COMPARATIVE EVALUATION OF LUNG FUNCTIONS BETWEEN AC AND NON AC USERS AMONG STUDENT POPULATION

ABSTRACT

BACKGROUND: Usage of air conditioners (AC) has been highly increased in this modern era. In addition to the cooling of the environment, it has a major impact on human health. Rapid influx of cold dry air increases the risk of bronchoconstriction in asthma patients due to the dehydration of the air pathway. So, the present study planned to comparatively evaluate the lung functional status in air conditioner and non air conditioner users.

MATERIALS AND METHOD: The pulmonary functional capacity was assessed using FVC, FEV1 and FEV1/FVC ratio, Peak expiratory flow rate (PEFR) and FEF 25-75% in a Helios 702 spirometer.

RESULTS: The lung functional capacities among the AC users showed a statistically significant decline in PEFR and FEF25-75% indicating the risk of airway obstruction.

CONCLUSION: The study concluded an innovative finding that AC users are developing ventilatory dysfunction and are at more risk of respiratory dysfunction. The coldness of the aerosol of the AC unit or other factors responsible may be allergens, infections and humidity level. Thus technical and hygienic features of air intake must be ensured to maintain a good indoor air quality.

Keywords: Air conditioners, innovative, Lung functions, Peak expiratory flow rate, Forced vital capacity.

Running title: Changes in lung functions in AC users.

INTRODUCTION

In this modern and fast evolving world the demand and usage of air-conditioners is highly increased .Almost every workplace ,school and home uses air-conditioners[1] **.Air-conditioners are used for lowering the temperature it is achieved so by the condition condensation of water vapour thereby reducing the humidity .The hyperventilation of cold air is one of the main reasons for bronco constriction in asthma patients.**[2]**Air conditioners are destructive to the environment and are responsible for global warming by directly affecting the ozone formation leading to the depletion of ozone layer .It is the major factor for aggravating the chronic obstructive pulmonary disease (COPD)and it also paves the way for many severe acute respiratory syndrome and many other airborne infectious agents**[3] **.Contamination of air conditioner is the major cause for hyperventilation pneumonitis.**[4]**Which causes many on the allergic reaction as it also increases the indoor air pollutants which leads to elevation of serum IgE which cause mucous membrane irritation and neurological symptoms such as headaches.**[5][6] Our team has extensive knowledge and research experience that has translate into high quality publications[7–11]

Usage of air conditioners decrease the efficiency of the lungs which leads to the decreased pulmonary function capacity .Increase inhalation of cold dry hair alters the functional capacity of the lungs which may induce rhinitis.[12]**Freon which are used in the cooling systems of the AC are highly toxic .Inhalation of freons in large amount increases the risk of atopic sensation which may lead to repetitive dehydration of small**

airway when large volumes of cold air is inhaled[13]**.It is also responsible for the increase indoor air pollutants ,house dust ,mites leading to high eosinophil activity**[14]**.**

Now this study is being conducted to compare the lung function of the people who are constantly exposed to an air conditioning work environment and people who are in a non-air-conditioned workplace using a pulmonary function test.

MATERIALS AND METHOD

The study was conducted among 20 students of a Saveetha dental college between the age group of 17 to 20 years of both genders with similar anthropometric measurements. Informed consent was obtained from the subjects. The Study was performed after clearance from the Institutional Human Ethical committee and no invasive procedures were used. Inclusion criteria involves healthy subjects with no history of pulmonary infections. The exclusion criteria involve smokers and those who were under medications and with any cardiological or respiratory disorders were excluded from this study.

The subjects were divided into 2 groups (10 subjects each)

Group 1:AC users

Group 2: Non-AC users

Their medical history and demographic details were collected along with physical examination. The lung functional capacities (i.e) Forced vital capacity (FVC), Forced expiratory volume in one second (FEV1), Peak expiratory flow rate (PEFR), FEV1/FVC ratio and the maximal mid expiratory flow rate [FEF(25-75%)] were compared between the two groups using pulmonary function tests. RMS Helios 702 spirometer was used to assess the pulmonary functional capacity of each individual.

Before the subjects were asked to perform the actual procedure, the procedure was demonstrated before the study participants. The procedure was based on the single breath technique where the participants were asked to forcefully inhale, followed by forceful exhalation into the tube and forceful inhalation from the tube. The subject was asked to repeat the technique three times and three readings were taken and the best reading was taken for calculation. The results were analysed statistically using the SPSS software version 23. The standard deviation and the mean values of all the subjects were calculated. The results were statistically analysed using independent t-test in SPSS version 23.

