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A Clustered Randomized Controlled Trial to Reduce Secondhand Smoke Exposure Among Nonsmoking Pregnant Women in Sichuan Province, China

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Abstract

Introduction: Nonsmoking pregnant women in China have significant exposure to secondhand smoke (SHS). Few interventions have focused on pregnant women reducing their SHS exposure.
Methods: This clustered randomized controlled trial, conducted at eight hospitals in Sichuan, China, compared a prenatal health education intervention with usual clinical care as a control. The primary outcome was self-reported "no SHS exposure" before and 3 months after birth. The intervention consisted of three large group educational sessions, standardized clinician advice, brief monthly follow-up calls, and educational materials and resources. A random sample of participants was biochemically validated before birth with hair nicotine, a long-term biomarker of smoke exposure.
Results: Overall, 1181 participants were randomized to intervention (n = 526) and control (n = 655) groups. More participants in the intervention group than the control group reported no SHS exposure 3 months after birth (Total: 77.9% vs. 52.6%, $P < .001$; Home: 81.2% vs. 53.3%, $P < .001$). The intervention group also had greater changes in improved smoke-free homes and SHS knowledge and attitudes. Controlling for covariates, the intervention group was less likely to report SHS exposure than the control group (Total: OR = 0.47, 95% CI = 0.31 to 0.71; Home: OR = 0.33, 95% CI = 0.21 to 0.53), and this effect was sustained 3 months after birth. The adjusted log concentration of hair nicotine for the intervention group decreased by 0.28 log µg/g more than the control group.
Conclusions: Our smoke-free health education intervention for nonsmoking pregnant women significantly reduced SHS exposure before and after birth. This intervention model can become part of a standard protocol for the care of pregnant women in hospital settings.

Introduction

China has the world's largest number of smokers (301 million with 52.9% male, 2.4% female), and thus there is an urgent need to address secondhand smoke (SHS) exposure.[1] SHS has no risk-free level of exposure for nonsmokers, and causes cancer, cardiovascular disease and chronic respiratory illness.[2] The majority of China's women report SHS exposure (71.6%) with many women in the population reporting home exposure (63.9%).[3,4]

In China, women of reproductive-age (15–49 years old) in the Global Adult Tobacco Survey reported high SHS exposure at home (65.1%) followed by work (52.6%).[5] SHS exposure can cause harmful effects to the fetus in nonsmoking pregnant women: low birthweight, fetal death, preterm delivery spontaneous abortion, and congenital malformation.[6] Our separate research in China's Sichuan province indicated even higher SHS exposure rates (75.1%), validated by hair nicotine, among nonsmoking pregnant women with smoking husbands.[7] Exposure was greater for women who were rural, had a husband with greater cigarette consumption, had less knowledge about SHS, had less negative attitudes about SHS, and had no smoke-free home rules.

China's one-child family policy[8] presents a unique opportunity to educate pregnant women about SHS health effects and reduce exposure to SHS. A previous pilot[9] in China showed that a prenatal health education intervention increased the likelihood of nonsmoking pregnant women taking assertive action when exposed to SHS in the home environment. This study seeks to determine the efficacy of a health education intervention compared to usual clinical care to reduce SHS exposure for nonsmoking pregnant women.

Methods

Study Design and Setting

This cluster randomized controlled trial was conducted between April and November 2008 in Sichuan province, China at eight district and county women and children's hospitals. All pregnant women who visited these hospitals to set up their initial prenatal files during the first 2 months of pregnancy were invited to participate by the research team. The research team waited in the same room where pregnant women could set up their prenatal files, and approached the pregnant women after their file completion. After having the study participation requirements explained to them, participants could then sign a written consent form that explained risks and benefits of participation. Additional inclusion criteria for the pregnant participants included: (1) being a never smoker, (2) having a husband who smoked, and (3) living with the husband who smoked.

