ORIGINAL ARTICLE

Prevalence and Factors Associated With Total Smoking Restriction at Home in Malaysia: Findings From a Nationwide Population-Based Study

Lim Kuang Hock[1], Lim Hui Li[2], Kee Chee Cheong[1], Sumarni Mohd Ghazali[1], Heng Pei Pei[1], Cheah Yong Kang[3], Lim Jia Hui[4]

[1] Institute for Medical Research, Jalan Pahag, 50588, Kuala Lumpur.
[2] Hospital Sultan Haji Ahmas Shah, Jalan Maran, 28000, Temerloh, Pahang Darul-Makmur.
[3] School of Economics, Finance and Banking. College of Business, Universiti Utara Malaysia. 06010 UUM Sintok, Kedah Darul Aman.
[4] Monash Malaysia University Campus, Jalan Lagoon Selatan, Bandar Sunway, 47500 Subang Jaya, Selangor

ABSTRACT

Introduction: Total restriction on smoking in the home is an effective tool to reduce Second-hand smoke (SHS) exposure in private dwellings. The aim of this study is to determine the prevalence of total smoking restrictions in Malaysian homes and factors associated with its adoption. **Methods:** We analyzed data from a cross-sectional, household study – the Global Adult Tobacco Survey 2011, which involved a representative sample of Malaysian adults. Factors associated with the adoption of a totally smoke free home policy was determined by multivariable logistic regression. **Results:** Out of the 4250 respondents studied, 40.9% (95% CI 38.1-43.8) adopted a total smoking restriction within their homes. Adoption of total smoke-free home policy was significantly higher among Chinese and Indians, those without smokers in the house, non-smokers and government employees. The likelihood of adopting the total smoking restriction at home was lower among current smokers, of Malay ethnicity, low education attainment, having at least one house member who smoked, residing in rural areas, single or widow/widower/divorcee, those working in the private sector or self-employed. **Conclusions:** Less than half of Malaysian households implemented a total smoking restriction in their residence. Targeted activities to encourage the adoption of voluntary smoke-free rules among groups least likely to implement 100% smoking restrictions in the home are urgently needed with participation of all stakeholders to ensure its success.

Keywords: Second-hand smoke, Total home smoking restriction, Population-based study, Malaysian adults, Global adult's tobacco survey

Corresponding Author:
Lim Kuang Hock, MSc
Email: limkh@imr.gov.my
Tel: +603-26162666

INTRODUCTION

Second-hand smoke (SHS) consists of sides-stream smoke and exhaled mainstream smoke (1). Exposure to SHS contributes to various health problems, such as increased risk of lung cancer, heart disease, and respiratory conditions among adults (2-4). It is estimated that SHS exposure contributes to 600,000 premature deaths globally annually and contributes to about 1% of the total global disease burden (5,6). Exposure to SHS also imposes an economic burden on individuals and countries, both through direct health care costs and indirect costs from reduced productivity. An estimated 10% of the total tobacco-related economic cost is attributable to second-hand tobacco smoke exposure (7).

To protect non-smokers from SHS exposure and to create environments that deter smokers from smoking, the Malaysian government through the Ministry of Health introduced a law restrictionning smoking in several public places, among them health facilities and in public transport vehicles through the Control of Tobacco Products Regulation 1993(8). The regulation has gone through several amendments, in 1997, 2004, 2006, 2008 and 2011 (9-12), to expand the non-smoking areas. As of the year 2016, 38 public areas and workplaces have been gazetted under the regulation (13-16). However, residential areas are not included in the regulation.

Some studies have shown that the home is a major site of exposure to SHS among adults and children (17,18)

particularly in homes with smokers. SHS exposure can be substantially reduced when smoking in the home is restricted completely (17,19,20). Furthermore, in smoke-free homes, the quantity of cigarettes smoked is reduced, smoking cessation increased, and smoking initiation among adolescents reduced (20,21). Overall, this measure will denormalise smoking in the home. Total home smoking restrictions have been associated with male gender (19), non-smoker status (22), no smokers in the home (19), fewer friends who smoked (23) higher levels of education (24), younger age (19,24), presence of children in the home (22,23) and belief that SHS is harmful (22). It is not known if these factors are relevant in the Malaysian context. Research in several countries have indicated that home smoking restrictions are not equally distributed in populations and vary widely among population subgroups (19, 25).

To our knowledge, to date there has never been a study to document the prevalence of home smoking restrictions in Malaysia. The national population-based surveys that have been carried out since 1996 (26-28) reported on the prevalence of smoking and factors associated with smoking among adults, but shared little data on SHS exposure. However, the 2006 National Health and Morbidity Survey (NHMS) did report that 21.5% of Malaysian adults were exposed to SHS for at least 15 minutes in the past week (27) but lacked information on where the exposure occurred.

Therefore, it is pertinent to investigate smoke free home policy adoption in Malaysia to assist in devising suitable measures to address SHS exposure at home. The purpose of this article is firstly to estimate the prevalence of private home smoking restrictions, and secondly, to identify factors associated with having a full restriction, in Malaysia.

