group and their matched Control is given in table 2(a) with mean PEFR in Group1 (5.73 ± 1.60) and that of Group 2 (6.54 ± 1.32). The reduction of PEFR in Group 1 is statistically significant with ($p = 0.007$).

B) **FORCED EXPIRATORY FLOW RATE ($FEF_{25-75\%}$):** It is the mean expiratory flow rate during middle 50% of FVC. It is a sensitive indicator of small airway disease.

AC USERS (GROUP 1) AND NON-AC USERS (GROUP 2):
Pulmonary function data of the study and control group is given in table 2(b) with $FEF^{25-75}\%$ as 4.13 ± 0.89 and 4.69 ± 0.79 and respectively. The difference being statistically significant with ($p=0.001$)

RESULTS:

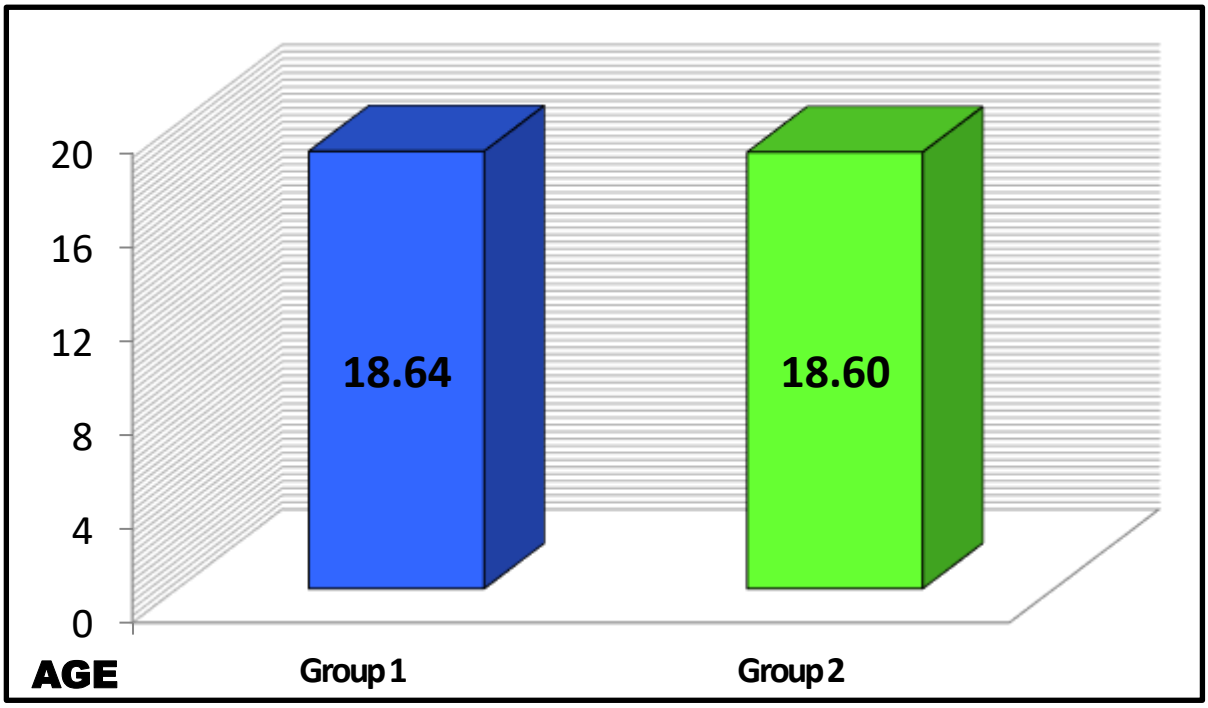

Figure 1 (a): Bar graph showing comparison of Mean Age of subjects in Group 1 (AC users) and Group 2 (Non-AC users).