RESULTS

When values of the lung functional capacities were compared , there was a slight decrease in the Forced vital capacity(FVC), Forced expiratory volume in one second (FEV1), FEV1/FVC ratio in AC users compared to non AC users and was not statistically significant ($p<0.05$). The study reported a statistically significant decreased in maximal mid expiratory flow rate [FEF(25-75%)] and PEFR in AC users compared to non AC users ($p<0.05$)

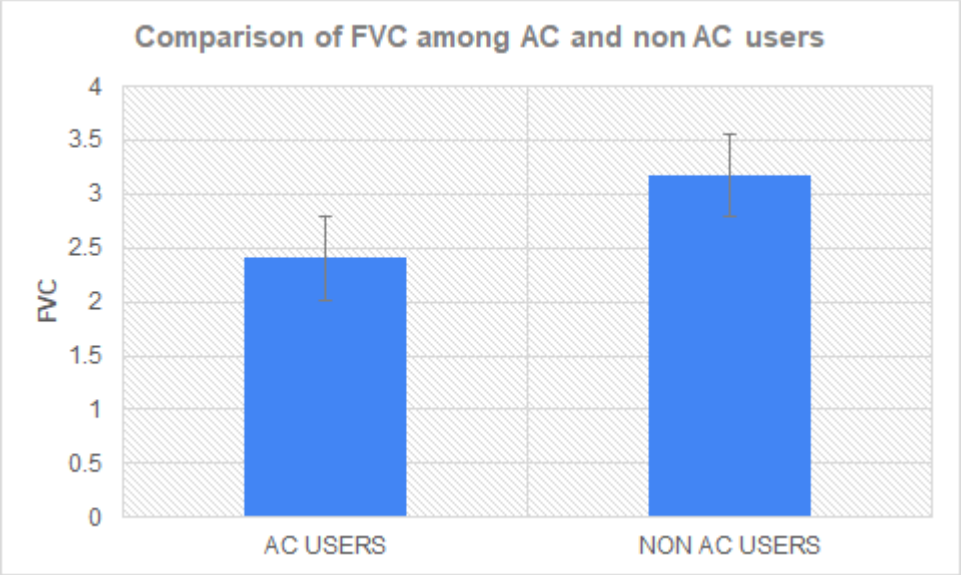

Figure 1: Represents the bar graph of comparison of FVC among AC and Non AC users. x-axis represents the subjects and y- axis represents FVC in L/sec There was statistical insignificant decrease in the value of FVC in the AC users compared to the Non AC users ($p<0.05$)

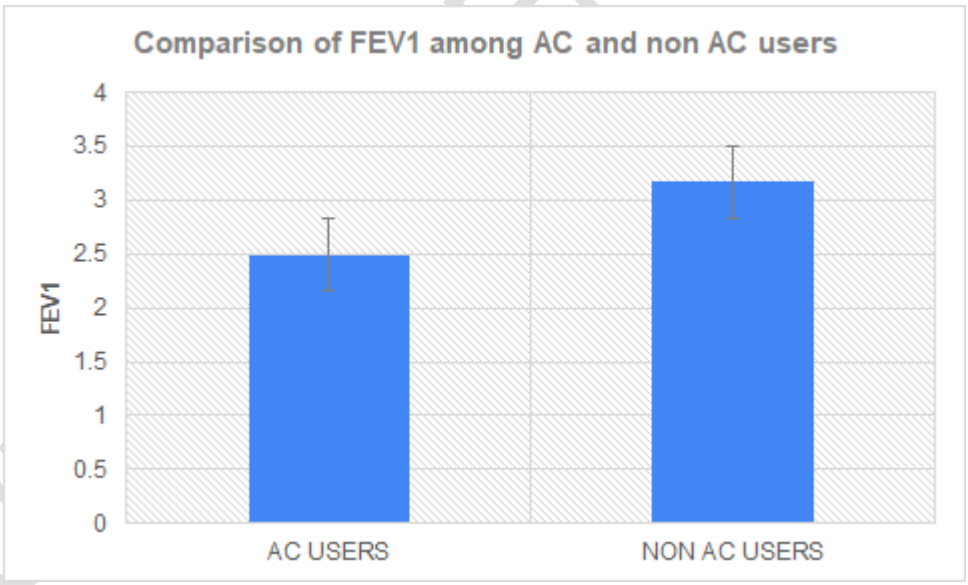

Figure 2 : Represents the bar graph of comparison of FEV1 among AC and Non AC users. . x-axis represents the subjects and y- axis represents FEV1 in L/sec There was statistical insignificant decrease in the value of FEV1 in the AC users compared to the Non AC users ($p<0.05$)

