

Correlation between Domestic Cigarette Smoke Exposure and Respiratory Complaints, Hospitalization and School Absence due to Respiratory Complains in the Indonesian Elementary School-Aged Children

Abstract

Background: Over 43 million Indonesian children who are exposed to cigarette smoke are at risk of having health hazard and morbidities. **Aims:** The aim of this study is to identify the correlation between cigarette smoke exposure and respiratory complaints, hospitalization, as well as school absence due to respiratory complaints in elementary school-aged Indonesian children. **Materials and Methods:** A cross-sectional study was conducted in nonsmoking elementary school-aged children. Participants were categorized into the exposed and unexposed groups based on the report of their parents. Questionnaire-retrieved data were analyzed to identify the correlation between cigarette smoke exposure and respiratory complaints, hospitalization, as well as school absence due to respiratory complaints in elementary school-aged children. **Results:** A total of 128 study participants of nonsmoking children aged 6–12 years (mean 9.8 ± standard deviation 1.6 years) were categorized into 64 children exposed and 64 children unexposed to domestic cigarette smoking. There was a significant correlation between smoking exposure and cough episodes as well as upper respiratory infection in children within the past 12 months. A cough episode of ≥3 times/year was found more prevalent in exposed children compared to the unexposed children (26.6% vs. 9.4%; $P < 0.05$). Cough ≥3 times/year was found in 50% of children exposed to cigarette smoke of a smoker with a smoking habit of >10 cigarettes/day. There was a correlation between cigarette smoke exposure and hospitalization frequency of ≥1 time(s)/year due to respiratory complaints in children ($P < 0.05$). **Conclusion:** Cigarette smoke exposure is correlated with complaints of cough, upper respiratory tract infection, and hospitalization due to respiratory complaints in children.

Keywords: Children, respiratory complaints, tobacco smoke exposure

Priska Duana Putri,
Agus Dwi Susanto,
Achmad Hudoyo,
Fariz Nurwidya,
Feni Fitriani Taufik,
Sita Andarini,
Budhi Antariksa

Department of Pulmonology
and Respiratory Medicine,
Faculty of Medicine, Universitas
Indonesia, Persahabatan
Hospital, Jakarta, Indonesia

Introduction

Exposure to domestic cigarette smoke is an important health problem as >85% of smokers in Indonesia are smoking with their family members at home. Over 97 million of Indonesian citizens are exposed to cigarette smoke every day and 43 million among them are children.^[1] The environmental cigarette smoke consists of mainstream smoke, which is directly inhaled by a smoker and the sidestream smoke, which is the result of ignited cigarette with the lighting of fire at the tip of the cigarettes.^[2] Home is the major source of cigarette exposure in children that may cause health problems.^[2] The health problems may bring impacts in children as it can increase the risk of hospitalization and school absence related to respiratory complaints. This study was aimed

to evaluate the correlation between cigarette smoke exposure and respiratory complaints (wheezing, cough, and upper respiratory tract infection), school absence, and the frequency of hospitalization due to respiratory complaints within the past 12 months and diagnosis of asthma in children.

Materials and Methods

This cross-sectional study is conducted in the elementary school-aged children at Cijantung 07 Elementary School, East Jakarta, between March and July 2014. The study protocol was approved by the Ethical Committee of the Faculty of Medicine University of Indonesia, Jakarta, Indonesia (Ethical Clearance Number: 689/H2.F1/ETIK/2013). Participants were categorized into exposed and unexposed

Received: 04 January, 2018.

Accepted: 06 July 2018.

Address for correspondence:

Dr. Fariz Nurwidya,
Jalan Persahabatan Raya No. 1,
Rawamangun, Jakarta 13230,
Indonesia.
E-mail: fariz.nurwidya@gmail.
com

Access this article online

Website:
www.ijabmr.org

DOI:
10.4103/ijabmr.IJABMR_344_17

Quick Response Code:



How to cite this article: Putri PD, Susanto AD, Hudoyo A, Nurwidya F, Taufik FF, Andarini S, et al. Correlation between domestic cigarette smoke exposure and respiratory complaints, hospitalization and school absence due to respiratory complaints in the Indonesian elementary school-aged children. *Int J App Basic Med Res* 2018;8:244-8.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

groups based on their exposure status. A child was categorized as having exposure to domestic cigarette smoke when there was a smoker who lived in the same house with the children. Evaluation of respiratory complaints was made based on their parents' report on complaints of wheezing, cough, and upper respiratory tract infection occurred in their children within the past 12 months. Diagnosis of asthma was made based on the parents' report that their children had been diagnosed with asthma by a doctor.^[3] School absence and hospitalization due to respiratory complaints within the past 12 months were identified based on the parents' report.

