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Research Article

# EFFECTIVENESS OF DISCONTINUATION OF PASSIVE SMOKING ON LUNG FUNCTION OF CHILDREN BY PEAK EXPIRATORY FLOW RATE (PEFR)

**Jyoti Sanghvi[1*], Ravindra Kumar[2] and Mithun Somani[1]**
[1]Department of Pediatrics, Sri Aurobindo Institute of Medical Sciences, Indore, Madhya Pradesh, India
[2]Central Research Laboratory, Sri Aurobindo Institute of Medical Sciences, Indore, Madhya Pradesh, India

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**Abstract:** This prospective study was conducted to evaluate the effect of passive smoking on lung function of children aged 5-15 years by measuring PEFR as a screening tool and thereby to educate parents about health effects of passive smoking. One hundred sixty seven unrelated children with a history of passive smoking were recruited for the study. The PEFRs was measured by mini Wright Peak Flow Meter twice at interval i.e. at baseline and after 3 months of discontinuation of passive smoking. No significant difference was observed in baseline PEFR of boys and girls. Frequency of smoking was also found associated with lower PEFRs. A significant improvement was seen in PEFRs after the discontinuation of passive smoking in 3 months interval. Alterations of the smoking behavior of family member's results in improved PEFR of their children.

**Keywords:** Passive smoking, Peak Expiratory Flow Rate, Children, Mini Wright flow meter

## INTRODUCTION

Passive smoking is the inhalation of smoke, called Second Hand Smoke (SHS) or Environmental Tobacco Smoke (ETS), from tobacco products used by others. It occurs when tobacco smoke permeates any environment, causing its inhalation by people within that environment. Exposure to second hand tobacco smoke causes disease, disability, and death[1]. Currently, the health risks of second hand smoke are a matter of scientific consensus, and these risks have been a major motivation for smoking bans in workplaces and indoor public places, including restaurants, bars and night clubs, as well as some open public spaces.

Health effects of passive smoking in children are sudden infant death syndrome (SIDS)[2], Asthma[3], Lung infections[4], more severe illness with bronchiolitis[5], increased risk of developing tuberculosis if exposed to a carrier[6], and Crohn's disease[7].

603,000 deaths in 192 countries were attributable to second-hand smoke in 2004, which was about 1.0% of worldwide mortality [8]. Doctor-diagnosed asthma is more common among non-smoking adults exposed to SHS than those not exposed. Among people with asthma, higher SHS exposure is associated with a greater risk of severe attacks. The children are most susceptible population in household environment for passive smoking, as members in family are smoking actively (mostly father & grandfather). Healthy as well as asthmatic children have increased bronchial hyper-reactivity when exposed to passive smoking. The most significant disturbance in the lung function of the asthmatics is the variable airway resistance, which can be gauged by the peak expiratory flow rate (PEFR). Peak expiratory flow rate (PEFR) is a simple and reliable way of following patients with bronchial asthma and other obstructive airway diseases [10], response to a bronchodilator in the assessment of asthmatic subjects even in the specific forms such as occupational asthma[11,12]. Peak expiratory flow rate is easily measured by using a mini-Wright's peak flow meter (mWPFM) which is easy to use, reliable and can be recorded even by the patients or by the parents at home.

So, using the mini-Wright, the present study aims to find any relationship between parental smoking and the PEFRs in healthy children and thereby to educate the parents about adverse health effects of smoking on their healthy children's lung function.

## MATERIAL AND METHODS

This prospective randomized study includes a total of 167 children (age 5 to 15 years) with a history of passive smoking from Pediatric OPD at Sri Aurobindo Institute of Medical Science (SAIMS), Indore from 2010 to 2011. After the approval from the institutional ethics committee, a written informed consent was taken from parents of respective children before including them into the study. Children below 5yrs, those having any form of respiratory tract infection, asthma, recurrent wheezing, (at start of study/ past 2 weeks/history of hospitalization for same at present), exposed to other significant air pollutant e.g. wood/coal burning, any

***Corresponding Author:**
**Dr. Jyoti Sanghvi,**
Associate Professor,
Department of Pediatrics,
Sri Arubindo Institute of Medical Sciences,
Indore, Madhya Pradesh, India.

particulate matter and cold/dry air, having history of aero-allergens exposures e.g. dust mite /cockroaches / pollens, having exposure to environmental tobacco smoke (ETS) other than household environment e.g. school and having history of chronic respiratory diseases e.g. cystic fibrosis/chronic lung disease were excluded from the study.

