# Potential Unintended Consequences of Smoke-Free Policies in Public Places on Pregnant Women in China

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**Background:** Smoke-free policies in public places have become more common in China. Little is known, however, about the potential unintended consequences of such policies on pregnant women.

**Methods:** The study was conducted in 2006 in Chengdu, China. Nonsmoking pregnant women (N=55) whose husband were smokers participated in a study of their knowledge about secondhand smoke and smoke-free policies, their exposure to secondhand smoke, and their husbands' smoking status at home. This study presents descriptive statistics, analyses based on family income and pregnant women's education level, and the findings of focus group discussions that examined the potential unintended consequences of the smoke-free policies on pregnant women.

**Results:** Exposure to secondhand smoke at home was reported by 69.1% of the pregnant women. Both family income and the education level of the pregnant women had a significant ($p<0.05$) association with exposure to secondhand smoke. The four main potential unintended consequences of the smoke-free policies were: (1) increased exposure of pregnant women to secondhand smoke at home; (2) reduced work efficiency; (3) adverse effect on family harmony; and (4) poor air quality at home.

**Conclusions:** Education is needed to increase knowledge of secondhand smoke among smokers and nonsmokers alike. When the smoking location is shifted from public places and workplaces to home, women, and in particular pregnant women, become the victims. Policymakers should recognize such potential unintended consequences and take necessary measures to increase awareness about the harms of secondhand smoke.
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## Introduction

One third of the world's tobacco leaf is grown by China, and China also has the largest number of cigarette consumers in the world.[1] Consumption was 1.7 trillion cigarettes (one third of the world's total) in 2000.[2] The smoking prevalence in China is among the highest in the world. In 2002, about 300 million people were current smokers.[3] More than 66% of men are smokers, compared with 3.1% of women.[4] The average number of cigarettes consumed by smokers in China is 14.8 cigarettes per day, and the average cost spent on cigarettes by Chinese smokers is renminbi (RMB) 2.73 (US$0.36) per day (in 2006, the exchange rate was 7.5RMB=US$1.00.[3]

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A recent report estimated that at least 540 million Chinese, including large numbers of women and children, are exposed to secondhand smoke (SHS).[5] The 2002 National Prevalence Survey[3] found that 90% of SHS exposure for those women occurs at home. A study conducted in Beijing, Shanghai, and Chengdu in 2002 showed the amount of women's exposure to SHS at home is much higher than in workplaces and public places.[6] Many studies conducted in Western countries have shown that exposure to SHS causes lung cancer and asthma.[7–9] For pregnant women, smoking has negative association with birth outcomes,[10] such as stillbirth and sudden infant death syndrome.[11–13] For those nonsmoking pregnant women with husbands who smoke, exposure to SHS at home is a serious health issue. Studies have shown that a pregnant woman's exposure to her partner's smoking may lead to reduced birth weight.[14–16] Another study also suggested that the amount of SHS exposure, as measured by serum cotinine concentration in pregnant women, was negatively associated with the newborn's birth weight.[11]



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To reduce SHS exposure to nonsmokers, the Tobacco Monopoly Act of the People's Republic of China, passed on June 29, 1991, has required that smoking should be banned or restricted on public transportation and in public places.[17] Since 1993, although there is still no law that bans smoking in public places and workplaces in China, 154 cities in China have established smoke-free regulations in public places.[18] In 1997, Chengdu (in Sichuan province) implemented a smoke-free policy in public places, which covers kindergartens, hospitals, schools, conference rooms, movie theaters, drinking establishments, post offices, shopping malls, book stores, and public transportation.[19] Although violators would be subject to a penalty, this policy has not been enforced effectively.

With the ratification of the World Health Organization's Framework Convention on Tobacco Control (www.who.int/fctc/en/index.html) by China in 2005, the enforcement of smoke-free policies has become increasingly effective. Smoke-free policies have succeeded in reducing tobacco use and SHS exposure in public places in China. A survey conducted in 2001 showed that individuals' exposure to SHS in public places in Beijing decreased from 54.1% prior to implementation of a smoke-free policy to 14.2% after implementation.[20] However, with the restriction of smoking in public areas, smokers may be shifting the location of their smoking from public areas and workplaces to their homes, where there are no restrictions.[21] This shift has the potential to increase nonsmokers' exposure to SHS at home.