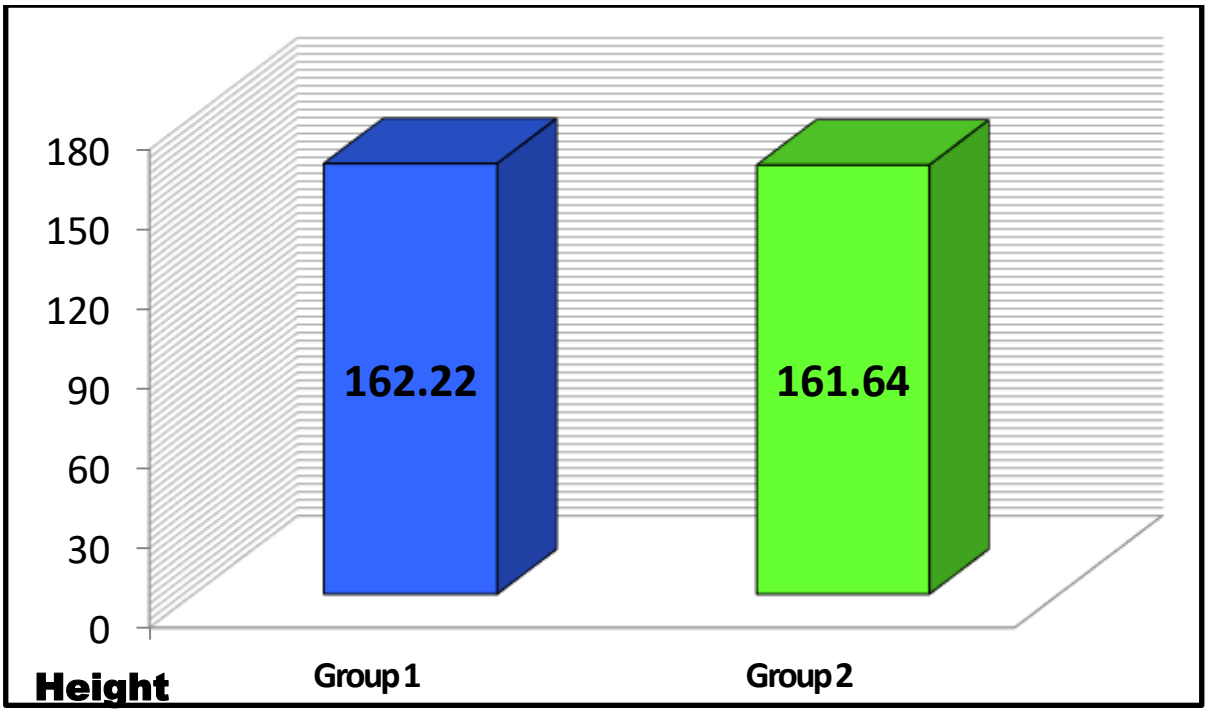

Figure 1(b): Bar graph showing comparison of Mean Height of subjects in Group 1 (AC users) and Group 2 (Non-AC users).

