

The Associations of Asthma Symptoms With Active and Passive Smoking in Hong Kong Adolescents

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BACKGROUND: Tobacco smoke has detrimental effects on the respiratory system. This study investigated the associations of active and passive smoking with asthma symptoms in Hong Kong adolescents. **METHODS:** A total of 6,494 Hong Kong secondary school students, with a mean \pm SD age of 15.0 ± 1.21 years, participated in the Health Related Behavior General Survey in 2000–2001. They reported their demographic factors (sex, age, housing type, district of living), lifestyles (smoking, drinking, extracurricular sports, eating), and asthma symptoms (exercise-induced bronchospasm [EIB] and nocturnal cough) in the questionnaire. In addition, number of smoking parents (none/one/both) and presence of a smoking best friend (yes/no) were assessed. Logistic regression models were used to determine the odds ratios (OR) of frequently having the asthma symptoms for different smoking status of students, parents, and best friend, with adjustment for demographic factors and lifestyles. **RESULTS:** The prevalence of former, light, and heavy smokers was 17.5%, 7.7%, and 1.0%, respectively. Moreover, 35.1% of the participants had one and 3.8% had 2 parents who smoked. Heavy smokers were more likely to experience EIB with OR (95% CI) of 2.27 (1.30–3.97) and nocturnal cough with OR (95% CI) of 3.45 (1.52–7.81), as well as both symptoms with OR (95% CI) = 4.69 (1.88–11.73) when compared to those who never smoked. The corresponding OR (95% CI) for having at least one smoking parent and a smoking best friend was 1.45 (1.17–1.81), 1.61 (1.06–2.42), and 2.43 (1.37–4.31), when compared with those without a parent or best friend who smoked. **CONCLUSIONS:** Adolescents who are heavy smokers and having parents and a best friend who smoke are more likely than others to have asthma symptoms. Both active and passive smoking are related to asthma symptoms in adolescents. *Key words:* active smoking; passive smoking; asthma symptoms; adolescents. [Respir Care 2012;57(9):1398–1404. © 2012 Daedalus Enterprises]

Introduction

Asthma is the one of the most common chronic diseases in children.¹ About 1 out of 11 United States children

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currently have asthma, causing a substantial burden on the healthcare system.² Tobacco smoke contains more than 4,000 harmful chemical compounds. Both active smoking³ and exposure to secondhand smoke^{4–6} lead to respiratory symptoms in adolescents. Exercise-induced bronchospasm (EIB)⁷ and nocturnal cough are the major asthma symptoms⁸ related to active smoking^{9,10} and passive smoking¹¹

SEE THE RELATED EDITORIAL ON PAGE 1528

in adolescents. While partners are the major source of secondhand smoke for adults,¹² adolescents' main exposure to secondhand smoke is from their parents^{5,13,14} and peers.^{15–17} The associations of asthma symptoms with active and passive smoking in adolescents are complex,¹⁸ and information in the Chinese populations is limited.

The prevalence of asthma among adolescents in Hong Kong is relatively higher than those living in the mainland China or in the West,¹⁹ although a decreasing trend was observed in recent years.²⁰ With a dense living environment in Hong Kong, the impact of passive smoke on the respiratory health in adolescents may be even more severe. This study investigated the additive associations of asthma symptoms with active smoking and passive smoking exposure in Hong Kong adolescents.

Methods

In this study, stratified sampling was used to select schools to represent sex, academic ability, and administrative districts in the Hong Kong school system. Any schools refusing to participate were replaced by another school with similar characteristics. A total of 6,494 students with mean \pm SD age of 15.0 ± 1.21 years (92.7% from grammar and 7.3% from vocational schools) participated in the Health Related Behavior General Survey in 2000–2001, with a response rate of 95%. The Health Related Behavior General Survey, licensed from the Schools Health Education Unit of the University of Exeter in the United Kingdom, was developed to assess health-related behaviors, including physical activity and risky behaviors such as substance use.²¹ Parental consent was sought, and students were briefed by trained teachers that participation was voluntary. Students completed their questionnaires in class, and the procedures for ensuring anonymity were also described to them. Ethics approval was obtained from the university ethics committee. Details of the administration of the study have been reported elsewhere.^{22,23}

Students reported their basic information, including sex, age, housing type, and district of living in the questionnaire. The smoking status of the students was assessed by the question “Which of the following statements describe your smoking status the best?” with options: A: I have never smoked at all, not even a puff; B: I have tried smoking once or twice; C: I used to smoke, but I don’t now; D: I smoke occasionally; and E: I smoke regularly. They were then classified into never (option A), former (options B and C), and current (options D and E) smokers. Smoking intensity was assessed by the number of cigarettes consumed in the last week. Current smokers were further classified into the light (smoked < 100 cigarettes in last week) and heavy (smoked ≥ 100 cigarettes in last week) smokers.