Many recent studies have indicated the success and popularity of the implementation of smoke-free polices in public places in western countries.[22–24] Yet little is known about any potential unintended consequences of such policies on pregnant women whose husbands smoke. The main objectives of this study were to examine the potential unintended consequences on pregnant women of smoke-free policies in public places and to provide helpful suggestions for health education programs to aid pregnant women in creating a smoke-free environment at home.

## Methods

### Study Setting and Sample

The study was conducted in three maternity hospitals at different levels (provincial, city, and county levels) in Chengdu, China, from October to December 2006. Chengdu is a provincial city with 11.1 million people, located in southwest China in the province of Sichuan.[25] In this city, a family is considered low-income with an annual income <RMB 40,000 (US$5333).[26] Pregnant women whose husbands were smokers and who made their routine prenatal visit to one of the three maternity hospitals were recruited as participants for a questionnaire survey and focus group discussion. There were no age or trimester limitations. Eligibility criteria in this study were that the pregnant woman was a nonsmoker; her husband was a smoker (defined as someone who had smoked ≥6 months during his lifetime and was smoking tobacco products at the time of the survey); and the woman was literate and willing to participate in the study. A total of 64 pregnant women were approached. Of these, 5 (7.8%) refused, and 4 (6.3%), although consenting, did not complete a valid questionnaire. Therefore, 55 women were study participants.

### Design and Procedure

Participants were invited to participate in a focus group discussion. A questionnaire consisting of two sections with a total of 25 questions was administered at the beginning of the discussion. The first section contained demographic questions about the pregnant women (age, education, occupation, monthly family income, and family type). The second section asked questions about the pregnant women's knowledge of SHS, their exposure to SHS at home, and their husbands' smoking status (number of cigarettes smoked and smoking periods per day) at home.

To explore the potential unintended consequences of the smoke-free policy on pregnant women, a total of six focus group discussions were conducted in the three maternity hospitals. Each focus group comprised 8–10 participants, plus a moderator and a note-taker, and lasted approximately 1.5 hours. The moderator followed a discussion guide:

- Introduce purpose of research, ethics approval, and consent, and get audiotaped agreement.
- Ask participants to complete questionnaire.
- Probe participants' knowledge of what SHS is.
- Probe participants' knowledge of the harms of SHS to a pregnant woman, her fetus, and her infant.
- Discuss smokers in the family and extent of exposure to SHS.
- Discuss experiences in asking people to quit or not smoke in participants' presence.
- Discuss smoke-free policies in Chengdu city.
- Discuss whether smoke-free policies in public places have any impact on participants' daily lives at home.

The discussions were audiotaped with the consent of the participants and transcribed by the note-taker. Milk and snacks were provided during the break. Each participant received RMB 50 (US$6.67) as compensation for her travelling expenses.

### Data Analysis

Data from the questionnaires were analyzed with STATA version 9.0. A descriptive analysis was performed on the respondents' demographic features (Table 1), their knowledge about SHS, their exposure to SHS at home, and their husbands' smoking status at home (Table 2). In addition, this study used the Pearson chi-square test to assess the differences in proportion of responses by monthly family income and pregnant women's education (Table 3). A $p$-value $<0.05$ was considered statistically significant, with all $p$-values being two-tailed.

A thematic analysis (Table 4) was performed to identify patterns and themes from the focus group discussions. The focus group discussion data were analyzed by two steps. (1) Each group transcript was reviewed in detail and a verbatim transcript of the whole discussion was produced. Then the

**Table 1.** Demographic characteristics of participants in focus groups (N=55)

| Demographic characteristics | *n* (%) |
|---|---|
| **Age (years)** | |
| ≤25 | 16 (29.4) |
| 26–30 | 31 (56.9) |
| >30 | 8 (13.7) |
| **Education** | |
| <High school | 14 (25.5) |
| High school | 24 (43.6) |
| >High school | 17 (30.9) |
| **Occupation** | |
| Blue-collar | 11 (20.0) |
| Service positions | 12 (21.8) |
| Unemployed | 12 (21.8) |
| White-collar | 20 (36.4) |
| **Monthly family income in previous year** | |
| Low-income (<RMB 2999) (<US$400) | 23 (42.6) |
| Middle-income (RMB 3000–5000) (US$400–$666.67) | 12 (22.2) |
| High-income (>RMB 5000) (>US$666.67) | 20 (35.2) |

RMB, renminbi

transcript was compared with the handwritten notes taken by the note-taker to ensure its accuracy.[27] (2) The data in the transcript were coded and assigned to categories. The quotations cited below were translated by researchers into English.

