RESEARCH ARTICLE

Implementation of Smoke-free Legislation in Malaysia: Are Adolescents Protected from Respiratory Health Effects?

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Abstract

Background: This study aimed to examine the relationship between respiratory health of Malaysian adolescents with secondhand smoke (SHS) exposure and smoke-free legislation (SFL) implementation. Materials and Methods: A total of 898 students from 21 schools across comprehensive- and partial-SFL states were recruited. SHS exposures and respiratory symptoms were assessed via questionnaire. Prenatal and postnatal SHS exposure information was obtained from parental-completed questionnaire. Results: The prevalence of respiratory symptoms was: 11.9% ever wheeze, 5.6% current wheeze, 22.3% exercise-induced wheeze, 12.4% nocturnal cough, and 13.1% self-reported asthma. SHS exposure was most frequently reported in restaurants. Hierarchical logistic regression indicates living in a comprehensive-SFL state was not associated with a lower risk of reporting asthma symptoms. SHS exposure in public transport was linked to increased risk for wheeze (Adjusted Odds Ratio (AOR) 16.6; 95% confidence interval (CI), 2.69-101.7) and current wheezing (AOR 24.6; 95% CI, 3.53-171.8). Conclusions: Adolescents continue to be exposed to SHS in a range of public venues in both comprehensive- and partial-SFL states. Respiratory symptoms are common among those reporting SHS exposure on public transportation. Non-compliance with SFL appears to be frequent in many venues across Malaysia and enforcement should be given priority in order to reduce exposure.

Keywords: Environmental tobacco smoke - wheezing - youth - smoke restriction - smoking ban - Malaysia

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Introduction

Second Hand Smoke or SHS exposure is linked to a range of detrimental respiratory health effects among a range of population like children and young adolescents (Halken et al., 1995; Hajnal et al., 1999; Hughes et al., 2008a; 2008b). Involuntary exposure to SHS among children have been frequently associated with respiratory effects (Gililand et al., 2001; Menzies et al., 2006) in addition to various adverse health impacts such as otitis media (Csaikainyi et al., 2012), reduced cognitive ability (Yolton et al., 2005), reduced elasticity of the arterial cardiovascular system (Kallio et al., 2009), impairment of prospective memory (Heffernan and O'Neill, 2012) and increased inflammation markers (Dinas et al., 2014).

Homes have traditionally been known as the main indoor source contributing to SHS exposure among children and young adolescents (Picazani et al., 2003; Matt et al., 2004; Chan et al. 2007; Hughes et al., 2008) but recent studies have shown that exposure in public places are another important source of SHS which can potentially increase the health risk of exposed individual. As recorded in the Global Youth Tobacco Survey (GYTS) (CDC, 2013) data collected from 1998 to 2006 have reported that 47% of youth in the South-East Asia region were exposed to SHS in public places. In the context of Malaysia, about 75.7% of adolescents were reported to have SHS exposure outside of home (GTSS Collaborative Group, 2006).

The Framework Convention of Tobacco Control (FCTC) was introduced in 2003 by the World Health Organization with the main purpose of protecting the public from the repercussions of tobacco consumption and SHS exposure (WHO, 2014). As a signatory to the treaty, Malaysia and other various countries had developed and implemented smoke-free legislation or SFL that prohibit smoking in public places in order to provide a smoke-free environment to citizens (Kashiwabara et al., 2011; Panda et al., 2012; Abidin et al., 2013; Oh et al., 2013). Malaysia has implemented a partial-SFL which prohibits smoking in 21 types of public spaces (Malaysia Act, 2008; Abidin

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et al., 2013).

Recent tobacco control development has prompted the introduction of a comprehensive smoking prohibition that was introduced in the state of Melaka in 2011 (Abidin et al., 2013). Unlike the partial-SFL, the comprehensive smoking restriction extends to non-air-conditioned public spaces. The comprehensive smoking restriction was implemented in five urban areas namely Bandar Warisan Dunia, Melaka Raya, Melaka International Trade Centre, Alor Gajah City Centre and Jasin City Centre (Figure 1). Non-compliance with the legislation could result in fines up to RM10,000 (3017.50 USD) or 2 years imprisonment.

