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Original Article

Decreased peak expiratory flow in pediatric passive smokers

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Abstract

Background Indonesia ranks fifth among countries with the highest aggregate levels of tobacco consumption in the world. Infants and children exposed to environmental tobacco smoke have increased rates of asthma, respiratory and ear infections, as well as reduced lung function. The effects of tobacco smoke exposure on lung function in children have been reported to be dependent on the source of smoke and the length and dose of exposure. Lung function may also be affected by a child's gender and asthma status.

Objective To compare peak expiratory flow (PEF) in pediatric passive smokers to that of children not exposed to second hand smoke, and to define factors that may affect PEF in passive smokers.

Methods In August 2009 we conducted a cross-sectional study at an elementary school in the Langkat district. Subjects were aged 6 to 12 years, and divided into two groups: passive smokers and those not exposed to secondhand smoke. Subjects' PEFs were measured with a Mini-Wright peak flow meter. Measurements were performed in triplicate with the highest value recorded as the PEF. Demographic data including age, sex, weight, height, family income, parental education levels and occupations were obtained through questionnaires.

Results Of the 170 participants, 100 were passive smokers and 70 were not exposed to secondhand smoke**.** Age distribution, weight and height were similar in both groups. We observed a significant difference in PEFs between the group of passive smokers and the group not exposed to secondhand smoke, 211.3 L/minute (SD 61.08) and 242.7 L/minute (SD 77.09), respectively ($P < 0.005$). The number of years of exposure to smoke ($P = 0.079$) and the number of cigarettes smoked daily in the household ($P = 0.098$) did not significantly influence PEF.

Conclusion The PEF in pediatric passive smokers was significantly lower than that of children not exposed to secondhand smoke. PEF in passive smokers was not influenced by the number of years of smoke exposure or the number of cigarettes smoked daily in the household. **[Paediatr Indones. 2011;51:198-201].**

Keywords : *peak expiratory flow, passive smoker*

Indonesia ranks fifth among countries with the highest aggregate levels of tobacco consumption in the world. Over half (57%) of Indonesian households have at least one smoker, and almost all smoke at home (91.8%).[1]

The effects of exposure to tobacco smoke are not restricted to the active smoker.[2] Infants and children exposed to environmental tobacco smoke have increased rates of asthma, respiratory and ear infections, as well as reduced lung function.[1] The effects on lung function in children are dependent on the source, length and dose of exposure and may be affected by the child's gender and asthma status.[3] Passive smoking is defined as the exposure of a nonsmoker to tobacco smoke in the environment. This tobacco smoke may be comprised of sidestream smoke (SS), emitted from the smouldering tobacco between puffs, and exhaled mainstream smoke (MS) from the smoker.[4]

Examination of lung function is important in the diagnosis and evaluation of illness and its treatment. It is also a useful tool for epidemiological surveys.[5-7]

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The peak flow meter (PFM) is a small, portable, inexpensive and easy to use instrument which may serve as an alternative tool to measure PEF and monitor obstructive pulmonary disease.[8,9] The objective of our study was to compare PEFs between pediatric passive smokers and those not exposed to secondhand smoke. In addition, we examined factors that may contribute to reduced PEF in passive smokers.

Methods

We conducted a cross-sectional study at an elementary school in the Langkat district in August 2009. All children aged 6 to 12 years and able to perform pulmonary function tests with PFM were eligible for the study. We excluded children with a history of atopy, asthma or chest wall anomaly, as well as active smokers and those who were uncooperative. PEF was measured while children stood or sat in a comfortable, upright position. Subjects took a deep breath, closed their lips firmly around the mouthpiece, then blew as forcefully and quickly as possible. This procedure was performed in triplicate with the highest value recorded as the PEF. Demographic data including age, sex, weight, height, family income, parental education levels and occupations were obtained through questionnaires. This study was approved by the Medical Ethics Committee, University of Sumatera Utara Medical School.

