A Study Of Peak Expiretory Flow Rate In Air-Condition Users

Savina O.George, Lalita M. Chandan.
Department of Physiology, Seth G. S. Medical College & K. E. M. H., Parel, Mumbai 12. India.

Abstract: Background & objectives: The inhalation of cold, dry air affects the lung functions. Because of the increased usage of air conditioners in the society, this study was undertaken to evaluate the effects of air conditioners on peak expiratory flow rate (PEFR), Respiratory Rate by comparing the subjects who were exposed to AC and the subjects who were not exposed to AC. **Method:** The study group comprised of 96 healthy males & females between the ages of 20-50 years, working in air-conditioned & non AC environment in tertiary Medical centre. Their PEFR was recorded using mini-Wright peak flow meter, the Respiratory Rate also recorded. Mann-Whitney Rank Sum Test was used to analyse the PEFR & Respiratory Rate**. Results:** There was a significant decrease in Peak Expiratory Flow Rate [PEFR] and a significant increase in the Respiratory Rate of those Subjects Working in AC Environment. **Conclusion:** The parameters of Lung Function assessed showed significant difference in these two groups. Thus AC users are more prone to respiratory disorders than those not using AC.

Keywords: Peak expiratory flow rate, Respiratory Rate, Air conditioners.

Author for correspondence: Savina O. George, Department of Physiology, Seth G. S. Medical College & K. E. M. H., Parel, Mumbai 12. India. Email id:savinaoommen@gmail.com

Introduction: In this computerised twenty first century, the use of air conditioners is unavoidable in working places like Hospitals (ICUs, Blood Banks), Libraries, IT centres, banks, etc. Till recently, it was thought that working in an air conditioned environment was pleasant. But the person working in such an Environment is facing its adverse effects also.

A previous study done on young healthy subjects using AC's in their cars for atleast 1 hour daily for duration of 6 months, showed a reduction in lung functions[1].

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 chest expansion and a significant increase in respiratory rate[2].

Air conditioners (AC) are used extensively these days indoor as well as while travelling. The air inside is cooled at the expense of air outside. The reduction in humidity of the air being cooled is due to the condensation of water vapours[2].

Peak expiratory flow rate has been defined by Wright and Mc Kerrow as the highest flow rate sustained by a subject for at least ten seconds[3]. Peak expiratory flow rate as a measurement of ventilatory function was introduced by Hadorn in 1942 and was accepted in 1949 as an index of Spirometry[4].

A number of factors like age, height, B.S.A. and high altitude affect PEFR. Peak expiratory flow rates have been reported earlier in these different groups[2]. The lung volumes and capacities were not significantly different in the two groups except for Peak expiratory flow rate (PEFR) is significantly decreased in subjects using AC's[2].

Peak expiratory flow rate is dependent upon several variables including airway resistance, maximal voluntary muscular effort and the possible compressive effect of the manoeuvre on thoracic airways[5].

PEFR measurements do not significantly differ in sitting or standing positions among healthy participants[6].

Nowadays the Hospitals have centralised AC, if not AC has to be maintained regularly in certain Departments, Library in case of Medical Colleges. There is no study done yet in medical professionals who are exposed to AC regularly.

This study is to study the effect of AC on PEFR and Respiratory Rate in medical & paramedical healthy Subjects who are exposed to AC in their work place and those not exposed to AC anywhere.

Material and Method: The study was done on 96 healthy Subjects of Tertiary Health Centre of Municipal Corporation of Greater Mumbai in the age group of 20-50 years who volunteered for the study. 48 Males & 48 Females were

evaluated. The Subjects were divided into two groups depending on AC usage at work (not using AC anywhere else, not the next day after holidays). Group I constituted 51 healthy Subjects exposed to AC at workplace for 6-8 hours/day for the past 6 months (AC maintained at 18-22 ^{o}C). The readings were taken amongst the Staff of Library, Blood Banks and Medicine Department who volunteered for the study.

Group II had 45 Subjects not using AC anywhere. These readings were taken amongst staff of Physiology, Anatomy & Medicine Departments of Medical College. Recordings were done in AC & non-AC users between 2-4 pm. Informed consent was obtained from all the participants and ethical approval for the study was obtained from the institutional ethical committee.Relevant General Physical Examination was performed and Anthropometrical measurements including age, height and weight were taken.

Exclusion criteria were:

1) Presence of any acute or chronic respiratory disorder (Asthma, COPD)
2) Systemic illness which directly or indirectly affects the respiratory system (Past h/o tuberculosis, any chronic drug intake)
3) History of any chest injury, myocardial infarction
4) Smokers
5) Allergy, skin diseases, breathlessness and cough with expectoration
6) Pregnant women

Instruments used in the study:

- Height Scale & Weighing Machine
- Mini-Wright's peak flow meter.

Study Procedure:

Anthropometric Measurements: - Following anthropometric measurements were taken in each gewas recorded from birthday by calendar to the nearest year.

1. **Height**: Height in centimetres was measured (to the nearest centimetre) with the standard anthropometric rod, with the subject, standing barefooted in erect position, feet touching the wall posteriorly**.**
2. **Weight**: in kilograms (with one decimal reading) was recorded with the subject standing on the weighing scale, barefooted wearing essential clothing.

Respiratory Rate: was counted for one whole minute in each of the Subjects.

Peak Expiratory Flow Rate was measured by Mini-Wright's Peak Flow meter which is an accurate rugged and portable instrument. A subject was seated comfortably in an upright position. The instrument is held horizontally in front of the mouth, pointer at zero mark. The Subjects' finger was kept away from the pointer and vents of the peak flow meter.

