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Original Article

Air Conditioner Users are More Prone to Respiratory Problems

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Abstract

Background: *Modern lifestyles in urban areas have been considered to be potentially responsible for the development of airway problems. One of the components of modern lifestyle is the intensive use of air conditioners (AC). Increased inhalation of cold dry air of air conditioner ultimately may cause alteration of pulmonary functions. The objective of this study was to assess the impact of air.* ***Materials & Methods:*** *This quasi-experimental study was conducted in the Department of Physiology, Chittagong Medical College, Chattogram, during January 2019 to December 2019 in collaboration with Continental Group Private Limited, Chattogram and EPV (Energypac Power Venture) Chittagong Limited, Patiya, Chattogram. 35 apparently healthy adult males between the ages 20-45 years, working in air-conditioned environment was taken as case. 35 healthy age and sex matched subjects, working in non-air-conditioned environment were taken as control. This study was done to measure pulmonary function test parameters among healthy AC users, and they were compared with non-users of AC to see the effects of AC on lung functions. Lung function test parameters like FVC, FEV_1, FEV_1/FVC ratio, respiratory rate and SPO_2 were measured by digital spirometer and pulse oximeter. Unpaired Student's 't' test and Chi-square test were done by using SPSS-25 for statistical analysis.* ***Results:*** *The mean value of FVC, FEV_1 and SPO_2 were significantly lowered in AC users; mean value of respiratory rate were significantly increased in AC users comparing with control. FEV_1/FVC ratio was increased in AC users compared with control.* ***Conclusion:*** *The result of this study suggests that pulmonary function is significantly decreased after usage of air conditioner. Therefore, public awareness for proper maintenance of AC, periodic analysis of pulmonary functions, limited use of AC and regular respiratory exercise can be recommended for preserving respiratory efficiency.*

Keywords: Spirometer, Pulse oximeter, FVC, FEV_1, FEV_1/FVC ratio, SPO_2.
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Introduction

Climate change is the most significant global challenge facing the world today[1,2]. Our environment has changed due to global warming, rapid industrialization, excessive environmental pollution and changing life style[3,4]. It negatively affects health and environment[5]. High urbanization and population growth leads to thermal stress[6-8]. Thermal comfort can be achieved by using Air Conditioner (AC). It cools and dehumidifies indoor air[3,9-12]. AC is becoming part and parcel in homes, hospitals, colleges, offices[13]. Central AC is preferred in companies and offices for the comfort of staffs[14,15]. Their work performance and productivity thus become better[14].

Air conditioners have bad effects also[16]. Long term use of air conditioning systems is destructive to the environment and harmful to the health. It may cause suffering from headache, fatigue and respiratory symptoms[13]. It also causes drying effects on skin and mucous membrane. Previous studies observed that prolonged inhalation of cold, dry air may lead to alterations in pulmonary function[3,11]. Inhalation of cold dry air causes repetitive dehydration injury with desquamation of the epithelial cells of the airway[3].

Thus, decreased tidal volume and restriction of chest expansion was observed in previous study[5]. Frequent inhalation of cold, dry air can cause both structural and functional changes in the respiratory system[17,18]. Cold air inhalation was supposed to become an exacerbating factor for obstructive pulmonary diseases which was observed by some studies on COPD patients[19]. Chronic respiratory

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diseases may occur by poor indoor air quality. Poorly maintained AC can facilitate the spread of a variety of fungi and bacteria. Legionella species have a higher tendency to colonize air-conditioning systems[20,21].

Air conditioners in cars and vehicles may exacerbate allergic rhinitis, bronchial asthma and hypersensitivity pneumonitis[1]. That may occur due to prolong inhalation of cold dry air and contamination of air conditioner with species of thermophilic actinomycetes and Aspergillus fumigatus. Respiratory symptoms also prevail due to cold dry air inhalation[22]. Pulmonary function tests are important for assessment of pulmonary diseases[1].

A very common effective diagnostic test to determine the lung functions is spirometry. It is a useful diagnostic tool for assessing lung conditions in both diseased and healthy people. Different spirometric lung function tests: forced vital capacity (FVC), forced expiratory volume in 1st second (FEV1) and FEV1/FVC ratio were done in different studies on air conditioner users. A significant reduction of lung functions in exposed groups was seen in many studies[3,5,11].