The comparison between PEF values of the two groups was analyzed by the Student's t-test. Multivariate analysis was used to determine the influence of length of smoke exposure and number of cigarettes smoked daily by household members on the mean PEF. We analyzed data with SPSS version 13.0. The significance level was accepted as $P < 0.05$ with a 95% confidence interval (95% CI).

Results

Of 182 children, 12 were excluded (5 subjects had asthma and 7 subjects were uncooperative). The remaining 170 participants consisted of 100 passive smokers and 70 who were not exposed to secondhand smoke. Subjects' demograpic data is shown in **Table 1.**

Subjects' ages, weights, and heights were similar in both groups. The passive smokers group had parents with lower monthly income than those of the other group.

There was a significant difference between mean PEFs in the passive smokers' group and the group of children not exposed to secondhand smoke, 211.3 L/

Table 1. Subjects' demographic data

Characteristic	Group	
	Passive smokers (n = 100)	Unexposed to smoke (n=70)
Gender		
Male, n (%)	40 (40)	36 (51.4)
Female, n (%)	60 (60)	34 (48.6)
Mean age, years (SD)	9.5 (1.64)	9.4 (1.95)
Mean weight, kg (SD)	23.3 (4.91)	24.9 (7.77)
Mean height, cm (SD)	128.7 (17.77)	127.5 (11.68)
Parental occupation, n (%)		
Laborer/Farmer	62 (62)	38 (54)
Entrepreneur	35 (35)	30 (43)
Government employee	3 (3)	2 (3)
Monthly family income, n (%)	46 (46)	23 (33)
< Rp 300,000	17 (17)	28 (40)
Rp 300,000 - Rp 600,000	26 (26)	12 (17)
Rp 600,000 – Rp 1 million	6 (6)	6 (9)
Rp 1 - 2 million	2 (2)	0 (0)
Rp 2 - 2.5 million	3 (3)	1 (1)
Rp 2.5 - 3 million		
Parental education, n (%)		
Low	75 (75)	52 (74)
Medium	23 (23)	16 (23)
High	2 (2)	2 (3)

Table 2. Mean PEFs of passive smokers based on years of smoke exposure and number of cigarettes smoked in the household per day

Variable		n	Mean PEF	SD	95% CI	*P*
Years of smoke exposure	1 – 3	14	217.9	62.16	181.97 - 253.75	0.079
	3 – 5	18	203.3	71.95	167.55 - 239.11	
	> 5	68	212.1	58.51	197.97 - 226.29	
Cigarettes smoked in household per day	< 10	77	210.7	62.48	196.53 - 224.90	0.098
	10 – 20	16	211.9	58.79	180.55 - 243.20	
	20 – 30	5	212.0	67.60	128.06 - 295.94	
	> 30	2	230.0	42.43	151.19 - 611.19	

minute (SD 61.08) and 242.7 L/minute (SD 77.09), respectively (P=0.005).

Table 2 shows that neither the number of years of smoke exposure (P=0.079) nor the number of cigarettes smoked daily (P= 0.098) had a significant influence on PEFs.

Discussion

Assessment of lung function in children is not easy to perform, generally because most children do not follow instructions well.[10] Successful lung function testing in children requires synchronization between the child and the tool, with the child understanding and following instructions.[11-13] We found the use of a peak flow meter to be feasible in children aged 6-12 years. With a suitable approach and simple instructions, subjects could perform pulmonary function tests properly.

Smoking prevalence among adults increased from 26.9% in 1995 to 31.5% in 2001 in Indonesia. Rural, adult males with little formal education and low income have a higher smoking prevalence.[1] A study in Liverpool showed that low socioeconomic status was a significant risk factor associated with environmental tobacco smoke exposure in young school children.[14] We also found that children of low-income or unemployed parents were more likely to have environmental tobacco smoke exposure.

