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**Original Article**

# Burden of Household Smoking Habits on the Occurrence of Respiratory Symptoms among Malaysian Adolescents

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**Abstract**

**Background:** This study aimed to assess the burden of household smoking habits on the occurrence of respiratory symptoms among young adolescents in Malaysia.

**Methodology:** The impact of Secondhand Smoke (SHS) exposures on the occurrence of respiratory symptoms was investigated on 234 adolescents (13-14 years old) residing in two states in Malaysia. Adolescents completed a self-administered questionnaire adapted from Global Youth Tobacco survey that comprised of items on socio-demographic and SHS exposures. Respiratory symptoms were assessed using a standard questionnaire of International Study of Asthma and Allergies in Childhood. Hair samples were collected from each adolescent and were analyzed for nicotine via Gas Chromatography-Mass Spectrophotometry with nitrogen detection method.

**Result**: The geometric mean of hair nicotine was 0.0184± 2.31 ng/mg. The prevalence of current, ever wheeze, nocturnal cough, exercised-induced wheeze and self-reported asthma were 7.69%, 14.1%, 11.5%, 20.5% and 13.7%, respectively. A significant association was found between household smoking status with exercise-induced wheeze (Adjusted Odds Ratio, AOR 1.06; 95%Confidence Interval, CI 0.42-2.66) and nocturnal cough (AOR 14.2; 95%CI 1.60-125). Reported ever wheeze was linked to reported SHS exposure in family's vehicle (AOR 3.27; 95%CI 1.15-9.34). The risk of exercise-induced wheeze was related with postnatal SHS exposure (AOR 2.69; 95%CI 1.13-6.43).

**Conclusion**: Respiratory symptoms were mostly affected by household smoking habits. Thus, in an attempt to reduce the repercussion of SHS exposure among younger adolescents, effort should be emphasized in encouraging parents to move from indoor to outdoor smoking far from the vicinity of children.

**Keywords:** Passive smoking, Household smoking habits, Youth, Respiratory health, Hair nicotine

## Introduction

Respiratory health is one of the largest public health concerns worldwide. The rising prevalence of respiratory morbidity demonstrated in industrialized regions of the world (1, 2) has suggested the contribution of environmental exposures in this scenario (3). Secondhand Smoke (SHS) has long been linked to ill-health effects and has been known as a respiratory irritant (4, 5).

Globally in 2011, SHS exposure was estimated to be responsible for an estimated 600,000 deaths among non-smokers population (6). There are firm evidences that SHS exposure can result in wheeze (7), cough (8), impaired lung function (9), lower respiratory illness and asthma (10). Recent reviews clearly addressed the contribution of SHS exposure towards the occurrence of respiratory symptoms among younger adolescents population (11, 12).

As revealed in previous cross-sectional studies, the prevalence of smoking among Malaysian adults was 25% (13, 14). Although the prevalence of smoking

in Malaysia had reduced by 2.8% within 10 years (1996-2006), the decrement is relatively small when compared with other countries that have shown decline between the range of 9% to 25% (15, 16). This figure highlights the fact that SHS exposure among non-smoking population will remain and continuously occur.

Parental smoking habits have been found as the main contributor to SHS exposure among non-smoking household members namely children. Multiple studies have identified SHS exposures to mostly occur at home and have been the most important source of indoor SHS exposure (11, 17-18). In United States, 35% of children (21 million) lived in homes where exposure to SHS occurred on a regular basis where there are residents or visitors who smoke at least a day per week (19). In the context of Malaysia, about 57% of the adolescents were exposed to SHS at home (20). In addition, as revealed by Abidin and colleagues (2011) (14), among 947 Malaysian schoolchildren, more than half of them (54.1%) were living with at least one family member who smokes. Besides the presence of smoker in household, the smoking habit in the family's vehicle worsen the impact of SHS exposure. Majority of smoking parents tends to expose their children to tobacco smoke in cars (21) however; few data are available in Malaysia. In the west, despite the proven repercussion of SHS (9, 11), many parents overlook its dangers and smoke in their vehicles, thus exposing their children to high concentrations of SHS.

This study will provide further investigation regarding the specific burden of household smoking habits on the occurrence of respiratory symptoms among young adolescents in Malaysia.