The question to ascertain the smoking status of the parents and the best friend was “Please select those who smoke regularly?” with options of father, mother, and best friend. The parental smoking status was then recoded into “both of them smoke,” “one of them smoke,” and “none of them smoke.”

QUICK LOOK

Current knowledge

Exposure to active or passive smoking is associated with lung dysfunction in adolescents and increases risk for reactive airway diseases.

What this paper contributes to our knowledge

Adolescents who are heavy smokers, have parents who smoke, or have a best friend who smokes have an increased risk of asthma symptoms.

The 2 major symptoms of asthma assessed were: EIB (When you run, do you wheeze or feel difficulty in breathing?) and nocturnal cough (Do you experience sleep disturbance due to coughing?) with options of A) never, B) seldom, C) often, and D) very often. Similar outcome measures have been used in other adolescent studies.²⁴ In addition, students’ lifestyles, including exercise, eating, and drinking, were examined. Students’ sports participation was assessed by a checklist of sporting events that they performed at least weekly.

Their eating habits were assessed by a single item: “Do you consider your health when making food choices?” A) never, B) sometimes, C) often, D) very often, E) always. Moreover, number of days of drinking alcohol in a week (0–7 d) were reported and recategorized into weekly (1–7 d) or non-weekly (0 d) in the analysis. The internal validity of the outcome measures was assessed by their relations, with number of days taking prescribed medicine for asthma, “How many days have you used medicine for asthma? (0–7 d),” using analysis of variance.

In the main analysis, responses to EIB and nocturnal cough were dichotomized into “frequent” (very often/often) and “infrequent” (seldom/never) groups. Logistic regression models were used to determine the ORs of having frequent (vs infrequent) EIB and nocturnal cough for different smoking status of the students, and their parents and best friend. In order to examine the combined effects of active and passive smoking on having frequent respiratory symptoms, a new variable combining the smoking status of parents (none/at least one) with the smoking status of their best friend (yes/no) was created and entered into the repeating logistic regression analyses. Sex, age, housing type, and district of living were adjusted in all the models.

Results

In Table 1, the prevalence of former smokers was 19.1% in boys and 15.8% in girls. The respective prevalence of light smokers was 8.4% and 7.0%, and the respective prevalence of heavy smokers was 1.7% and 0.3%. Regarding

THE ASSOCIATIONS OF ASTHMA SYMPTOMS WITH ACTIVE AND PASSIVE SMOKING

Table 1. Basic Characteristics, Lifestyles, and Asthma Symptoms of Students, and Smoking Status of Parents and Best Friend

