Workplace exposure to secondhand smoke and its association with respiratory symptoms—a cross-sectional study among workers in Shanghai

Pinpin Zheng,1 Weixia Li,1 Simon Chapman,2 Zhixing Zhang,3 Junling Gao,1 Hua Fu1

ABSTRACT

Objective To describe workplace exposure to secondhand smoke (SHS) among different working populations in Shanghai; to identify any association between respiratory symptoms and SHS exposure in these workplaces.

Design Cross-sectional survey with a standardised questionnaire.

Setting 150 worksites (including restaurants, shopping malls, hotels, hospitals, schools, kindergartens).

Subjects 3530 workers.

Outcome measures Prevalence of workers with workplace exposure to SHS; average time of exposure to SHS per day; proportion of workers reporting any respiratory and sensory symptoms.

Results 13.3% of employees were covered by complete smoke-free policies. Restaurant employees had the highest level of exposure to SHS (67% exposed with 2.95±3.10 h of exposure on average per day) while kindergarten employees had the lowest level (0.5% exposed with 0.01±0.01 h of exposure per day). Compared with employees from kindergartens, non-smoking workers from restaurants and shopping malls reported a higher proportion of respiratory and sensory symptoms and were more likely to suffer from all eight respiratory and sensory symptoms (OR 1.8–8.9). The length of exposure to SHS each day was positively associated with all eight symptoms except runny nose.

Conclusions Workplace exposure to SHS is extensive in Shanghai and the implementation of the current municipal regulation does not provide adequate worker protection. There is an urgent need to establish 100% smoke-free legislation covering all workplaces and public places in Shanghai.

Globally, more than half of all countries, accounting for nearly two thirds of the world’s population, still allow smoking in government offices, workplaces and other indoor places, meaning that a majority of workers worldwide are occupationally exposed to secondhand smoke (SHS).1 The WHO has estimated that each year workplace exposure to SHS causes an estimated 200 000 deaths among employees and that one in seven work-related deaths are attributable to chronic exposure to SHS in the workplace.1

Smoking contributes to four of the five leading causes of death in China today2 with the 2007 national tobacco control report declaring that one million deaths per year including 100 000 deaths caused by SHS were attributable to tobacco.3 It is estimated that among the 500 million people exposed to SHS in China, 67% of nonsmokers are exposed in public places such as shopping malls and restaurants and 55% are exposed in workplaces.3 Although the Framework Convention on Tobacco Control (FCTC) has been in force in China since 2006, there is no national law prohibiting tobacco use in indoor public places. Under the encouragement of the central government, some provincial and city governments passed local bans prohibiting smoking in some public places. However, SHS exposure in workplaces needs to be better addressed. Although some research has showed that SHS is a particular occupational health hazard for food-service workers,4 most smoking restrictions in China exclude restaurants and bars. Even in some public places which have been covered by smoking restriction regulations, ineffective strategies such as smoking zones (rooms) still expose employees to SHS.

As an international metropolis in China, Shanghai (population 19.2 million) established a municipal regulation prohibiting smoking in public places as early as 1994 and made some improvements in 1997. However, smoking is only banned in some public places such as cinemas, indoor gymnasias, public transport, waiting rooms, clinical areas and patient rooms in hospitals, indoor areas in schools and kindergartens, and shopping areas larger than 200 m². As these are regulations rather than laws, they are often poorly enforced and SHS exposure is frequent in public places and workplaces.5 In 2009, the Shanghai government began to draft a new legislation to restrict smoking in the public places.

Most studies examining workplace exposure to SHS and assessing the association between exposure to SHS and common respiratory symptoms have been conducted in western countries and mainly focused on hospitality workers.6–8 A population-based study in Hong Kong did not provide details of exposure to SHS among the specified work groups.9 The objective of this study was to determine and compare the prevalence of workplace exposure to SHS among different working populations as well as identifying any association between reported respiratory symptoms and workplace exposure to SHS. Hopefully, the results of this study can provide useful evidence in evaluating the implementation of the current regulations.

METHODS

A cross-sectional study was conducted from March to August in 2009. Five districts were randomly selected among the 19 districts in Shanghai...
(Changning, Huangbu, Qingan, Xuhui, Minhang). In each
district, 2 hospitals, 2 schools (one primary school and one
junior high school), 2 kindergartens and 15–20 restaurants were
selected to present areas where people frequently visit or were
popular among local residents. Hotels (four star and above) and
shopping malls (larger than 200 m²) were randomly selected
from the three downtown districts (Changning, Huangbu,
Qingan) due to the wide range of hotels and shopping malls in
Shanghai (population 19.2 million). Altogether, 9 hospitals,
9 schools (4 primary schools and 5 junior high schools), 10
kindergartens, 11 shopping malls, 91 restaurants and 20 hotels
were involved in the study.