## Material and Methods

### *Study design and population*

This cross-sectional study was conducted in 2013 in two states (Kedah and Melaka) in Malaysia among adolescents aged 13-14 years old. Approximately 18 secondary schools were randomly sampled from a list of secondary schools obtained from Education State Department (22).The students in form one and two (equivalent to eighth and ninth grade in Iran) were chosen as the study populations.

A total of 680 adolescents were invited into this study. Initially, envelopes containing parental questionnaire, parental permission form and research information sheets were disseminated to the adolescents. Parents were asked to fill in the parental permission form and those who allowed their children to be involved in the study were required to complete the parental questionnaire. Only 530 (77.9%) (Response rate) of envelopes were returned to the researcher on the next day. In total, 234 (44.2%) eligible adolescents who meet the inclusion criteria of 1) having hair at least 3 cm length and 2) hair was not premed, bleached or dyed in past 3 months were recruited in the study after obtaining parental permission.

### *Assessment on SHS exposures and respiratory symptoms*

Two sets of questionnaires were used in this study in which it comprised of 1) a self-completed questionnaire for adolescent and 2) a household information request questionnaire for parents. A modified-version of Global Youth Tobacco Survey's (GYTS) questionnaire was used to collect SHS exposures information of adolescents while prenatal and postnatal SHS exposure data were obtained from the parental-completed questionnaire. Items on respiratory health were based on the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire (23). Questionnaire for adolescents was administrated in their respective classrooms. In answering the respiratory health items, the paper questionnaire was supplemented with an ISAAC video questionnaire to assist adolescents in giving clearer picture of each symptom.

In this study, the adolescents were also asked to provide hair samples for the measurement of nicotine, a primary metabolite of tobacco that have been widely used in examining SHS exposure levels (24). An average of 30 strands of hair from the vortex posterior of the head was clipped with a clean stainless steel scissors as close as possible to the scalp. The collected strands of hair were then stored in individual polyethylene bag until pending analysis.

Collected hair samples were sent to the National Poison Centre, Penang, Malaysia for analysis with nitrogen detection methods by using Gas Chromatography–Mass Spectrometry (GC-MS). Once in the laboratory, each bag of hair samples was washed twice, using dichloromethane with 15 minutes sonication and were dried overnight at 30°C. Approximately 3cm of collected hair strands for each subject was measured, cut, minced into ~1mm pieces, weighed accurately, and were mixed with 100µl of sodium hydroxide (NaOH) (1M), 50µl of internal standard (IS) and left for overnight digestion at room temperature. The 3cm length of hair approximately represents a previous 3 months exposure to SHS. The following day, 1ml of distilled water was added, briefly mixed and centrifuged. The clear supernatant was recovered and extracted using 0.4mL solvent mixture (methanol:chloroform (1:3). The extract was centrifuged (5min at 2,500 rpm) and dried over anhydrous sodium sulphate. The organic extract was then transferred into an auto-sampler vial (25).

### *Statistical data analysis*

All data analysis was performed using IBM SPSS Statistics 21.0 (SPSS Inc., Chicago, IL, USA). Descriptive analysis was used to describe socio-demographic characteristics, prevalence of reported respiratory symptoms, SHS exposures and hair nicotine level of adolescents. Hair nicotine concentration below than limit of detection (LOD) (0.04ng/mg) were assigned an imputed value randomly sampled from the left tail of a truncated log normal distribution (14, 26). Multiple logistic regression was performed to estimate the effect of SHS exposures towards the occurrence of respiratory symptoms as presented in AOR and 95%CI. The well-proven independent variables in the previous SHS-related studies, which showed its contribution to the occurrence of respiratory symptoms, were included into the model. The model comprised of two blocks that the first block represented the confounder factors and the related SHS exposure predictors included in the second block. In addition, the correlation within states, schools and adolescents themselves as variance components in the population were taken into account to be controlled in the model (27, 28).

## Result

### *Socio demographic information and respiratory symptoms*

About 60% of the participated adolescents were females and majority of them were of the Malay ethnicity (91%) (Table 1). More than half of the adolescents were of families earning more than RM1000 (67.3%) per month. Overall, the highest parental education was the secondary level (father=65%; mother=68%).The findings of the reported respiratory symptoms were as follows: 14.1% wheezing ever, 7.69% current wheezing, 20.5% exercise-induced wheeze, 11.5% nocturnal cough and 13.7% asthma (Table 1).