Among its member states, the introduction of FCTC's SFL has been shown to be associated with subsequent health improvements (Eisner et al., 1998; Allwright et al., 2005). In other SFL-related studies, smoking restrictions were found to be associated with improved lung function of SHS-exposed non-smoking adults (Gorini et al., 2008) and linked with lowered SHS exposures among children (Akhtar et al., 2007). These findings indicate SFL implementation was linked to improvements in respiratory health among a range of population sub-groups.

Recent studies had been conducted in several countries which focused on the implication of the SFL compliance among the public (Panda et al., 2012; Abidin et al., 2013; Oh et al., 2013). The environmental assessments on the measurement of particulate matter (PM2.5) and air nicotine in public places demonstrated that the concentration of contaminants continues to be high including in spaces where smoking is prohibited by law (King et al., 2011; Abidin et al., 2013; Oh et al., 2013).This evidence showed that non-smoking population continually to be exposed to SHS even in the wake of the SFL implementation.

In the context of Malaysia, in terms of its effectiveness there have been no local studies conducted among the public population in which the beneficial impact of reduced SHS exposures and its association with improved respiratory symptoms is evident. The effectiveness of the comprehensive-SFL in Melaka in its ability to protect susceptible population needs to be studied in order to identify gaps in implementation and eventually to further promote its use to other states in Malaysia. The main objective of this study was to examine the relationship between respiratory symptoms among adolescents and the implementation of SFL.

Materials and Methods

There has been no baseline study performed in Melaka prior to the implementation of the comprehensive-SFL in 2011. To overcome the lack of baseline data, measurements of effectiveness were conducted by comparing the distribution of SHS exposures and reported respiratory symptoms in a neighboring state with partial-SFL.

Study design and participants

This was a comparative cross-sectional study among 13-14 years old adolescents in Melaka (comprehensive-SFL state) and Kedah (partial-SFL state). Kedah was chosen as comparative state in this study since there were similarities in term of socio-demographic characteristic between both states.

In total, 11 out of 30 schools in Melaka and 10 out of 20 schools in Kedah were randomly selected for this study. The schools were selected from a list of secondary schools provided by Department of Education, Malaysia (ERAS, 2012). Schools located in urban areas of both states were sampled using a systematic random sampling method (Therese, 2004).

A total of 1,050 adolescents were selected based on a systematic random sampling method where the name lists of all students were obtained from school authorities prior to the data collection. From each school, 50 students from form one and two were selected to participate in this study.

Questionnaire

Questionnaires used in this study consisted of 1) a parental-completed questionnaire and 2) a self-completed questionnaire for each participating adolescent. All materials disseminated were provided in Malay language. Parental-administered questionnaires were used to gather relevant information related to socio-demographic