The eligibility criteria for employees included: (1) being
18 years or older, (2) being employed for a minimum of 24 h per
week, (3) being employed in the current workplace for at least
30 days and (4) working indoors at least 5 h per day. In restaur-
ants, chefs and outdoor waiters were excluded from the survey.
In hotels, only employees working in lobbies were involved in
the survey. Approval for this study was obtained from the Ethics
Committee of the School of Public Health, Fudan University.
In each of the selected establishments, we asked the manager
to provide a list of staff meeting the above criteria. All employees
on the list were approached by us to participate in the survey.
Once their permission had been obtained, the investigators
conducted face-to-face interviews using standardised question-
naires. In total, 5925 workers were targeted and 5530 agreed to
participate (99.9% response rate).

The sample size was calculated by estimating the prevalence of
SHS exposure among the working population. The previous
study in China estimated a SHS exposure prevalence of 33% in
the workplace among nonsmokers. It was estimated that 87 subjects
were needed for each group in order to obtain an α level of 5% with
statistical power of 90%. However, considering the proportion of
nonsmokers in the whole study population as well as the varia-
tion of prevalence of SHS exposure among the different work
groups, we enlarged the sample size to 200 for each work group.

MEASURES
Participating employees provided information on demographics,
sources and hours of SHS exposure, and respiratory symptoms.
SHS exposure was assessed by asking ‘In a typical working day,
how many hours are you exposed to other people’s tobacco
smoke indoors at work?’ Respondents who self-reported 0 h of
exposure were classified as not exposed, while the others were
classified as exposed. To measure SHS exposure at home,
participants were asked ‘Do you live with a smoker?’ Exposure
to SHS other than at work or home was measured by asking
‘How do you assess your exposure to SHS in settings other than
home and work? (1) often, (2) sometimes, (3) seldom, (4) never’.

Survey participants were asked to identify the workplace
smoking policy that was most similar to theirs: (1) smoking is
not allowed anywhere in the workplaces, (2) smoking is allowed
only in designated areas, (3) smoking is allowed in most areas.
The item selected by most workers was defined as the policy
type in each worksite.

Compliance with the smoking policy was assessed by asking
‘If there is some restriction on smoking in your workplaces, how
do you assess the enforcement of the policy? (1) enforced most
of the time, (2) enforced sometimes, (3) seldom enforced’. The
worksites were recorded as being compliant only if over 60% of
respondents reported that the policy could be enforced most of
the time.

The International Union against Tuberculosis and Lung
Disease’s Bronchial Symptoms Questionnaire was used to assess
the adverse health effects of SHS exposure. Five upper respira-
tory symptoms were surveyed, including wheezing, dyspnoea,
morning cough, cough during the rest of the day or night, as
well as phlegm production. Three sensory symptoms were
surveyed including red or irritated eyes; runny nose, sneezing, or
nasal mucus; and sore throat. Respondents were asked if they
had experienced any of the above symptoms in the previous
4 weeks. To assess the presence of other conditions, including
those that could potentially account for these symptoms,
participants were also asked whether they had experienced
a cold in the preceding 4 weeks, had doctor confirmed asthma or
any other health conditions that caused respiratory problems.

We categorised employees into two groups: current smokers
and nonsmokers. Being a current smoker meant any smoker
who had ever smoked more than 100 cigarettes in his/her life
and had smoked in the past 30 days. Nonsmokers were identified
as those who had smoked less than 100 cigarettes in their life
time, or those who had not smoked (even a puff) in the past
30 days.

To evaluate the impact of the municipal regulation, we
recorded the working population in one of two groups. Group 1:
workers in worksites covered by the municipal regulation such
as shopping malls, schools, hospitals and kindergartens. Group 2:
workers in worksites not covered by the municipal regulation
including restaurants and hotels.

Statistical analysis
Fisher’s exact test or the χ² test was used to examine group
differences for categorical variables, and the Student t test was
used to examine differences between groups for continuous data.
Logistic regression models were used to investigate predictors
of respiratory symptoms after adjusting for possible confounding
factors. The control variables included in the analyses were
presence of cold, asthma, respiratory conditions, home SHS
exposure and other exposure to SHS, age, gender and education.
All subjects were included in estimating workplace exposure to
SHS. However, only nonsmokers were included when assessing
the proportion of subjects suffering from respiratory symptoms
and evaluating the relationship between the workplace SHS
exposure and respiratory symptoms.

