Secondhand Smoke (SHS) Exposure among Primary School Students in Hong Kong Before and After Smoke-Free Legislation in 2007

SY Ho, MP Wang, WS Lo, KK Mak, TH Lam & Hong Kong Council on Smoking and Health

1. Introduction
Secondhand smoke (SHS) causes heart disease, is a class I human carcinogen and an established cause of respiratory illness in children. The World Health Organisation estimated that about half the world's children are exposed to SHS. Smoking bans in public places have been effective in reducing SHS exposure. Cotinine level, as a proxy of SHS exposure, has decreased in Scottish children after the implementation of smoke-free legislation. In Hong Kong, the amended Smoking (Public Health) Ordinance that significantly extended smoking bans in public places and indoor workplaces took effect on 1 January 2007. We investigated SHS exposure among primary school students before and after the implementation of the smoke-free legislation.

2. Methods
The Hong Kong Council on Smoking and Health (COSH) had organized educational theatre performances for primary school students. In 2006, 19 of the participating schools were randomly selected in the first survey with 3,243 primary (P) 2-4 students. In 2008, another 10 schools were randomly sampled and 14 of the 19 schools in 2006 were again included in the second survey with overall 4,965 P2-4 and 4,031 P5-6 students in these 24 schools. The student response rate was 96% in 2006 and 93% in 2008.

Self-administered and anonymous questionnaires were used to collect information before viewing the theatre performance on socio-demographic characteristics (age, sex, place of birth), respiratory symptoms (self-reported frequent cough or phlegm), SHS exposure (number of days exposed in the past 7 days at home and outside home, respectively), smoking among household members and place of
exposure outside home in the past 30 days) and
atitudes and knowledge towards SHS exposure.
The analyses were mainly based on P2-4 data in
2006 and 2008 weighted to the distribution
of school grades in Hong Kong. Logistic regression
was used to calculate the change in the likelihood
of SHS exposure post-legislation, and the excess risk of
respiratory symptoms due to SHS exposure after
adjusting for potential confounders. Strong excess
risks of respiratory symptoms in the exposed versus
the unexposed indicate heavy exposure to SHS.

3. Results

3.1 Student characteristics

Table 1 shows that socio-demographic
characteristics of P2-4 students were similar in
the two surveys except that the 2008 sample
was slightly older.

Table 1.

Socio-demographic characteristics of P2-4 students
in 2006 and 2008 (%).

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=2,243)</td>
<td>(n=3,906)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boy</td>
<td>50.3</td>
<td>52.2</td>
</tr>
<tr>
<td>Girl</td>
<td>49.7</td>
<td>47.8</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 or below</td>
<td>24.8</td>
<td>16.4</td>
</tr>
<tr>
<td>8</td>
<td>32.6</td>
<td>28.5</td>
</tr>
<tr>
<td>9 or above</td>
<td>42.4</td>
<td>55.1</td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>29.7</td>
<td>29.3</td>
</tr>
<tr>
<td>P3</td>
<td>33.8</td>
<td>32.6</td>
</tr>
<tr>
<td>P4</td>
<td>36.6</td>
<td>38.1</td>
</tr>
<tr>
<td>Place of birth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hong Kong</td>
<td>73.3</td>
<td>73.4</td>
</tr>
<tr>
<td>Mainland China</td>
<td>23.3</td>
<td>22.8</td>
</tr>
<tr>
<td>Others</td>
<td>3.5</td>
<td>3.8</td>
</tr>
</tbody>
</table>

3.2 Knowledge and attitudes towards SHS

Most students knew that even a little exposure to
SHS is harmful (73%) and thought that no one
should smoke in public places (76%) and at
their home (83%) even in 2006. These proportions
had further increased by 1-5% points in 2008.
On the other hand, 2% points fewer students
knew that tobacco companies want to attract
youth to smoke in 2008 (Figure 1).

P4-6 students in 2008 were additionally asked
about their opinion on smoke-free legislation.
Most of them agreed that smoking should be
forbidden at home when a child is present (78%)
and in public places when a child is near (80%)
(Figure 2).

Figure 2.