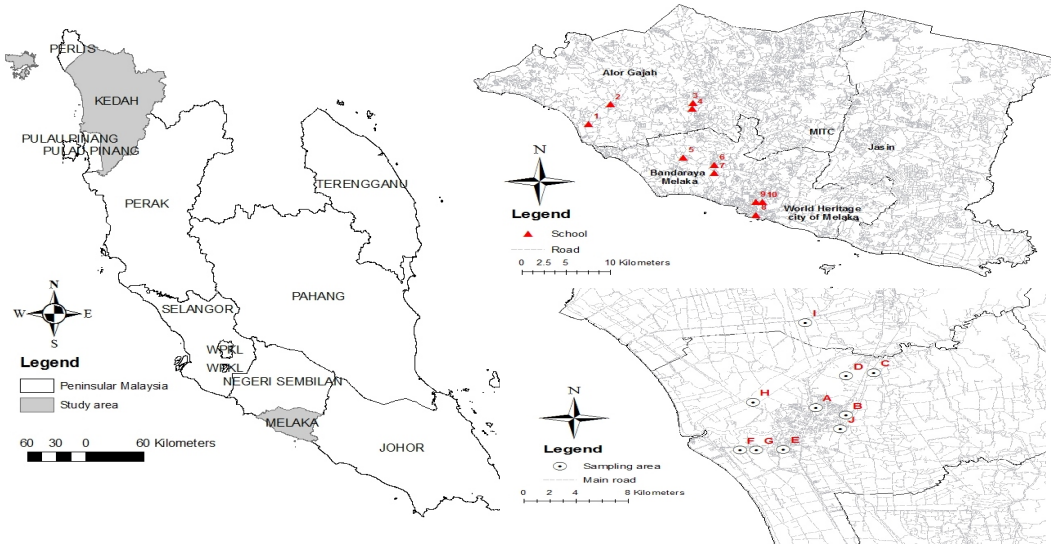

Figure 1. Map of Melaka, Kedah and Location of Schools Involved

background of the participants and data on history of prenatal and postnatal SHS exposures.

Standardized questionnaires disseminated to adolescents were used to obtain information regarding respiratory symptoms and current SHS exposures at and outside of home. Questions on respiratory symptoms were based on the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire for asthma among 13-14 years old (Asher et al., 1995). The ISAAC questionnaire were back-to-back translated from English to Malay and was validated by a native medical professional well versed in both languages. Ambiguities found in the questionnaire were amended.

Together with the distribution of the questionnaires, parents were given an envelope consisting of respondent information sheets and parental permission form via their children. To participate in this study, the signed permission form and the completed questionnaire was returned to the researcher within the same week. Adolescents who obtained permission to participate in this study were invited to complete the self-administered questionnaire in their respective classroom. In addition to the questionnaire, the ISAAC video for respiratory symptoms was presented to the adolescents to assist them in answering the written questionnaire. ISAAC video was developed by Wellington Asthma Research Group and consisted of five scenes of young adolescents who demonstrating five respiratory symptoms (ISAAC, 2012). The study protocol was approved by the Medical Research Ethical Committee of Universiti Putra Malaysia.

Assessment of SHS exposures

Assessment of current SHS exposure included adolescents' exposure in the previous three months. Questions on indoor SHS exposure included household smoking habits and practiced of home smoking restriction among smoking family members. The questions also cover the frequency of SHS exposures through following questions: "1) how many days a week do people smoke in your presence?; and 3) how many hours a day are you exposed to tobacco smoke indoors?." Outdoor SHS exposures were assessed via the following questions; "are there any individual who smokes in any restaurant, air-conditioned restaurant, entertainment venues, shopping complex and public transports you had visited in the last 30 days?." Prenatal SHS exposure was defined according to the mother's exposure during pregnancy to smoke from either her husband or others, while postnatal or early-life exposure to SHS was defined by smoking of the mother, father, or other household members.

Statistical analyses

Statistical analyses were performed using IBM SPSS Statistics 21.0 (SPSS Inc., Chicago, IL, USA). Descriptive analyses were used to describe socio-demographic information as well as the prevalence of respiratory symptoms. To determine the differences of the prevalence between the partial-SFL and comprehensive-SFL states, the chi-square test was performed for data analysis. In order to examine the association between respiratory symptoms and SHS exposure, multi-level logistic regression analyses were used to obtain Adjusted Odds Ratio (AOR) with 95% Confidence Interval (CI) . Significant independent variables in the cross-tabulation test and well-proven variables which contribute to respiratory symptoms in other studies were included in the multi-level logistic regression analysis. It was performed to assess the significant risk factors associated with reported respiratory symptoms. Significance level was set at $p<0.05$ however for the multi-level logistic regressions,

Table 1. Socio Demographic Information of Respondents (N=898)