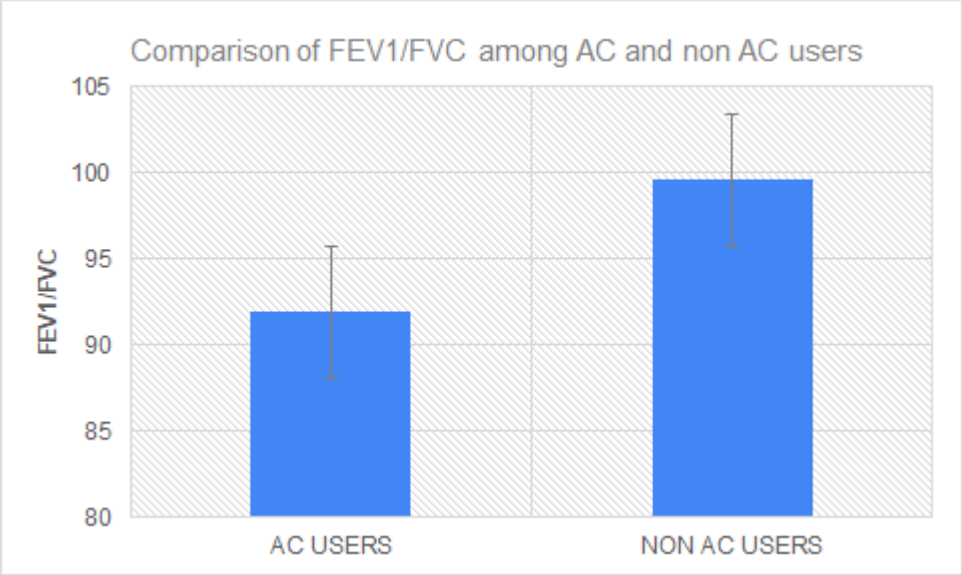

Figure 3: Represents the bar graph of comparison of FEV1/FVC among AC and Non AC users. . x-axis represents the subjects and y- axis represents FEV1/FVC in ratio There was statistical insignificant decrease in the value of FEV1 /FVC in the AC users compared to the Non AC users ($p<0.05$)

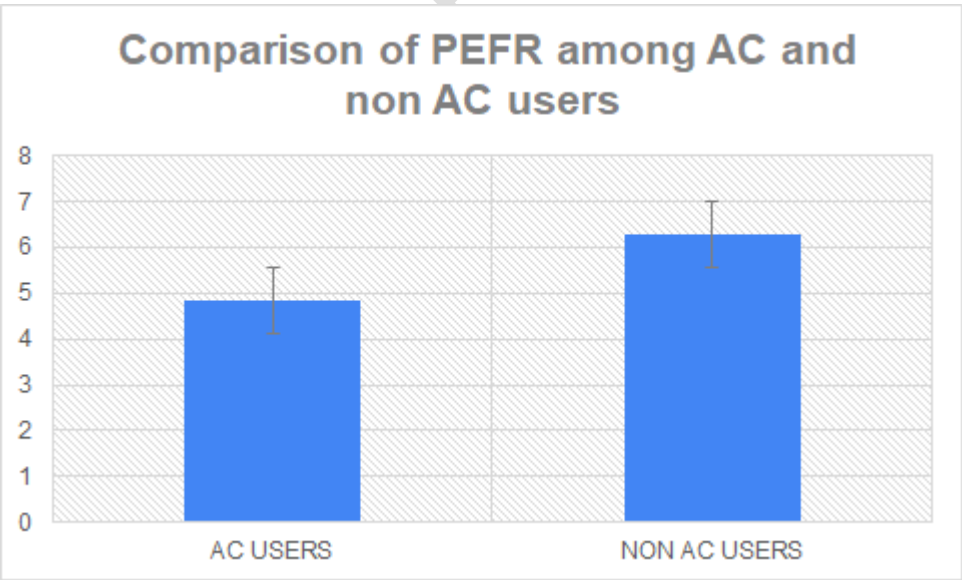

Figure 4: Represents the bar graph of comparison of PEFR among AC and Non AC users. x-axis represents the subjects and y- axis represents PEFR in L/sec There was

statistical significant decrease in the value of PEFR in the AC users compared to the Non AC users (p<0.05)