	Boys, no. (%) (n = 3,284)	Girls, no. (%) (n = 3,210)	All, no. (%) (n = 6,494)
Age Group, y			
13 or below	151 (4.6)	49 (1.5)	200 (3.1)
14	1,067 (32.5)	1,430 (44.5)	2,497 (38.5)
15	1,128 (34.3)	1,290 (40.2)	2,418 (37.2)
16	328 (10.0)	310 (9.7)	638 (9.8)
17	134 (4.1)	97 (3.0)	231 (3.6)
18 or above	476 (14.5)	34 (1.1)	510 (7.9)
Housing			
Private	1,491 (45.4)	1,312 (40.9)	2,803 (43.2)
Public or others	1,793 (54.6)	1,898 (59.1)	3,691 (56.8)
Participating in Extracurricular Sports			
None	1,156 (35.2)	1,566 (48.8)	2,722 (41.9)
1–2	1,410 (42.9)	1,219 (38.0)	2,629 (40.5)
3 or above	718 (21.9)	425 (13.2)	1,143 (17.6)
Eating Healthy			
Never/seldom	2,217 (67.5)	2,220 (69.2)	4,437 (68.3)
Sometimes/always	1,067 (32.5)	990 (30.8)	2,057 (31.7)
Weekly Drinking			
No	2,542 (77.4)	2,514 (78.3)	5,056 (77.9)
Yes	742 (22.6)	696 (21.7)	1,438 (22.1)
Smoking Status of Student			
Never	2,326 (70.8)	2,466 (76.8)	4,792 (73.8)
Former	626 (19.1)	508 (15.8)	1,134 (17.5)
Current			
Light smokers (< 100 cigarettes in last week)	276 (8.4)	226 (7.0)	502 (7.7)
Heavy smokers (≥ 100 cigarettes in last week)	56 (1.7)	10 (0.3)	66 (1.0)
Smoking Status of Parents			
None of them are smokers	2,008 (61.1)	1,960 (61.1)	3,968 (61.1)
Either one is smoker	1,146 (34.9)	1,131 (35.2)	2,277 (35.1)
Both are smokers	130 (4.0)	119 (3.7)	249 (3.8)
Presence of a Smoking Best Friend			
No	2,454 (74.7)	2,595 (80.8)	5,049 (77.7)
Yes	830 (25.3)	615 (19.2)	1,445 (22.3)
Exercise-Induced Bronchospasm			
Never	1,168 (35.6)	829 (25.8)	1,997 (30.8)
Occasionally	1,607 (48.9)	1,746 (54.4)	3,353 (51.6)
Often	316 (9.6)	382 (11.9)	698 (10.7)
Very often	193 (5.9)	253 (7.9)	446 (6.9)
Nocturnal Cough			
Never	2,290 (69.7)	1,969 (61.3)	4,259 (65.6)
Seldom	862 (26.2)	1,136 (35.4)	1,998 (30.8)
Often	77 (2.3)	69 (2.1)	146 (2.2)
Very often	55 (1.7)	36 (1.1)	91 (1.4)
Frequent exercise-induced bronchospasm and nocturnal cough (often/very often)	57 (2.0)	44 (1.4)	101 (1.7)
Number of days prescribed medicine for asthma was taken (last week) (mean)	0.11 (0.67)	0.08 (0.60)	0.09 (0.63)

parental smoking status, 35.1% of students had one parent who smoked, and 3.8% had two. A total of 22.3% of the students reported the presence of a best friend who smoked. Moreover, 17.6% and 3.6% of them frequently experi-

enced exercise-induced wheeze and nocturnal cough, respectively. The prevalence of weekly drinking was 22.1%, participating in any extracurricular sports was 58.1%, and sometimes/always eating healthily was 31.7%. In Table 2,

Table 2. Number of Days Prescribed Medicine for Asthma Was Taken in the Past 7 Days Among Students With Asthma Symptoms

	Days, mean \pm SD
Exercise-Induced Bronchospasm	
Never	0.05 \pm 0.43
Seldom	0.06 \pm 0.50
Often	0.21 \pm 0.94
Very often	0.34 \pm 1.28
<i>P</i> *	< .001
Nocturnal Cough	
Never	0.05 \pm 0.45
Seldom	0.09 \pm 0.62
Often	0.75 \pm 1.78
Very often	0.99 \pm 2.06
<i>P</i> *	< .001
Frequent Exercise-Induced Bronchospasm and Nocturnal Cough (often/very often)	
No	0.07 \pm 0.56
Yes	1.12 \pm 2.16
<i>P</i> *	< .001

* *P* for analysis of variance.

the mean number of days taking anti-asthma medicine increased significantly with the frequency of having EIB or nocturnal cough, or both.

In Table 3, the prevalence of having frequent EIB increased from former (17.9%), to light smokers (20.9%), and heavy smokers (31.8%). The respective prevalence for nocturnal cough also increased from 5.5% to 6.6% and 12.1%. When compared to the never smokers, heavy smokers were significantly more likely to experience frequent EIB with odds ratio (OR) (95% CI) of 2.33 (1.34–4.06). When compared to never smokers, the OR (95% CI) of frequent nocturnal cough increased significantly from former (1.71 [1.24–2.37]), to light (1.76 [1.12–2.77]) and heavy (3.31 [1.46–7.50]) smokers, with *P* for trend of .03. The OR (95% CI) of frequent EIB (1.16 [1.01–1.33] for one, 1.43 [1.05–1.97] for two), nocturnal cough (1.25 [0.95–1.65] for one, 1.79 [1.06–3.02] for two), and both symptoms (1.43 [0.96–2.14] for one, 2.06 [1.00–4.25] for two) all increased significantly (*P* < .05) with number of smoking parents. Having a smoking best friend was not independently associated with frequent EIB, nocturnal cough, or both, with non-significant ORs (95% CI) of 1.12 (0.94–1.33), 1.21 (0.87–1.68), and 1.57 (0.99–2.49), respectively.