3.3 Prevalence of SHS exposure

Figure 3 shows that significantly more (P<0.001)
P2-4 students were exposed to SHS
post-legislation at home (2008: 14.1%; 95%CI
13.1% to 15.1% vs. 2006: 10.2%; 95%CI 9.2% to
11.3%), outside home (2008: 27.2%; 95%CI
26.0% to 28.5% vs. 2006: 19.8%; 95%CI 18.4% to
21.2%) and anywhere (2008: 31.2%; 95%CI
29.5% to 32.7% vs. 2006: 23.2%; 95%CI 22.0% to
24.4%). Exposure outside home was more
prevalent than exposure at home in both 2006
and 2008. Home exposure was typically 4-7
days per week and outside home exposure 1-3
days per week in both years.

Figure 3.

After adjusting for sex, age, place of birth, grade,
parental smoking status and clustering effect of
schools, students in 2008 were 56% (95% CI
25% - 92%), 60% (95% CI 26% - 103%) and
54% (95% CI 25% - 89%) more likely to
exposure to any SHS exposure at home, outside
home and anywhere, respectively, compared
with students in 2006 (Figure 4).

Figure 4.

Change in prevalence of SHS exposure from 2006 to 2008
The overall prevalence of SHS exposure was higher in 2008 than in 2006 in each grade from P2 to P4, and much higher prevalence was observed in P5 (50%) and P6 (58%) than in junior grades in 2008 (Figure 5).

Figure 5.

Overall prevalence of SHS exposure by school grade

Presenting home and outside home exposures separately, Figure 6 shows that both exposures have increased post-legislation in each grade from P2 to P4, and that exposure outside home was more prevalent than exposure at home in P2, P3 and P4 in each year.

Figure 6.

Prevalence of SHS exposure by school grade and places of exposure

Figure 7 shows that parental smoking rates were stable with an insignificant 1.1% point increase in the proportion of families without any smoking parent.

Figure 7.

Prevalence of smoking parents in P2-4 students

For the same parental smoking status, P2-4 students in 2008 had higher prevalence of SHS exposure than those in 2006, suggesting that smoking parents smoked more often at home post-legislation (Figure 8).

Figure 8.

Prevalence of SHS exposure at home by parental smoking status

As to the place of SHS exposure outside home in the past 30 days, streets were most commonly reported (34.4%) by P2-4 students in 2008, followed by parks (15.4%) and bus stops (13.4%). SHS exposure was also reported in supposedly smoke-free places such as restaurants (12.7%), shopping malls (8%) and in the washrooms or stairways of these establishments (Figure 9).

Figure 9.

Places of SHS exposure outside home in the past 30 days in 2008

In 2006, P2-4 students who were born in Mainland China were 36.6% (3.4% points) more likely to report SHS exposure at home than their Hong Kong born counterparts and such socioeconomic discrepancy has increased to 45.3% (5.8% points) in 2008 (Figure 10). As regards SHS exposure outside home, which was 8.1% (1.6% points) lower among Mainland China born students in 2006, has become 3.6% (1% points) higher in 2008 compared with Hong Kong born students (P=0.17) (Figure 11).

Figure 10.

Prevalence of SHS exposure at home by place of birth (P2-4)
Figure 11. Prevalence of SHS exposure outside home by place of birth (P2-4)

Figure 12 shows that regardless of the place of SHS exposure, more frequent exposure was associated with higher prevalence of frequent respiratory symptoms in both 2006 and 2008. Overall, among those who had any SHS exposure, 41.8% in 2008 vs 40.7% in 2006 had frequent respiratory symptoms (P=0.60). It should be noted that the prevalence of respiratory symptoms was also insignificantly higher in 2008 than 2006 among those who were unexposed (36.7% vs 34.5%) (P=0.10).

Figure 13. Prevalence of respiratory symptoms by SHS exposure at home

Stratified by the place of SHS exposure (Figures 13 and 14), similar dose-response relations were observed in each survey. However, despite the higher background rate of respiratory symptoms among those who were unexposed outside home in 2008 than 2006 (Figure 14), similar prevalence of respiratory symptoms was observed among those exposed in 2008 and 2006 (all P>0.05).