Variables	Comprehensive-SFL State		Partial-SFL State		Total	
	n (%)					
Gender*						
Male	177	(39)	203	(46)	380	(42.3)
Female	277	(61)	241	(54)	518	(57.7)
Total	454	(100)	444	(100)	898	(100)
Ethnicity*						
Malay	337	(74)	388	(87)	725	(80.7)
Non-Malay	117	(26)	56	(13)	173	(19.3)
Total	454	(100)	444	(100)	898	(100)
Household income*						
<RM500[a]	47	(10.4)	56	(13)	103	(11.5)
RM501-RM2000	231	(50.8)	253	(57)	484	(53.9)
> RM2000[b]	161	(35.5)	135	(30)	296	(33.0)
Missing	15	(3.3)	0	(0)	15	(1.7)
Total	454	(100)	444	(100)	898	(100)
Father's educational level*						
Primary	0	(0)	0	(0)	0	(0)
Secondary	271	(66)	338	(76.1)	609	(67.8)
Tertiary	138	(34)	96	(21.6)	234	(26.1)
Missing	45	(9.9)	10	(2.3)	55	(6.1)
Total	454	(100)	444	(100)	898	(100)
Mother's educational level*						
Primary	0	(0)	0	(0)	0	(0)
Secondary	284	(62.6)	361	(81.3)	645	(71.8)
Tertiary	131	(28.8)	81	(18.2)	212	(23.6)
Missing	39	(8.6)	2	(0.5)	41	(4.6)
Total	454	(100)	444	(100)	898	(100)

*significant at $p<0.05$; [a]RM500= 150.4 USD; [b]RM2000= 601.4 USD

Table 2. Prevalence of Respiratory Symptoms among Adolescents in the Full-SFL and Partial SFL State (%)

Respiratory symptoms (n)	Comprehensive-SFL State (N=454) n (%)	Partial-SFL State (N=444) n (%)
Wheezing ever*		
Yes (107)	70 (15.4)	37 (8)
Current wheezing*		
Yes (50)	31 (6.8)	19 (4)
Attack of breathlessness in the past 3 months*		
Never (7)	2 (0.4)	5 (1)
1-3 (34)	16 (3.5)	18 (4)
4-12 (13)	12 (2.6)	1 (0.2)
>12 (3)	2 (0.4)	1 (0.2)
Average of sleep interrupted because of shortness of breath in the chest in the past 3 months*		
Never (20)	12 (2.6)	8 (2)
<1 night per week (21)	11 (2.4)	10 (2)
≥1 night per week (15)	10 (2.2)	5 (1)
Wheezing ever been severe enough to limit speech to only one or two words at a time between breath*		
Yes (13)	6 (1.3)	7 (2)
Self-reported asthma*		
Yes (118)	76 (16.7)	42 (10)
Exercise-induced wheeze*		
Yes (200)	118 (26)	82 (19)
Nocturnal cough*		
Yes (111)	58 (12.8)	53 (12)

*significant at $p<0.05$

a Bonferroni correction was applied where p value was set at p<0.005.

Results

Out of 1,050 invited participants, 898 (85.5%) adolescents participated in this study. The response rate was 90.8% (n=454) for the comprehensive-SFL state and 92.5% (n=444) for the partial-SFL state.

There were more females (57.7%), Malay ethnicity (80.7%), and families earning less than RM2000.00/month (USD 601.4) (65.4%) in both states (Table 1). Generally in both states, the highest parental education was the secondary level.

Prevalence of respiratory symptoms

A higher prevalence for wheezing ever (15.4%), current wheezing (6.8%), attack of breathlessness in the past 3 months (6.5%), asthma (16.7%) and exercise-induced wheeze (26%) was reported in the comprehensive-SFL state compared to the partial-SFL state (Table 2).