Prolong exposure along with poor maintenance of AC can result in deleterious effects on the respiratory system with reduced lung functions and hypoxia[3]. So whole body function may be affected[22]. There is a scarcity of studies examining the effects of air conditioning on various pulmonary functions among the Bangladeshi population. Therefore, this study was designed to assess the impact of air conditioning on lung function.

Materials and Methods

This study was a quasi-experimental research design. It was conducted in the Department of Physiology, Chittagong Medical College, Chattogram, Bangladesh with collaboration of ABC (Associated Builders Corporation Limited) private limited, Chattogram and EPV (Energypac Power Venture Ltd.) Chittagong, Patiya, Chattogram after ethical approval of Chittagong Medical College (CMC) [Ref: CMC/PG/2019/2767]. The study was carried out over a year period, from January to December 2019.

Study procedure: A total of 35 AC users were taken as experimental groups, and 35 non-AC users were taken as control. Adult male employees working in different selective air conditioned and non-air-conditioned organization of Chattogram were selected based on inclusion and exclusion criteria of the study. All employees of the selected organization were provided with a pre-design case record form. Information about age of employees, duration of job, site and position of workplace, information of general health, history of present or past disease, food habits and habits of smoking and alcohol consumption or tobacco chewing were collected and recorded in predesigned case record form. To ensure proper exclusion, participants were asked about any history of respiratory distress, skin rashes, chronic cough, recent fever, or recent surgeries.

Recent history of taking paracetamol, antibiotics or any drugs such as bronchodilator, anti-tubercular, sedative, antidepressant, beta blocker, ACE inhibitor, anticonvulsant, steroid, chemotherapeutic drug, aspirin and other NSAID were taken. Height and body weight were measured & recorded.

General and systemic examinations were done to see general physical condition of the subjects for inclusion and exclusion. For exclusion, participants were examined for signs of anemia, jaundice, cyanosis, and edema. In addition, blood pressure and temperature were measured, and pulse and respiratory rates were recorded. Auscultation of heart and lung was done to exclude any other cardio-respiratory abnormality.

Assessment of pulmonary function: FVC, FEV_1 and FEV_1/FVC were measured by using digital spirometer (Chestgraph HI-101, Japan) in relaxed and upright sitting posture and SPO_2 were measured by using pulse oximeter of experimental and control group.

Statistical Analysis: Data was compiled in a Microsoft Office Excel worksheet to generate a master sheet. Later, data were fed into SPSS V25 for processing and analysis. Between-group comparisons of these variables were conducted using the unpaired Student's t-test and the Chi-square test.

Results

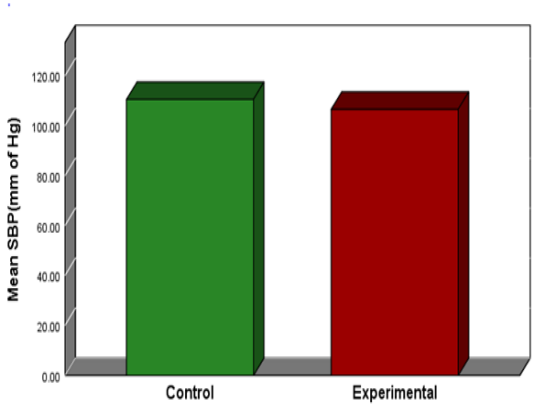

Figure-1: Mean SBP in control and experimental group (n=70, 35 in each group)

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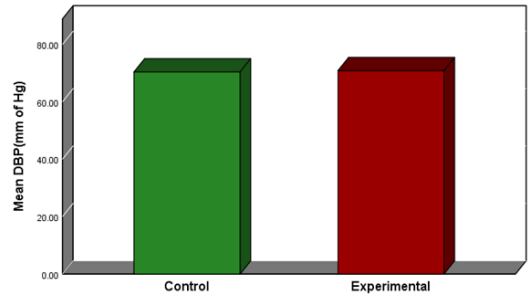

Figure-2: Mean DBP in control and experimental group (n=70, 35 in each group)

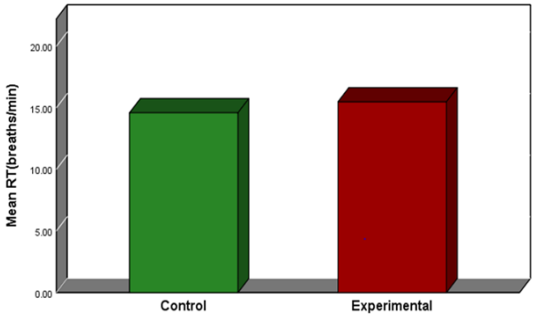

Figure-4: Mean Respiratory rate (breaths/min) in control and experimental group (n=70)