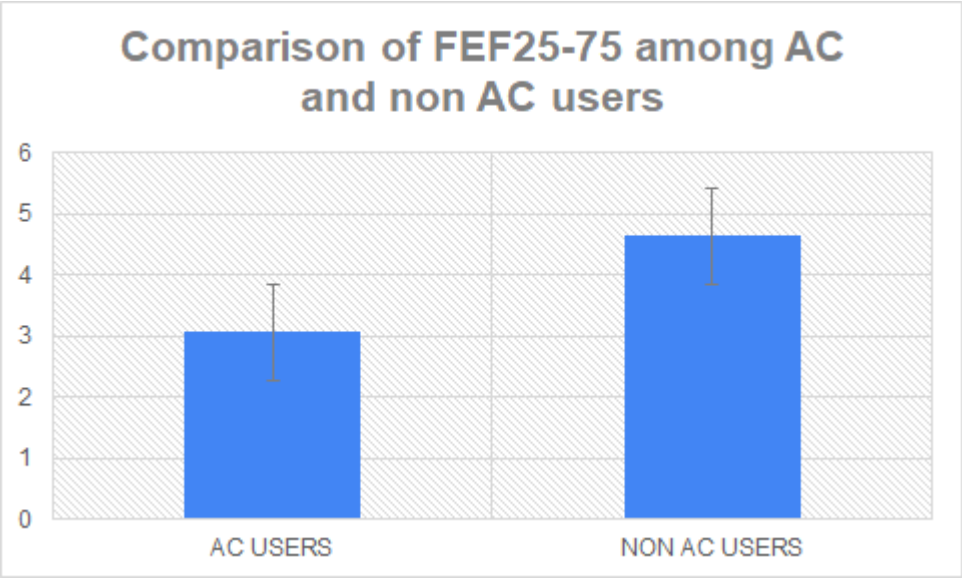

Figure 5: Represents the bar graph of comparison of FEF (25 - 75) among AC and Non-AC users. x-axis represents the subjects and y- axis represents FEF 25-75 in L/sec There was statistical significant decrease in the value of FEF (25 - 75)in the AC users compared to the Non AC users (p<0.05)

DISCUSSION

The respiratory dysfunction observed in AC users is more like an obstructive pattern. In the present study we found statistical decreases in maximum mid expiratory flour are (i.e) FEF 25-75%. It's a sensitive indicator of small airway disease where most chronic obstructive pulmonary disease starts. A similar study stated that medical students exposed to AC for 6 months increased respiratory symptoms and were more prone for bronco constriction[2,15,16]**. Nasal breathing of cold air increases engorgement of venous sinus in the sub mucosa leading to nasal congestion, sneezing and rhinitis.**[17][17,18]**)**

The results of the study showed that peak expiratory flow rate is significantly decreased in the subject exposed to the air condition work environment .PEFR is mainly the

caliber of bronchi and bronchioles which are exposed to reflex bronchoconstriction.[19,20][21][19,20] **The main reason for bronco constriction in asthma patients is due to hyperventilation of cold air.**[22,23][3]

It was also found that when the duration of ventilation is increased there is significant fall in FEV1 .It was found that the level of ventilation plays a major role in bronco constriction than the dryness of cold dry air.[24,25][26,27]

Remodeling of airways like that of asthma patients can be seen in people exposed to repeated cooling of the air leading to desiccation of the airway.[28–30]

It was identified that in children who were exposed to AC had mean lower than the other children who are forced and heating and air-conditioning in the study other domestic factors such as heating devices, gas stoves, etc. were considered. The inhalation of cold dry air leads to removal of protective mucosal barriers[31–33]**. The study sample is small, and the AC users are not exposed to air conditioners throughout the entire day. Study samples can be increased for more accurate results. Other parameters can also be included such as diet and exercise.**

CONCLUSION

The present study suggested that regular AC users keep developing ventilatory dysfunction and are at more risk of respiratory dysfunction. The coldness of the aerosol of the AC unit or other factors responsible may be allergens, infections and humidity levels. The sample size determined in the study was less and so further studies on more sample size can substantiate the clear pathology produced by use of air conditioners. Thus technical and hygienic features of air intake must be ensured to maintain a good indoor air quality.[GV1] [V2]