Table 3. SHS Exposure of Adolescents

SHS Exposure (n)		Comprehensive-SFL State (N=454) No. (%)	Partial-SFL State (N=444) No. (%)
Smoking family members	Yes (550)	275(60.8)	275 (62.1)
Daily SHS exposure			
<1 hour (653)		302(66.5)	351 (79.1)
1-4 hours (180)		102(22.5)	78 (17.6)
≥5 hours (40)		26 (5.7)	14 (3.2)
Missing (25)		24 (5.3)	1 (0.2)
Smoking restriction	Yes (560)	301(68.4)	259 (58.5)
Prenatal SHS exposure	Yes (149)	84(18.5)	65 (14.6)
Prenatal daily SHS Exposure			
<1 hour (804)		394(86.8)	410 (92.3)
1-4 hours (59)		35 (7.7)	24 (5.4)
>5 hours (16)		6 (1.3)	10 (2.3)
Missing (19)		19 (4.2)	0 (0)
Postnatal SHS exposure	Yes (230)	105(23.1)	125 (28.2)
Permit smoking in vehicle	Yes (152)	69(15.5)	83 (18.7)
SHS exposure in public places:			
a) Restaurant	Yes (524)	275(60.6)	249 (56.1)
b) Air-conditioning restauranta	Yes (107)	55(12.1)	52 (11.7)
c) Entertainment venuea	Yes (199)	85(18.7)	114 (25.7)
d) Shopping complexa	Yes (410)	213(46.9)	197 (44.4)
e) Public transporta	Yes (74)	42 (9.3)	32 (7.2)

*Significant at p<0.05; [a]Public places which covered under Part IV: Prohibition on smoking, Control of Tobacco Product Regulation 2004 and non-compliance among the comprehensive-SFL state and the partial-SFL states' residents

SHS exposures

Daily SHS exposure and smoking restriction at home demonstrated a significant difference in both states in which partial-SFL state had higher percentage of subjects who had exposure less than 1 hour/day (Table 3). The partial-SFL state had higher percentage of adolescents who were exposed to SHS at home (42%) compared to the comprehensive-SFL state (32%). Home smoking restrictions were common in the comprehensive-SFL state (68.4%) compared to the partial-SFL state (58.5%). In terms of prenatal and postnatal SHS exposures, there were no significant differences between the partial-SFL and comprehensive-SFL states.

In terms of outdoor SHS exposures, there was a higher reported prevalence of exposure in restaurants (60.6%), air-conditioning restaurants (12.1%), shopping complexes (46.9%), and public transport (9.3%) in the comprehensive-SFL state compared to the partial-SFL state.

Association between reported respiratory symptoms and SHS exposures

The SFL implementation was not associated with a lower risk for the reporting of asthma symptoms (Table 4). Reported SHS exposure in public transport was significantly associated with reported wheezing ever (AOR 16.6; 95%CI, 2.69-102) and current wheezing (AOR 24.6; 95%CI, 3.53-172).

Discussion

This study aimed to assess the relationship between reported respiratory symptoms and the implementation of SFL among Malaysian adolescents living in states with different implementation level of SFL. In this study, half of the adolescents reported recent SHS exposure while they were in non-air-conditioning restaurants. There were also

Table 4. Hierarchical Logistic Regression on SHS Exposures (simultaneously) Associated with Respiratory Symptoms [AOR (95%CI)][a]