### *SHS exposures*

Approximately 146 (62.4%) of the adolescents had smoking family members whereby 97.4% of them lived with at least one smoking family member. About 21.8% of them were exposed to SHS more than 4 days/week in which more than half of adolescents (67.9%) had one-hour exposure or less/day. There were 37.6% of adolescents exposed to SHS at home as shown by home smoking restriction practised (Table 2).

Hair nicotine level ranged from less than LOD to 0.161ng/mg. A cut off point of more than 0.2ng/mg was used to identify active smoking (29-31). Thus, all participated adolescents were considered as non-smokers. The geometric mean of hair nicotine was 0.0184± 2.31ng/mg.

### *Effect of SHS exposure on the occurrence of respiratory symptoms*

From the results of the multi-level logistic regression, household smoking was found to be associated with the symptoms of exercise-induced wheeze (AOR 1.06; 95%CI, 0.42-2.66) and nocturnal cough (AOR 14.2; 95%CI, 1.60-125) (Table 3).

Adolescents who lived with smoking family members were more likely to report exercise-induced

wheeze (1.06-fold risk) and nocturnal cough (14-fold risk) compared to those without smoking family members. SHS exposure in family's vehicle was a significant factor, which contributed to the reported symptom of wheezing ever (AOR 3.27; 95%CI, 1.15-9.34).

This study found that home smoking restriction was linked with a protective effect for adolescents to report the exercise-induced wheeze (AOR 0.33; 95%CI, 0.14-0.77). In addition, postnatal SHS exposure was shown to be associated with the reported exercise-induced wheeze (AOR 2.69; 95%CI 1.13-6.43).

The history of parental asthma was the only variable, which showed a significant association with self-reported asthma among adolescents. The adolescents who have an asthmatic parent tend to be more likely to report asthma (AOR 3.17; 95%CI 1.08-9.36) compared with other adolescents.

Gender was shown to be associated with reported ever, current wheezing and nocturnal cough. Female adolescents were more likely to report ever wheezing (AOR 3.78; 95%CI 1.27-11.2), current wheezing (AOR 8.42; 95%CI 1.42-49.9) and nocturnal cough (AOR 4.66; 95%CI 1.30-16.7) compared to male adolescents.

**Table 1:** Socio-demographic characteristics of adolescents (n= 234)

| Variables | n | % |
|---|---|---|
| **Socio-demographic characteristics** | | |
| Gender | | |
| Male | 94 | 40.2 |
| Female | 140 | 59.8 |
| Ethnicity | | |
| Malay | 213 | 91.0 |
| Non-Malay | 21 | 8.97 |
| Household income | | |
| <RM1000* | 99 | 42.3 |
| ≥RM1000 | 134 | 57.3 |
| Missing | 1 | 0.43 |
| Father's education level | | |
| Secondary | 153 | 65.4 |
| Tertiary | 69 | 29.5 |
| Missing | 12 | 5.12 |
| Mother's education level | | |
| Secondary | 160 | 68.4 |
| Tertiary | 64 | 27.4 |
| Missing | 10 | 4.27 |
| Respiratory symptoms | | |
| Wheezing ever | | |
| Yes | 33 | 14.1 |
| Current wheezing | | |
| Yes | 18 | 7.69 |
| Exercise-induced wheeze | | |
| Yes | 48 | 20.5 |
| Nocturnal cough | | |
| Yes | 27 | 11.5 |
| Self-reported asthma | | |
| Yes | 32 | 13.7 |

*RM1000 = 307.50 USD

**Table 2:** SHS exposure of adolescents (n=234)

| SHS exposure | n | % |
|---|---|---|
| Smoking family member | | |
| No | 86 | 36.8 |
| Yes | 146 | 62.4 |
| Missing | 2 | 0.86 |
| No. of smoking family members | | |
| ≤1 person | 228 | 97.4 |
| >1 person | 4 | 1.71 |
| Missing | 2 | 0.85 |
| Daily SHS exposure (day/week) | | |
| ≤4 days | 178 | 76.1 |
| >4 days | 51 | 21.8 |
| Missing | 5 | 2.14 |
| SHS exposure hour (hour/day) | | |
| ≤1 hour | 159 | 67.9 |
| >1 hours | 68 | 29.1 |
| Missing | 7 | 2.99 |
| Smoking in family's vehicle | | |
| No | 182 | 77.8 |
| Yes | 50 | 21.4 |
| Missing | 2 | 0.86 |
| Home-smoking restriction | | |
| No | 88 | 37. 6 |
| Yes | 143 | 61.1 |
| Missing | 3 | 1.28 |
| Prenatal SHS exposure | | |
| No | 177 | 75.6 |
| Yes | 56 | 23.9 |
| Missing | 1 | 0.43 |
| Postnatal SHS exposure | | |
| No | 142 | 60.7 |
| Yes | 86 | 36.8 |
| Missing | 6 | 2.57 |

## Discussion

This study aimed to assess the burden of household smoking habits on the occurrence of respiratory symptoms among 234 young adolescents in Malaysia.

