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RESEARCH ARTICLE OPEN ACCESS

EFFECTIVENESS OF DEEP BREATHING EXERCISES ON THE PEAK EXPIRATORY FLOW RATE IN ADULT CIGARETTE RETAILERS EXPOSED TO ENVIRONMENTAL TOBACCO SMOKE USING MINI WRIGHT'S PEAK FLOW METER

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ABSTRACT

Background: Passive smoking leads to lung impairment and an increased risk of lower respiratory tract illnesses as proven by many studies. Small Cigarette retailers like tea stall and *Paan* shop owners are exposed to passive Smoking throughout the working hours, and are prone to developing Respiratory Disorders. ***Aim:*** To assess the effectiveness of Deep Breathing Exercises on the Peak Expiratory Flow Rate in adult, non-smoking, cigarette retailers using a Peak Flow meter. ***Method:*** The study involved 50 Adult, Non-smoking, cigarette retailers exposed to the Environmental Tobacco Smoke. Group A was Intervention Group (n=25) and Group B was control (n=25). Group A was given Deep breathing Exercises for 1 week and PEFR was assessed pre and post intervention in both the groups. ***Results:*** Out of 36 subjects, 67% (n=24) had reduced Peak Flow Rates than normal predicted for them. Remaining 33% (n=12) had normal PEFR. Out of 36 subjects, 83% fell in the Green Zone (n= 30), 17% in the Yellow Zone (n=6) and none in the Red zone (n=0). Group A showed improvement in the Peak Flow readings ($p<0.001$). ***Conclusion*:** Deep Breathing Exercises are effective to improve Peak Flow Rates.

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INTRODUCTION

Tobacco smoking is still one of the main preventable causes of many health problems and premature death. Tobacco smoke affects the entire body but predominantly the respiratory system by- impairing ciliary movement, impairing alveolar macrophages functioning, hypertrophy and hyperplasia of mucous glands, obstruction of small airways and bronchospasm.[1] There are two types of Tobacco smoke: Mainstream smoke which is directly inhaled by the smoker and side stream smoke or second-hand smoke or passive smoking which comes from the burning tip of cigarette mixed with surrounded air. Second-hand smoke is sometimes referred to Environmental Tobacco Smoke (ETS). It is a combination of the smoke exhaled by a smoker and the smoke that comes from the end of a burning cigarette. When someone breathes in this smoke, it is often referred to as passive smoking.[2] Respiratory ill effects of secondhand smoke exposure have been already proven by previous studies which include a higher rate, an earlier onset, and an exacerbation of asthma, Spirometry indicators of lung impairment, an increased risk of lower respiratory tract illnesses.[3] Cessation of smoking combined with breathing exercises and lifestyle modifications are proven to be beneficial in improving the lung compliance and spirometry parameters in patients with Asthma and Chronic Obstructive Pulmonary Diseases.Deep breathing exercises help improve ventilation and perfusion of oxygen, breath holding helps open up collateral channels, prevent and reverse atelectasis as well as aid in removal of secretions.Diaphragmatic breathing consists of a smooth and deep nasal inspiration with anterior displacement of the abdominal region, which emphasizes the action of the diaphragm.[4-6] Thoracic expansion and breath holding helps open up collateral channels, prevent and reverse atelectasis as well as aid in removal of secretions. Thoracic mobility exercises improve biomechanics of respiration.[7,8]Alternate Nostril breathing (ANB) in Pranayama also known as *Anulom Vilom,* help improve respiratory functions if practiced daily.[9,10]Peak expiratory flow rate (PEFR) is the maximal expiratory flow rate sustained by a subject for at least 10 milliseconds expressed in Liter per minute (L/min). PEFR is a simple, reliable, reproducible and easily measurable ventilatory lung function test. Mini-Wright peak flow meter is cheap, easily portable and reproducible device for PEFR(r= 0.9).[11]

Need of Study: Small Cigarette retailers like tea stall owners, Pan shop owners, Food stall owners work outdoors and are exposed to air pollution as well as ETS throughout the working hours. They are

exposed to this tobacco smoke in more concentration during the peak hours (breakfast/ lunch break/ evening time) Most of them may have sedentary lifestyle, long sitting jobs or Lack of awareness and/or the shop being the only source of income so they can't leave the job which exposes them to the passive smoking during the working hours. In the long run this can deteriorate the lung functions and increase the risk of various respiratory diseases. Most of them might not be able to afford the pulmonary rehabilitation, therefore there is a strong need to come up with a set of simple, cost-effective exercise interventions which are easy to perform at the workstation and follow throughout the day to protect them from further deterioration as well as to improve lung and pulmonary compliance in the exposed group.