In Table 4, within the combinations of smoking status of parents and best friend, having no smoking parent but a smoking best friend had similar odds of having frequent respiratory symptoms as having at least one smoking parent but not a smoking best friend. Students having at least

one smoking parent and a smoking best friend, however, were significantly more likely to experience frequent EIB with OR (95% CI) of 1.45 (1.17–1.81), nocturnal cough with OR (95% CI) of 1.61 (1.06–2.42), or both with OR (95% CI) of 2.43 (1.37–4.31) than those without any parents or best friends who smoked.

Discussion

When compared to current smokers, heavy smokers had a higher likelihood of frequent EIB, and both former and current (regardless of intensity) smokers had a higher likelihood of frequent nocturnal coughing. The higher odds of having EIB in current smokers than others in this study were in agreement with that reported in Korean adolescents.⁹ Similar increasing odds of nocturnal cough¹⁰ and breathing problems²⁵ from never, to former and current smokers were also reported in other adolescent studies. Moreover, a higher likelihood of respiratory problems in higher smoking intensity students than the lower intensity group was also found in a longitudinal study.³ These results were supported by the experiments showing poorer lung function, as indicated by reduced FEV₁ and forced expiratory flow during the middle half of the FVC maneuver (FEF_{25–75%}),²⁶ and exhaled NO level²⁷ in adolescent smokers. Furthermore, a higher likelihood of nocturnal coughing²⁸ and asthma²⁹ for adolescents with parents who smoked was reported in surveys and experimental results.³⁰ In addition, our results further showed that active and passive smoking have additive effects on asthma symptoms in adolescents, as reported in other studies.^{31,32} This is consistent with the finding that parents of children with asthma have better knowledge and practices regarding secondhand smoke.³³ The associations between passive smoking and asthma symptoms among Hong Kong adolescents also suggest that the health authority should offer more education targeting parents to decrease second-hand smoke exposure.

There are several strengths and limitations in our study. The study relies on self-reported data to assess the smoking status and symptoms of asthma. Similar questions were used to assess the smoking status in other local adolescent studies.^{34,35} Moreover, self-reported symptoms of asthma have been found to be reliable in repeated cross-sectional studies.³⁶ The high correlations between the asthma symptoms and anti-asthma medication reported in adolescents³⁷ in our study also provided good support for the internal validity of the outcome variables. While most of the existing studies on adolescent asthma did not investigate the impact of smoking intensity, our results imply that lower intensity of smoking is also detrimental to respiratory systems, although many adolescents probably underestimate its health risks.³⁸ On the other hand, the causal relations between smoking and asthma symptoms are unclear with

THE ASSOCIATIONS OF ASTHMA SYMPTOMS WITH ACTIVE AND PASSIVE SMOKING

Table 3. Adjusted Odds Ratios of Frequent Asthma Symptoms for Smoking Status of Students, Parents, and Best Friend