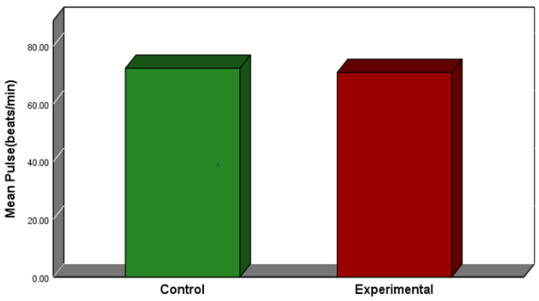

Figure-3: Mean pulse rate (beats/min) in control and experimental group (n=70, 35 in each group)

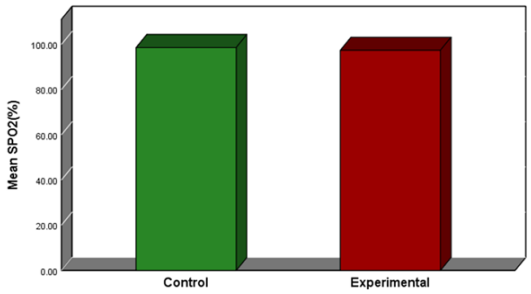

Figure-5: Mean SPO_2 (%) in control and experimental group (n=70, 35 in each group)

Table-I: Age, height, weight, body mass index (BMI), Hb concentration, random blood sugar (RBS), pulse and blood pressure in control and experimental group (n=70)

Attributes	Control Group [n=35] Mean ± SD (Range)	Experimental Group [n=35] Mean ± SD (Range)	p-value
Age (years)	33.80 ± 3.604 (20 - 40)	32.77 ± 3.82 (20 - 40)	0.251^{ns}
Height (cm)	165.74 ± 4.841 (157 - 177)	167.31 ± 6.21 (152 - 178)	0.242^{ns}
Weight (Kg)	61.43 ± 3.680 (55 - 68)	62.49 ± 4.804 (52 - 72)	0.305^{ns}
BMI (Kg/m^2)	22.32 ± 0.636 (18.50 - 22.90)	22.21 ± 0.613 (18.50 - 22.90)	0.415^{ns}
Hb level (gm/dl)	14.01 ± 0.445 (13.2 - 15.4)	14.18 ± 0.647 (13.2 - 15.6)	0.201^{ns}
RBS (mmol/L)	5.63 ± 0.452 (4.9 - 6.8)	5.83 ± 0.662 (4.6 - 7.2)	0.139^{ns}
Pulse (beats/min)	72.342 ± 5.480 (60 - 85)	70.886 ± 7.335 (60 - 80)	0.662^{ns}
SBP (mm of Hg)	110.57 ± 11.868 (100 - 130)	106.57 ± 9.684 (100 - 130)	0.242^{ns}
DBP (mm of Hg)	70.428 ± 6.810 (60 - 80)	70.00 ± 6.860 (60 - 80)	0.795^{ns}

p-value obtained from Unpaired Student's t-test, ns = statistically not significant

Table-II: Comparison of socio-demographic characteristics between control & experimental group (n=70)

Socio-demographic characteristics		Control group (n=35)	Experimental group (n=35)	p-value
Education level (%)	Graduate	65.7%	71.4%	0.607^{ns}
	Undergraduate	34.3%	28.6%	
Marital status (%)	Married	54.3%	60%	0.629^{ns}
	Unmarried	45.7%	40%	
Salary structure (%)	Grade I	46.9%	52.6%	0.631^{ns}
	Grade II	53.1%	47.4%	

p-value obtained from $\chi 2$ test, ns = statistically not significant

Table-III: Respiratory parameters in control and experimental group (n=70)

Respiratory Attributes	Control group Mean ± SD (Range)	Experimental group Mean ± SD (Range)	p-value
FVC (Liter)	3.17 ± 0.623 (2.66 - 4.36)	2.25 ± 0.387 (1.64 - 3.01)	$<0.05^{s}$
FEV_1 (Liter)	3.00 ± 0.314 (2.44 - 4.25)	2.17 ± 0.367 (1.51 - 2.96)	$<0.05^{s}$
FEV_1 (%)	94.94 ± 3.730 (85 - 100)	96.33 ± 4.163 (88 - 100)	0.147^{ns}
Respiratory rate (breaths/min)	14.60 ± 1.117 (13 - 18)	15.48 ± 1.442 (14 - 18)	$<0.05^{s}$
SPO_2 (%)	98.62 ± 0.547 (97 - 99)	97.40 ± 2.032 (93 - 99)	$<0.05^{s}$

p-value obtained from Unpaired Student's t-test, s = statistically significant, ns = statistically not significant