Questionnaires were administered to all participants at three time points: baseline (during first 2 months of pregnancy), post-intervention (before birth, about 8 months of pregnancy), and 3 months after birth. The pregnant women in the intervention group hospitals participated in group-based health education activities and individual standardized clinician advice and follow-up calls (see below), all of which lasted for approximately 6 months after enrollment. The pregnant women in the control group hospitals received only study assessment and usual clinical care for their prenatal and postpartum appointments, without any standardized clinician advice about SHS or smoke exposure. All hospitals had the same number of prenatal visits for participants: prenatal care in China is mandated by law to have monthly visits between 3–8 months, biweekly between the 32nd week to 36th week, and weekly after the 36th week. Clinician advice about tobacco use and exposure is not mandated in prenatal care in China.[10] Biochemical validation of tobacco exposure using hair nicotine at baseline and post-intervention was conducted for a systematically sampled subset (multiples of 5) of participants.

The study was approved by the medical science ethical committee of Sichuan University, and all subjects provided written informed consent before participation. The trial was registered with the Chinese Clinical Trial Registry in Chengdu, China which is part of the World Health Organization's International Clinical Trial Registry Platform. Each participant received at the time of recruitment baby products valued at 200 Chinese Yuan (about US $30). The baby products were received by the intervention group after each of the 3 hospital-based group activities, and the control group after every questionnaire was completed.

Randomization and Masking

Each participating hospital was the unit of randomization in order to minimize contamination among participants, since there were large-group activities. The eight hospitals were selected by a computerized random number generator for 32 district/county women and children's hospitals, which all had an annual number of live births over 1000. The selected hospitals were assigned to intervention or control by computerized random allocation by a researcher who was not involved in the study and was blind to the identity of the hospitals. Based on Loke's study,[10] the minimum number of pregnant women required for our study was 120 women for each hospital, with three hospitals needed for each group, for a 5% level of significance, 90% power, and intracluster correlation coefficient $\rho = 0.08$. We anticipated a loss to follow up of 20% and therefore planned to randomize four hospitals in each group.

Health Education Intervention

Our study intervention was the same as a previous pilot.[9] The activities at the intervention group hospitals lasted over 6 months after enrollment and ended before the participant gave birth. Since the study's primary outcome was reduction in SHS exposure, the intervention group participants were told in the first hospital-based educational activities and subsequent follow-up phone calls that quitting smoking was not a required outcome for her husband. The multi-component intervention consisted of three hospital-based group educational activities, clinician advice at prenatal checkups, and brief (10 minutes) monthly telephone calls, and educational materials and resources (a resource booklet about SHS and communication skills, "no smoking" signage for home use, a telephone hotline for counseling). The purpose of the calls was to follow-up about establishing a smoke-free home rule and reinforcing skills. The hospital-based educational activities included three large group sessions (about 90 women per session) over 3 months that addressed: motivational speeches by hospital leaders, lectures on the dangers of smoking and SHS, a video about SHS and communication skills, role-playing communication exercises, and games about SHS knowledge. Over 80% of the intervention participants participated in all activities (group session 1: 95%, session 2: 90%, session 3: 90%). The clinician advice at prenatal checkups included: SHS is harmful, ask your husband to stop smoking in your presence, and ask your husband to smoke outdoors.

The team implementing the study activities consisted of the lead author (L. Yang) who led and trained a team of students. The team conducted the intervention group-based activities and individual follow-up phone calls. The team also coordinated with the intervention hospitals' leaders and clinicians in communicating the study purpose and standardized clinical messages.

Measures

The primary outcome was self-reported "no SHS exposure" in the past week. The questionnaire[9] included: demographics, SHS knowledge and attitudes, household smoking rules, and self-reported SHS exposure. While the type of housing was not assessed, participants reported if they lived in an urban or rural area, where typical urban homes may be smaller in multi-unit housing and rural homes may be larger and free-standing. SHS knowledge was measured by three domains with "yes or no" answers with a total score of 24 using +1 for a correct answer and 0 for an incorrect or missing answer: (1) definition and components, (2) associated diseases, and (3) harmful effects on pregnancy and the fetus. SHS attitudes about exposure were categorized as "strongly dislike," "dislike," and "indifferent." Household smoking rules were categorized as: (1) allowed in all parts of the home, (2) allowed in some parts of the home, and (3) not allowed in any part of the home. SHS exposure was defined as exposure to another person's tobacco smoke for at least 15 minutes daily for more than 1 day every week, a World Health Organization definition used in China's national survey.[4] Participants were asked about their husband's daily cigarette consumption, and daily average duration of SHS exposure and source (home, work, public places) during the last week. The questionnaire was distributed and collected by a trained doctor or nurse, but self-administered by the participant.

