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Randomized trial of a secondhand smoke exposure reduction intervention among hospital-based pregnant women

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HIGHLIGHTS

- Pregnancy may be an opportune time to engage in SHS risk reduction.
- Chinese pregnant women can be empowered to confront their male smoking relatives.
- Pregnant women can be taught techniques to reduce their exposure to SHS.

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ABSTRACT

Objective: This study sought to assess the effectiveness of a secondhand tobacco smoke (SHS) prevention program based on an expanded Health Belief Model (HBM) incorporating self-efficacy among pregnant women in a hospital setting in Taiwan.
Methodology: This study utilized a two-group longitudinal randomized controlled trial design. Participants in the intervention group ($n = 50$) enrolled in a SHS prevention program based on the HBM, while participants in the comparison group ($n = 50$) received standard government-mandated counseling care. Both groups were given questionnaires as a pre-test, two weeks into the intervention, and one month following the conclusion of the intervention. The questionnaire and intervention were developed based on the understanding gained through a series of in-depth interviews and a focus-group conducted among pregnant women. Exhaled carbon monoxide was also measured and used as a proxy for SHS exposure.
Results: Intervention group scores were all significantly higher than comparison group scores ($p < 0.001$), indicating a significant increase in knowledge, HBM scores, cues to action, self-efficacy, preventative behaviors, and a significant decrease in smoking exposure. These differences remained significant at the one-month follow-up assessment ($p < 0.001$).
Conclusions: These results should encourage health professionals to educate pregnant women regarding the harms of SHS while both empowering and equipping them with the tools to confront their family members and effectively reduce their SHS exposure while promoting smoke-free social norms.

1. Introduction

Numerous tobacco-related diseases and premature deaths are consequences of persistent tobacco exposure (Panzano, Wayne, Pickworth, & Connolly, 2010). The disease burden resulting from SHS exposure includes cardiovascular disease, lung cancer, respiratory disease, breast cancer, chronic obstructive pulmonary disease (COPD), tuberculosis, as well as developmental defects in children and fetuses (Oberg, Jaakkola, Woodward, Peruga, & Pruss-Ustun, 2011).

The toxic substances in SHS can also readily cross the placenta and affect the fetus directly, increasing the risk for impaired fetal growth, low birth weight, preterm delivery, as well as neonatal and perinatal morbidity and mortality (Hackshaw, Rodeck, & Boniface, 2011). In addition to physiological sequelae, exposure to SHS while in utero has also

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been demonstrated to be associated with a greater frequency of psychological distress, drug consumption, eating disorders, and body image problems later in life (Omoloja et al., 2013). The findings from the above studies underscore the need to reduce the exposure of pregnant women to SHS.

Exposure to SHS at home by a smoking spouse has been shown to be a major source of exposure (Yoo et al., 2010) with smoking cessation among the spouses of pregnant women being one of the most effective ways to reduce SHS exposure during pregnancy. This is particularly the case in Taiwan where the brunt of tobacco exposure stems from men whose smoking prevalence is over seven-times that of women (Bureau of Health Promotion, 2012), with this sexual disparity being supported by the role that tobacco plays in social and cultural interactions in male-dominated Chinese culture (Ma et al., 2008).

Unlike some countries where smoking has become a social stigma in the last few decades, in Han Chinese cultural circles male smoking is still very much accepted. Smoking behavior plays important social and cultural roles (Ma et al., 2008) with cigarettes acting as social tools and facilitators of engagement, most predominately among men. Such behaviors are largely intertwined with the Confucian heritage of social networks which underlie all of Chinese social behavior. Across this cultural backdrop where confrontation is avoided and conformity is idealized, tobacco use and sharing serve as physical manifestations of social harmony (Davey & Zhao, 2012). Being cognizant of this, women have traditionally accepted the fact that men smoke in their presence (Goodman, 2004), with one study conducted by Yang et al. reporting that 54.4% of pregnant women placed no restriction on their husband's smoking at home (Yang, Tong, Mao, & Hu, 2010). Furthermore, as attempts aimed at encouraging smoking cessation among the husbands of pregnant women in both the east and west have met with limited success and failed to achieve sustained effects (Aveyard, Lawrence, Evans, & Cheng, 2005; Loke & Lam, 2005), SHS reduction may represent the most effective strategy for harm reduction.

However, even among the husbands of Western countries, in-pregnancy smoking cessation programs have not demonstrated sustained effects (Aveyard et al., 2005), and only one pilot study in the literature conducted in Sichuan, China has focused on helping pregnant women to reduce their exposure to SHS through an educational intervention. While that study's results were encouraging, demonstrating the success of their Health Belief Model (HBM)-based educational intervention, it did not incorporate either a random sample or a comparison group in its design (Lee, 2008).

Therefore, this study set out to further validate the effect of an educational intervention utilizing the HBM framework to educate pregnant women about the harms of SHS while both empowering and equipping them with the tools to confront their family members and effectively reduce their SHS exposure.