RESULTS
There were 3530 workers from 150 worksites (classified into six
workgroups) who completed the survey. Of these, 18 (12.0%) of
worksites had a total smoking ban, which covered 13.3% employees.
Even among the 39 worksites covered by municipal
regulation, only 14 (35.8%) banned smoking with 92.9% being
compliant. There were 63 (42.0%) worksites which had desig-
nated smoking areas and 39 (61.9%) were compliant. Regardless
of whether worksites were covered by the municipal regulation,
the proportion of compliance among the worksites with
smoking ban was higher than that of worksites only with
designated smoking area (94.4% vs 61.9%) (table 1).

Although there were some worksites covered by the munic-
iproval regulation, total bans were not common with most (except
kindergartens) adopting designated smoking areas. Table 2 shows
exposure to SHS among different working populations. Munic-
iproval regulation was best enforced among kindergartens where
only 0.5% employees reported exposure to SHS at work with an
average 0.01 h of exposure per day. The low level of SHS exposure
in kindergartens may be due to the high proportion of females in
these worksites who rarely smoke. With the least protection from
municipal regulations and worksite smoking policies, restaurant
workers were exposed most to SHS with the highest proportion
Hotels (n = 17) (94.4) 1 (5.6) 39 (61.9) 24 (38.1)

Worksites in group 2*

Hospitals (n = 9–11) 2 (66.7) 1 (33.3) 7 (60.0) 4 (36.4)

Schools (n = 9) 3 (100) 0 (0) 5 (83.3) 1 (16.7)

Kindergartens (n = 10) 8 (100) 0 (0) 2 (100) 0 (0)

Worksites in group 1* (n = 39)

Hotels (n = 20) 0 / 0 / 0 / 0 / 0 / 8 (40.0) 12 (60.0)

Hospitals (n = 11) 2 (66.7) 1 (33.3) 7 (60.0) 4 (36.4)

Shopping malls (n = 485) 31.9 ± 8.9

Schools (n = 379) 37.2 ± 9.4

Kindergartens (n = 206) 38.3 ± 9.2

Group 1 (n = 1515) 37.2 ± 9.4

Group 2 (n = 2015) 38.3 ± 9.2

Table 1 Smoking policies and compliance in worksites

<table>
<thead>
<tr>
<th>Smoking policy</th>
<th>Restaurants (n = 1216)</th>
<th>Hotels (n = 739)</th>
<th>Shopping malls (n = 485)</th>
<th>Hospitals (n = 445)</th>
<th>Schools (n = 379)</th>
<th>Kindergartens (n = 206)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ban smoking (%)</td>
<td>30.1</td>
<td>26.5</td>
<td>31.8</td>
<td>12.5</td>
<td>5.5</td>
<td>2.4</td>
</tr>
<tr>
<td>Current smoking rates (%)</td>
<td>49.7</td>
<td>48.6</td>
<td>57.8</td>
<td>68.9</td>
<td>74.7</td>
<td>97.6</td>
</tr>
<tr>
<td>Age</td>
<td>27.3 ± 7.6</td>
<td>31.9 ± 8.9</td>
<td>33.5 ± 6.9</td>
<td>35.7 ± 10.6</td>
<td>37.2 ± 9.4</td>
<td>38.3 ± 9.2</td>
</tr>
<tr>
<td>Proportion of Female (%)</td>
<td>30.1</td>
<td>26.5</td>
<td>31.8</td>
<td>12.5</td>
<td>5.5</td>
<td>2.4</td>
</tr>
<tr>
<td>Smoking policy</td>
<td>2.3</td>
<td>0</td>
<td>0</td>
<td>37.8</td>
<td>33.3</td>
<td>70.6</td>
</tr>
<tr>
<td>Designated area (%)</td>
<td>11.1</td>
<td>100</td>
<td>100</td>
<td>62.2</td>
<td>66.7</td>
<td>29.4</td>
</tr>
<tr>
<td>No ban</td>
<td>86.6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>54.8</td>
</tr>
<tr>
<td>Exposed to SHS at work (%)</td>
<td>67.0</td>
<td>49.0</td>
<td>64.0</td>
<td>46.9</td>
<td>21.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Average exposing time per day (hour)</td>
<td>2.95 ± 3.10</td>
<td>1.23 ± 2.01</td>
<td>1.79 ± 2.47</td>
<td>1.11 ± 1.71</td>
<td>0.30 ± 0.62</td>
<td>0.01 ± 0.01</td>
</tr>
</tbody>
</table>

A significant difference (p < 0.05) were founded in age, proportion of female, current smoking rate, proportion of exposed to SHS in the workplace and the average exposing time per work day in different working populations and different groups.