Hair Nicotine Measurements

Hair nicotine, a long-term biomarker of smoke exposure, was measured in a systematically sampled subset of participants (multiples of 5) after the baseline questionnaire and post-intervention (before birth). Hair strands were cut at the scalp from the back of the head around the occipital bone. The sample was then trimmed to 1.0–1.5 cm from the root end, which reflects past month exposure,[11] and immediately sealed in a labeled envelope and plastic bag. The analytical method adapted the procedure developed by Kintz.[12] The analytes were tested with capillary gas chromatography at a laboratory in Sichuan University, using a nicotine standard (Sigma Chemical Company, St. Louis, MO).

Statistical Analysis

Statistical analysis was performed with SPSS 13.0 software (Chicago, IL) and STATA 10.0 software (Stata Corp, College Station, TX). The primary outcome was past week daily SHS exposure in total and at home, with the outcome categorized as "no exposure", "15–59 minutes", or ">59 minutes" (comparison group) for post-intervention and 3 months after birth. Categorical data were analyzed using chi-square analyses, and continuous variables using independent Student's *t* tests.

A difference-in-differences (DID) approach,[13] using an ordinal logistic regression model, was utilized to examine the efficacy of the intervention at the individual level (see Supplementary Appendix for full model description). This DID approach accounts for time period, observations by group assignment, differential effect of the intervention between time periods, and covariates (age, educational background, working situation, monthly family net income, urban vs. rural status, husband's daily cigarette consumption, knowledge of SHS, attitudes towards SHS, and household smoking rules.) The variable for hospital was not significant in bivariate analyses, and was not included in final analyses.

Bias-corrected matching estimator,[14] which reflects propensity score adjustment using matching, was also used for the post-intervention hair nicotine DID linear regression analysis to adjust for demographic differences between the control and intervention groups (see Supplementary Appendix for full model description). The bias-adjusted matching estimator combines some of the bias reduction from matching, by comparing units with similar values of the covariates, and the bias reduction from the regression. The hair nicotine analysis has been previously described in a Chinese journal, but is included here for reader accessibility.[15]

Results

Hospitals and Participants Analyzed

Figure 1 describes the flow diagram of the randomized controlled trial after randomization of the eight hospitals. The study at baseline had 1181 pregnant women (526 interventions, 655 controls), post-intervention had 1053 women (484 intervention, 569 control), and 3 months after birth had a total of 979 pregnant women (456 interventions, 523 controls). There was no difference in demographic characteristics between the study drop-outs and participants (data not shown).

The characteristics of the eight women and children's hospitals within the two clusters were balanced at baseline (data not shown). These hospital characteristics include number of health personnel, number of beds, number of inpatients, number of visits, income of hospital units, and expenditures of hospital units.

Table 1 describes the demographic features of the intervention and control groups. Two-thirds were from rural areas, over half were lower-educated (middle school or less), less than half were employed, and over a quarter were lower income. For tobacco-related variables, over half had husbands who smoked more than half a pack of cigarettes daily, the majority did not have a smoke-free home rule, and the majority disliked being exposed to SHS (over half "strongly dislike"). The control group differed significantly from the intervention group with higher proportions of women who were from rural areas, were lower-educated, had lower income, and had fewer smoke-free home rules. Since these group differences potentially could affect the study outcomes by overestimating the intervention's impact, the DID model included covariates and the hair nicotine analysis used the bias-corrected matching estimator to adjust for demographic differences between the control and intervention groups.