The inclusion criteria were children aged 6–12 years, nonsmoker, and both children and their parents who were willing to participate in the study. The exclusion criteria were incomplete data of questionnaires. The participants were recruited using consecutive sampling method.

Data collection included measurement of height and body weight, filling out questionnaire to obtain data on identity and sociodemographic characteristics of the participants, data associated with characteristics of domestic cigarette smoke exposure (the number of smokers at home, the number of cigarette smoked per day by smoker(s) at home, the type of cigarettes, duration of exposure, and mean cigarette exposure per day) and respiratory complaints (wheezing, cough, and upper respiratory tract infection), school absence and frequency of hospitalization within the past 12 months, and diagnosis of asthma in children. The questionnaire has been used in the previous study involving tobacco smoke-exposed children.^[4,5] The obtained data were subsequently analyzed by univariate, bivariate, and multivariate analysis using the Statistical Package for the Social Sciences (SPSS) software program

version 16.0 (IBM Corp, Armonk, NY, USA). $P < 0.05$ was considered to be statistically significant.

Results

The population study involved 128 children, which was consistent with the calculated sample size. Participants were categorized into two groups based on their exposure status to cigarette smoke, i.e., there were 64 children each in the exposed and unexposed group. The mean age was 9.8 ± 1.6 years, and the median age was 10 years. Most of the children have parents with education level of junior high or senior high graduates. Participant characteristics based on sociodemographic data are shown in Table 1.

Demographic characteristics based on the exposure to cigarette smoke in children who were exposed to the cigarette smoke showed that there were 17 children (26.6%) who lived together with ≥ 2 smokers and most of the children lived in the same house with 1 smoker, i.e., 47 children (73.4%). Most of the children (65.6%) were exposed to cigarette smoke of smokers who had < 10 cigarettes daily. The type of cigarettes smoked by smokers who lived with the children mostly was kretek cigarettes (cigarettes made with a blend of tobacco, cloves, and other flavors), i.e., 90.6%. The longest duration of cigarette exposure in those children was ≥ 5 years, which was found in 62.5% of participants. The mean duration of daily cigarette smoke exposure was > 1 h/day, which was found in 26 children (40.6%). The characteristics of cigarette smoke exposure in the exposed children can be seen in Table 2.

Next, we determine that the impact of domestic cigarette smoke exposure on children regarding respiratory complaints was evaluated based on complaints of wheezing,

Table 1: Sociodemographic characteristics of the children

Variable	Total (n=128), n (%)	Exposed group (n=64), n (%)	Unexposed group (n=64), n (%)	P
Sex				0.367*
Boys	51 (39.8)	28 (43.8)	23 (35.9)	
Girls	77 (60.2)	36 (56.2)	41 (64.1)	
Nutrition status				0.467#
Severe thinness	6 (4.7)	4 (6.2)	2 (3.1)	
Thinness	14 (10.9)	6 (9.4)	8 (12.5)	
Normal	83 (64.8)	38 (59.4)	45 (70.3)	
Overweight	17 (13.3)	11 (17.2)	6 (9.4)	
Obesity	8 (6.2)	5 (7.8)	3 (4.7)	
Father's education				0.083#
Primary school	11 (8.6)	9 (14.1)	2 (3.1)	
Middle-high school	95 (74.2)	44 (68.8)	51 (79.7)	
University or over	22 (17.2)	11 (17.2)	11 (17.2)	
Mother's education				0.864#
Primary school	16 (12.5)	9 (14.1)	7 (10.9)	
Middle-high school	96 (75)	47 (73.4)	49 (76.6)	
University or over	16 (12.5)	8 (12.5)	8 (12.5)	

*Fisher test; #Kolmogorov–Smirnov test

cough, and upper respiratory tract infection within the past 12 months. As shown in Table 3, there were complaints on wheezing of ≥ 3 times/year in the exposed children, i.e., 2 children (3.1%), while in the unexposed group, none had wheezing complaints of ≥ 3 times/year. In the unexposed group, there were 61 children (95.3%) without wheezing complaints, while 59 children (92.2%) in the exposed group did not have wheezing. There was no significant correlation between domestic cigarette exposure status in children and wheezing complaints ($P = 1.000$).

There were 17 children (26.6%) with cough complaints of ≥ 3 times/year in the exposed group, while in the unexposed group, there were 6 children (9.4%). There

was a significant difference on cough complaints between exposed and unexposed children ($P = 0.001$).