## Results

### Questionnaire Survey

**A descriptive analysis.** Table 1 shows the demographic data from questionnaire survey for the 55 nonsmoking pregnant women participating in this study: more than half (56.9%) of them were aged 26–30 years, and the majority of the participants (69.1%) did not have an education level beyond high school; among all of the participants, 20.0% and 21.8% worked in blue-collar and service positions, respectively, and 42.6% had a monthly family income in previous year below RMB 3000 (US$400). Table 2 shows that only 16.4% of the pregnant women correctly described the definition of SHS, and only 31.9% of them believed that SHS is harmful to pregnant women and their fetus; most (69.1%) reported exposure to SHS at home. With respect to the husband's smoking status at home, 89.1% of husbands had more than two smoking periods per day inside the home, and 52.7% of them smoked more than 10 cigarettes per day.

**Income-based and education-based analysis.** As income and education are two main measurements of SES, this study examines the husbands' smoking status at home (number of smoking periods and cigarettes smoked per day), pregnant women's knowledge of SHS, and their exposure to SHS at home by monthly family income and pregnant women's education. The results (Table 3) show that husbands from high-income families were significantly less likely than those from middle-income and low-income families to have more than two smoking periods per day at home (73.7% vs 100%, 95.8%, $p<0.05$). Pregnant women from high-income families were significantly more likely than those from middle-income and low-income families to have less exposure to SHS at home (47.4% vs 25.0%, 20.8%, $p<0.05$). A slight but nonsignificant difference was found among husbands from low-income, middle-income, and high-income families in the percentage of husbands who smoked ≥10 cigarettes per day at home (50.0% vs 58.3%, 52.6%, $p>0.05$). No significant difference was found in husbands' smoking status at home by pregnant women's education. But pregnant women whose educational level was high school or above were significantly more likely than those with less than a high school education to have less exposure to SHS at home (50.0%, 29.4% vs 0%, $p<0.05$). This finding implies that the poor and less educated are more likely to smoke or to be exposed to SHS than the wealthier and better educated.

### Focus Group Discussions

Recurrent themes and ideas discerned from the focus group discussions are shown in Table 4. In general, the women felt that they had little knowledge about SHS and its harms and did not think that SHS was harmful to a fetus. They also reported that many barriers, such as the entrenched culture of smoking, existed in creating smoke-free environments at home and in public places. Participants also felt that women's status in the home and the workplace was such that it would be difficult for them to assert themselves to protect their own health.

**Table 2.** Pregnant women's knowledge and exposure to SHS, and husbands' smoking status at home (N=55)

| Pregnant women | *n* (%) |
|---|---|
| **SHS means inhaling the smoke from the burning cigarette and the smoke breathed out by the smoker** | |
| Yes | 9 (16.4) |
| No | 46 (83.6) |
| **SHS is harmful to a pregnant women and fetus** | |
| Yes | 18 (31.9) |
| No | 22 (40.7) |
| Don't know | 15 (27.4) |
| **Pregnant women's exposure to SHS at home per day** | |
| None | 17 (30.9) |
| <15 min | 32 (58.2) |
| ≥15 min | 6 (10.9) |
| **Husband's smoking status** | |
| **Smoking periods per day at home** | |
| <2 smoking periods | 6 (10.9) |
| ≥2 smoking periods | 49 (89.1) |
| **# of cigarettes smoked per day at home** | |
| <10 cigarettes | 26 (47.3) |
| ≥10 cigarettes | 29 (52.7) |