	Exercise-Induced Bronchospasm			Nocturnal Cough			Both Symptoms		
	%	OR* (95% CI)	P	%	OR* (95% CI)	P	%	OR* (95% CI)	P
Smoking Status of Students									
Never	17.0	1		2.8	1		1.4	1	
Former	17.9	1.03 (0.86–1.23)	.77	5.5	1.71 (1.24–2.37)	.001	2.1	1.19 (0.72–1.94)	.50
Current									
Light smokers (< 100 cigarettes in last week)	20.9	1.20 (0.93–1.55)	.17	6.6	1.76 (1.12–2.77)	.02	2.4	1.10 (0.55–2.21)	.79
Heavy smokers (≥ 100 cigarettes in last week)	31.8	2.33 (1.34–4.06)	.003	12.1	3.31 (1.46–7.50)	.004	10.6	4.57 (1.83–11.43)	.001
P for trend†			< .001			.03			.06
Smoking Status of Parents									
Both are non-smokers	16.6	1		3.0	1		1.3	1	
One is smoker	18.8	1.16 (1.01–1.33)	.03	4.3	1.25 (0.95–1.65)	.12	2.1	1.43 (0.96–2.14)	.08
Both are smokers	23.3	1.43 (1.05–1.97)	.03	7.6	1.79 (1.06–3.02)	.03	4.0	2.06 (1.00–4.25)	.04
P for trend			.01			.004			.01
Presence of a Smoking Best Friend									
No	16.9	1		3.1	1		1.4	1	
Yes	20.0	1.12 (0.94–1.33)	.20	5.7	1.21 (0.87–1.68)	.26	2.9	1.57 (0.99–2.49)	.06

* Odds ratio (OR) adjusted for sex, age, house type, school type, extracurricular sports, and healthy eating, drinking.

† P for trend from never to former and current smokers.

Table 4. The Associations of Having Frequent Asthma Symptoms With Smoking Status of Students and Smoking Status Combinations of Parents and Best Friends

	Exercise-Induced Bronchospasm			Nocturnal Cough			Both Symptoms		
	%	OR* (95% CI)	P	%	OR* (95% CI)	P	%	OR* (95% CI)	P
Student Smoking Status									
Never	17.0	1		2.8	1		1.4	1	
Former	17.9	1.03 (0.87–1.24)	.72	5.5	1.72 (1.24–2.37)	.001	2.1	1.19 (0.73–1.95)	.48
Current									
Light smokers (< 100 cigarettes in last week)	20.9	1.20 (0.93–1.56)	.16	6.6	1.78 (1.13–2.79)	.013	2.4	1.11 (0.55–2.23)	.77
Heavy smokers (≥ 100 cigarettes in last week)	31.8	2.27 (1.30–3.97)	.004	12.1	3.45 (1.52–7.81)	.003	10.6	4.69 (1.88–11.73)	.001
P for trend†			< .001			.03			.05
Number of regular smoking parents and best friends									
No smoking parent + No smoking best friend	16.5	1		2.7	1		1.2	1	
No smoking parent + Smoking best friend	16.8	0.96 (0.76–1.22)	.76	4.8	1.25 (0.81–1.95)	.32	2.1	1.51 (0.79–2.88)	.21
At least one smoking parent + No smoking best friend	17.7	1.09 (0.94–1.28)	.25	3.8	1.32 (0.95–1.83)	.09	1.7	1.45 (0.89–2.35)	.13
At least one smoking parent + Smoking best friend	23.1	1.45 (1.17–1.81)	.001	6.5	1.61 (1.06–2.42)	.02	3.7	2.43 (1.37–4.31)	.002
P for trend			.02			.01			.03

* Odds ratio (OR) adjusted for sex, age, house type, school type, extracurricular sports, and healthy eating, drinking.

† P for trend from never to former and current smokers.

a cross-sectional design and the existence of confounding variables. A recent study showed that students with asthma had a higher inclination to smoke than those without asthma.³⁹ As a potential confounder, stressful life events in adolescents were significantly related to both asthma and asthma morbidity. At the same time, adolescents with

asthma tended to cope with stressful life events by smoking.⁴⁰ Although exercise is closely related to asthma in adolescents,⁴¹ we did not find different results from the logistic regression models after excluding exercise in the sensitivity test. Other possible risk factors of asthma, such as obesity,⁴² were also not included in this analysis. Furthermore, no in-

formation regarding the level of pollution of local areas of students' residence was available. Environmental pollutants are important factors contributing to respiratory problems in children.⁴³ Future studies should investigate the sustainability of the asthma symptoms in adolescents at different stages of smoking, with special consideration of environmental factors in Hong Kong.⁴⁴

Conclusions

This study supports the previous findings that both active and passive smoking are related to asthma symptoms in adolescents. Both non-smoking and smoking adolescents should be protected against secondhand exposure to prevent occurrence of asthma.

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THE ASSOCIATIONS OF ASTHMA SYMPTOMS WITH ACTIVE AND PASSIVE SMOKING

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