A Comparative Study Of Computerized Spirometric Parameters Between Air Conditioner Users And Non Air Conditioner Users

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Abstract: Background: Nowadays Air conditioners are one of the luxurious needs of human being and their use has been increasing day by day. According to few 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. Method: 50 male subjects having age group of 25-50 years and using air conditioners since at least last 6 months and for a minimum duration of 6 hours per day were selected for the study. 50 males of same age group who did not use air conditioners at all 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. Result: There was statistically significant reduction in PEFR (Peak Expiratory Flow Rate), FEF_{25} (Forced Expiratory Flow at 25% of Forced Vital Capacity), FEF_{50} (Forced Expiratory Flow at 50% of Forced Vital Capacity), FEF_{25-75}(Mid Expiratory Flow Rate), and MVV (Maximum Voluntary Ventilation) in air conditioner users as compared to that in non air conditioner users. Conclusion: Intensive use of air conditioner may predispose to respiratory dysfunction in form of early small airway obstruction. However further studies including a large sample size is indicated for in depth evaluation.

Key Words: Computerized Spirometric parameters, Air conditioner users, Non air conditioner users

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Introduction: Nowadays Air conditioners are one of the luxurious needs of human beings. It is used in various fields such as hospitals, banks, colleges, offices, cinema theatres, vehicles, railways, food plazas, shopping malls etc.

Review of literature shows that inhalation of cold dry air for long period makes the airway smooth muscles more sensitive leading to alteration of pulmonary functions. It has been observed that hyperventilation of cold dry air causes bronchoconstriction in asthmatic patients.[1] Intensive use of air conditioner also increases the risk of atopic sensitization.[2,3] Increased prevalence of IgG induced sensitization and hypersensitivity pneumonitis was reported in persons exposed to aerosol contaminated air conditioners.[4] Hypersensitivity pneumonitis caused by bacteria, fungi and molds contaminating air conditioning systems had been also reported.[5] A Japanese study showed that specific mite populations including Der p were higher in homes with ACs.[6]The present study was aimed at considering whether intensive use of air conditioners affected pulmonary functions. Computerized Spirometry was used as it is a simple and useful test to identify and monitor respiratory impairment.

Material and Method: The present study was carried out at department of physiology Govt. Medical College, Bhavnagar after institutional review board approval.

50 male subjects having age group of 25-50 years and using air conditioners since at least last 6 months and for a minimum duration of 6 hours per day were selected for the study. 50 males of same age group who did not use air conditioners at all were taken as control.

Exclusion criteria: (1) Presence of any acute or chronic respiratory disease.(2) Smokers.(3) Use of AC on irregular basis.(4) Systemic illness which may directly or indirectly affect the respiratory system.

In all the subjects, after taking written informed consent, brief history and anthopometric parameters like age, height, weight were taken. Computerized spirometric parameters were measured by SPIRO EXCEL.

SPIRO EXCEL: Spiro excel is an instrument designed for lung function screening. The core of the system is the “intelligent” flow meter that, connected through the USB Cable, turns any personal

computer (laptop or desktop) into a complete pulmonary function testing lab. Spiro excel is designed in such a way that it is easy and simple to operate and gives highly accurate results. The system is composed of turbine flow meter, the measurement and elaboration device (light weight and ergonomic) and the communication cable by the software pack.

Spiro excel is a device that uses electronic and mechanical precision components and must be used in the following ambient condition,
-Temperature maintained between 5˚C and 40 ˚C.
-Relative humidity less than 90 %.
-Absence of noxious smoke and excessive dust.
-Absence of any kind of heat and water source nearby.

COMPUTERIZED SPIROMETRIC PARAMETERS USING "SPIROEXCEL":All the tests were recorded in sitting and relaxed position in chair with no any tight clothing which substantially restricts full chest and abdominal expansion.

Subjects were explained and demonstrated about the procedure to be performed. They were allowed to do enough practice, as lung volume depends on subject's voluntary effort. Full series of tests takes time of about four to five minutes. The testing procedures were quite simple, non-invasive and harmless. Only three manoeuvres required to collect all data which are FVC (Forced Vital Capacity), SVC (Slow Vital Capacity) and MVV (Maximum Voluntary Ventilation).

For FVC manoeuvre, after nose clipping, subject was instructed to take maximum deep inspiration as much as possible and hold it ,then mouth piece was kept firmly in the mouth between lips so as to avoid escape of any air, then asked to blow out forcefully and as fast and long as much possible in the mouth piece and by doing this, value of FVC and its components were obtained.