SHS, secondhand smoke

**Table 3.** Husbands' smoking and pregnant women's exposure to SHS by family income and pregnant women's education (N=55)

| | Family income | | | Pregnant women's education | | |
|---|---|---|---|---|---|---|
| | Low *n* (%) | Middle *n* (%) | High *n* (%) | <High school *n* (%) | High school *n* (%) | >High school *n* (%) |
| **Husband's daily smoking frequency at home**[a] | | | | | | |
| <2 smoking periods | 1 (4.2) | 0 (0.0) | 5 (26.3) | 0 (0.0) | 2 (8.3) | 4 (23.5) |
| ≥2 smoking periods | 23 (95.8) | 12 (100.0) | 14 (73.7) | 14 (100.0) | 22 (91.7) | 13 (76.5) |
| **Husbands' number of cigarettes smoked daily at home** | | | | | | |
| <10 cigarettes | 12 (50.0) | 5 (41.7) | 9 (47.4) | 7 (50.0) | 11 (45.8) | 8 (47.1) |
| ≥10 cigarettes | 12 (50.0) | 7 (58.3) | 10 (52.6) | 7 (50.0) | 13 (54.2) | 9 (52.9) |
| **Pregnant women's exposure to SHS at home**[a,b] | | | | | | |
| None | 5 (20.8) | 3 (25.0) | 9 (47.4) | 0 (0.0) | 12 (50.0) | 5 (29.4) |
| <15 min | 18 (75.0) | 5 (41.7) | 9 (47.4) | 12 (85.7) | 11 (45.8) | 9 (52.9) |
| ≥15 min | 1 (4.2) | 4 (33.3) | 1 (5.3) | 2 (14.3) | 1 (4.2) | 3 (17.6) |

[a]Significant ($p<0.05$) difference among low, middle, and high family income
[b]Significant ($p<0.05$) difference among pregnant women's education: less than high school, high school, and more than high school.
SHS, secondhand smoke

**Potential unintended consequences of smoke-free policy in public places.** Four main potential unintended consequences of smoke-free policies emerged from these discussions. (*Gn* represents a participant from group n [n=1–6]).

**1. Increased exposure of pregnant women to secondhand smoke at home**

A shift in smoking location is one of the key potential unintended consequences mentioned by the pregnant women in focus group discussions: 69.1% ($n$=38) of the participants reported that their husbands shifted their smoking location from public areas and workplaces to home after the implementation of smoke-free policies in public places.

G1,4: Usually, he (husband) smoked on the bus or taxi to home, but since he can't smoke in the worksite or on public transportation anymore, our home became an ideal smoking place for him as there is no restriction on smoking at all.

G3,5: It seems that he was anxious about something, and he began to smoke immediately as soon as he returned home because he had refrained from smoking during his work for the whole day. To avoid the constraints of the smoke-free policy in public places, he would rather stay at home on weekends or holidays.

G2: He had received a warning by the security guard when he was smoking in a shopping mall. Now he prefers to smoke at home. He said "I feel safer" because there is no need to worry about penalties.

Some women thought that the number of cigarettes smoked by husbands at home had also increased.

**Table 4.** Recurrent themes in focus group discussions

| Knowledge of SHS | Exposure to SHS at home | Experience of and barriers to smoking cessation | Smoke-free policy |
|---|---|---|---|
| Unfamiliar with or misconception about SHS | Frequent exposure to SHS | Needs a lot of persistence to encourage someone to quit smoking | Decreased smoking prevalence in public places |
| Lack of knowledge of the harms of SHS to pregnant woman, fetus, and infant | Exposure to SHS from father-in-law in extended family | Very hard to quit smoking | Reduced exposure to SHS |
| Limited access to knowledge related to SHS | Difficult to avoid SHS | Unique social culture of smoking in China | Increased exposure to SHS at home |
| Need authoritative information about SHS | Feel uncomfortable smelling the smoke | Should show respect to supervisor and father-in-law | Husband's work efficiency reduced |
| | | Need to be understanding of husband | Adverse effect on family harmony |
| | | Feel helpless and depressed when unable to persuade smokers to quit | Worsened air quality at home |

SHS, secondhand smoke

G5: He used to smoke at most three cigarettes at home per day, but now he smokes many more. He regards it as compensation.

Several pregnant women also expressed their tolerance of their husbands' behavior.

G4: He has been a heavy smoker for many years. I need to be understanding of him.

**2. Reduced efficiency at work**

Half of the pregnant women highlighted their husbands' feeling of reduced efficiency at work caused by workplace smoking restrictions.