MATERIALS AND METHODS

Data was derived from the Malaysian Global Adult Tobacco Survey (GATS-M) 2011, "GATS-M" was a cross-sectional study employed the three-stage proportionate-to-size sampling, to obtain a representative sample of non-institutionalized Malaysians aged 15 years and above. The first stage consisted of 15 Malaysian states whilst second stage was the division of urban and rural areas by each state. The primary sampling units were enumeration blocks (EBs) (artificial geographical areas created by the Department of Statistics) which consist of 80-120 living quarters based on year 2010 population census and living quarters (LQs) were the secondary sampling unit. A total of 426 EBs (222 urban and 204 rural) were selected by stratified sampling and from these, 5,112 LQs were selected via simple random sampling.

Face to face approach was used to obtain information from the selected respondents using handheld computers (IPAQ) by trained research assistants (RA). Each RA had one iPAQ. A real case file containing the addresses and names of household members aged 15 years and above from the selected LQs by simple random sampling was pre-loaded into the iPAQ before the field work. Trained research assistants provided detailed explanation of the purpose of the survey to the selected respondents. The interview was commencing only after obtaining written consent. All the responses were entered by the interviewer in the iPAQ,

Short telephone interviews for verification with 10% of the completed households was employed for quality control. To ensure a high response rate, selected respondents who were not at home after at least three attempted visits were excluded from the survey. The detailed methodology has been published previously (29) Medical Research and Ethical Committee, Ministry of Health Malaysia provide the ethical clearance for the study.

The dependent variables included restriction on smoking at home, which was examined by the item "Which of the following describes the regulation about smoking in your house" with the four answer choices. Those who answered "smoking is allowed in the house"; "no regulation" or "smoking usually is not allowed but there are exceptions" were classified as not adopting a total home smoking restriction, those who selected the choice of "not allowed in the house" was categorised as total restriction.

Independent variables were social demographics variables (gender, ethnicity, education attainment, age group, locality marital status, income level (the lowest quintile being the poorest and the highest quintile being the richest). Smoking status, household member/s who smoked, and the knowledge of health hazard of SHS .Smoking status was evaluated by the item "Do you currently smoke cigarettes?" Respondents who answered "not at all" to the item was classified as "non-smokers" whilst those who answered "daily, less than daily" as "current smokers". Whilst status of household member/s who smoked was examined by "Does any member of your household smoke? The knowledge of SHS was measured by four items, namely i) Breathing other people's smoke causes serious illness, ii) SHS causes heart disease among adults, iii) SHS causes cancer among adults and iv) SHS causes cancer in children with the choice of "Yes" or "No".

The data were cleaned, and weights were applied in the analysis for study design, and non-response rate. Descriptive statistics were calculated to illustrate the social demographic characteristics of the respondents. Cross tabulation was employed to describe proportion of respondents exposed to SHS, with Chi-square tests comparing categorical independent variables with home smoking policy. Multivariable logistic regression

(MLR) analysis was used to determine the association of independent variables with Total smoking restriction at home . The model included all independent variables that were significant at p≤0.25 in the univariable analyses (30). The fit of the final models was checked by STATA version 11 statistical software using modified Hosmer-Lemeshow Goodness of Fit test for complex samples (31). A non-significant p value (>0.05) indicated that the model had good fit. Tests for possible two-way interactions in the final custom model showed no significant interactions were present. SPSS statistical software version 20 was used to carry out the analysis.

RESULTS

The study response rate was 81.2% (4,250/5,233), with a balanced proportion of male and female respondents (51.2% and 48.8%). Almost three-quarters of the respondents resided in urban localities (72.1%) and were non-smokers (76.9%). Most respondents were Malay (58.9%) followed by Chinese (18.6%), other ethnic (13.2%) and Indian (9.3%). Two-thirds of respondents were in the young adult to middle-age groups (25-64 years). Total and partial smoke-free homes were reported by 40.9% and 16.9% of respondents respectively (Table I).

Table II shows the proportion of total smoke-free homes was significantly higher among respondents of Chinese(54.6%) and Indian (50.7%) ethnicity, government employees (49.5%), females (45.4%) and urban residents (44.1%). The proportion of total smoke-free homes was lower among respondents with lower education attainment (30.3%) and in lowest quintile of income (25.8%). The proportion of total smoke free homes among non- smoker and without household members who smoked were almost two times higher than their counterparts (46.7% vs 22.0%; 50.9% vs 23.9%). While the proportion who perceived SHS will cause harm to non-smoker and cancer to children were significantly higher compared to their counterparts. The study also revealed that the proportion of partial home free smoke were not significant across all social demographic variables.