Group1: workers who worked in worksites covered by the municipal regulation.

Group2: workers who worked in worksites not covered by the municipal regulation.

Ban Smoking: smoking is not allowed anywhere in the workplaces.

Designated areas: smoking is allowed only in designated areas.

No ban: smoking is allowed in most areas.


Table 2 Sample characteristics and exposure to secondhand smoke (SMS)

<table>
<thead>
<tr>
<th>Age</th>
<th>Restaurants (n = 1216)</th>
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<td>2.4</td>
</tr>
<tr>
<td>Smoking policy</td>
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<td>0</td>
<td>0</td>
<td>37.8</td>
<td>33.3</td>
<td>70.6</td>
</tr>
<tr>
<td>Designated area (%)</td>
<td>11.1</td>
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<td>100</td>
<td>62.2</td>
<td>66.7</td>
<td>29.4</td>
</tr>
<tr>
<td>No ban</td>
<td>86.6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>54.8</td>
</tr>
<tr>
<td>Exposed to SHS at work (%)</td>
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<td>49.0</td>
<td>64.0</td>
<td>46.9</td>
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</tr>
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<td>Average exposing time per day (hour)</td>
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<td>1.11 ± 1.71</td>
<td>0.30 ± 0.62</td>
<td>0.01 ± 0.01</td>
</tr>
</tbody>
</table>

The highest level of exposure to SHS among the different worksites was among restaurant employees. This is almost certainly a reflection of the lowest implementation of smoke-free policy in these settings. Although restaurant workers were the worker group who experienced most symptoms from SHS,
they remain excluded from smoke-free legislation. The results of our study support the need of a comprehensive smoke-free legislation, covering all workplaces, including restaurants and hotels.

Because of the weakness of the municipal regulation, protection of the working population provided by the current regulation is quite limited. In the 39 worksites covered by the municipal laws in this study, only 14 banned smoking in all indoor areas. It is not surprising that workers in shopping malls covered by the regulation were still mostly (64%) exposed to SHS for an average of 1.79 h per day. The high level of exposure to SHS was also associated with high reports of respiratory and sensory symptoms among workers in shopping malls. Our site visiting found that in these malls some smokers (including the employees) smoked in restrooms and employees’ cafes. The regulation only prohibits smoking in the shopping areas, not in these other areas.

As expected, compared to workers in restaurants with smoking zones or without any restrictions, workers in smoke-free restaurants were better protected from exposure to SHS, having the lowest proportion of exposed workers and shortest duration of exposure per shift. Workers in restaurants with smoking zones had a similar level of exposure to SHS of workers visiting found that in these malls some smokers (including the employees) smoked in restrooms and employees’ cafes. The regulation only prohibits smoking in the shopping areas, not in these other areas.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Comparison of exposure to SHS among the restaurant workers under different smoking policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ban smoking (n = 42)</td>
<td>Designated areas (n = 218)</td>
</tr>
<tr>
<td>Current smoking rates (%)</td>
<td>21.4</td>
</tr>
<tr>
<td>Exposed to SHS at work (%)</td>
<td>24.2</td>
</tr>
<tr>
<td>Average exposing time per day at work (h)</td>
<td>0.57 ± 1.12</td>
</tr>
<tr>
<td>Workers’ estimates about compliance (%)</td>
<td>80.1 ± 14.1</td>
</tr>
</tbody>
</table>

Ban smoking: smoking is not allowed anywhere in the workplaces
Designated areas: smoking is allowed only in designated areas.
No ban: smoking is allowed in most areas.