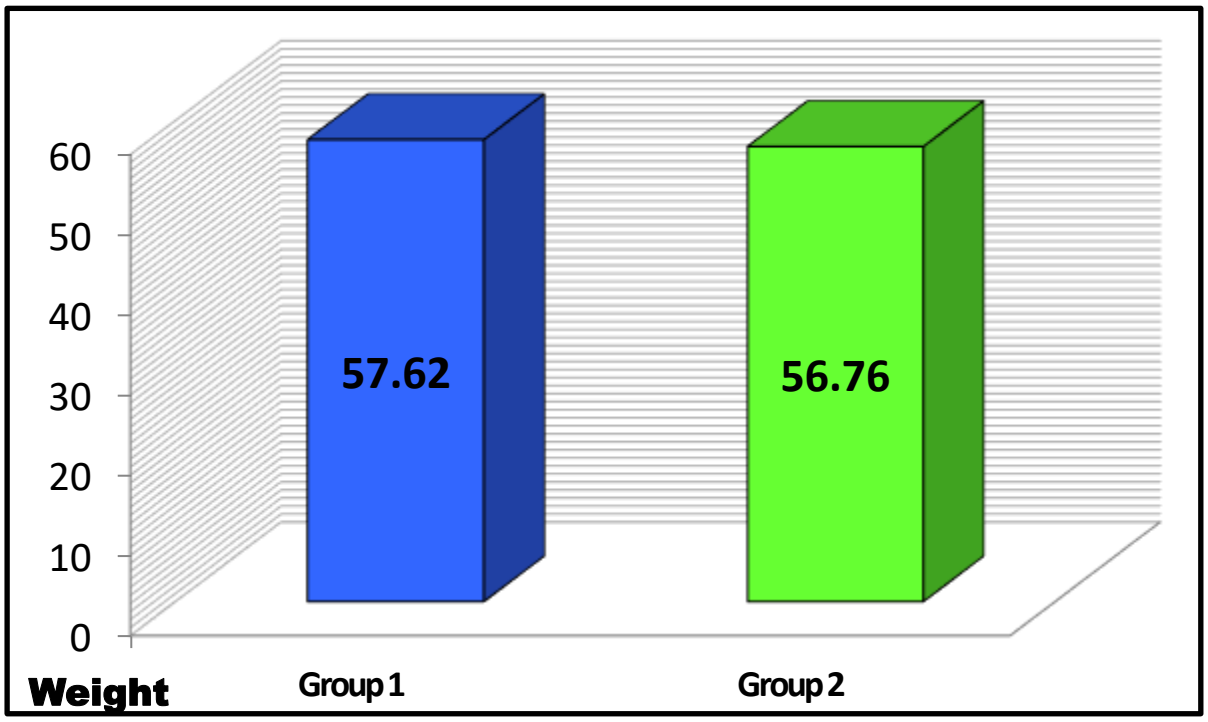

Figure 1(c): Bar graph showing comparison of Mean Weight of subjects in Group 1 (AC users) and Group 2 (Non-AC users).

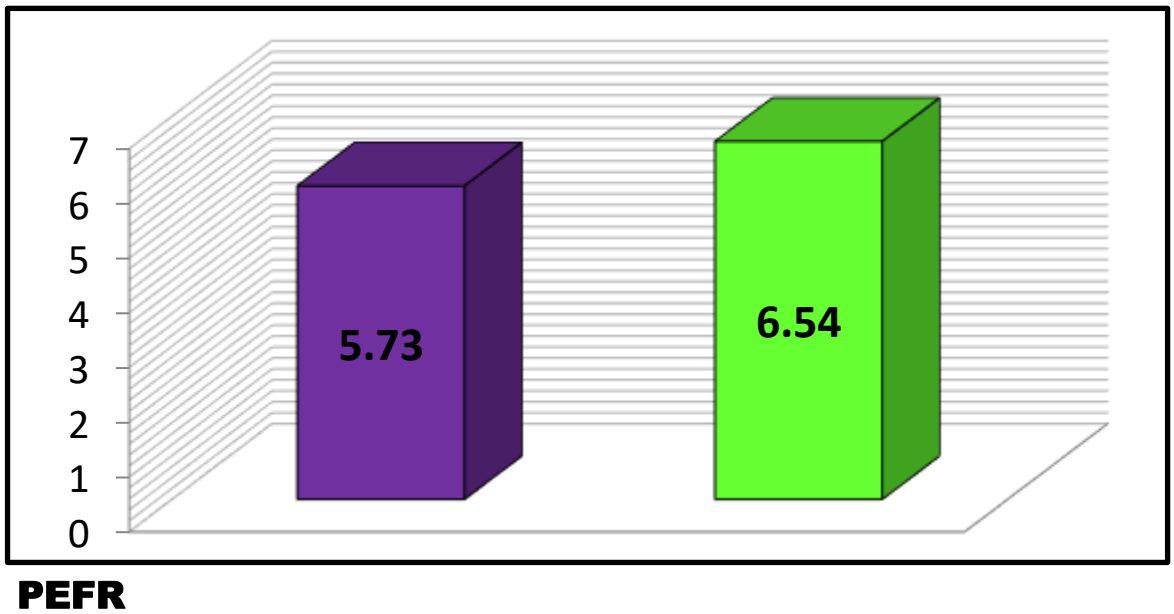

Figure 2(a): Bar graph showing comparison of Mean PEFR of subjects in Group 1 (AC users) and Group 2 (Non-AC users).