Aim: To find whether a set of simple and cost-effective deep breathing exercises will be effective, to protect them from further deterioration as well as to improve lung and pulmonary compliance in the exposed group. It may also help redefine the norms for public spaces regarding tobacco control.

MATERIALS AND METHODOLOGY

This experimental study involved 50 Adult, Non-smoking, asymptomatic, cigarette retailers exposed to ETS. The study was conducted for 6 months in the PCMC area of Pune. Cigarette retailers having Age 30yrs to 65yrs, having work for at least 5 days a week for minimum 8-10 hours, since at least past 2-5 years, with Body Mass Index between 18.5 to 29.99 Kg/M2 and not having any previous exposure to Pulmonary Rehabilitation Program were included in this study. Individuals with pre diagnosed respiratory condition or on any medication, trauma to chest or recent surgeries or hospitalization, Prominent Chest deformity or Neurological Disorder were excluded. Ex-smokers and individuals who had been exposed to toxic inhalants were also excluded.

Procedure: Written consent was taken from each subject and they were divided into group of 25 each by Random Sampling method. All the subjects were explained about the exercise program. After demonstration and instructions, under the observation of the investigator, Pre-Peak Expiratory flow rate readings were taken using mini-Wright's peak flow meter (r=0.9), with the subject in comfortable sitting position. Best of the 3 readings was noted. Group A received Deep Breathing Exercises as its intervention for a follow up period of 1 week and Group B was a control. Once the exercises were taught properly, the subjects were given a video clip of the same exercise program to follow at home for the next week. The subjects performed the set of exercises once daily in the evening. Compliance to the intervention was monitored by using daily diary by the subjectsand by the physiotherapist using phone application as and when required. After 1 week, reassessment of peak flow was done by the therapist, using the same Peak flow meter with subject in a comfortable sitting position and the readings were documented and later analyzed and interpreted.

Intervention Type: Deep Breathing Exercises
Diaphragmatic Breathing - 10 reps
Thoracic Expansion exercise - 10 reps
Thoracic Mobility exercise – 10 reps.
Alternate Nostril breathing -10 reps.

Statistical Analysis

Data was analyzed, using the Paired-t test for comparing the values of Peak flow values within the groups, i.e., pre and post values of PEFR in Group A (Intervention) and Group B (control) Unpaired-T test was used to analyze post PEFR values of both groups. For statistical analysis Excel, InStat were used. The following data represents 18 Participants in both Group A and Group B.

Reference Values of Peak Flow Rate:
PEF in L/Min (Male) = -1.807 (Age) + 3.206 (Height) (r:0.892)
PEF in L/Min (Female) = -1.454 (Age) + 2.368 (Height) (r:0.882)

Table I. Characteristics of the Participants.

CHARACTERISTICS	MEAN VALUE	SD
AGE	46.389	± 7.86 YRS.
HEIGHT	160.444	± 7.35 CM
BMI	22.733	± 1.99 KG/M^2

Out of 36 subjects, 92% (n= 33) were Males and 8% subjects (n=3) were Females.

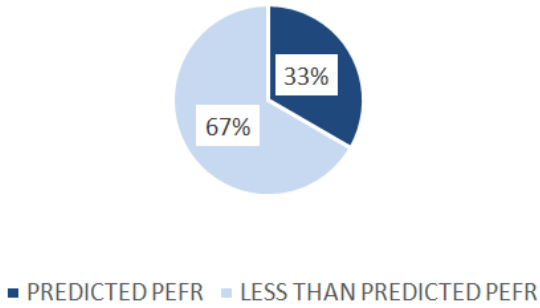

Fig. 1. Subjects with less than predicted PEFR

Interpretation: Out of 36 subjects that participated in this study, 67% i.e. 2/3rd of the total participants (n= 24) had reduced Peak Flow than predicted for them. 33% i.e. 1/3rd of the total participants (n=12) had values of PEFR in the normal range of predicted PEFR.