More upper respiratory tract infection complaints of ≥ 3 times/year in exposed children, i.e., 21 children (32.8%) were found more frequently compared to unexposed children. There was a significant difference on the incidence of upper respiratory tract infection between children exposed and unexposed to domestic cigarette smoke ($P = 0.000$). Further analysis in exposed children group revealed a significant correlation between the number of smoked cigarette and cough complaints within the past 12 months ($P = 0.011$).

Exposure to cigarette smoke may cause respiratory complaints resulting in increased risk of hospitalization and school absence due to respiratory complaints in children. In our study, the incidence of hospitalization of ≥ 1 times/year due to respiratory complaints in the exposed children was eight children (12.5%), while in the unexposed children group, it was only one child (1.6%) ($P = 0.033$; odds ratio [OR]: 9; 95% confidence interval [CI]: 1.1–74.2). There was a correlation between cigarette smoke exposure and history of hospitalization due to respiratory complaints in children.

On logistic regression analysis, we found variables associated with ≥ 1 times/year hospitalization due to respiratory complaints, i.e., exposure to cigarette smoke ($P = 0.032$; OR: 11.18) and history of asthma in children ($P = 2.31$; OR: 10.05). School absence of ≥ 5 days due to respiratory complaints in the children exposed to cigarette smoke was 4 (6.2%) and 0 in children without exposure. There was no significant correlation between domestic cigarette smoke in children and school absence ($P = 0.143$) as well as the diagnosis of asthma in children. The

Table 2: Characteristics of cigarette smoke exposure in children exposed to domestic cigarette smoke

Variable	Total (%)
Number of household smokers	
≥ 2	17 (26.6)
1	47 (73.4)
Number of cigarettes per day	
>20	2 (3.1)
10-20	20 (31.2)
<10	42 (65.6)
Cigarette's type	
Kretek	58 (90.6)
White cigarettes	3 (4.7)
Mixed	3 (4.7)
Duration of exposure (years)	
≥ 5	40 (62.5)
<5	24 (37.5)
Tobacco smoke exposure per day (h)	
>1	26 (40.6)
≤ 1	38 (59.4)

Table 3: The correlation between domestic cigarette smoke exposure in children and respiratory complaints (wheezing, cough, and upper respiratory tract infection) within the past 12 months as well as the asthma diagnosis in children

Variable	Total (n=128), n (%)	Exposed group (n=64), n (%)	Unexposed group (n=64), n (%)	P
Wheezing episode				1.000 [#]
≥ 3 times/year	2 (1.6)	2 (3.1)	0	
1-2 times/year	6 (4.7)	3 (4.7)	3 (4.7)	
Never	120 (93.8)	59 (92.2)	61 (95.3)	
Cough episode				0.001 [#]
≥ 3 times/year	23 (18)	17 (26.6)	6 (9.4)	
1-2 times/year	70 (54.7)	38 (59.4)	32 (50)	
Never	35 (27.3)	9 (14.1)	26 (40.6)	
Upper respiratory infection				0.000 [#]
≥ 3 times/year	24 (18.8)	21 (32.8)	3 (4.7)	
1-2 times/year	51 (39.8)	24 (37.5)	27 (42.2)	
Never	53 (41.4)	19 (29.7)	34 (53.1)	
Asthma diagnosis				1.000*
Yes	7 (5.5)	3 (4.7)	4 (6.2)	
No	121 (94.5)	61 (95.3)	60 (93.8)	

*Fisher test; [#]Kolmogorov–Smirnov test

correlation between domestic cigarette smoke exposure and its impact on hospitalization as well as school absence due to respiratory complaints can be seen in Table 4.

Discussion

Data provided by the Centers for Disease Control and Prevention (CDC) in 2010 indicate that over 50% of children with the age of 3–11 years are exposed to environmental cigarette smoke.^[6] Children are more susceptible to physiological changes caused by environmental cigarette smoke exposure and they are more sensitive to the health related impact of the cigarette.^[4,7]

Cigarette smoke exposure in children results in 9500 cases of hospitalization each year in England.^[8] The effects of cigarette smoke exposure on respiratory complaints are evaluated based on the complaints of wheezing, cough, and upper respiratory tract infection. In this study, we found a significant correlation between cigarette smoke exposure and cough as well as respiratory tract infection in children within 1 year. The mechanism of cigarette smoke-induced cough has been an area of intensive investigation. From *in vitro* study, single-cell reverse transcription-polymerase chain reaction analysis revealed that transient receptor potential cation channel, subfamily A, member 1 (TRPA1) mRNA is expressed in respiratory vagal sensory neurons and played role in cough.^[9] A study using animal models also suggests that cigarette smoke evoke cough by activation of respiratory sensory nerve receptor, including TRPA1.^[10]