Outcomes: Self-Report Exposure

Table 2 compares the self-reported SHS exposure between the intervention and control groups over the three time periods (baseline, post-intervention before birth, 3 months after birth). By the last two time periods, the majority of the intervention group reported "no SHS exposure over the past week in total" and "no SHS exposure over the past week at home, but this was only over half of the control group. Consistent with these exposure reports, more husbands in the intervention group smoked fewer cigarettes (<5 daily) over the study period. Also, more women in the intervention group reported no smoking was allowed in the home over the study period, whereas the control group did not have a significant increase. Knowledge increases about SHS and attitudes against SHS exposure were higher in the intervention group. Interestingly, the control group's weakest "indifferent" attitudes against SHS exposure worsened from a baseline low at 7% to almost half at 3 months after birth, in contrast with the intervention group's persistently low rate.

Table 3 describes the DID model analyses for self-reported total or home SHS exposure. Compared to the control group, the intervention group had a significant reduction in self-reported SHS exposure from total sources and at home during the last two time periods (post-intervention before birth and 3 months after birth). There was no difference in this relative effect between the last two time periods, meaning that the intervention's significant reduction was sustained. Factors independently associated with greater self-reported SHS exposure include being from a rural area, heavier husband daily cigarette consumption, less restrictive smoking home rules, and an indifferent attitude towards SHS exposure.