REFERENCES

[1] Kamath SM, Manjunath Kamath S, Jaison D, Rao SK, Sridhar K, Kasthuri N, et al. In vitro augmentation of chondrogenesis by Epigallocatechin gallate in primary Human chondrocytes - Sustained release model for cartilage regeneration. Journal of Drug Delivery Science and Technology 2020;60:101992. https://doi.org/10.1016/j.jddst.2020.101992.
[2] Khaliq F, Sharma S, Tandon OP. Pulmonary functions in air conditioner users. Indian J Physiol Pharmacol 2006;50:67–72.
[3] Clarizia G, Bernardo P. Diverse Applications of Organic-Inorganic Nanocomposites: Emerging Research and Opportunities: Emerging Research and Opportunities. IGI Global; 2019.
[4] Hulke S, Deora K, Bhargava D. Comparison of Pulmonary Function Test in Petrol Pump Worker and Auto-rickshaw Driver. Advanced Biomedical Research 2019;8:44. https://doi.org/10.4103/abr.abr_204_18.
[5] Vidya G, Kumar BA, Kalpana M, Chand K. Pulmonary function tests in air conditioner users. International Journal of Medicine and Biomedical Research 2014:75–80. https://doi.org/10.14194/ijmbr.3.2.3.
[6] Ezhilarasan D. Critical role of estrogen in the progression of chronic liver diseases. Hepatobiliary Pancreat Dis Int 2020;19:429–34.
[7] Sathish T, Karthick S. Wear behaviour analysis on aluminium alloy 7050 with reinforced SiC through taguchi approach. Journal of Materials Research and Technology 2020;9:3481–7.
[8] Campeau PM, Kasperaviciute D, Lu JT, Burrage LC, Kim C, Hori M, et al. The genetic basis of DOORS syndrome: an exome-sequencing study. Lancet Neurol 2014;13:44–58.
[9] Dhinesh B, Niruban Bharathi R, Isaac JoshuaRamesh Lalvani J, Parthasarathy M, Annamalai K. An experimental analysis on the influence of fuel borne additives on the single cylinder diesel engine powered by Cymbopogon flexuosus biofuel. J Energy Inst 2017;90:634–45.
[10] Parthasarathy M, Isaac JoshuaRamesh Lalvani J, Dhinesh B, Annamalai K. Effect of hydrogen on ethanol-biodiesel blend on performance and emission characteristics of a direct injection diesel engine. Ecotoxicol Environ Saf 2016;134:433–9.
[11] Gopalakannan S, Senthilvelan T, Ranganathan S. Modeling and Optimization of EDM Process Parameters on Machining of Al 7075-B4C MMC Using RSM. Procedia Engineering 2012;38:685–90.
[12] Pistelli R. Reference values for pulmonary function test: suggestions for a correct use and interpretation. Shortness of Breath 2014. https://doi.org/10.11138/sob/2014.3.2.075.
[13] Lavanya MEG, Mahalakshmi V, Srinithi V, Nivetha M. Computational analysis of pulmonary artery stenosis. 2017 International Conference on Innovations in Green Energy and Healthcare Technologies (IGEHT) 2017. https://doi.org/10.1109/igeht.2017.8094105.
[14] Takao M, Miyahara Y, Shinboku H, Nishijima K, Morimitsu T, Hara K. Noninvasive Assessment of Right Heart Function by 81mKr Equilibrium Radionuclide Ventriculography in Chronic Pulmonary Diseases. Chest 1996;109:67–72. https://doi.org/10.1378/chest.109.1.67.
[15] Nambi G, Kamal W, Es S, Joshi S, Trivedi P. Spinal manipulation plus laser therapy versus laser therapy alone in the treatment of chronic non-specific low back pain: a randomized controlled study. Eur J Phys Rehabil Med 2018;54:880–9.
[16] Wadhwa R, Paudel KR, Chin LH, Hon CM, Madheswaran T, Gupta G, et al. Anti-inflammatory and anticancer activities of Naringenin-loaded liquid crystalline nanoparticles in vitro. J Food Biochem 2021;45:e13572.
[17] Website n.d. Saraswathi I, Saikarthik J, Senthil Kumar K, Srinivasan KM, Ardhanaari