Significant associations were observed between total home smoking restriction and level of education, occupation, ethnic group, marital status, residential area, smoking status, at least one household member who smoked and age groups (Table III). Respondents with tertiary education attainment were more likely to apply a total smoking restriction at home than those without formal education. and those who worked in the private sector and the self-employed were less likely to not have a smoke-free home policy compared to government employees. Respondents from the lower quintile of income (quintile 1) were less likely to have a total home smoking restriction than those from the highest quintile. In addition, smokers and those who had

Table 1: Social and demographic characteristics of respondents (n=4250)

Variable	n	%	95% CI	
			Lower	Upper
Gender				
Male	2086	51.2	49.3	53.1
Female	2164	48.8	46.9	50.7
Ethnicity				
Malay	2531	58.9	55.0	62.6
Chinese	641	18.6	15.7	21.8
Indian	263	9.4	7.5	11.6
Others	815	13.2	11.2	15.6
Marital status				
Married	2712	58.5	56.2	60.8
Single	1042	35.1	32.9	37.4
Widow/er	490	6.4	5.6	7.2
Education attainment				
- Less than primary	651	10.1	8.9	11.4
- Primary	1393	30.8	28.7	32.8
- Secondary	1779	46.6	44.4	48.7
College and above	406	12.6	10.9	14.6
Occupation				
Government	397	8.8	7.7	10.1
Private	1112	32.1	29.6	34.7
Self employed	843	15.2	13.7	16.7
Home maker	1707	39.6	37.4	41.9
Retiree	187	4.3	3.5	5.4
Age group (Years old)				
15-24	742	27.7	25.7	29.8
25-44	1768	41.5	39.4	43.7
45-64	1326	23.8	22.0	25.5
65+	414	7.1	6.1	8.2
Income level				
Quintile 5	846	29.3	26.9	31.9
Quintile 4	842	23.3	21.6	25.1
Quintile 3	822	20.6	18.9	22.5
Quintile 2	829	15.4	13.9	17.0
Quintile 1	844	11.4	10.0	12.9
Residential area				
Urban	2065	72.1	70.6	73.6
Rural	2185	27.9	26.4	29.4
Smoking status				
Smoker	989	23.1	21.2	25.2
Non-smoker	3261	76.9	74.8	76.8
Home smoking restriction				
None	2207	46.2	43.4	49.0
Partial	430	16.9	10.9	15.1
Total	1549	40.9	38.1	43.8
Have at least one smoker in the home				
Yes	1598	36.1	34.0	38.3
No	2645	63.9	61.7	66.0

Table II: Total restriction on Smoking at home by social-demography, smoking status and knowledge of SHS Hazard

Variable	Total restriction of smoking at home								Chi-Square value	p value
	No total restriction				Total restriction					
	N*	n**	%	95% CI	N	n	%	95% CI		
Gender										
Male	658444	1386	63.3	59.6-66.7	3819972	672	36.7	33.3-40.2	30.65	<0.001
Female	5361902	1251	546	51.2-52.9	4458045	874	45.4	42.1-48.8		
Ethnicity										
Malay	7643171	1696	64.1	60.9-67.1	4288497	810	35.9	32.9-39.1	104.05	<0.001
Chinese	1701910	297	45.4	39.4-51.6	2045254	331	54.6	48.4-60.6		
Indian	931102	129	49.3	40.7-57.9	958514	131	50.7	42.1-59.3		
Others	1665986	514	62.8	55.6-69.5	985753	277	37.2	30.4-44.4		
Age group(years)										
15-24	3327442	458	59.7	54.4-64.4	2250264	268	39.3	35.6-45.3	0.394	0.975
25-44	4962159	1079	58.9	55.3-62.4	3463899	667	41.1	37.6-44.7		
45-64	2813134	834	58.5	53.8-63.0	1996949	478	41.5	37.0-46.2		
65+	843508	266	59.8	51.7-67.4	566964	136	40.2	32.6-48.3		
Marital status										
Married	6787938	1632	57.2	54.0-60.3	5086369	1054	42.8	39.7-46.0	9.26	0.051
Single	4348113	674	61.7	57.4-65.8	2700154	345	38.3	34.2-42.6		
Widow/widower/divorcee	799911	328	62.7	55.7-69.2	476191	140	37.3	30.8-44.3		
Education level										
Less than primary	1373273	457	69.7	63.5-75.0	596708	168	30.3	25.0-36.1	32.74	<0.001
Primary	3634255	887	58.2	53.9-62.5	2605151	492	41.8	37.5-46.1		
Secondary	5588763	1076	59.6	55.8-62.3	3792787	687	40.4	36.7-44.2		
College and above	1315653	208	51.3	45.2-57.4	1246912	194	48.7	42.6-54.8		
Occupation										
Government	892965	201	50.5	43.5-57.4	896946	192	49.5	42.6-56.5	53.46	<0.001
Private	4043127	692	62.3	58.3-66.2	2443300	402	37.7	33.8-41.7		
Self employed	2094579	612	67.8	62.7-72.5	995398	222	32.2	27.5-37.3		
Home maker	4099738	1031	56.3	52.3-60.1	3495716	643	43.7	39.9-47.7		
Income level										
Quintile 5	3067557	442	52.5	47.1-57.8	2777579	394	47.5	42.2-52.9	76.74	<0.001
Quintile 4	2543850	471	54.9	50.0-59.7	2089879	359	45.1	40.3-50.0		
Quintile 3	2600258	522	62.5	57.6-67.2	1556806	294	37.4	32.8-42.4		
Quintile 2	1868290	537	60.3	54.8-65.5	1230853	282	39.7	34.5-45.2		
Quintile 1	1660439	615	74.2	68.8-79.0	576782	205	25.8	21.0-31.2		
Residential										
Urban	8144153	1131	55.9	52.5-59.3	6417374	899	44.1	40.4-47.8	43.89	<0.001
Rural	3802163	1503	67.1	63.0-71.0	1860642	650	32.9	29.0-37.0		
Smoking status										
Smoker	3685573	800	78.0	50.2-56.4	1041618	184	22.0	18.1-26.5	188.58	<0.001
Non-smoker	8260744	1837	53.2	50.2-56.4	7236399	1365	46.7	43.6-49.8		
At least one household member smoked										
Yes	5619026	1260	76.3	72.6-79.6	1747758	327	23.7	20.4-27.5	294.87	<0.001
No	4873570	1373	49.1	45.9-52.3	6525852	1219	50.9	47.7-54.1		
Hazard of SHS (nonsmoker)										
Yes	9964790	2154	57.4	54.3-66.3	7409697	1370	42.6	39.7-45.7	25.07	<0.001
No	904769	203	69.6	65.6-90.1	855475	177	30.4	25.6-35.7		
Hazard of SHS (Heart disease)										
Yes	9534416	2040	58.9	55.8-61.9	6649983	1237	41.1	38.1-44.2	0.60	0.855
No	992375	237	59.7	54.6-64.6	1618975	311	40.3	35.4-45.4		
Hazard of SHS (Cancer-Adult)										
Yes	10207474	2194	58.5	55.5-61.5	7241631	1361	41.5	38.5-44.5	2.73	0.192
No	599023	156	62.4	56.7-67.8	1036386	188	37.6	32.2-43.4		
Hazard of SHS (Cancer-children)										
Yes	1009612	2176	57.7	54.7-60.6	7346340	1367	42.3	39.4-45.3	11.38	0.008
No	679134	149	69.7	62.0-72.9	922618	181	32.3	27.1-38.0		