The study conducted by Gergen *et al.*^[3] showed that there was a correlation between symptoms of respiratory tract infection of ≥ 3 times/year in children without exposure and those who are exposed to >20 cigarettes/year. Complaints of wheezing of ≥ 3 times in a year were found in 7.5% of children without exposure and in 10.6% of children exposed to the smoke of 1–20 cigarettes/day and the complaints were found in 12.6% of children exposed to >20 cigarettes/day.^[3] A meta-analysis conducted by Strachan and Cook^[11] found that smoker parents had OR of wheezing complaints up to the age of 6 years, i.e., 1.31 (95% CI: 1.22–1.41), and it subsequently was decreased after the age of 6 years with an OR of 1.13 (95%

CI: 1.04–1.22). Different results may occur since our study was conducted in children of certain population, and the results were obtained based on filling up questionnaires that may cause recall bias. The correlation between cigarette smoke exposure and respiratory diseases should be done as a hospital-based study to observe the correlation between cigarette smoke exposure and certain disease.

Cabana *et al.*^[5] suggested that cigarette smoke exposure can induce the development of asthma and its acute symptoms. Smoker parents can be the cause of asthma in children, and the prevalence of asthma is increasing with the greater number of smokers at home. One of the measures to prevent the development of acute asthma symptoms is by reducing cigarette smoke exposure.^[5] In our study, the incidence of asthma in children with and without exposure was 4.7% and 6.2%, respectively. There was no significant correlation between domestic cigarette smoke exposure and the incidence of asthma in children ($P = 1.000$). The results may be found since some children with asthma avoided the cigarette smoke exposure and affected the smoking behavior of their family members at home; therefore, it contributed to the insignificant correlation between cigarette smoke exposure and the diagnosis of asthma in our cross-sectional study. Similar results were found in a study conducted by Levy *et al.*,^[10,12] who evaluated the correlation between cigarette smoke exposure and children's health, which demonstrated that the asthma diagnosis in children without cigarette smoke exposure was found in 10.4% of participants, while diagnosis of asthma in children who lived with 1 and ≥ 2 smokers at home was found in 11.9% and 9.8%, respectively ($P = 0.78$). A study conducted by Gergen *et al.*,^[3] in children aged 2 months–5 years demonstrated that domestic cigarette smoke exposure increases the incidence of chronic bronchitis, ≥ 3 episodes of wheezing in a year, and diagnosis of asthma. The effect can be found consistently in those with exposure of ≥ 20 cigarettes/day. Gergen *et al.*^[3] study also suggested that cigarette smoke exposure had a significant correlation with asthma in children during the first 5 years of life, while the symptom of wheezing and diagnosis of asthma have no significant correlation with cigarette smoke exposure in children of older age. A meta-analysis of 14 case-control

Table 4: Correlation between domestic cigarette smoke exposure in children and incidence of hospitalization as well as school absence

Variable	Total (n=128), n (%)	Exposed group (n=64), n (%)	Unexposed group (n=64), n (%)	P
Incidence of hospitalization				0.033*
≥ 1 times/year	9 (7)	8 (12.5)	1 (1.6)	OR 9 (1.1-74.2)
Never	119 (93)	56 (87.5)	63 (98.4)	
School absence				0.143#
≥ 5 days	4 (3.1)	4 (6.2)	0	
1-4 days	17 (13.3)	13 (20.3)	4 (6.2)	
Never	107 (83.6)	47 (73.4)	60 (93.8)	

*Fisher test; #Kolmogorov–Smirnov test. OR: Odds ratio

studies performed by Strachan and Cook^[11] found that smoking parents had asthma OR of 1.37 (95% CI: 1.15–1.64) compared to children with nonsmoker parents.

In our study, we found a significant correlation between domestic cigarette smoke exposures in children and hospitalization rate due to respiratory complaints. The United States Environmental Protection Agency reported that cigarette smoke exposure increases the risk of lower respiratory tract infection in children causing 7500–15,000 hospitalizations each year.^[13] A meta-analysis found that the risk of hospitalization due to complaints of lower respiratory tract infection in children is OR of 1.46 (95% CI: 1.27–1.66) when one or both of parents are smokers.^[14] Different results are obtained from a study conducted by Victora *et al.*,^[15] in Brazil, which showed that there was no significant correlation between smoking parents and hospitalization due to complaints of lower respiratory tract infection (OR: 0.94; 95% CI: 0.72–1.22).