Figure 14. Prevalence of respiratory symptoms by SHS exposure outside home

After adjusting for age, sex, grade, parental smoking status, and clustering effect of schools, the excess risk of respiratory symptoms due to per day increase in overall SHS exposure (home or outside home) was insignificantly lower in 2008 (14%; 95% CI 5% to 23%) than 2006 (18%; 95% CI 5% to 33%) (Figure 15).

Figure 15. Excess risk of respiratory symptoms due to SHS exposure

However, the excess risk for per day increase in exposure has become higher post-legislation for exposure at home (2008: 7%; 95% CI -5% to 20% vs 2006: 0%; 95% CI -11% to 19%) (Figure 16), but lower for exposure outside home (2008: 20%; 95% CI 7% to 34% vs 2006: 35%; 95% CI 14% to 58%) (Figure 17), although the differences were not statistically significant. It is also noted that while SHS exposure outside home was associated with much higher excess risk of respiratory symptoms than home exposure in 2006 (35% vs 0%), such difference has been reduced in 2008 (outside home 20% vs home 7%).

Figure 16. Excess risk of respiratory symptoms due to SHS exposure at home

Excess risk based on odds ratios.
Adjusting for age, sex, grade, place of birth, parental smoking status, and clustering effect of schools and SHS exposure outside home.
*P<0.05
4. Discussion

4.1 Prevalence of SHS exposure at home
Post-legislation, students were 56% (95% CI 25% - 92%) more likely to report SHS exposure at home. Increases were observed in families regardless of whether one or both parents smoked. Since the prevalence of parental smoking was stable, smoking at home by family members has likely become more common following the smoking bans in many public places starting in 2007.

Stronger attitudes against SHS might have prompted the reporting of exposure in 2008, but the large increase in home exposure was unlikely to have been due to the 1% point increase in students supporting smoke-free homes in 2008 vs 2006. Moreover, students who supported smoke-free homes were less likely to report home exposure in each survey.

4.2 Prevalence of SHS exposure outside home
Compared with students in 2006, students in 2008 were 60% (95% CI 26% - 103%) more likely to report SHS exposure outside home. The indoor smoking bans including workplaces and restaurants might have resulted in more people smoking outdoors, and indeed the streets (34.4%), parks (15.4%) and bus stops (13.4%) were the most common places of SHS exposure outside home in the past 30 days among P2-4 students.

Students who supported smoke-free public places were more likely to report SHS exposure outside home in each survey, therefore the greater support in 2008 vs 2006 might have contributed to the increased prevalence of SHS exposure outside home but the effect was likely to be small since the proportion of students who supported smoke-free public places had only increased by 3%.

4.3 Prevalence of SHS exposure overall and the associated risk of respiratory symptoms
Overall, the students in 2008 were 54% (95% CI 25% - 89%) more likely to report SHS exposure than in 2006. To estimate the dose of SHS, which also depends on the duration and concentration of exposure, the excess risk of respiratory symptoms in the exposed compared with the unexposed was used as an indicator. Excluding students who had ever smoked and adjusting for demographic characteristics and parental smoking status, the excess risk due to per day increase in SHS exposure at home and outside home post-legislation had increased (from 0% to 7%) and decreased (from 35% to 20%), respectively. Overall, the excess risk had decreased from 18% in 2006 to 14% in 2008. Further adjusting for air pollution index and influenza consultation rate had little effect on the results.

The increased prevalence of exposure to SHS at home and in public places is consistent with some local anecdotal reports. The reduction in the excess risk of respiratory symptoms due to SHS exposure outside home was probably due to the shorter and lower concentration of exposure mainly in outdoor public places (e.g. streets) in 2008 compared with that in restaurants in 2006.

It should be noted that these findings on the effects of smoke-free legislation were specific to primary school students and may vary among different subgroups in the population. For instance, the exposure of catering workers to SHS is likely to have dropped significantly after the legislation.

4.4 Validity of SHS exposure
SHS exposure was based on two simple questions about the number of days in which the students were exposed in the past 7 days. Young children may not be able to provide more detailed information on the duration and intensity of exposure reliably.