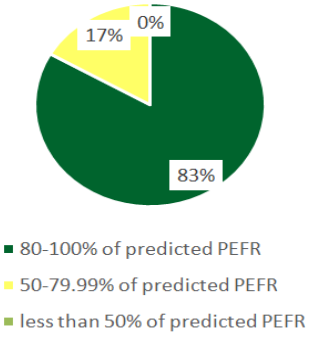

Fig. 2. Distribution of subjects according to PEFR zones

Interpretation: Out of 36 subjects, 83% fell in the Green Zone (n= 30) whereas the 17% of the total subjects (n=6) fell in the Yellow Zone. No subjects fell in the red zone. (n=0).

Table 2. Mean of Pre and post PEFR values of Group A and Group B

Group a	Mean	SD	P value	T Value	Mean Difference
Pre-intervention pefr	390	59.111	0.00014	4.884	-18.889
Post intervention pefr	409.444	58.256			

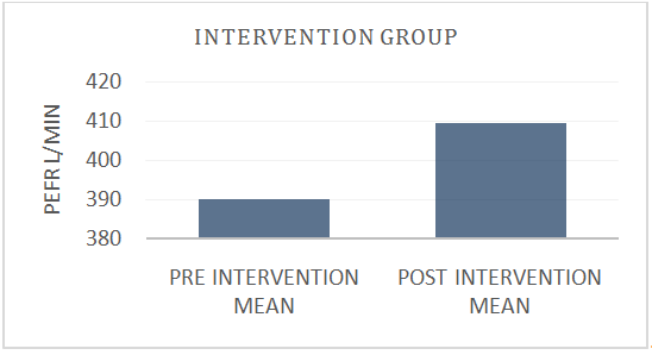

Fig. 3. Mean of Pre and post PEFR values of Group A

Interpretation: The data passed the normality tests. A paired t test was done between pre and post values of group A which received the intervention. This group showed improvement in the Peak Flow readings post intervention with the P value <0.0001 making it statistically significant.

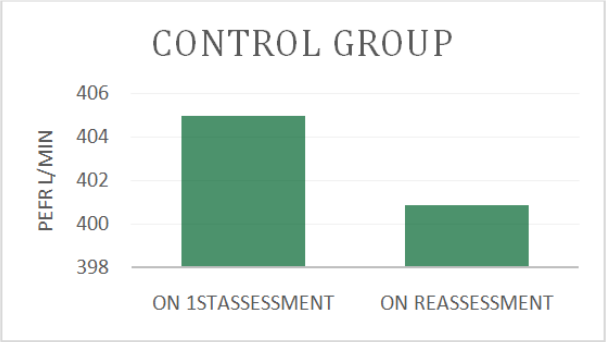

Fig. 4. Mean of Pre and post PEFR values of Group B

Table 3. Pre and post PEFR values of Group B.

Group b	Mean	SD	P value	T Value	Mean Difference
Pefr on assessment	405	52.9428	0.5084	0.675	2.222
Pefr on re-assessment	402.777	57.7831			

Interpretation: The data passed the normality tests. Paired t test was done between pre and post values of group B which was the control group. There is no significant difference in PEFR values on reassessment, with P value > 0.5 making it statistically insignificant.

Table 4. Post PEFR values of Group A and Group B

Groups	Mean	SD	P value	T Value	Mean Difference
Post pefr (group a)	409.444	58.256	0.743	0.333	6.667
Post pefr (group b)	402.778	57.783			

Interpretation: An unpaired t test was carried out between post values of group A and B. There is no significant difference between the post values of Group A and Group B. Its p value is 0.333 making it statistically insignificant.