N* - Estimate population n**- sample

Table III: Multivariable Logistic Regression (MLR) to determine associated factors with total smoking restriction at home

Variable	Adjusted Odd Ratio	95% CI	
		lower	upper
Gender			
Male	0.94	0.76	1.16
Female	Ref		
Ethnicity			
Malay	0.55*	0.41	0.75
Chinese	Ref		
Indian	0.91	0.60	1.38
Others	0.83	0.56	1.25
Marital status			
Married	Ref		
Single	0.79*	0.65	0.98
Widow/widower/divorcee	0.69*	0.49	0.91
Education level			
Less than primary	0.56*	0.37	0.83
Primary	0.99	0.73	1.33
Secondary	0.93	0.71	1.22
College or above	Ref		
Occupation			
Government	Ref		
Private	0.63*	0.43	0.91
Self employed	0.61*	0.41	0.91
Home maker	0.75	0.51	1.08
Retiree	1.12	0.60	1.72
Income level			
Quintile 5	Ref		
Quintile 4	1.08	0.82	1.41
Quintile 3	0.89	0.66	1.20
Quintile 2	1.12	0.81	1.59
Quintile 1	0.66*	0.46	0.95
Residential area			
Urban	Ref		
Rural	0.76*	0.58	0.98
Smoking status			
Smoker	0.56*	0.41	0.76
Non-smoker	Ref		
At least one household member smoker			
Yes	0.38*	0.30	0.48
No	Ref		
Hazard of SHS to non-smoker)			
Yes	Ref		
No	0.71	0.50	1.01
Hazard of SHS (Cancer-Adult)			
Yes	Ref		
No	1.30	0.86	1.96
Hazard of SHS (Cancer-children)			
Yes	Ref		
No	0.86*	0.60	0.99

* significant at p<0.005

household members who smoked also reported lower odds of having a total home smoking restriction policy.