Our study found no significant correlation between domestic cigarette smoke exposure in children and school absence ($P = 0.143$). Levy *et al.*^[12] suggested that school absence can be considered as a marker of morbidities in children. They studied children with 6–11 years of age, showing that 24%–34% of children who lived with one smoker had school absence due to respiratory complaints. Children who lived with one smoker at home had a 1.68 risk (95% CI: 1.2–2.34) of school absence compared to children who did not live with smokers, and the duration of school absence in children was increased consistent with the number of smokers at home.^[10,12] A study conducted by Gilliland *et al.*^[16] found that children with domestic cigarette smoke exposure had a relative risk of 1.27 (95% CI: 1.04–1.56) on school absence due to respiratory complaints. School absence due to respiratory disease in children exposed to domestic cigarette smoke may cause poor school performance and affect social and intellectual development in the children.^[16]

There were some study limitations in this study. The physician-diagnosed asthma diagnosis was based on parental report, and lung function test was not performed in this study which might implicate in the possibility of bias.

Conclusion

Our findings revealed a correlation between cigarette smoke exposure and complaints of cough, upper respiratory tract infection, and hospitalization rate due to respiratory complaints in children within the past 12 months. An effective law to create free smoking zone at home should come into the effect in order to prevent the hazardous impact of cigarette smoke on children's health.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Achadi A, Soerojo W, Barber S. The relevance and prospects of advancing tobacco control in Indonesia. *Health Policy* 2005;72:333-49.
2. U.S. Department of Health and Human. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. Atlanta: Department of Health and Human Services, Center for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2006.
3. Gergen PJ, Fowler JA, Maurer KR, Davis WW, Overpeck MD. The burden of environmental tobacco smoke exposure on the respiratory health of children 2 months through 5 years of age in the United States: Third National Health and Nutrition Examination Survey, 1988 to 1994. *Pediatrics* 1998;101:E8.
4. Tutka P, Wielosz M, Zatoński W. Exposure to environmental tobacco smoke and children health. *Int J Occup Med Environ Health* 2002;15:325-35.
5. Cabana M, Birk N, Slish K. Exposure to tobacco smoke and chronic asthma symptoms. *Pediatr Asthma Immunol* 2005;18:180-8.
6. Centers for Disease Control and Prevention (CDC). Vital signs: Nonsmokers' exposure to secondhand smoke – United States, 1999-2008. *MMWR Morb Mortal Wkly Rep* 2010;59:1141-6.
7. Cheraghi M, Salvi S. Environmental tobacco smoke (ETS) and respiratory health in children. *Eur J Pediatr* 2009;168:897-905.
8. Jarvis MJ, Mindell J, Gilmore A, Feyerabend C, West R. Smoke-free homes in England: Prevalence, trends and validation by cotinine in children. *Tob Control* 2009;18:491-5.
9. Nassenstein C, Kwong K, Taylor-Clark T, Kollarik M, Macglashan DM, Braun A, *et al.* Expression and function of the ion channel TRPA1 in vagal afferent nerves innervating mouse lungs. *J Physiol* 2008;586:1595-604.
10. Birrell MA, Belvisi MG, Grace M, Sadofsky L, Faruqi S, Hele DJ, *et al.* TRPA1 agonists evoke coughing in guinea pig and human volunteers. *Am J Respir Crit Care Med* 2009;180:1042-7.
11. Strachan DP, Cook DG. Health effects of passive smoking 6. Parental smoking and childhood asthma: Longitudinal and case-control studies. *Thorax* 1998;53:204-12.
12. Levy DE, Winickoff JP, Rigotti NA. School absenteeism among children living with smokers. *Pediatrics* 2011;128:650-6.
13. US Environmental Protection Agency. Fact Sheet: Respiratory Health Effects of Passive Smoking; 2004. Available from: <http://www.no-smoke.org/document.php?id=212>. [Last accessed on 2014 Aug 04].
14. Jones LL, Hashim A, McKeever T, Cook DG, Britton J, Leonardi-Bee J. Parental and household smoking and the increased risk of bronchitis, bronchiolitis and other lower respiratory infections in infancy: Systematic review and meta-analysis. *Respir Res* 2011;12:5.
15. Victora CG, Fuchs SC, Flores JA, Fonseca W, Kirkwood B. Risk factors for pneumonia among children in a Brazilian metropolitan area. *Pediatrics* 1994;93:977-85.
16. Gilliland FD, Berhane K, Islam T, Wenten M, Rappaport E, Avol E, *et al.* Environmental tobacco smoke and absenteeism related to respiratory illness in schoolchildren. *Am J Epidemiol* 2003;157:861-9.