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Discussion

Based on general examination and inclusion and exclusion criteria, 35 subjects were selected as experimental groups from AC offices and 35 apparently healthy control were selected from non-AC offices. Age, height, weight, BMI, Hb level, RBS, blood pressure, pulse rate and socio-demographic characteristics of study subjects of both groups were measured and compared (Table-I and Table-II).

During the study, respiratory parameters: FVC, FEV_1, FEV_1/FVC ratio, respiratory rate and SPO_2 were taken both from control and experimental group. FVC and FEV_1 significantly decreased in experimental group ($p<0.05$). This finding was consistent with previous study[13]. It was hypothesized that prolonged use of AC might lead to decreased FVC and FEV_1 due to hyperresponsive airway epithelium, thickened lamina propria, and airway remodeling. However, no significant difference in FEV_1 was observed between the control and experimental groups (Table-III and Figure-1 to Figure-5).

In this study, significantly increased respiratory rate and significantly decreased SPO_2 were seen between control & experimental groups ($p<0.05$). Reduced dynamic compliance in airway obstruction leads to increased respiratory rate[5], which is similar to present study (Table-III, Figure-1 to Figure-5). They also supposed that bronchoconstriction might be the causal factors for decreased air entry and chest expansion. In present study reduced mean value of SPO_2 and increased mean respiratory rate might be due to reduced chest expansion, decreased air entry, increased airway obstruction and airway remodeling. It might lead to an increase in oxygen demand from AC users.

The result of the present study showed that AC and central AC systems had a profound negative impact on pulmonary functions. So, periodic analysis of pulmonary functions of employees working in air-conditioned environments is very helpful for early diagnosis of respiratory dysfunction as well as prevention of further different respiratory complications.

Conclusion

The present study shows working in an air-conditioned environment brought significant reduction in respiratory functions in the AC exposed group in comparison to non-AC exposed group. It is difficult to explain about the exact mechanism involved here but probably hyperresponsive respiratory tract, reduced airway patency of AC exposed subjects and lack of proper regular maintenance of AC may be responsible for these changes. Therefore, this study concludes that AC has a profound negative impact on respiratory health.

Limitations

- A small sample size, limited age range, inadequate facilities, and short study duration
- Blood pressure was measured only in left hand.
- Chest X-ray was not done due to not being given permission by office authority.
- Lack of pre-employment lung function data and absence of participant follow-up.

Recommendations

- Similar study with different age groups and longer duration can be conducted.
- Further studies may include parameters such as humidity levels, airflow velocity, microbial cultures from AC units, and the characteristics of the air-conditioned spaces
- Chest X-ray should be carried out to ensure any pathological changes in lungs.
- Public awareness campaigns can promote proper AC maintenance and limited use to support lung health.
- Authorities can be advised to conduct periodic medical check-ups for employees and implement mandatory pre-employment health screenings.
- Employees in AC environments can be advised to consume fresh fruits, vegetables, fish, and foods rich in vitamins A, C, E, and dietary fiber to improve pulmonary function.

Conflict of Interest

The authors declared that they have no conflicts of interest.

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References

1. Watts G, Battarbee RW, Bloomfield JP, Crossman J, Daccache A, Durance I, et al. Climate change and water in the UK - past changes and future prospects. Prog Phys Geogr. 2015; 39 (1): 6-28. doi: 10.1177/0309133314542957.
2. Rasi H, Kuivila H, Polkki T, Bloigu R, Rintamaki H, Tourula M. A descriptive quantative of 7 and 8 year old children's outdoor recreation, cold exposure and symptoms in winter in Northern Finland. Int J Circumpolar Health. 2017; 76 (1): 1-7. doi: 10.1080/22423982.