DISCUSSION

This study revealed that approximately two-fifths (40.9%) of Malaysian households practice a total smoking restriction at home. The proportion was higher compared to 19% reported by Hughes et al (2009) among residents in Seoul (17), South Korea. The six counties study (31) reported a prevalence of 26% among Chinese adults and another study in Shanghai reported 33% (22). However, a Polish study reported almost similar results, 37.1% (33) Nevertheless, these proportions are far lower than the 78% and 81.1% reported in the United States (34) and in European countries (59.5% of French, 63.5% in Ireland, 61.3% in Italy, 74.4% in Czechoslovakia and 87% in Sweden (35). The International Tobacco Control (ITC) wave 3 study in Malaysia in 2009 reported similar prevalence of smoking restriction i.e 40%(35). This plateau may be linked to a smoking prevalence among Malaysian adults similarly plateauing between 2006-2011 (27,28). The reasons why the proportion of total smoking restrictions at home in Malaysia is lower compared to other countries might be due to differences in the nature and duration of anti-tobacco control measures as well as differences in terms of social approval or social norms for smoking. Each country has their own country-specific interventions and policies with special focus on smoke-free public places and adopting 100% smoke-free homes, which are not practised in Malaysia. In both developed (United States) and developing countries (Poland), total home smoking restrictions have been consistently less prevalent among smokers (20,33) The greater resistance among smokers to implement smoking restriction at home may be due to their behaviour. They resist change even though they realize that smoking is harmful to health, to reduce the psychological dissonance, they mentally downplay the risks so that it is compatible with their smoking habit (37). It is also plausible that respondents who smoke are more likely to live with other smokers or with non-smokers who are tolerant of smoking (17). Another plausible reason for the current finding is nicotine dependence among adult smokers. More than 90% of Malaysian smokers are daily smokers (28) and the likelihood of nicotine dependence is high. Therefore, they might be reluctant to implement a total smoke free home in addition to the expansion of smoke-free areas under the control of tobacco regulation.

Respondents who reported having at least one household member who smoked were also less likely to apply a total smoking restriction at home. This corroborates findings by Gonzales et al. (38) in their study on home smoking restrictions among US and Mexico-born Hispanic women with young children, in which 94% of respondents without household member smoked applied total smoking restriction compared to 62% among those with household members who smoked. Similarly, Zhen and colleague (22) and Hughes et al (17) reported that one of the factors associated with home smoking

restrictions was having no other smokers in the family. The finding indicates the difficulty encountered to apply total smoke free restriction in the home in the presence of a smoker among the household members, and more so if the smoker is the elderly or head of the family. This is especially pertinent in Malaysian households in which elderly or males generally occupy positions of high social status and if the smoker is older, the sense of respect may deter households from completely restriction of smoking.

The association between independent variables such as "knowledge on health effects of SHS to non-smokers", "SHS is a cause of cancer", and "SHS causes heart disease" diminished after adjusted the effect for other independent variables, leaving only "SHS causes cancer in children" statistically significant. This contradicts the findings of Kaleta et al. 2016 (33) among adults in Poland who reported a significant association between knowledge of SHS health hazard and total home smoking restriction. Similarly, Zheng et al. (22) and Berg et al (39) also reported similar findings. Our findings are also at odds with the Health Belief model (40) (Rosenstock 1974) which predicts that believing in a threat leads to health-promoting actions. This suggests that knowledge on SHS is insufficient to change behavior among Malaysian adults. In addition, the threats of adverse health effects that may only manifest in another 20 years hardly generates the motivation to change as posited by the human behavior theory that only imminent effect will motivate change in behavior (41). However, the association between knowledge on the health hazards of SHS and total smoking restriction at home remains intact in multivariable analysis. The finding is in line with previous research on predictors of home policies (22,32). Our study shows that the presence of children plays a protective role, i.e., it increases the likelihood of a restriction. Theoretically, the presence of children reflects cultural norms that prescribe protection of children from harm and concern for the children's health due to their vulnerability to SHS (22). In addition, the community expects parents to be responsible for such protection. Therefore, there is an opportunity to increase total smoking restriction at home among Malaysians by intensifying health promotion that focus on families with children. Besides reducing SHS exposure, children who grow up in households with smoking restrictions may have lower rates of smoking initiation or acceptability of smoking (42).

Divorcees/widow/widower and single respondents were more likely to not have a total smoking restriction at home. This runs counter to findings by Zheng et al (22) among residents in Shanghai. These findings may be explained by the 'marriage protection' theory (43), which suggest that married people tend to have more economic advantages and receive more social support, which can make them more willing to practice healthier behavior such as applying a total smoking restriction at home. Moreover, divorcees/widow/widower might face more emotional distress due to lack of social and psychological support, and therefore not much attention was given by them to their health aspects.

Almost fifty percent of the Malays and other indigenous ethnic groups did not have a total smoking restriction at home and it is significantly higher compared to the Chinese and Indian ethnic groups however the odds of having a total smoking restriction among other indigenous ethnics compared to Chinese diminished after adjusting for the effect of other independent variables. This deserves further investigation from a social cultural aspect, especially as adjustment for age, socio-economic status and intrapersonal factors did not remove the effect of Malay ethnicity on total smoking restriction at home. In addition, qualitative studies to explore the related factors might be another alternative to elucidate the reasons. The lower odds for having a total smoking restriction among Malay compared to Chinese ethnicity might be due to the higher prevalence of anti-smoking behavior among the Chinese as reported by Lim et al (2009) (44).