DISCUSSION

Tobacco smoke contains at least 172 toxic substances, including 3 regulated outdoor air pollutants, 33 Hazardous Air Pollutants, 47 Chemicals restricted as Hazardous Waste and 67 Known Human or Animal Carcinogens (Repace,2006). This is true whether tobacco smoke is inhaled in the act of smoking, or inhaled by nonsmokers out of the air indoors or outdoors.[12]In a study done in 2011, by Dr Rachel E Jordan et.al, increasing passive smoke exposure was independently associated with increased risk of COPD. Marked association was observed between passive smoking exposure and respiratory symptoms, but the most marked effects were on the development of clinically significant COPD (airflow obstruction plus symptoms), where the risk among never smokers was doubled if exposure exceeded 20 h/week.[13]In the study we found that, out of 36 subjects that participated in this study, 67% i.e. 2/3rd of the total participants (n= 24) had reduced Peak Flow than predicted for them. Remaining 33% i.e. 1/3rd of the total participants (n=12) had values of PEFR in the normal range of predicted PEFR. In this, 83% of all subjects fell in the Green Zone (n= 30) whereas the 17% of the total subjects (n=6) fell in the Yellow Zone. No subjects fell in the red zone. (n=0)

The next objective of the study was to find whether a set of simple and cost-effective Deep Breathing Exercises will be effective, to protect them from further deterioration as well as to improve lung and pulmonary compliance in the exposed group. The results of the study showed that the group which received Deep Breathing Exercises as an intervention, had an improvement in their Peak Expiratory Flow readings which were statistically significant. ($p < 0.05$)The Results showed improvements in the Peak Expiratory Flow rates, after 1 week of intervention of Deep Breathing Exercises in the Group A. Paired t test was performed with P value <0.001 suggestive of clinical significance. Nutsupa U, in 2019 reviewed Nineteen studies (n=745), in their analysis. When compared to the control groups, respiratory rate significantly ($p \leq 0.001$) improved in the pursed-lip breathing (PLB), ventilatory feedback (VF) plus exercise, diaphragmatic breathing exercise (DBE), and combined Breathing Exercises.[14] Another study by Dr. David A Jones, PhD PT which had fourteen healthy older people (69 ± 3.6 yrs.) who used diaphragmatic breathing (DB), Triflo II (TF), and a water pressure threshold device (Breathe MAX; BM) in a randomized and balanced crossover design. The study concluded that Substantial lung inflation could be achieved with any of the above-mentioned methods.[15]Group B was, the control group, which did not receive any intervention, did not show any improvement in the PEFR values ($p > 0.05$) This minuscule fall in the Peak Flow rate of the group was statistically insignificant, thought it might be indicative of continuation of deterioration at a minor level as the exposure to the Secondhand Smoke continues. The study was limited by several factors. First, the small sample size of the study limits its statistical power and thus the study population may not be a representative sample of the larger population of cigarette retailers exposed to ETS. The majority of the participants were males (92%) and rest (8%) were females, therefore the data is inconclusive of both PEFR parameters and effectiveness of DBEs in the female participants.History of childhood asthma/ exposure to Secondhand smoke was not taken into consideration. Internal factors such as Immunity, eating and sleeping habits, cardiovascular health and Extrinsic factors like area of residence, ventilation, indoor air pollution, whether mask was used continuously or not during the pandemic was not assessed which can also affect the lung parameters. Accurate measurement of distance from the source of ETS, level of air pollution in the area or amount of exposure could not be accounted for due to time and financial restrictions. Our study represents an initial step toward improved understanding of the health effects of ETS exposure in otherwise healthy older cigarette retailers based on objective measures of pulmonary function.

CONCLUSION

The results of the study showed that 2/3rd of the subjects had reduced Peak Flow Rates than normal predicted for them. Most of them fell in the green zone of the Peak flow range but, they are at a risk of developing Respiratory Disorders in later life. This study supports the positive effects of Deep Breathing Exercises. These are simple, cost effective, easy to follow exercises which do not require special equipment, can be performed at home or at the work station and will help prevent deterioration of Lung functions if practiced daily.

Recommendation and Future Scope

- The study can be conducted on a larger population.
- Study duration can be longer to check the effectiveness of the exercises.
- Other parameters can be assessed with Pulmonary Function Testing.
- Compare the effectiveness of Deep Breathing exercises with that of Inspiratory Muscles Training.
- Can be further continued incorporating physical activities along with the deep breathing exercises.
- Can be conducted on Active smokers and Ex- smokers.

Clinical Implication: Deep Breathing Exercises are extremely effective to maintain and further improve the Peak Expiratory flow rates in adults exposed to Environmental Tobacco Smoke who are at a risk of developing COPD or other respiratory conditions.These exercises are simple, cost effective, easy to follow,do not require

special Equipment and can be performed at home or at the work station to improve respiratory parameters.

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