The association between environmental tobacco smoke exposure and lung dysfunction has been reported in several epidemiological studies from different countries. It has been shown that people exposed to environmental tobacco smoke have an increased frequency of respiratory symptoms and reduced lung function.[15] Exposure to environmental tobacco smoke may cause increased coughing, wheezing, sputum production, respiratory illness, airway reactivity, as well as decreased forced expiratory volume in 1 second (FEV1)[16] and FEV1/forced vital capacity (FVC) ratio.[17-19]

A meta-analysis consisting of 21 cross-sectional studies from 1979-1997 on changes in lung function related to environmental tobacco smoke exposure, reported a reduction in FEV1 in 18 of the 21 studies. They concluded that maternal smoking was associated with a small but significant reduction in lung function in school-aged children. Most effects appeared to be due to maternal smoking during pregnancy.[20] Some studies suggest effects of environmental tobacco smoke exposure separate from maternal smoking during pregnancy.[21,22] In a Turkish study of 360 children aged 9 to 13 years, paternal smoking was adversely associated with a reduction in forced vital capacity (FVC), forced expiratory flow at 25 to 75% of vital capacity (FEF25–75), and PEF rate. This influence of paternal smoking may be explained by the fact that more men than women smoke in Turkey.[21] Similarly, a Chinese study showed that the offspring of fathers smoking 30 or more cigarettes per day had a significant reduction in FEV1 and FVC. In China, the prevalence of smoking among men is 61%, compared with 7% among women.[22] Our data confirmed that parental smoking is the most important source of passive exposure to smoke in children. All subjects in our study had one active smoker at home, almost always the father. The majority of fathers (77%) smoked fewer than 10 cigarettes per day.

A study of 6 to 12 year old children reported measurable effects of current environmental tobacco smoke exposure on both FEV1 and maximal mid-expiratory flow (MMEF), although the effects were even greater in children with prenatal exposure.[23] Other studies have reported on the relative contributions of prenatal and postnatal tobacco exposure on pulmonary function outcomes in children. They concluded that maternal smoking in pregnancy has a greater effect on children's lung function than exposure to subsequent or current smoking, when effects on the lungs were assessed in school-aged children. Decreased lung function growth during adolescence was reported to be associated with both early exposure to maternal smoking (in the first 5 years of life) and current maternal smoking, although the effect was attenuated in older children (11 to 18 year olds) compared with a younger age group (6 to 10 year olds).[24] In our study, all active smokers at home were the fathers. No subjects had early exposure to maternal smoking. We found the average length of exposure to cigarette smoke was more than 5 years (68%) from the father.

A limitation of our study was its cross-sectional design. A prospective, cohort study would be more useful to analyze changes in pulmonary function in children before and after exposure to cigarette smoke.