The study found a significant association between both household income level and education attainment with total household smoking restriction. Interestingly, the higher the level of an individual's education and income, the more likely they are to have a total smoking restriction at home. This is in line with the finding from the studies in Korea and Poland (17,33). The better educated one is, the more concerned one would be about health and therefore the lesser the likelihood not to have total smoking restriction at home. In addition, lower prevalence of smoking among higher education and higher income (27,28) segments of society might introduce the non-smoking norm among them and therefore increase the likelihood for respondents to translate the norm into practice through making their home free from such behavior, those factors might be the plausible reasons.

This study revealed that government employees have higher odds of having total smoking restrictions at home compared to their counterparts who are self-employed and working in the private sector. The norm which had been internalized from the policy which had been practice might contribute to current finding in view of smoke free regulation have been introduced in government facilities since 1993 (8). The current finding concurs with the published literature which revealed a positive relationship between smoking restrictions in the workplace and at home (23).

Our study showed that residents in urban areas have higher odds of adopting a total smoke free home policy. Among the possible explanations are, most of the public smoke-free area under the regulation are in urban areas, the implementation of regulation might unintentionally influence the residents in the areas

as shown by previous studies, (23,45) This might be explained by the Bronfenbrener ecology theory that the environment is among the important elements that influence human behavior (46). A case in point, Cheng et al,(47) revealed that a voluntary 100% smoke free-home rule was adopted by people living with smokers (OR 7.76, 95% CI 5.27, 11.43) and does who do not (OR 4.12, 95% CI 3.28, 5.16) in locality with various smoke-free public areas. This may due to strong clean indoor air laws might influence adoption of a smoke-free policy at home. However, longitudinal studies are strongly recommended to prove the hypothesis.

Though the higher proportion of females who reported total home smoking restriction was significant in univariate analysis, the gender effect diminished after adjusting for the effect of the other independent variables. This is consistent with outcome from study by Zheng et al (22) among adults in Shanghai, although almost 99% of Malaysian adult females are nonsmokers, less than half (45.4%) applied a total smoking restriction at home. This, some have suggested is a reflection of the patriarchal nature of Malaysian and Asian societies. As the majority of smokers are male, female members of the household refrain from arguing or object to smoking by their spouse at home in order to maintain harmony in the home (48,49).

Several limitations should be noted in our study. The cross-sectional data limits establishment of causal relationship between independent and dependent variables. Secondly, total smoking restriction at home was based on self-report which might be subject to under- or over-reporting. Further research in this area should consider the use of objective measures (e.g. air monitors), other independent variables such friends or relatives of respondents which might influence the total smoking restriction at home, health status of family members of the respondent and attitude toward SHS, independent variables which had not been included in our study. While we recognize the limitations of the survey, this approach still provides reliable data. The good response rate (81.5%) reduces the likelihood of response bias. We believe that the personalized approach employed in this study encouraged genuine responses to questions on the implementation of a total smoking restriction at home. In addition, quality control measures were implemented throughout the study to reduce systematic errors.

CONCLUSION

The present study revealed that approximately two-fifths of Malaysian homes adopted smoking restriction, and had identified that smokers or those who stayed together with at least one smoker household member, the Malays, single or widows/widowers/divorcees, private or self-employees, those of lower socio-economic status (less than primary educational level, income level at Quintile 1, rural dweller), or those who did not aware of the health hazards of SHS were the high-risk sub-populations for not adopting smoking restriction at home. Future promotional , interventional programmes and researches should focused on these sub-populations to promote smoking restrictions and help to reduce SHS-related burden of disease.

ACKNOWLEDGEMENTS

We would like to thank the Director-General of Health, Malaysia for his permission to publish this paper.

REFERENCES

1. World Health Organization (WHO) / International Agency for Research on Cancer (IARC). Tobacco smoke and involuntary smoking: summary of data reported and evaluation. Geneva: WHO; 2004.
2. Olasky SJ, Levy D, Moran A. Second hand smoke and cardiovascular disease in low and middle income countries: a case for action. Global Heart 2012; 7(2): 151-160.
3. Samet JM, Avila-Tang E, Boffetta P, Hannan LM, Olivo-Marston S, Thun MJ, Rudin CM. Lung cancer in never smokers: Clinical epidemiology and environmental risk factors. Clinical Cancer Research 2009; 15(18): 5626-5645.
4. U.S. Department of Health and Human Services. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. Rockville, MD: U.S. Department of Health and Human Services, Centers 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.
5. Lιberg M, Jaakkola MS, Woodward A, Peruga A, Prьss-Ustьn A. Worldwide burden of disease from exposure to second-hand smoke: a retrospective analysis of data from 192 countries www.thelancet.com Published online November 26, 2010 DOI:10.1016/S0140-6736(10)61388-8 3
6. WHO Report on the Global Tobacco Epidemic, 2009: Implementing Smoke-free Environments. World Health Organization, Geneva (http://www.who.int/tobacco/mpower/ 2009/en/index.html, accessed 28 October 2016
7. European Communities (2004). The Adopting Standards and Specifications for Educational Content(ASPECT) Consortium. Tobacco or health in the European Union past, present and future. Luxembourg: Office for Official Publications of the European Communities; 2004.
8. Government of Malaysia (2005). Food act 1993: Control of tobacco productregulations. 2004. http://www.tobaccocontrollaws.org/files/live/Malaysia/Malaysia%20-%20TC%20Regs%202004.pdf (accessed 5 Sep 2018).