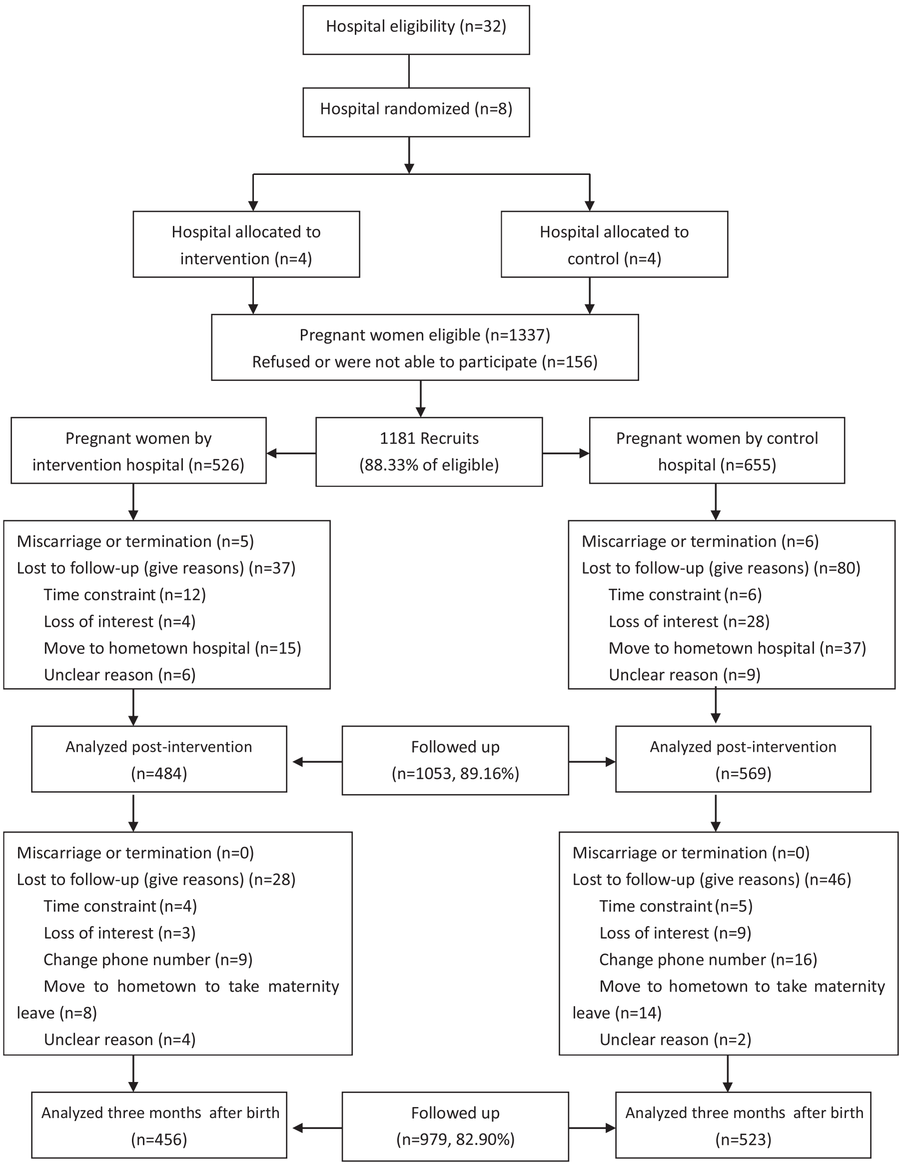

Figure 1. Flow diagram of the clustered randomized controlled trial for nonsmoking pregnant women in Sichuan province, China.

Hair Nicotine Validation

For biochemical validation in a subsample post-intervention before birth, 236 pregnant women were systematically approached among all participants, 186 agreed to have their hair sampled at baseline (91 intervention, 95 control), and 160 were available for post-intervention measurement (80 intervention, 80 control). There was no difference in demographic characteristics between the refusers and participants, or those lost to follow-up post-intervention (data not shown).

In bivariate analyses, the intervention group reported significantly less SHS exposure from baseline to post-intervention for both past week total and home exposure (Intervention Total: 23% to 81.2%, $P < .001$; Home: 36.3% to 90.0%, $P < .001$), compared to the control which had no significant increase (Control Total: 25.3% to 32.4%, $P = .23$; Home: 34.7% to 45.0%, $P = .64$). Correspondingly, the mean of hair nicotine concentration in the intervention group decreased significantly from baseline to post-intervention (Intervention mean and standard error (μg/g): 3.47 (4.37) to 1.94 (1.32), $P < .001$), but did not significantly change in the control group (Control mean and standard error (μg/g): 2.76 (2.39) to 2.93 (3.45), $P = .64$). This difference is also reflected in the concentration range of hair nicotine, which at baseline is similar (Intervention 0.74–25.57 μg/g; Control 0.52–21.65 μg/g) but at post-intervention is much smaller for the intervention group (Intervention 0.40–12.49 μg/g; Control 0.61–23.7 μg/g).

The DID model and bias-adjusted matching estimator were used to find the effect of the intervention on hair nicotine levels. The final model including all the covariates accounted for 32.0% of the variance in concentration of nicotine in the hair, and without the intervention variable was 29%. Thus, 3% of the variance is explained by the intervention beyond the covariates. The bias-adjusted matching estimator was −0.28 ($P < .001$), which means from baseline to intervention, the adjusted log concentration of hair nicotine in the intervention group was 0.28 lower than the control group, and the difference was significantly different between the two groups.

Table 1. Baseline Characteristics of Nonsmoking Pregnant Women Living With a Smoking Husband in Sichuan Province, China

	All (n = 1181)	Intervention group (n = 526)	Control group (n = 655)
Characteristic	n (%)	n (%)	n (%)
Age (y) (mean ± *SD*)	25.6 ± 4.5	25.8 ± 4.1	25.4 ± 4.8
Rural vs. urban region			
Rural	784 (66.4)	314 (59.7)	470 (71.8)
Urban	397(33.6)	212(40.3)	185 (28.2)
Education			
Middle school or less than middle school	633(53.6)	225 (42.8)	408 (62.3)
High school	381(32.3)	202 (38.4)	179 (27.3)
College or higher	167(14.1)	99 (18.8)	68 (10.4)
Working situation			
Employed	564(47.8)	251(47.7)	343(52.4)
Unemployed	617(52.2)	275(52.3)	312(47.6)
Family net income per month (RMB)			
Under 1000	329(27.9)	107(20.3)	222(33.9)
1000–3000	552(46.7)	241(45.8)	311(47.5)
Over 3000	300(25.4)	178(33.8)	122(18.6)
Husband's daily cigarette consumption			
Under 5	248 (21.0)	120 (22.6)	128 (19.7)
5–9	307 (26.0)	121 (22.7)	186 (28.7)
10–14	268 (22.7)	129 (24.2)	139 (21.4)
15–19	238 (20.2)	108 (20.3)	130 (20.0)
Over 20	120 (10.1)	54 (10.2)	66 (10.2)
Household smoking ban			
Smoking was allowed in all parts of the home	642 (54.4)	254 (48.3)	388 (59.2)
Smoking was allowed in some parts of the home	371 (31.4)	187 (35.6)	184 (28.1)
Smoking was not allowed in any part of the home	168 (14.2)	85 (16.1)	83 (12.7)
Scores of SHS knowledge (mean ± *SD*)	5.5 ± 3.9	5.6 ± 4.1	5.4 ± 3.6
Attitudes towards SHS			
Indifferent	78(6.6)	32 (6.1)	46 (7.0)
Dislike	501(42.4)	242 (46.0)	259 (39.5)
Strongly dislike	602(51.0)	252 (47.9)	350 (53.5)