This study addressed several significant findings. Primarily, living with smoking family members was linked to the likelihood to report exercise-induced wheeze and nocturnal cough. Secondly, SHS exposure in the family's vehicle was linked with the increased risk of adolescents to report wheezing ever. Thirdly, the home-smoking restriction was shown to be a protective factor for adolescents to report exercise-induced wheeze. Also, having the SHS exposure during early of life was shown to be one of the predictors for reporting the exercise-induced wheezing during the adolescent ages.

Many SHS-related studies conducted have focused only on the effect of SHS exposures on respiratory symptoms without involving any objective measurement of biomarkers (7, 10, 32). Thus, the data on hair nicotine level have added to the body of current knowledge in confirming the SHS exposure of the adolescents. Hair nicotine level has been used and validated as a gold standard in assessing SHS exposure among children and adults (33-35).

**Table 3:** Multiple logistic regression of SHS exposure associated with respiratory symptoms [A]

| | Wheezing ever | | | Wheezing current | | | Exercise-induced wheeze | | | Nocturnal cough | | | Self-reported asthma | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **B(S.E)** | **Wald** | **OR (95% CI)** | **B(S.E)** | **Wald** | **OR (95% CI)** | **B(S.E)** | **Wald** | **OR (95% CI)** | **B(S.E)** | **Wald** | **OR (95% CI)** | **B(S.E)** | **Wald** | **OR (95% CI)** |
| Gender ([a] Male) | | | | | | | | | | | | | | | |
| Female | 1.33 (0.56) | 5.71 | **3.78 (1.27-11.2)*** | 2.13 (0.91) | 5.49 | **8.42 (1.42-49.9)*** | 0.72 (0.42) | 3.02 | 2.06 (0.91-4.64) | 1.54 (0.65) | 5.60 | **4.66 (1.30-16.7)*** | 0.30 (0.47) | 0.42 | 1.36 (0.54-3.41) |
| Ethnicity ([a]Non Malay) | | | | | | | | | | | | | | | |
| Malay | -1.52 (1.17) | 1.68 | 0.22 (0.02-2.18) | -0.79 (1.27) | 0.39 | 0.46 (0.04-5.45) | -0.09 (0.67) | 0.02 | 0.92 (0.25-3.38) | -1.14 (1.23) | 0.88 | 0.32 (0.03-3.49) | 0.15 (0.73) | 0.04 | 1.16 (0.28-4.80) |
| Smoking status of family members ([a]No) | | | | | | | | | | | | | | | |
| Yes | 0.91 (0.66) | 1.92 | 2.49 (0.69-9.00) | 1.99 (1.16) | 2.96 | 7.29 (0.76-70.1) | 1.29 (0.49) | 6.93 | **3.63 (1.39-9.50)*** | 2.65 (1.11) | 5.68 | **14.2 (1.60-125.)*** | 0.46 (0.55) | 0.68 | 1.58 (0.54-4.65) |
| Daily SHS exposure ([a]≤4 days) | | | | | | | | | | | | | | | |
| >4 days | -0.83 (0.55) | 2.24 | 0.44 (0.15-1.29) | -0.79 (0.69) | 1.32 | 0.45 (0.12-1.75) | 0.06 (0.47) | 0.01 | 1.06 (0.42-2.66) | -0.45 (0.60) | 0.57 | 0.64 (0.20-2.07) | -0.41 (0.56) | 0.53 | 0.66 (0.22-2.01) |
| SHS exposure hours ([a]≤1 hours) | | | | | | | | | | | | | | | |
| >1 hours | 0.70 (0.50) | 1.99 | 2.01 (0.76-5.32) | 0.12 (0.64) | 0.03 | 1.13 (0.32-3.94) | -0.88 (0.45) | 3.79 | 0.41 (0.17-1.01) | 0.44 (0.55) | 0.65 | 1.56 (0.53-4.56) | -0.22 (0.52) | 0.18 | 0.80 (0.29-2.22) |
| Smoking in family's vehicle ([a]No) | | | | | | | | | | | | | | | |