9. Government of Malaysia (2008). Federal government gazette: Declaration of non-smoking areas. 2011. http://www.tobaccocontrollaws.org/files/live/Malaysia/Malaysia%20-%20Dec.%20of%20Non-Smoking%20Area%202011.pdf (accessed 5 Sep 2018).
10. Government of Malaysia (2012). Food act 1983: control of tobacco product (amendment) regulation. 2012. http://www.tobaccocontrollaws.org/files/live/Malaysia/Malaysia%20-%20Dec.%20of%20Non-Smoking%20Area%202012.pdf (accessed 5 Sep 2018).
11. Government of Malaysia. Declaration of non-smoking area. 2012. http://www.federalgazette.agc.gov.my/outputp/pub_20121001_Perisytiharan%20Kaw%20Larangan%20Merokok%202012.pdf (accessed 5 Sep 2018).
12. Government of Malaysia. Declaration of non-smoking area. 2014. http://www.federalgazette.agc.gov.my/outputp/pub_20140618_P.U.%20(B)%20312%20-%20Perisytiharan%20Larangan%20Merokok.pdf (accessed 5 Sept 2018).
13. Government of Malaysia. Declaration of non-smoking area. 2015. http://www.federalgazette.agc.gov.my/outputp/pub_20150709_P.U.%20(B)%20273%20%20Perisytiharan%20Kawasan%20Larangan%20Merokok%202015.pdf (accessed 5 Sept 2018).
14. Government of Malaysia. Declaration of non-smoking area. 2017. http://www.federalgazette.agc.gov.my/outputp/pub_20170414_P.U.%20(%20B)%20195%202017.pdf (accessed 5 Sept 2018).
15. Government of Malaysia. Declaration of non-smoking area. 2017. http://www.federalgazette.agc.gov.my/outputp/pub_20170515_P.U.(B)2532017.pdf (accessed 5 Sept 2018).
16. Government of Malaysia. Declaration of non-smoking area. 2017. http://www.federalgazette.agc.gov.my/outputp/pub_20170621_Draf 20 Perisytiharan %20kawasan%20larangan%20merokok%20Terengganu%202 017. (accessed 5 Sep 2018).
17. Hughes, S.C., Corcos,I.A., Hofstetter, C.R., Hovell, M.F., Irvin, V.L., et al Home smoking restriction among Korean in Seoul. Asia Pacific Journal of Public Health, 2009; 21(1): 63-70.
18. Shaw A, Ritchie D, Semple S, Turner S, O'Donnell R, Amos A, Millo L, Wilson J. Reducing children's exposure to second hand smoke in the home: a literature review. A report by ASH Scotland, 2012.
19. Kegler, M.C.,& Malcoe, L.H. Smoking restrictions in the home and car among rural native American and white families with young children. Preventive Medicine, 2002; 35(4): 334–342.
20. Pizacani,B.A., Martin, D.P., Stark, M.J., Koepsell, T.D., Thompson. B., & Diehr, P. A prospective study of household smoking bans and subsequent cessation related behaviour: the smoking bans and subsequent cessation related behaviour: th role of stage of change. Tobacco Control, 2004; 13(1): 23–28.
21. Mills, A.I., Messer, K., Gilpin, E.A., Pierce, J.P. The effect of smoke-free homes on adult smoking behavior: a review of smoke-free homes on adult smoking behavior. Nicotine and Tobacco Research, 2009;11(10):1131-1141.
22. Zheng. P., Kegler, M.C., Berg, C.J., Fu, W., Wang, J., Zhou X, et al. Correlates of smoke-free home policies in Shanghai, China. Biomedical Research International. 2014; 2014:249534.
23. Berg, C.J., Daley, C.M., Nazir, N., Cully, A., Pacheco, C.M., Buchanan, T, et al Smoke-free policies in the workplace and in the home among. American Indians. Journal of Health Disparities Research and Practice ,2012; 5(2):81-91
24. Kegler, M.C., Haardorfer, R., Bundy, L.T., Escoffert, C., Berg,C.J., Fernandez M, et al. Do partial home smoking bans signal progress toward a smoke-free home? Health Education Research, 2016; 31(1): 24-35
25. Abdullah, A.S., Hua, F., Xia, X., Hurlburt, S., Ng, P., MacLeod, W., et al. Second-hand smoke exposure and household smoking bans in Chinese families: a qualitative study. Health Social Care Community 2012; 20(4): 356–64.
26. Institute of Public Health, Ministry of Health Malaysia 1996, National Health and Morbidity Survey. 1996 Volume 15,Smoking.
27. Institute of Public Health, Ministry of Health Malaysia 2008. The Third National Health and Morbidity Survey- Smoking, 2006.
28. Institute for Public Health (IPH).Report of the Global Adult Tobacco Survey (GATS) Malaysia. 2011. Ministry of Health, Malaysia. 2012.
29. Azahadi ,O., M Fadhli, M.Y., Tee, G.H., Tahir, A., Morton, J., Pujari, S. Methodology of Global Adult Tobacco Survey (GATS), Malaysia, 2011. International Journal of Public Health Research, 2015; 3(2):297-305.
30. Hosmer DW, Lemeshow S. Applied Logistic Regression. New York: Wiley; 2000
31. Archer, K.J., Lemeshow, S.,& Hosmer, D,W. Goodness-of-fit tests for logistic regression models when data are collected using a complex sampling design. Computational Statistic & Data Analysis, 2007; 51:4450–4464.
32. Ji, M., Ding, D., Hovell, M. F., Xia, X., Zheng, P., & Fu, H. Home smoking bans in an urbanizing community in China. American journal of preventive medicine, 2009;37(2), 132-6.
33. Kaleta D, Fronczak A, Usidame B, Dziankowska-Zaborszczyk,E, Makowiec-Dąbrowska T, Wojtysiak P. Implementation of smoke-free homes in Poland. Int J Occup Med Environ Health.2016; 29(1):137-48.
34. King BA, Dube SR, Tynan MA.. Secondhand smoke exposure in cars among middle and high