The subject was shown how to expire maximally after full inspiration in order to familiarize him with the equipment. The subjects were trained to inspire in maximally and use their full force during expiration. The subject was then asked to breathe out maximally into the peak flow meter after taking a maximum inspiration with disposable mouthpiece attached without nose clip.During the tests the subject was adequately encouraged to perform at their optimum level. Test was repeated at least 3 times and the best matching results was considered for analysis. The readings were taken between 2-4 pm, after atleast two working days (i. e., not the next day after holidays). All the instruments were calibrated and verified before they were used. The measurements were taken single handed by the investigator.

Statistical Analysis: All data were analyzed by SPSS (Statistical Package for social sciences, Version 20, SPSS) and MedCal C Software. Mean, Standard Deviation obtained. Where quantitative data failed 'Normality test', non-parametric test has been applied. Normality Test (Shapiro-Wilk) failed ($p < 0.05$), thus Mann-Whitney U Test applied.

Results: The Statistical analysis of Subjects using AC and those not using AC was done. The results are mentioned as Mean $\pm$ Standard Deviation.

1) The Anthropometric parameters did not show any statistical Significance between the two groups as shown in Table 1

Table 1: Anthropometric Parameters

Parameters	AC users	Non users
n	51	45
Age (yr)	33.6 ± 7.5	32.9 ± 7.7
Height (cm)	160.9 ± 9.7	161.9 ± 9.2
Weight (kg)	62.0 ± 11.5	9± 11.2

2) The Respiratory Rate was significantly higher in Subjects using AC at workplace compared to those not exposed to AC anywhere as shown in Table 2. Also the PEFR was significantly low in Subject exposed to AC regularly compared to those not exposed.

Table 2: Comparison of Respiratory Rate and PEFR in Study Group

Parameters	AC users	Non users	Mann Whitney Test	p value
n	51	45		
RR (per min.)	20.75 ± 3.27	17.29 ± 2.14	5.115	3.13E-07
PEFR (L/min)	405.88 ± 116.11	449.78 ± 105.52	2.002	0.045

3.13E-07= 0.000000313 (where E stands for 10 raised to minus seven →universally accepted scientific notation)
i. e., p < 0.01

Note: Normality Test (Shapiro-Wilk) failed (p < 0.05), thus Mann-Whitney Rank Sum Test applied.
p value in both the parameters – RR & PEFR is statistically significant

Discussion: This Study was done amongst Medical & Paramedical Staff of Tertiary Medical Health Centre. Some Departments had Centralized AC plants, while in some Departments the AC supply was localized to the respective area. In Hospitals the regular maintenance of ACs, bacterial count, etc. can affect variables. This was eliminated, in this Tertiary Medical Centre, the AC in various Departments being regularly maintained monthly by the Hospital AC Department, also the bacterial count regularly carried out by the Microbiology Department & sterilization accordingly done on regular basis. Calibration Certificate also maintained for temperature, Relative Humidity, air flow, etc.

This study was carried out on 51 Healthy Subjects (Males & Females) working in AC environment for 6-8 hours/day who volunteered for the study and 45 Healthy Subjects not exposed to AC anywhere. 48 of our participants were male and the numbers of females were equally the same. In this study when males using AC v/s those not using AC were compared it was found that the difference in Respiratory Rate was Statistically Significant, whereas the PEFR was not found to be statistically significant. Among Females the difference was Statistically Significant in the Respiratory Rate & PEFR values in both the groups.

Overall the Respiratory Rate was found to be significantlyincreased& the PEFR Significantly decreased in Subjects in AC environment.

A study done on young healthy subjects using AC's in their cars for atleast 1 hour daily for 6 months, showed a reduction in lung volumes using PFTs, suggestive of predisposition of AC users towards respiratory disorders[1]. This study was done on only 10 subjects & AC in cars.

AC does more to our environmentthan just lowering temperature. AC's andcentral AC systems can have a profoundimpact on quality of air we breathe. Thetechnical, hygienic and microbiologicalfeature of air intakes must be better insuredin order to avoid the air intake becoming a risk component as regards contaminationand indoor air quality[1].This was specifically addressed to in our study, being in Hospital setup.

Another Study on bank employees working in AC, for 6 months & above showed that a significant reduction in FEV1, FEF25-75%, and PEFR values, and in chest expansion and a significant increase in respiratory rate[2]. This study was done only in male Subjects.

PEFR reflects mainly the calibre of the bronchi and larger bronchioles, which are subjected to reflex bronchoconstriction[7].Repeated cooling and dessication of peripheral airways can cause airway remodelling similar to that seen in asthma[8]. Personal smoking and intensive use of

AC's appeared to be positively related to atopic sensitization and enhanced eosinophil activity[9].Peak expiratory flow rate is an effective measure of effort dependent airflow[10].

Hence long term AC use affects lung function, which may predispose to Asthma in sensitive Subjeccts.

Conclusion: In Hospitals AC is needed, especially in this modern day. Hence this study was undertaken to evaluate the effect of AC on lung functions on those exposed to AC v/s those not exposed to AC from amongst Medical and Paramedical Staff.

The parameters of Lung Function assessed showed significant difference in these two groups. The Respiratory Rate Significantly increased & the PEFR significantly decreased in the AC group. Males & Females both are affected. Thus AC users are more prone to respiratory disorders. The lung functions of the Subject were affected which affects the overall output of the individual

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