G2: My husband is a heavy smoker and is a supervisor in his company. At the beginning of the implementation of the smoke-free policy, he did not complain at all. But, with increasingly stricter implementation of this policy in his workplace, he had to take a break from his work for smoking. He thought it had a negative effect on his work efficiency because he found it hard to concentrate on his work when he came back to office after smoking outside.

G3: Two smoking areas were set up in his workplace after the implementation of the smoke-free policy. In order to smoke in the allowed area, he had to leave his desk frequently. He said he often missed some important calls and clients during his leave. Once, a client sent a complaint about his absence during the office hour.

G4: He had tried to quit smoking, but it lasted only 2 days. He said he felt dizzy and sleepy during that time, and even could not participate calmly in discussions in meetings. So he gave up quitting.

**3. Adverse effect on family harmony**

Many participants felt that family harmony was affected. Some women described the adverse effect on their families:

G4: He complained to me about the pressure from his work, which made both of us feel depressed. I feel very nervous when I see him in a bad mood.

G6: The lower his work efficiency the more uncompleted work he had to take home. Sometimes, he had to work very late because of the uncompleted work from the daytime. He looks so exhausted and stressed that I worry about his health now.

**4. Poor air quality at home**

Some participants (24.7%) also thought that smoking restrictions in public places contributed to the increased indoor air pollution in the home environment.

G4: My husband tries to smoke only on the balcony. However, you can still smell the cigarette because the ventilation is poor.

G1: With his increased smoking frequency and amount of cigarettes smoked at home, our indoor air quality gets worse and worse.

Several pregnant women explained how the environmental tobacco smoke affects indoor air quality and their health.

G2,6: The curtains and furniture in my home were left with a heavy cigarette smell for a long time. I felt disgusted at the smell.

G5: Even if the smell from tobacco smoke is not heavy, potentially it will still have a great impact on my health because we stay indoors for long periods of time.

## Discussion

Education is crucial to improve pregnant women's knowledge of the harmfulness of SHS. In a society that has a "one-child" policy, all family members attach great importance to the health of the pregnant woman and the child. During their pregnancy, women may have influence on the smoking behavior of their husbands and other family members. It is therefore important to provide additional knowledge about SHS to pregnant women. Interventions to increase the knowledge of these pregnant women, including media, health talks, and brochures will be useful. It is also suggested that the appropriate content related to SHS be included in the standard protocol for care of pregnant women in antenatal care settings.

Findings of the potential unintended consequences in this study are consistent with studies showing that location restrictions on smoking may contribute to the phenomenon of "compensatory" smoking after leaving a restricted area.[28,29] Although home is a place to feel free and relaxed, maintenance of family health is a mutual responsibility. Therefore, educational campaigns should also be developed to raise awareness about such risks and encourage husbands to modify their own behavior at home. Moreover, previous studies showed that even smokers are likely to implement a "no smoking" rule voluntarily in their homes after comprehensive smoke-free laws are enacted.[30,31] Therefore, laws mandating smoke-free public places could encourage smokers to create a "smoke-free" family, which protects children and other family members from the dangers of SHS. This would also be an effective way to improve home air quality that has been polluted by smoke.

In addition, the focus group discussions suggest that the smoking restriction policies in the husbands' workplaces seem to have caused interruption of their work. Recommendation in this study for help in quitting smoking include: (1) smoking cessation advice incorporated into healthcare services; (2) easily accessible and low-cost pharmacologic therapy such as Nicotine Replacement Therapy; and (3) last but not the least, governmen-

tal support, which is crucial to any tobacco control activities in China, because China's tobacco production and cigarette marketing are all under the control of the State Tobacco Monopoly Administration.[32]

A limitation of this study is the potential bias of the focus groups because group and individual opinions can be swayed by dominant participants or by the moderator.[33,34] Furthermore, all data are based on pregnant women's self-report without quantitative measure of SHS exposure at home and any actual change in husbands' behaviors in the home and workplace. This study is also limited by the small sample size. Further research with a larger sample is needed to ascertain the validity of these findings.

In conclusion, this study examines the potential unintended consequences of tobacco control policies on pregnant women. It suggests that it is necessary to develop and implement proper health education programs aimed at improving pregnant women's knowledge, attitudes, and behavior concerning SHS.

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