| Yes | 1.19 (0.54) | 4.92 | **3.27 (1.15-9.34)*** | 1.33 (0.68) | 3.86 | 3.76(1.00-14.1) | 0.57 (0.47) | 1.46 | 1.77 (0.70-4.49) | 0.79 (0.60) | 1.72 | 2.20 (0. 68-7.14) | 0.85 (0.55) | 2.38 | 2.33 (0.80-6.80) |
| Home smoking restriction (Yes) | | | | | | | | | | | | | | | |
| No | 0.14 (0.51) | 0.08 | 1.15 (0.43-3.09) | 0.08 (0.69) | 0.01 | 1.08 (0.28-4.17) | -1.12 (0.44) | 6.60 | **0.33 (0.14-0.77)*** | -0.95 (0.63) | 2.30 | 0.39 (0.12-1.32) | -0.93 (0.52) | 3.23 | 0.40 (0.14-1.09) |
| Hair nicotine level (ng/mg) | 0.29 (0.63) | 0.21 | 1.33 (0.39-4.55) | 0.89 (0.94) | 0.90 | 2.44 (0.39-15.4) | 1.05 (0.57) | 3.44 | 2.87 (0.94-8.72) | -0.92 (0.64) | 2.09 | 0.40 (0.12-1.38) | 1.13 (0.71) | 2.56 | 3.10 (0.78-12.3) |
| Parental asthma([a]No) | | | | | | | | | | | | | | | |
| Yes | 0.23 (0.66) | 0.12 | 1.26 (0.35-4.56) | 0.01 (0.85) | 0.00 | 1.01 (0.19-5.27) | -0.30 (0.60) | 0.25 | 0.74 (0.23-2.41) | -1.24 (0.92) | 1.80 | 0.29 (0.05-1.77) | 1.16 (0.55) | 4.38 | **3.17 (1.08-9.36)*** |
| Prenatal SHS exposure ([a]No) | | | | | | | | | | | | | | | |
| Yes | 0.21 (0.59) | 0.12 | 1.23 (0.38-3.93) | 0.94(0.77) | 1.50 | 2.57 (0.57-11.6) | -0.95(0.51) | 3.51 | 0.39 (0.14-1.05) | 0.99 (0.66) | 2.23 | 2.68 (0.73-9.78) | 0.06 (0.58) | 0.01 | 1.06 (0.34-3.31) |
| Postnatal SHS exposure ([a]No) | | | | | | | | | | | | | | | |
| Yes | 0.23 (0.57) | 0.16 | 1.25 (0.41-3.80) | 0.11 (0.77) | 0.02 | 1.11 (0.24-5.07) | 0.99 (0.45) | 4.96 | **2.69 (1.13-6.43)*** | 0.28 (0.66) | 0.18 | 1.33 (0.36-4.87) | 0.37 (0.54) | 0.47 | 1.40 (0.50-4.18) |
| Classification rate | 85.6 (18.8/96.8) | | | 91.9 (11.1/99.0) | | | 80.6 (21.7/96.0) | | | 88.7 (26.9/96.9) | | | 86.9 (6.9/99.0) | | |
| Cox & Snell R Square-Nagelkerke R Square | 0.171-0.305 | | | 0.153-0.355 | | | 0.141-0.221 | | | 0.202-0.393 | | | 0.085-0.158 | | |

[A] Model controlled for clustering effects in hierarchical analysis (state-classroom-students)/ *Significant at p value $P<0.05$ /[a] Reference group

The lack of objective measures in assessing respiratory symptoms is one of the limitations in this study. Notwithstanding this limitation, this study relied on both the validated ISAAC written and video questionnaire (23) as it is a well-established tool in the measurement of the respiratory symptoms of children and adolescents. The household smoking status was shown to be associated with reported exercise-induced wheeze and nocturnal cough among adolescents. Adolescents who lived with smoking family members would encounter about 1.06-fold and 14-fold of risk to report a symptom of exercise-induced wheeze and nocturnal cough, respectively compared to those living with non-smoking family members. However, this finding was in contrast with the earlier study (36) in relation to reported nocturnal cough in which household smoking habit was not found to have a significant influence on the occurrence of the symptom. This result therefore needs to be interpreted with caution. The significant association found might be due to over estimation of multiple logistic regression result, which was affected by a large range of confidence interval shown for the AOR (37).