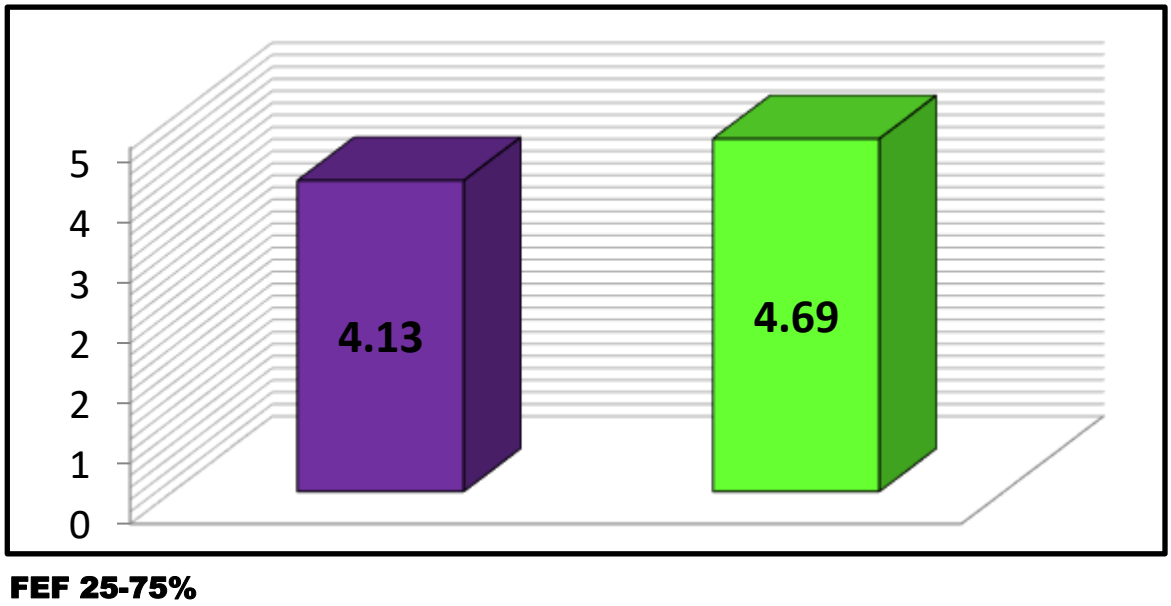

Figure 2(b): Bar graph showing comparison of Mean $FEF_{25-75\%}$ of subjects in Group 1(AC users) and Group 2 (Non-AC users).

DISCUSSIONS:

The present study was undertaken in the Department of Physiology, Maharishi Markandeshwar Institute of Medical Sciences & Research, Mullana to determine the effect of cool, dry air inhalation after AC usage on PEFR and FEF^{25-75}.

Based on observations in clinical and epidemiological fields the hyperventilation of cold dry air has seeked attention since some years as a source of assessment of bronchial hyper-responsivness. The result found out was that it's the hyperventilation because of inhalation of cold dry air that causes constriction of bronchioles and increases airway resistance in asthmatic patient.[6]

Sabade et al reported a non significant difference in the anthropometric data such as in age, height and weight amongst AC users and Non-AC users.[7]

Borse LJ et al observed that there was no significant difference in the anthropometric parameters (age, weight, height) between Ac and Non Ac users.[8]

Our observations are in quite agreement with the observations made by Vidya G et al who also reported the anthropometric parameters to be non-significant in Ac and Non Ac users.[9]

Our study is in agreement with study done by Khaliq et al as PEFR is also significantly decreased in subjects after AC exposure.[10]

Similar results were shown by Solanki HK et al by demonstrating a reduction in PEFR following AC usage in subjects using car AC's.[11] The subjects were driving the cars themselves, the flow of air being towards their faces, that probably is the reason behind the reduction in PEFR as described by Scharf SM et al.[12]

Maqsood Ali and Musaib Ali likewise documented reduction in PEFR of AC users. They have related the reduction in PEFR being caused by inhalation of cold dry air causing the airway muscles smooth.[13]

George O.S found a significant reduction in the subjects using AC in their cars for 6 months and the most obvious causefound was atopic sensitization and enhanced eosinophil activity. PEFR is an effective measure of effort dependent airflow.[14]

Hulke MS et al found a significant decrease in PEFR with $p<0.05$ as in our study.[15]
Cotes JE found that Peak Expiratory Flow Rate depends on the expiratory efforts exerted during forceful expiration and also on the position of airways and it mainly represents the strength of the bronchi and larger bronchioles that are subjected to reflex constriction of the bronchi.[16]
Babitha R et al found a significant decrease in $FEF_{25-75\%}$ in subjects working in banks. It is in quite agreement with our study.[17]
As observed by Iravani J and Melville GN there is a decrease in $FEF_{25-75\%}$ probably due to inhalation of cold, dry air causing dehydration and desquamation of the epithelial cells that leads to removal of the protective mucosal barrier.[18]
One more reason given by Barnes PJ et al stated nasobronchial reflex is caused by sensory nerve exposure through the maxillary afferent and vagal efferent nerves. This causes parasympathetic nerve activation and bronchoconstriction leading to decrease in $FEF_{25-75\%}$.[19]
Choudhhari PS, Doiphode SR , Zingade SU, Munibuddin Ahmed BM also found a decrease in F

CONCLUSION:

Since there was a significant decrease observed in pulmonary flow rates after inhalation of cool, dry air from exposure to AC's, this shows a predisposition of AC users towards pulmonary function dysfunction.

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