Variables		Wheezing ever	Current wheezing	Exercise-induced wheeze	Nocturnal cough	Self-reported asthma
BLOCK 1						
Family members' smoking status ([b]No)	Yes	0.61 (0.07-5.30)	0.57 (0.07-4.89)	1.23 (0.27-5.58)	1.16 (0.12-6.95)	0.85 (0.18-3.92)
SHS (day) ([b]<4)	>4	1.20 (0.30-4.96))	0.59 (0.10-3.52)	1.47 (0.54-4.03)	1.45 (0.46-4.63)	1.17 (0.39-3.54)
Smoking restriction ([b]Yes)	No	2.30 (0.20-27.26)	1.31 (0.11-15.54)	1.35 (0.34-5.37)	1.06 (0.23-4.92)	1.25 (0.28-5.50)
SHS exposure at restaurant ([b]Yes)	No	2.02 (0.49-8.41)	1.03 (0.19-5.73)	0.93 (0.33-2.59)	1.67 (0.52-5.32)	0.84 (0.28-2.58)
SHS exposure at shopping complex ([b]Yes)	No	2.82 (0.70-11.30)	2.87 (0.57-14.34)	1.55 (0.58-4.13)	0.80 (0.26-2.47)	1.15 (0.41-3.23)
SHS exposure in public transport ([b]No)	Yes	16.6 (2.69-101.7)*	24.6 (3.53-171.8)*	1.27 (0.30-5.39)	4.09 (0.93-18.03)	2.64 (0.65-10.67)
BLOCK 2						
State ([b]Comprehensive-SFL)	Partial-SFL	0.26 (0.06-1.16)	0.21 (0.04-1.25)	0.26 (0.09-0.70)	0.70 (0.23-2.14)	0.56 (0.20-1.58)
BLOCK 3						
Gender ([b]Male)	Female	5.42 (1.17-25.08)	0.31 (0.06-1.61)	0.58 (0.22-1.52)	0.58 (0.19-1.81)	0.96 (0.34-2.67)
Prenatal SHS exposure ([b]Yes)	No	0.08 (0.004-1.91)	-	0.27 (0.02-4.03)	-	-
Prenatal SHS exposure ([b]<1hour)	1-4 hours	1.15 (0.29-4.57)	0.6 (0.13-3.07)	0.62 (0.23-1.69)	0.66 (0.20-2.20)	0.88 (0.29-2.61)
	>5 hours	1.10 (0.09-12.37)	1.71 (0.13-22.50)	0.38 (0.07-2.11)	0.89 (0.16-4.99)	0.78 (0.14-4.36)
	Classification rate	90.4 (37.5/99.0)	93.0(41.7/99.0)	75.4(25.8/94.0)	82.5(5.3/97.9)	82.5(9.1/100)
	Cox & Snell R Square-Nagelkerke R square					
		0.20-0.36	0.19-0.38	0.13-0.19	0.08-0.13	0.06-0.10

*Bonferroni correction, significant at p<0.005; [a]Multi-level logistic model (exposure-state-student) was applied with all factors related to SHS exposures, implementation of SFL in both states, and personal factors were included in the model simultaneously; [b]Reference

significant associations shown between reported wheezing ever and current wheezing with SHS exposure in public transport; there was no statistically significant difference according to the SFL implementation level.

This study has a limitation. Information on prenatal and postnatal SHS exposures was collected retrospectively via questionnaire. The method of memory recall over an extended period of more than 10 years is likely to be subjected to bias (Matt et al., 2000; Yolton et al., 2005). Notwithstanding these limitations, this study only recruited younger adolescents group (13-14 years old) in which the possibility of being an active smoker is small (Institute of Public Health, 2008). The questionnaire answering sessions were conducted in a classroom setting. This helped to ensure the instructions given to the students involved were standardized. Moreover, the paper questionnaire was supplemented with the ISAAC video questionnaire to assist the adolescents in the session.

The adolescents in the comprehensive-SFL state had higher prevalence of respiratory symptoms compared to the adolescents in the partial-SFL state. Asthmatic adolescents were more common in the comprehensive-SFL state (16.7%) compared to the partial-SFL state (10%) and they were more likely to report respiratory symptoms compared with the non-asthmatic. It is possible that the higher percentage of reported asthma in the comprehensive-SFL state may be a result of greater awareness of asthma due to the comprehensive SFL and the associated public health campaigns.

Adolescents living in the comprehensive-SFL state were less likely to be exposed to SHS at home compared to the partial-SFL state. This was shown by the higher home smoking restrictions practiced in the comprehensive-SFL state. Adolescents in the comprehensive-SFL state were also less likely to have smoking family members compared to adolescents living in the partial-SFL state.