Parents of the children recruited underwent thorough counseling and education about health hazards of smoking on themselves and lung function of their children. Exposure information had been obtained by comparable questionnaires, recording personal data, body measurements, past history of respiratory diseases, immunization, socio-economic status, evaluation of asthma provocating risk factors, peak expiratory flow rate (PEFR) and respiratory system examination of children. Eighty two parents gave their consent to quit smoking or smoke outside (Group A) while 85 parents did not give their consent to stop smoking (Group B). To ensure that family members of Group A had actually quit smoking completely we visited their home three times randomly and also enquired from their neighbors.

A detailed proforma was filled which included children's age, sex, height, weight of child, no of smokers in a family, frequency of smoking and type of smoke.

Peak expiratory flow rate (PEFR) measured by same instrument were compared between two groups in follow up under two defined conditions:

1. At start of study in each group.
2. After three months follow up in each group.

**Sampling of PEFR:**

All Children were demonstrated how to use mini Wright Peak Flow Meter (mWPFM) correctly. For each determination the child was instructed to make a maximal inspiratory effort and then to make the maximum and most rapid expiratory effort possible in standing position. Serial 3 maximal expiratory blows for PEFR were registered in individual sheet after the child had become familiar with the technique and best of three readings were accepted in each case for data analysis.

**Data Analysis:**

The data obtained from study was then analysed by using IBM SPSS 20.0 (IBM Corp, USA). Mean values of age, BMI, PEFR were compared in group A and B by student t test. Effect of type of smoke and frequency of smoking on PEFR values were calculated by one way ANOVA test. Difference in distribution of type of smoke, frequency of smoking and number of smokers in group A and B were calculated by chi square test. Paired sample t test was used to see the effect of quitting of passive smoking on PEFR. Linear regression analysis were also performed to see the effect of age, sex, status of passive smoking, type of smoke, frequency of passive smoking. P value <0.05 were taken as significant.

## RESULTS

The mean age of 167 children [89 Male, 78 females] was 8.53±2.9 years. The mean Peak expiratory flow rate at baseline was 235.39±61.7 L/Min. No difference in baseline PEFR values was observed in boys and girls. The baseline PEFR values were found significantly associated with frequency of smoking. We found no association of baseline PEFR values with number of smokers in a family and type of smoke (Table 1). A significant correlation of baseline PEFR values was observed with age (r=0.942, P value <0.0001) and body mass index(r 0.695, P value< 0.0001).

The children were divided into two groups depending upon the passive smoking discontinued (Group A, N=82) and continued (Group B, N=85). Among the group A, 77 parents quit smoking completely and 5 parents stopped smoking at home.

We found no significant difference in age, sex, BMI and Baseline PEFR in two groups. Passive smoking in our cohort of cases includes smoke of standard cigarette, bidi and both. Bidi is popular in rural parts of India and are made of crude sun-dried tobacco wrapped in a dried Tendu (*Dyospyros Melanoxylon*) leaf. The mean baseline PEFR was lower in children with passive smoke of bidi alone than that of cigarette alone (Table 1). The cigarette smoking was common in both groups but the number of bidi and/or both bidi and cigarette smokers in family members of group B were higher as compared to group A (Table 2). There was no significant difference between mean baseline PEFR values in two groups.

**Table.1:** Mean Baseline PEFR values in different parameters

| Parameters | Baseline PEFR ( L/Min) | P value |
|---|---|---|
| **Sex** | | |
| Male | 237.98±63.64 | 0.564 |
| Female | 232.44± 59.7 | |
| **Number of Smokers in Family** | | |
| 1 | 231.59±59.38 | 0.163 |
| >1 | 247.07±67.79 | |
| **Type of smoke** | | |
| Cigarette | 246.0±70.3 | |
| Bidi | 231.57±59.7 | 0.433 |
| Both | 245.2±65.3 | |
| **Frequency of smoking** | | |
| <10 | 256.94±66.68 | |
| 10-15 | 228.72±57.37 | 0.012 |
| >15 | 222.0±58.14 | |

**Table.2:** Demographic characteristics of Group A and B

| Parameter | Group A | Group B | P value |
|---|---|---|---|
| Age(Years) | 8.6±2.9 | 8.5±2.8 | 0.798 |
| Sex(male: female) | 41:41 | 48:37 | 0.402 |
| BMI(Kg/m$^2$) | 16.0±1.5 | 16.5±1.9 | 0.115 |
| Number of Smokers in Family | | | |
| 1 | 63(76.8) | 63(74.1) | 0.684 |
| >1 | 19(23.2) | 22(25.9) | |
| Type of smoke | | | |
| Cigarette | 67(81.7) | 54(63.5) | |
| Bidi | 4(4.9) | 11(12.9) | 0.027 |
| Both | 11(13.4) | 20(23.5) | |
| Frequency of smoking | | | |
| <10 | 29(35.4) | 10(25.6) | |
| 10-15 | 32(39.0) | 47(59.5) | 0.001 |
| >15 | 21(25.6) | 28(32.9) | |
| Baseline PEFR ( L/Min) | 241.1±64.7 | 229.8±58.5 | 0.248 |

Using paired sample t test, we observed a significant increase in PEFR after the 3 months of study in group A while no change in PEFR rate was observed in group B (Table 3).