SHS = secondhand smoke.

Discussion

Our smoke-free health education intervention for nonsmoking pregnant women, conducted in China's Sichuan province, demonstrated a significant reduction in SHS exposure and is validated biochemically in a subsample by a long-term biomarker of exposure. While both the intervention and control group reported less total and home SHS exposure over the study period, the majority (~80%) of the intervention group reported no SHS exposure 3 months after birth. Controlling for covariates, the intervention group was less likely to report SHS exposure than the control group (47% less total exposure, 33% less home exposure), and this effect was sustained between post-intervention and 3 months after birth. In the subsample that had biochemical validation, adjusting for demographic differences, the intervention group's log concentration of hair nicotine was 0.28 log µg/g lower than the control group. Only the intervention group had a significant decrease in mean hair nicotine concentration.

The intervention group's change in attitudes, knowledge, and behavior support the significant reduction in SHS exposure, compared to the control group. The intervention group had significantly increased changes in SHS knowledge and attitudes against SHS exposure, consistent with the previous pilot.[9] Also, the intervention group had more smoke-free home rules and significant decreases in the husband's daily cigarette consumption. It is concerning that the control group became significantly more "indifferent" to SHS exposure 3 months after birth, unlike the intervention group; this concerning change after birth may increase the risk of SHS exposure to the baby and associated future health harms as a child.[2]

Since most women in China report the home as a SHS exposure source, this study underscores that establishing and enforcing smoke-free policies at home can significantly reduce SHS exposure. Establishing and enforcing smoke-free home rules is an important strategy for reducing nonsmokers exposure to SHS and supporting smokers to quit,[16,17] and self-efficacy[18] and perceived social norms[19] are key. The hair nicotine of the subsample still demonstrated substantial SHS exposure even though 80%–90% of the intervention group reported no past week exposure. This may be because the husband smoking outside of the home does not reduce SHS exposure to the levels of having a nonsmoking husband,[20] and future studies should encourage husband's smoking cessation. Also, women in China report SHS exposure in public places, the second highest exposure source after the home.[3] Smoke-free public regulations have been effective in reducing exposure.[2] At present, China is implementing the World Health Organization's Framework Convention on Tobacco Control, which promotes smoke-free public regulations, but progress is slow.[21] While the 2008 Olympics led to widespread smoke-free public policies in Beijing, the enforcement and dissemination of such policies need to be continued. However, focusing only on smoke-free policies in public places in China may have unintended consequences for pregnant women in China: (1) increased SHS exposure at home, (2) reduced work efficiency, (3)

Table 2. Self-Reported Secondhand Smoke (SHS) Exposure, Knowledge, and Attitudes for Nonsmoking Pregnant Women Living With a Smoking Husband at Baseline, Post-Intervention, and After Birth in Sichuan Province, China