Although this study could not demonstrate the difference on home smoking restriction before and after the SFL implementation, there was a clear difference on home smoking restriction practiced by families between the comprehensive-SFL and the partial-SFL states. A previous study in Scotland showed that smoking restriction at homes was more common after the SFL implementation compared to prior to implementation (Akhtar et al., 2007). The current study results in relation to household smoking restrictions suggest that it is possible that the benefits of comprehensive-SFL go beyond the intended impact of reducing SHS exposure in public spaces.

The most frequent SHS exposure reported in this study occurred in restaurants. Despite the existing smoking prohibition in public spaces in Malaysia (Malaysia Act, 2008) there were more reports of SHS exposure that occurred at restaurants in the comprehensive-SFL state compared to the partial-SFL state. However, the current legislation failed to cover the non-air-conditioned public premises, thus, resulting in the high reported percentage of smoking in restaurants in this study. There is a clear need to amend the current legislation in Malaysia to include public spaces such as open-air restaurants.

This study was also able to identify the gaps in the compliance of SFL in both states. Adolescents in the comprehensive-SFL state reported frequent SHS exposures (>50%) in air-conditioned restaurants and shopping complexes, whereas in the partial-SFL state, SHS exposure mostly occurred at entertainment venues. The high levels of non-compliance may be due to a poorly understood SFL campaign or weak enforcement. Nationally, the enforcement of smoking restriction lies under Ministry of Health specifically under the authorization of the Assistant Environmental Health Officers (AEHO). These officers are the authorized persons to raise penalty charges or compounds for any cases of SFL non-compliance (Tee et al., 2013). The penalty system has been enforced nationwide but due to other routine duties of the officers, enforcement activity covering all public areas may not be taking place.

This study identified that a proportion of adolescents were frequently exposed to SHS on public transport. Smoking prohibition in public transportation applies throughout Malaysia (Malaysia Act, 2008), in addition to the non-smoking policy stipulated by transportation companies. Although the exposure in public transport was the least reported venue for adolescents (compared to all other public spaces included in this study), the association identified between this exposure and respiratory ill health suggests that it is particularly important to focus on. Although enforcement by the AEHO is regularly performed (Melaka Smoke Free Zones, 2013) this finding emphasizes the need for monitoring compliance to SFL in public transportations. This is important because the exposure to SHS in public vehicles may be more detrimental as the volume in such environments may be small causing exposure to occur at higher concentrations compared to other more spacious public places (Jones, 1999).

Similar to a previous study, this study showed a significant positive link between the reported respiratory symptoms with exposures to SHS in public transport (Martin-Pujol et al., 2013). Study have shown that adolescent spend more time outside the home (GTSS Collaborative Group, 2006) and more likely to utilize public transportation. Thus, effective preventive measures to reduce SHS exposure in public transport needs to be given a higher priority. However, this finding needs to be carefully interpreted because the number of adolescents reporting SHS exposure on public transportation was relatively small (<10%). Statistically, a small percentage would project a large CI for the OR (James and Savitri, 2005). Thus, the finding of this study should consider the factor of overestimation as presented in the hierarchical logistic regression results.

This study was unable to identify any impact arising from comprehensive-SFL implementation compared to partial-SFL in terms of differential respiratory symptoms or the occurrence of asthma among non-smoking adolescents. A major concern is high levels of non-compliance with SFL as evidenced by the finding of this study where SHS exposures were reported to occur in many smoking-prohibited public spaces.

This study has been able to provide a baseline data on the status of SHS exposures and the level of respiratory symptoms among 13-14 years old adolescents. Future

studies might be able to utilize the findings in this study for the purpose of assessing the effectiveness of SFL in Melaka.

In conclusion, this study identified an association between SHS exposure in public places and reported respiratory symptoms in adolescents. This study also showed non-compliance with SFL in the comprehensive and partial-SFL states. Stricter enforcement of SFL in public places by the relevant authority should be a priority. With improved compliance, SFL implementation has the potential to protect adolescents from the negative health effects of SHS.

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