The use of objective measures such as nicotine in hair was not possible for all participants due to limited resources. Such measures, however, cannot distinguish the place of SHS exposure, which must rely on self-report. Nevertheless, we have performed nicotine hair tests in a small sample of students in 2006 and found satisfactory sensitivity (75%) and specificity (63%) of self-reported SHS exposure. The observed association between SHS exposure and respiratory symptoms as expected also lend support to the validity of exposure data.

4.5 Validity of self-reported respiratory symptoms
As more students became aware of the harm of SHS (73% in 2006, 78% in 2008), we compared the prevalence of respiratory symptoms in 2006 and 2008 in students who had never smoked and were not exposed to SHS. Adjusting for air pollution and influenza activity, no significant difference in reporting was evident, suggesting that there was no over-reporting of symptoms in 2008 relative to 2006. Furthermore, respiratory symptoms were asked before SHS exposure in both surveys to avoid over-reporting of symptoms in those exposed.

4.6 Inequality in SHS exposure
The discrepancy of more prevalent SHS exposure at home in students born in Mainland China than those born in Hong Kong had increased post-legislation. Parents of Mainland born students might be more likely to work in jobs (e.g. sales and catering) and live in places (e.g.
public housing estates which ban smoking in common areas) that became smoke-free post-legislation, and resorted to smoking at home.

4.7 Comparison with overseas findings
Smoke-free legislation in Scotland had led to lower SHS exposure in children, as measured by cotinine. Smokers there are provided with free smoking cessation services to quit smoking. In contrast the resources put into smoking cessation in the public sector are very limited in Hong Kong and hence parental smoking rates have not dropped after legislation in 2007.

5. Conclusions
5.1 Among P2-4 students in Hong Kong, the prevalence of exposure to SHS at home has increased by 56% (95% CI 25% - 92%). The associated risk of respiratory symptoms had also increased, suggesting that the intensity of exposure at home had also increased.

5.2 Although the prevalence of SHS exposure outside home increased by 60% (95% CI 26% - 103%), the associated risk of respiratory symptoms decreased by 42.9% (35% in 2006, 20% in 2008), suggesting that the intensity of SHS exposure outside home had decreased.

5.3 Regardless of the place of exposure, the prevalence of exposure to SHS increased by 54% (95% CI 25% - 89%) while the associated risk of respiratory symptoms decreased by 22.2% (18% in 2006, 14% in 2008), suggesting a lower intensity of SHS exposure among those who were exposed.

5.4 No significant reduction in the prevalence of parental smoking was evident post-legislation.

5.5 Further reduction of exposure at home and in public places is needed to protect our children from the harm of secondhand smoke.

6. Recommendations
6.1 Large-scale smoking cessation programme should be implemented to provide affordable and convenient services to help smokers quit.

6.2 Smoking bans in public places should be further enforced.

6.3 Exposing other people, especially children, to secondhand smoke is unacceptable. This should be publicised strategically to shape social norms.

6.4 Legislation to ban smoking at public places when a child is near and at home when a child is present should be considered and discussed by the public.

6.5 Further research with cotinine or nicotine measurement in children is needed to assess secondhand exposure objectively.

7. References

8. Acknowledgements
We thank Dr. HK Lai for his useful comments on data analysis. We are grateful to the Hong Kong Council on Smoking and Health for funding and excellent support in fieldwork by Ms. Wendy Kong and Ms. Crystal Chan. Finally, we thank Ms. Jessica Yong and a group of nursing students for data entry and students, parents, teachers and schools who have participated in this study.

School of Public Health, Li Ka Shing Faculty of Medicine, The University of Hong Kong
5/F., William MW Mong Block, 21 Sassoon Road, Pokfulam, Hong Kong
Tel : (852) 2819-9280 Fax : (852)2855-9528
Website : http://sph.hku.hk/index.php E-mail : hkusph@hkucc.hku.hk

Hong Kong Council on Smoking and Health
Unit 4402-03, 44/F., Hopewell Centre, 183 Queen’s Road East, Wanchai, H.K.
Tel : (852) 2838-8822 Fax : (852)2575-3966
Website : http://www.smokefree.hk E-mail : enq@cosh.org.hk

Copyright © 2010 Hong Kong Council on Smoking and Health. All Rights Reserved. First Edition, 2010