	Intervention group					Control group				
Variable	Baseline n = 526 (%)	Post-intervention n = 484 (%)	Three months after birth n = 456 (%)	P^a	P^b	Baseline n = 655 (%)	Post-intervention n = 569 (%)	Three months after birth n = 523 (%)	P^a	P^b
Past week total daily average exposure										
No exposure[c]	26.8	79.3	77.9	<.001	.015	23.4	52.7	52.6	<.001	.007
15–59 min	37.6	12.8	17.8			41.4	27.3	33.6		
≥60 min	35.6	7.9	4.3			35.2	20.0	13.8		
Past week home daily average exposure										
No exposure[d]	44.5	86.5	81.2	<.001	.001	40.5	58.7	53.3	<.001	.014
15–59 min	37.6	7.9	15.1			39.4	30.4	38.4		
≥60 min	17.9	5.6	3.7			20.1	10.9	8.3		
Husband's daily cigarette consumption										
Under 5	22.6	39.5	36.8	<.001	.83	19.7	19.7	15.5	<.001	.001
5–9	22.7	24.8	24.8			28.7	24.8	18.8		
10–14	24.2	16.7	19.1			21.4	23.7	34.4		
15–19	20.3	7.9	8.8			20.0	15.3	12.8		
Over 20	10.2	11.1	10.5			10.2	16.5	18.5		
Household smoking rule										
Smoking allowed in all parts of the home	48.3	20.0	21.3	<.001	.23	59.2	41.7	53.4	.06	.37
Smoking allowed in some parts of the home	35.6	33.1	37.3			28.1	41.7	29.8		
Smoking not allowed in any part of the home	16.1	46.9	41.4			12.7	16.6	16.8		
Scores of SHS knowledge (mean ± *SD*)	5.6 ± 4.1	15.0 ± 7.4	14.3 ± 6.9	<.001	.16	5.4 ± 3.6	7.3 ± 5.0	7.3 ± 4.8	<.001	.92
Attitudes towards SHS										
Indifferent	6.1	2.1	2.9	.001	.64	7.0	6.2	47.4	<.001	<.001
Dislike	46.0	37.2	38.6			39.5	40.6	42.1		
Strongly dislike	47.9	60.7	58.5			53.5	53.2	10.5		

[a]Three months after birth compared to baseline.
[b]Post-intervention compared to 3 months after birth.
[c]$P < .001$ for past week total "no SHS exposure" between intervention and control at 3 months after birth.
[d]$P < .001$ for past week home "no SHS exposure" between intervention and control at 3 months after birth.

adverse effects on family harmony, and (4) poor air quality at home.[22] The World Health Organization recommends preventing or reducing tobacco use and SHS exposure in reproductive-aged women,[23] and emphasizing smoke-free homes in addition to public policies would be an important and effective strategy, besides being culturally resonant.

Most intervention studies have concentrated on helping pregnant women to quit smoking[24] or on helping husbands to quit,[25,26] and only a few randomized trials have examined helping nonsmoking pregnant women reduce their SHS exposure. Loke[10] described how brief advice by an obstetrician in Guangzhou, China was associated with husbands reportedly reducing their daily cigarette consumption. Kazemi et al.[27] described how a one-on-one health education intervention (two sessions, total 30 minutes) on the harms of SHS exposure was associated with self-reported decreased SHS exposure during pregnancy. El-Mohandes et al.[28] described how a cognitive-behavioral intervention reduced self-reported SHS exposure among African American women by half before delivery, compared to the control group. With the opportunity to intervene during prenatal care, more research is needed for these promising interventions to protect the pregnant mother and child.

Limitations to this study include generalizability beyond Sichuan province and the hospital setting, since participants may not reflect the whole of China or other countries and the women sampled sought prenatal health care in Women and Children's hospitals instead of general hospitals. However, as far as the authors are aware, this is the largest smoke-free health education intervention for nonsmoking pregnant women. Due to limited resources, hair nicotine was not measured of all participants, but the systematic sampling helped to reduce bias. A strength of the study is that hair nicotine is a long-term biomarker of exposure reflecting several months rather than just hours to days. Hair nicotine levels were higher in this population than has been reported in China previously,[29] but that study only had a convenience sample of 40 households in China. Interestingly, another study in China showed that air nicotine levels were lower in county (rural) areas of Sichuan than other provinces, and Beijing.[30] The definition of "no SHS exposure" in this study is not absolute as it still allows for some exposure, but at least provides a standardized benchmark for countries that do not yet have widespread smoke-free public policies. Since we randomized at the level of the hospital, there were baseline differences in the intervention and control groups, but our regression analyses adjusted for these differences.