school students--United States, 2000-2009. Pediatrics.2012 ;129(3):446-52. King
35. Heck,J.E., Stucker, I., Allwright. S., Gritz, E.R., Haglunde, M., Healton, C.G, et al. The European respiratory journal, 2010;35(5): 969-979..
36. ITC Project (March 2012). ITC Malaysia National Report. Findings from Wave 1 to 4 Surveys (2005 –2009). University of Waterloo, Waterloo, Ontario, Canada; Universiti Sains Malaysia, Pulau Pinang, Malaysia; and Ministry of Health, Putrajaya, Malaysia.
37. Cooper, J. (2007). Cognitive Dissonance, Fifty years of a classic theory. London: Sage Publications.
38. Gonzales M, Malcoe LH, Kegler MC, Espinoza J. Prevalence and predictors of home and automobile smoking bans and child environmental tobacco smoke exposure: A cross sectional study of U.S.- and Mexico-born Hispanic women with young children. BMC Public Health. 2006; 6:265.
39. Berg CJ, Zheng PP, Kegler MC. Perceived benefits of smoke-free homes, the process of establishing them, and enforcement challenges in Shanghai, China: a qualitative study 2015. BMC Public Health 15:89
40. Rosenstock IM. Historical origins of the health belief model. Health Education Monographs 1974, 2, 328–335.
41. Oncken, C., Mckee,S., Krishnan-Sarin, S., O'Malley, S.,& Mazure. C.M. Knowledge and perceived risk of smoking-related conditions: a survey of cigarette smokers. Preventive Medicine, 2005; 40(6): 779-784.
42. Conley, T.C., Siegel, M., Winickoff. J., Biener, L., & Rigotti, N.A. Household smoking bans and adolescents' perceived prevalence of smoking and social acceptability of smoking. Preventive Medicine, 2005; 41:349-356.
43. Schoenbom C: Marital status and health: United States, 1999– 2002, advance data from vital and health statistics. 2004, MD, Huattsville: National Center for Health
44. Lim, K.H., Sumarni, M.G., Amal, N.M., Hanjeet, K., Wan Rozita, W.M., & Norhamimah, A. Tobacco use, knowledge and attitude among Malaysians age Tobacco use, knowledge and attitude among Malaysians age 18 and above. Tropical Biomedicine,2009; 26(1): 92–99
45. Hovell, M. F., Adams, M. A., Hofstetter, C. R., Martнnez-Donate, A. P., Gonzбlez-Pйrez, G. J., Rovniak, L. S., & Boman-Davis, M. C. (2013). Complete home smoking bans and antitobacco contingencies: a natural experiment. Nicotine & tobacco research, 2013;16(2), 186-96.
46. Bronfenbrenner, u. (1979). The ecology of human development. Cambridge, Ma: Harvard University Press.
47. Cheng ,K.W., Glantz, S.A., & Lightwood, J.M. Association between smoke free laws and voluntary smoke free home rules. American Journal of Preventive Medicine, 2011; 41(6): 566–572.
48. Mao, A. Space and power: young mothers' management of smoking in extended families in China. Health Place. 2013; 21:102–9.
49. Ooi, J.X., Teh, K.X., Tam, C.L., Sadasivan ,S.,& Kadirvelu. A. Passive Smoking: Perceptions and Practices among Urban Working Adults .International Journal of Collaborative Research on Internal Medicine & Public Health 2014; 6(6):.160-167.