3. Thakur D, Oommen ER. Air conditioner users are more prone to respiratory problems. Int J Basic App Physiol. 2016; 5 (1): 151-4.
4. Forzieri G, Cescatti A, E Silva FB, Feyen L. Increasing risk overtime of weather-related hazards to the European population: a data-driven prognostic study. Lancet Planet Health. 2017; 1 (5): e200-e208. doi: 10.1016/S2542-5196(17)30082-7.
5. Babitha R, Rangarajan R, Muhil M, Basavarajaiah MG. Pulmonary function tests in air conditioner users. J Clin Diagn Res. 2011; 5 (3): 532-5. doi: 10.18203/23206012.ijrms2019 3938.
6. Patz JA, Campbell-Lendrum D, Holloway T, Foley JA. Impact of regional climate change on human health. Nature. 2005; 438 (7006): 310-7. doi: 10.1038/nature04188.
7. Kinney PL, O'Neill MS, Bell ML, Schwartz J. Approaches for estimating effects of climate change on heat-related deaths: challenges and opportunities. Environ Sci Policy. 2008; 11 (1): 87-96. doi: 10.1016/j.envsci.2007.08.001.
8. Mboera LEG, Mayala BK, Kweka EJ, Mazigo HD. Impact of climate on human health and health systems in Tanzania. Tanzan J Health Res. 2011; 13 (5 Supp l1): 407-26. doi: 10. 4314/thrb.v13i1.10.
9. Lundgren K, Kjellstrom T. Sustainability Challenges from Climate Change and Air Conditioning Use in Urban Areas. Sustainability. 2013; 5 (7): 3116-28. doi: 10. 3390/su5073116.
10. George SO, Chandan LM. A study of peak expiratory flow rate in air condition users. IJBAP. 2012; 1 (1): 151-4.
11. Boorse LJ, Yadav RD, Modak HK, Chandan LM. Pulmonary function tests in young healthy male exposed to air-conditioned work environment. Int J Health Sci Res. 2012; 2 (6): 35-41.
12. Choudhari SP, Doiphobe RS, Zingade US, Badam KM, Munibuddin A. Study of pulmonary functions in air-conditioned car drivers: a cross-sectional study. IOSR-JDMS. 2014; 13 (12): 48-50. doi: 10.9790/0853-131264850.
13. Mustaq F, Sharma S, Mustaq M, Kaur S. A study of pulmonary functions in female students living in air conditioned and non-air-conditioned environment. Indian J Basic Appl Med Res. 2018; 8 (1): 49-56.
14. Ruth HJ, Vincet L. Pulmonary functions in car air conditioner users and non-air conditioner users in tertiary care center, South Tamil Nadu, India. Int J Res Med Sci. 2019; 7 (9): 3510-6. doi: 10.18203/2320-6012.
15. Zhou X, Yan D, Shi X. Comparative research on different air conditioning systems for residential buildings. Front Archit Res. 2017; 6 (1): 42-52. doi: 10.1016/j.foar.2016.11.004.
16. Preziosi P, Czernichow S, Gehanno P, Hereberg S. Workplace air conditioning and health services attendance among French middle-aged women: a prospective cohort study. Int J Epidemiol. 2004; 33 (5): 1120-3. doi: 10.1093/ije/dyh136.
17. Plevkova J, Biringerova Z, Gavliakova S. Thermo sensitive TRPM8 channel and its role in cold induced airway symptoms. Open J Mol Integr Physiol. 2012; 2: 21-6. doi: 10.4236/ojmip.2012.21004.
18. Davis MS, Freed AN. Repetitive hyperpnoea causes peripheral airway obstruction and eosinophilia. Eur Respir J. 1999; 14 (1): 57-62. doi: 10.1034/j.1399-3003.1999.14a11.x.
19. Cruz AA, Naclerio RM, Proud P, Togais A. Epithelial shedding is associated with nasalnreactions to cold, dry air. J Allergy Clin Immunol. 2006; 117 (6): 1351-8. doi: 10.1016/j.jaci.2006.01.054.
20. Sakamoto R, Ohno A, Nakahara T, Satomura K, Iwanaga S, Kouyama Y, et al. Is driving a car a risk for Legionnaires' disease? Epidemiol Infect. 2009; 137 (11): 1615-22. doi: 10.1017/S0950268809002568.
21. Mouchtouri VA, Goutziana G, Kremastinou J, Hadjichristodoulou C. Legionella species colonization in cooling towers: risk factors and assessment of control measures. Am J Infect Control. 2010; 38 (1): 50-5. doi: 10.1016/j.ajic.2009.04.285.
22. Jain C, Yesikar V, Dixit S, Rokade R. Prevalence of respiratory illness among A.C users at Indore city: A case control analytical study. Int J Public Health Res. 2016; 3 (3): 119-24. doi: 10.17511/ijphr.2016.i3.05.

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