This study also revealed that the SHS exposure in the family's vehicle was statistically associated with the higher probability for reported wheezing ever among adolescents. The risk of reporting wheezing ever would be 3-fold for adolescents who were exposed to SHS in the family's vehicle compared to those without the exposure. Adolescents who were exposed to SHS in such enclosed spaces tend to have higher SHS exposure due to the small volume of area in which particles can easily become concentrated within the limited space. Previous studies have addressed that children who were subjected to SHS in small spaces such as cars would encounter 27 times the amount of toxins than usual (38). Even though the exposure might occur intermittently, exposure for a long period will adversely affect the respiratory system of exposed adolescents. There is a lack of public awareness campaign or health promotion advocating smoking bans in vehicles in Malaysia, but for other western countries, smoking bans in vehicles with small children have been implemented (39).

Home-smoking restriction was found to be a protective factor in reducing the risk of adolescents to report the exercise-induced wheeze. The practice of smoke-free home policy appeared to be a very important factor in minimizing adolescents' exposure to SHS. In fact, the current study have found that majority of parents (85%) who have strictly enforced a home-smoking restriction had also enforced smoke-free car policy (data not shown) and this was also revealed earlier (21). This suggests that parents who practised the smoke-free policy in vehicles and home have recognized and were aware of the main source and the health consequences of SHS exposure, which might be encountered by their children.

This study was able to demonstrate a significant association of postnatal SHS exposure on the occurrence of exercise-induced wheeze whereas prenatal exposure was not correlated with any reported respiratory symptom. Adolescent who experienced postnatal SHS exposure were over 3-fold more likely to report the symptoms than those without the exposure. This finding was in line with Larsson and colleagues (40) in which the exposure to SHS during childhood was linked with reported asthma and contributed to smoking likelihood in their adulthood (41).

In assessing the impact of SHS exposures on the likelihood of adolescents to report asthma, only parental asthma was shown to be associated with adolescents' self-reported asthma. This finding addressed that asthmatic heredity might be important factor in rising risk of asthma cases among adolescents (42-44). In addition, this study also highlighted that gender has become one of the predictors for the occurrence of few respiratory symptoms. Female was found to have higher risk to report current wheezing and nocturnal cough compared to male. Higher level of awareness and sensitiveness on a disease status among girls and women might explain the association as revealed in previous study (45) and these reasons make female more willing to report and discuss an experienced health symptom than male counterpart (46).

The geometric mean of hair nicotine level was 0.0184±2.31ng/mg within the range of less than LOD to 0.160ng/mg. Further analysis was per-

formed (data not shown) and there was no significant difference found between adolescents living with and without household smoking in contrary to the findings of other studies (47, 48). Compared with other studies (49, 50), the hair nicotine level in this study was low. The detection of low hair nicotine level among the adolescents might be due to the ability of adolescents to show avoidance behaviour from smoking parents compared with younger children who tend to be closer with their parents. In addition, the intermittent exposure of adolescents to SHS while in public places caused the exposure to occur at low level and this might explain the lower hair nicotine level detected among adolescents compared with other studies' population. Several studies found evidence of a dose-response relationship between increasing hair nicotine level and related health outcomes (51, 52). As reported earlier (52), the increment of hair nicotine level was associated with low birth weight and preterm delivery. However, this study was unable to depict the dose-response relationship as no significant association were found between hair nicotine levels and any reported respiratory symptoms among adolescents. Under reporting of the respiratory symptoms among the adolescents may as well occur due to recall bias and this might weaken the possibility of association with hair nicotine level to be depicted.

## Conclusion

This study was able to link SHS exposures with reported respiratory symptoms among adolescents. Overall, the finding showed that parental or household smoking habits played a vital role in predicting their children's risk towards respiratory symptoms specifically in their adolescents' ages. This study highlights the problem of adolescents who were exposed to SHS due to smoking habits of their parents. Thus, in an attempt to reduce the repercussion of SHS exposure among younger adolescents, efforts should be emphasized in encouraging parents to move from indoor to outdoor smoking far from the vicinity of children.

## Ethical considerations

Ethical issues such as plagiarisms, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, et cetera have been completely observed by the authors.

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