In summary, this health education intervention is a promising, large-scale prenatal care tool to promote nonsmoking pregnant women and their child (before and after birth) having reduced SHS exposure. Intervening during this medical care opportunity might protect millions of pregnant women from exposure to SHS and their children, as air nicotine and hair nicotine concentrations increased in women and children from 31 countries with more smokers in

Table 3. Difference-in-Differences Model Fitted on Self-Reported Total or Home Secondhand Smoke (SHS) Exposure for Nonsmoking Pregnant Women Living With a Smoking Husband in Sichuan Province, China

	Total secondhand smoke exposure		Secondhand exposure at home	
	OR	95% CI	*OR*	95% CI
Constant (no exposure)	0.55	0.27 to 1.11	0.88	0.42 to 1.82
Constant (15–59 min exposure)	3.27	1.64 to 6.52	6.99	3.36 to 14.52
D_i	0.98	0.76 to 1.26	0.93	0.72 to 1.20
D_1T_i	0.28	0.22 to 0.36	0.47	0.36 to 0.62
D_2T_i	0.57	0.42 to 0.75	0.67	0.50 to 0.90
$D_i \times D_1T_i$	0.47	0.31 to 0.71	0.33	0.21 to 0.53
$D_i \times D_1T_i \times D_2T_i$	0.98	0.63 to 1.55	1.56	0.95 to 2.56
Age (y)	1.00	0.99 to 1.02	1.00	0.98 to 1.02
Region				
Rural	1.73	1.43 to 2.09	1.78	1.46 to 2.18
Urban	—		—	
Education				
Middle school or less than middle school	0.95	0.71 to 1.27	0.77	0.57 to 1.04
High school	1.22	0.92 to 1.61	1.04	0.78 to 1.41
College or higher	—		—	
Working situation				
Unemployed	0.91	0.77 to 1.07	1.02	0.86 to 1.22
Employed	—		—	
Husband's daily cigarette consumption				
Under 5	0.18	0.13 to 0.24	0.11	0.08 to 0.15
5–9	0.28	0.22 to 0.36	0.20	0.16 to 0.27
10–14	0.43	0.33 to 0.55	0.46	0.35 to 0.59
15–19	0.52	0.39 to 0.69	0.60	0.45 to 0.79
Over 20	—		—	
Smoking home rules				
Smoking was allowed in all parts of the home	4.01	3.11 to 5.16	4.88	3.68 to 6.47
Smoking was allowed in some parts of the home	2.21	1.71 to 2.86	1.89	1.41 to 2.52
Smoking was not allowed in any part of the home	—		—	
Family net income per month (RMB)				
Under 999	0.84	0.66 to 1.07	0.87	0.68 to 1.11
1000–2999	0.98	0.79 to 1.20	0.97	0.78 to 1.21
Over 3000	—		—	
Scores of SHS knowledge	1.00	0.99 to 1.02	1.00	0.99 to 1.02
Attitude				
Indifferent	1.93	1.46 to 2.57	1.77	1.33 to 2.26
Dislike	1.24	1.04 to 1.49	1.07	0.88 to 1.30
Strongly dislike	—		—	

CI = confidence interval; *OR* = odds ratio. D_i = dummy variable for group assignment; D_1T_i = dummy variable for time period (0 = baseline survey period, 1 = second and third survey period); D_2T_i = dummy variable for time period (0 = baseline and second survey periods, 1 = third survey period); $D_i \times D_1T_i$ = effect of the intervention; $D_i \times D_1T_i \times D_2T_i$ = differential effect of the intervention between the second and third survey period.

the household.[29] Future studies should consider a more stringent measure of "no SHS exposure," a cost-effectiveness study for policymakers, scaling up to other sites nationwide and prenatal care environments, extended intervention and follow-up period into the early childhood years, and encouragement of the husband's smoking cessation.

Supplementary Material

Supplementary Appendix can be found online at http://www.ntr.oxfordjournals.org

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Declaration of Interests

None declared.

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