For MVV manoeuvre, the subject was asked to perform inspiration and expiration as fast and as deep as possible in the mouth piece for minimum of 15 seconds with nose clipped. For SVC manoeuvre, the subject was asked to perform first three tidal respiration and one deep expiration and deep inspiration followed by other three tidal respirations in the mouth piece with nose clipped. Following acceptability criteria were used for good quality results.

Statistical Analysis: The outcome of computerized spirometry was measured as mean ± SD for each of the parameters. The parameters between AC users and non AC users were compared by applying unpaired t test. P value less than 0.05 was taken as statistically significant.

Result: The anthropometric parameters of AC users and non AC users are shown in table 1. No statistical difference was observed between them on these parameters. Computerized spirometric parameters of AC users and non AC users are shown in table 2. The values of PEFR, FEF25, FEF50, FEF25-75 and MVV were statistically significantly decreased in AC users as compared to those in non AC users

Table 1: Anthropological parameters

	AC Users (Mean ± SD)	Non AC Users (Mean ± SD)	P value
Age (years)	33.42±5.82	35.7±6.31	0.0636
Height (cms)	169.6±5.97	166.78±8.58	0.0599
Weight (kg)	66.72±12.3	64.58±11.82	0.3781

Table 2: Computerized spirometric parameters

Parameters	AC Users (Mean ±SD)	Non AC Users (Mean±SD)	P value
FVC	3.17±0.42	3.39±0.72	0.0622
FEV1	2.71±0.52	2.83±0.72	0.3449
PEFR(L/S)	6.04±1.97	9.45±2.66	<0.0001*
FEF_{25-75}(L/S)	4.33±1.24	5.32±1.51	0.0005*
FEF_{25}(L/S)	5.84±2.06	8.76±3.01	<0.0001*
FEF_{50}(L/S)	4.89±1.42	6.16±2.14	0.0007*
FEF_{75}(L/S)	2.68±0.93	3.03±1.00	0.0726
FEV1/FVC(%)	85.83±12.39	84.89±17.14	0.7550
SVC(L)	3.46±0.71	3.49±0.93	0.8374
MVV (L/M)	45.95±25.40	66.87±21.56	<0.0001*

* = Statistically significant

Discussion: In the present study, there is definite impairment in PEFR, FEF_{25}, FEF_{50}, FEF_{25-75} & 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.
Farah Khaliq et al.[7] found statistically significant decrease in PEFR , FEF_{25}, FEF_{50}, FEF_{75} and FEF_{25-75} among AC users as compared to non AC users. Yelam SB et al.[8] found statistically significant decrease in PEFR , FEF_{25}, FEF_{50}, FEF_{75}, FEF_{25-75} and MVV among AC users as compared to non AC users.R Babitha et al.[9] found statistically significant decrease in PEFR, FEF_{25-75} and FEV_1 among AC users as compared to non AC users.Laxmikant J Borse et al.[10] found statistically significant decrease in PEFR, FEF_{25}, FEF_{50}, FEF_{75} & FEF_{25-75} among AC users as compared to non AC users.

PEFR is the maximum velocity with which air is forced out of the lung. PEFR depends on expiratory efforts exerted during forceful expiration as well as status of upper airways which are subjected to reflex bronchoconstriction. In present study PEFR was significantly decreased in AC users. This finding suggests involvement of the upper airways due to exposure to AC environment.

In the present study the values of FEF_{25-75}, FEF_{25} & FEF_{50} were significantly decreased in AC users. Decrease in these expiratory flow rates especially FEF_{25-75} which is the flow rate over the middle half of forced vital capacity, in the presence of normal FEV_1 suggests early small airway obstruction.
In present study, MVV was also significantly decreased in AC users. This finding suggests decrease in breathing reserve.

According to Fontanneri et al.[11] 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. According to Beasely R et al.[12] airway epithelial damage due to cold dry air is a critical feature of airway hyper responsiveness. According to Barnes P J[13] 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[14].

Therefore probable reasons for the findings of the present study may be airway hyper responsiveness, epithelial damage, activation of parasympathetic nerves, release of histamine, SRS-A(Slowly reactive substance of anaphylaxis), atopic sensitization or increase in Der P mite allergen density.

Conclusion: Intensive use of air conditioner may predispose to respiratory dysfunction in form of early small and upper airway obstruction. So we suggest frequent computerized spirometry of the workers who work regularly in AC environment. This will ensure early detection of any underlying respiratory dysfunction and its cure.

Limitation of study: As the sample size was too small (n=50) in the present study, it cannot be directly applied to general population. Further studies on a large sample size are indicated. Inclusion of various other parameters like duration of exposure to AC, velocity of cold air of AC, humidity of the environment and space to which the subjects are exposed during air conditioning may further help for in depth evaluation.

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