M, Gunapriya R. Impact of COVID-19 outbreak on the mental health status of undergraduate medical students in a COVID-19 treating medical college: a prospective longitudinal study [Internet]. Vol. 8, PeerJ. 2020. p. e10164. Available from: http://dx.doi.org/10.7717/peerj.10164.
[18] Rajakumari R, Volova T, Oluwafemi OS, Rajesh Kumar S, Thomas S, Kalarikkal N. Grape seed extract-soluplus dispersion and its antioxidant activity. Drug Development and Industrial Pharmacy 2020;46:1219–29. https://doi.org/10.1080/03639045.2020.1788059.
[19] Gruenwald P. Normal and abnormal expansion of the lungs of newborn infants obtained at autopsy. I. Expansion of lungs by liquid media. The Anatomical Record 1961;139:471–81. https://doi.org/10.1002/ar.1091390404.
[20] Website n.d. Santhakumar P, Roy A, Mohanraj KG, Jayaraman S, Durairaj R. Ethanolic Extract of Capparis decidua Fruit Ameliorates Methotrexate-Induced Hepatotoxicity by Activating Nrf2/HO-1 and PPARγ Mediated Pathways [Internet]. Vol. 55, Indian Journal of Pharmaceutical Education and Research. 2021. p. s265–74. Available from: http://dx.doi.org/10.5530/ijper.55.1s.59.
[21] Egbuna C, Mishra AP, Goyal MR. Preparation of Phytopharmaceuticals for the Management of Disorders: The Development of Nutraceuticals and Traditional Medicine. Academic Press; 2020.
[22] Desjardins A, de Luca S, Cartier A, L'Archevêque J, Ghezzo H, Malo J-L. 321 Non-specific bronchial hyperresponsiveness to inhaled histamine and hyperventilation of cold dry air in individuals with respiratory symptoms on unknown etiology. Journal of Allergy and Clinical Immunology 1988;81:248. https://doi.org/10.1016/0091-6749(88)90555-6.
[23] Prakash AKS, Devaraj E. Cytotoxic potentials of S. cumini methanolic seed kernel extract in human hepatoma HepG2 cells. Environmental Toxicology 2019;34:1313–9. https://doi.org/10.1002/tox.22832.
[24] Resnick AD, Deal EC Jr, Ingram RH Jr, McFadden ER Jr. A critical assessment of the mechanism by which hyperoxia attenuates exercise-induced asthma. J Clin Invest 1979;64:541–9.
[25] Vivekanandhan K, Shanmugam P, Barabadi H, Arumugam V, Daniel Raj Daniel Paul Raj D, Sivasubramanian M, et al. Emerging Therapeutic Approaches to Combat COVID-19: Present Status and Future Perspectives. Front Mol Biosci 2021;8:604447.
[26] Barabadi H, Mojab F, Vahidi H, Marashi B, Talank N, Hosseini O, et al. Green synthesis, characterization, antibacterial and biofilm inhibitory activity of silver nanoparticles compared to commercial silver nanoparticles. Inorg Chem Commun 2021;129:108647.
[27] Wahab PUA, Madhulaxmi M, Senthilnathan P, Muthusekhar MR, Vohra Y, Abhinav RP. Scalpel Versus Diathermy in Wound Healing After Mucosal Incisions: A Split-Mouth Study. J Oral Maxillofac Surg 2018;76:1160–4.
[28] Tahmasebi S, Qasim MT, Krivenkova MV, Zekiy AO, Thangavelu L, Aravindhan S, et al. The effects of oxygen–ozone therapy on regulatory T- cell responses in multiple sclerosis patients. Cell Biology International 2021;45:1498–509. https://doi.org/10.1002/cbin.11589.
[29] Bharath B, Perinbam K, Devanesan S, AlSalhi MS, Saravanan M. Evaluation of the anticancer potential of Hexadecanoic acid from brown algae Turbinaria ornata on HT–29 colon cancer cells. Journal of Molecular Structure 2021;1235:130229. https://doi.org/10.1016/j.molstruc.2021.130229.
[30] Sridharan G, Ramani P, Patankar S, Vijayaraghavan R. Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma. J Oral Pathol Med

2019;48:299–306.
[31] Iravani J, Norris Melville G. Mucociliary function in the respiratory tract as influenced by physicochemical factors. Pharmacology & Therapeutics Part B: General and Systematic Pharmacology 1976;2:471–92. https://doi.org/10.1016/0306-039x(76)90003-9.
[32] Shabgah AG, Ezzatifar F, Aravindhan S, Zekiy AO, Ahmadi M, Gheibihayat SM, et al. Shedding more light on the role of Midkine in hepatocellular carcinoma: New perspectives on diagnosis and therapy. IUBMB Life 2021;73:659–69. https://doi.org/10.1002/iub.2458.
[33] R H, Hannah R, Ramani P, Ramanathan A, Jancy MR, Gheena S, et al. CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology 2020;130:306–12. https://doi.org/10.1016/j.oooo.2020.06.021.