The effect of discontinuation of passive smoking on PEFR was assessed by fitting analysis of covariance models with PEFR at 3 months of follow up as the response, passive smoking status as a study factor, and baseline PEFR, age, sex, number of smokers in a family, and type of smoking as covariates. We found that only the baseline PEFR and status of passive smoking is significantly associated with PEFR at follow-up after 3 months (P value< 0.0001). There were no significant interactions of above covariates with change in PEFR values.

**Table.3:** Peak Experimental flow rate in both groups

| Groups | PEFR at start of study (L/Min) | PEFR after 3 months (L/Min) | P value |
|---|---|---|---|
| A | 241.1±64.7 | 262.9±67.0 | 0.000 |
| B | 229.8±58.5 | 228.5±55.8 | 0.424 |

## DISCUSSION

Children have been identified as a population sensitive to the effects of environmental tobacco smoke, since exposure during childhood can be high and the children may be particularly vulnerable to noxious stimuli during the period of growth and development.

We observed that mean baseline PEFR was lower in children with passive smoke of bidi alone than that of Cigarette alone. This may be due to the fact that amount of nicotine and tobacco alkaloids present in the mainstream smoke (MS) of bidi products is likely to be different from those present in the MS of standard cigarettes because of the differences in their design as no filter exists in most bidis. The side-stream (SS) smoke released from such products is also likely to be different from the side-stream of standard cigarettes due to differences in tobacco processing, burning rate and temperature, and the use of additives for burning tobacco. In a study from Mumbai, the bidi, an Indian cigarette and a brand of American cigarette were analyzed by gas chromatography-flame ionization detection for the levels of nicotine and minor tobacco alkaloids in the MS and SS smoke [19]. The analysis demonstrated higher total nicotine and minor tobacco alkaloids in tobacco from bidi (37.7 mg/g) compared to Indian or American cigarettes (14-16 mg/g). This study also demonstrated higher delivery of nicotine and alkaloids by bidi as evidenced by higher concentration of nicotine in the MS smoke (MS/SS) compared to that released by a regular cigarette.

Parmar *et al.,* [9] reported that PEFRs of girls are higher than that of boys in early childhood while during adolescence the trend reversed**.** But this is not evident in the other Indian studies for children [16,17] and also there was not any gender difference found amongst Indian children domiciled in the UK [18]. Similarly in present study no gender difference was observed in relation to PEFRs. The effect of passive smoking on PEFR of children of similar age groups were studied by other investigators[13-15,20-28], but we objectively studied improvement in PEFR after discontinuing smoking by parents for three months, that has not been tested by any other study till date. In present study, a significant improvement is seen in PEFR values after discontinuation of passive smoking for 3 months only. We did not find any other study who studied the effect of cessation of passive smoking on lung function of normal children. Wilson et al 2001 conducted a similar type of study on 44 asthmatic children but they did not find any significant difference on percent predictive FEV1 after cessation of passive smoking even after one year [29].

The frequency of smoking has been found to be one of major contributory factors in children's lung function. We showed that the PEFR values were lower in children with passive smoking of more than 10 cigarettes and or bidi. Similar study by Venners *et al.,* [14] showed >30cigarattes/day have largest lung deficits, decrease in $FEV_1$ by -79 ml & FVC by -71 ml, Dold *et al.,* [27] concluded >20 cigarettes/day at home decrease PEFR by 4.9%.

We have not studied the effect of duration of passive smoking on PEFR values and it was a limitation to our study.

In conclusion the peak expiatory flow rate (PEFR) measurement is a very simple, reliable and reproducible pulmonary function test which can be performed by using mini-Wright peak flow meter (a cheap & portable instrument). Modifications of the smoking behavior of parents can result in lower deterioration in the lung function (PEFR) or may

improve PEFR of their children. So, Healthcare providers should interact with parents at key times, such as during pregnancy, at birth, at well child visits, as well as on visits for illness so as to produce smoke free environment in household premises for all the children.

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