The failure of voluntary smoke-free policies to protect workers from exposure suggests that such voluntary policies are unlikely to provide satisfactory protection. This study shows that workers’ estimates about compliance were higher in smoke-free restaurants than those working in restaurants with separate smoking sections. This may imply that total bans may be easier to implement. However, the 24% who were exposed to SHS with these voluntary smoke-free policies still indicate that such voluntary policies are difficult to implement completely. Therefore, making all indoor workplaces smoke free is the only effective and feasible method to protect the health of the working populations and customers who visit those workplaces. Although there were some anecdotes that smoke-free restaurants may have a negative impact on business, many international studies have shown that cafes and restaurants do not experience any negative economic effects and may even experience some positive effects after the introduction of smoke-free laws. Another study in Shanghai also indicated that smoke-free policy may even increase the intent to eat out among restaurant customers.

Seven respiratory and sensory symptoms were increased with increasing level of workplace exposure to SHS, when measured as reported hours exposed per day. Workers in restaurants and shopping malls who had high levels of exposure to SHS at work...
Workplace exposure to SHS in China is widespread and has not been well addressed. This study provides a comprehensive map of workplace SHS exposure among several different working populations in Shanghai and indicates its association with respiratory symptoms. Workplace smoking bans are urgently needed in China to improve occupational health.

Second, the exposure to SHS in this study was self-reported, which may lead to some recall bias. However, other studies have confirmed that self-reported exposure is a valid measure with self-reported levels being consistent with biological markers such as urinary and salivary cotinine. Although the FCTC has been in force since 2006, tobacco control efforts in China still meet some obstacles due to the large smoking population and the role of tobacco industry in the economy. Recently, the Shanghai government has instituted new legislation on smoking restrictions in public places. However, although considerable achievements have been made in creating a smoke-free environment, there is still a big gap between the legislation and the standards set out in the FCTC. For example, although it is well known that hospitality workers suffer most from SHS and either ventilation or smoking separation cannot provide complete protection, smoking zones (rooms) are still permitted in some public places including restaurants. The global plan of action on workers’ health (2008–2017) emphasises the elimination of SHS from all indoor workplaces to protect and promote health at workplace. We hope the evidence of this study will support further steps towards the introduction of 100% smoke-free workplaces.

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Competing interests None.

Patient consent Obtained.

Ethics approval This study was conducted with the approval of the Approval for this study was obtained from the Ethics Committee of the School of Public Health, Fudan University.

Contributors ZZ, WL and JG completed the field work, PZ completed the data analysis and wrote the manuscript, SC contributed a lot of writing and shaping the whole paper, HF supervised the whole study.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES


Table 5 Prevalence and ORs for association of respiratory and sensory symptoms with workplace smoking bans

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Workers in group 1 %</th>
<th>OR</th>
<th>95% CI</th>
<th>Workers in group 2 %</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheeze</td>
<td>2.8</td>
<td>1</td>
<td>8.2</td>
<td>1.91</td>
<td>1.02</td>
<td>4.86</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>9.4</td>
<td>1</td>
<td>18.9</td>
<td>2.05</td>
<td>1.07</td>
<td>3.81</td>
</tr>
<tr>
<td>Morning cough</td>
<td>10.7</td>
<td>1</td>
<td>17.5</td>
<td>1.05</td>
<td>0.62</td>
<td>1.67</td>
</tr>
<tr>
<td>Frequent cough</td>
<td>11.3</td>
<td>1</td>
<td>19.5</td>
<td>1.82</td>
<td>1.25</td>
<td>3.39</td>
</tr>
<tr>
<td>Phlegm</td>
<td>22.7</td>
<td>1</td>
<td>31.8</td>
<td>1.30</td>
<td>1.02</td>
<td>1.97</td>
</tr>
<tr>
<td>Sore eyes</td>
<td>18.2</td>
<td>1</td>
<td>25.9</td>
<td>1.57</td>
<td>1.21</td>
<td>2.19</td>
</tr>
<tr>
<td>Runny nose</td>
<td>24.1</td>
<td>1</td>
<td>31.8</td>
<td>1.20</td>
<td>0.62</td>
<td>2.34</td>
</tr>
<tr>
<td>Sore throat</td>
<td>37.5</td>
<td>1</td>
<td>49.7</td>
<td>1.27</td>
<td>1.03</td>
<td>1.68</td>
</tr>
<tr>
<td>Any symptom</td>
<td>62.8</td>
<td>1</td>
<td>82.0</td>
<td>1.49</td>
<td>1.10</td>
<td>2.05</td>
</tr>
</tbody>
</table>

What this paper adds

Figure 1 Association between hours of workplace exposure to secondhand smoke (SHS) per day and respiratory symptoms. *Adjusted for presence of cold, asthma, respiratory condition, home SHS exposure and other exposures to SHS, age, gender and education. AOR, adjusted odds ratio.