References

1. WHO Indonesia and Ministry of Health Republic of Indonesia. Tobacco consumption & prevalence in Indonesia. [cited 2009 June]. Available from: *http://www.litbang.depkes.go.id/tobaccofree*
2. Carlsen KH, Carlsen KCL. Respiratory effects of tobacco smoking on infants and young children. Pediatr Respir Rev. 2008;9:11-20.
3. Henderson AJ. The effects of tobacco smoke exposure on respiratory health in school-aged children. Pediatr Respir Rev. 2008;9:21-8.
4. WHO. Environmental tobacco smoke. Denmark. 2000. [cited 2009 June]. Available from: http://*www.euro.who.int/8_lets.pdf*
5. Daulay RM, Said M, Naning R, Dadiyanto DW. Prosedur tindakan pada penyakit respiratori. In: Rahajoe NN, Supriyatno B, Setyanto DB, editors. Buku Ajar Respirologi Anak. 1st ed. Jakarta: Ikatan Dokter Anak Indonesia; 2008. p. 583-95.
6. Kaswandani N. Uji fungsi paru pada batuk kronik. In: Trihono PP, Kurniati N, editors. Strategi pendekatan klinis secara professional batuk pada anak. Jakarta: Departemen Ilmu Kesehatan Anak FKUI-RSCM; 2006.p.26-39.
7. Wirjodiarjo M. Evaluasi klinik fungsi paru dalam pemecahan masalah kesehatan anak. In: Rahajoe N, Rahajoe NN, Boediman I, Said M, Wirjodiarjo M, Supriyatno B, editors. Perkembangan masalah pulmonologi anak saat ini. Jakarta: Pendidikan Kedokteran Berkelanjutan Ilmu Kesehatan Anak FK-UI; 1994.p.45-73
8. Wirjodiarjo M, Said M, Budiman HI. Perbandingan hasil pengukuran peak flow rate antara mini wright peak flow meter dan spirometer elektronik pada anak. Majalah Kedokteran Indonesia. 1992;42:575-84.
9. Aditama TY, Mangunnegoro H, Fachrurodji H, Saharawati D. Penggunaan arus puncak ekspirasi maksimal dalam penilaian faal paru. Medika.1987;7:670-72.
10. American Lung Association. Peak flow meters. 2008 June; [cited 2009 June]. Available from: http://*www.lungusa.org/b.22586/peak_flow_meters.htm*
11. Paton JY. A practical approach to the interpretation of lung testing in children. Pediatr Respir Rev. 2000;1:241-8.
12. Milner AD. Lung volume measurements in childhood. Pediatr Respir Rev. 2000;1:135-40.
13. Beardsmore SC. Ethical issues in lung function testing in children. Pediatr Respir Rev. 2000;1:342-346.
14. Delpisheh A, Kelly Y, Brabin BJ. Passive cigarette smoke exposure in primary school children in Liverpool. Public Health. 2006;120:65-9.
15. Wang S, Witten ML. Environmental tobacco smoke and lung function. In: Watson RR, Witten ML, editors. Environmental tobacco smoke. New York: CRC Press; 2000.p.301-5.
16. O'Connor GT, Weiss ST, Tager IB, Speizer FE. The effect of passive smoking on pulmonary function and nonspecific bronchial responsiveness in a population based sample of children and young adults. Am Rev Respir Dis. 1987;135:800-3.
17. Sherril DL, Martinez FD, Lebowitz MD, Holdaway MD, Flannery EM, Herbison GP, et al. Longitudinal effects of passive smoking on pulmonary function in New Zealand children. Am Rev Respir Dis. 1992;145:1136-40.
18. Young S, Souef PNL, Geelhoed GC, Stick SM, Turner KJ, Landau LI. The influence of family history of asthma and parental smoking on airway responsiveness in early infancy. N Engl J Med. 1991;324:1168-71.
19. Frischer T, Kuehr J, Meinert R, Karmaus W, Barth R, Hermann-Kunz E, et al. Maternal smoking in early childhood: a risk factor for bronchial responsiveness to exercise in primary-school children. J Pediatr. 1992;121:17-21.
20. Cook DG, Strachan DP, Carey IM. Health effects of passive smoking. 9; Parental smoking and spirometric indices in children. Thorax. 1998;53:884-93.
21. Bek K, Tomac N, Delibas A, Tuna F, Tezic HT, Sungkur M. The effect of smoking on pulmonary function during childhood. Postgrad Med J. 1999;75:339-41.
22. Venners SA, Wang X, Chen C, Wang B, Ni J, Jin Y, et al. Exposure-response relationship between paternal smoking and children's pulmonary function. Am J Respir Crit Care Med. 2001;164:973-6.
23. Moshammer H, Hoek G, Luttman GH. Parental smoking and lung function in children: an international study. Am J Respir Crit Care Med. 2006;173:1255-63.
24. Wang X, Wypij D, Gold DR. A longitudinal study of the effects of parental smoking on pulmonary function in children 6-18 years. Am J Respir Crit Care Med. 1994;139:1139-52.