2. Methods

2.1. In-depth interviews and focus-group discussions

This study utilized in-depth interviews (IDIs) and focus group discussions (FGDs) to establish a better understanding of the needs and obstacles of our target population. All of the FGDs/IDIs were conducted in Mandarin Chinese using a discussion guide. The guide included questions and queries on the following themes: the hazards of smoking and SHS exposure, attitudes and behaviors towards SHS, and knowledge regarding the health effects of SHS on pregnant women and children. A single health educator performed 50-minute IDIs among 12 pregnant women. Each IDI lasted about 50 min. One senior nurse and one health educator worked as a team to conduct the FGDs among two groups of four women. Each FGD lasted about 90 min during which time the women were asked to elaborate on their experience with SHS exposure and to describe how they felt and acted around SHS, including what obstacles they confronted and what kind of help they would like to have. They were also asked specifically about SHS and the health of their baby. None of the women who participated in the IDIs or FGDs were subjects in the present study.

Through the FGDs and IDIs, the women expressed a feeling of powerlessness and low self-efficacy. Many of the issues that emerged from the interviews were similar to the general impressions about the social and cultural backdrop of the entrenched problem of smoking, the status of women in Chinese society, and the prevailing barriers to a smoke-free environment. The findings from these interviews were used to design the content of the questionnaire and the pilot intervention utilized in this study with one of the major aims of this intervention being directed towards increasing the women's sense of self-efficacy in reducing their exposure to SHS.

2.2. Conceptual framework

The conceptual basis of this empirical study was built on the expanded HBM including Bandura's addition of self-efficacy (Bandura, 1977). This model is a motivational framework and based on the proposition that a person will take a health-related action if she feels that a negative health condition can be avoided, and that she is capable of doing it (Glanz, Rimer, & Viswanath, 2008). Many studies investigating health behavioral changes have utilized the HBM, with the model having moreover been operationalized to investigate SHS exposure among other populations (Li et al., 2003). The conceptual framework for this study is presented in Fig. 1 and Fig. 2.

2.3. Study design

A two-group longitudinal randomized controlled trial was conducted. First, all the women registering for their government-mandated prenatal care visits during May of 2010 at the obstetrics and gynecology clinic of Taipei City Hospital, Taiwan were identified. Then those that met the following inclusion criteria were considered eligible for the study: eighteen years of age or older, had not exceeded 12 weeks of gestation, non-smoking, had smoking husbands or relatives living with them, and gave written informed consent. We continued taking cases until we had a total of 120 subjects based on our sample size calculation and after allotting for potential loss to follow-up. We then used their registration numbers to randomize the pregnant women to either the intervention group or comparison group. Fifty-five participants were randomly assigned to the intervention group and 65 to the comparison group. During the 20-week program conducted between November 2010 and March 2011, five participants (9%) from the intervention group and 15 (23%) from the comparison group dropped out due to lack of interest. Every participant filled out the 20-minute questionnaire three times at prenatal care visits which were all interspaced by one month intervals. The subjects in the intervention group also received a 50-minute face-to-face educational intervention at the second prenatal care visit and two 10-minute follow-up phone calls the first and second weeks following the intervention. This yielded a total of 100 subjects and a retention rate of 91% among the intervention group and 77% among the comparison group.

Participants in the intervention group ($n = 50$) were enrolled in the program based on the expanded HBM incorporating self-efficacy, while participants in the comparison group ($n = 50$) received standard counseling care. Prior to the intervention, both groups were given pretest questionnaires at their first prenatal care visits. The intervention was conducted one month later, when both groups returned for another prenatal care visit. The immediate post-intervention effect questionnaire was also distributed at this time to both groups to test the immediate effect. The one month post-intervention assessments were distributed one month following the intervention at another prenatal care visit to test the delay of impact effect (Green, 1977). Fig. 1 presents a flow chart of the study process.

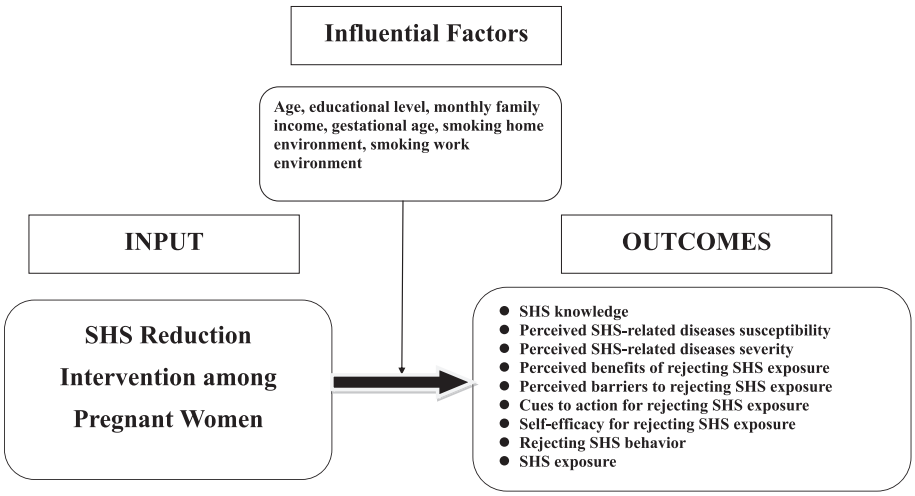

Fig. 1. The conceptual framework for the intervention.

2.4. Intervention

While the intervention scheme was developed with an expanded HBM incorporating self-efficacy as a background conceptual framework, the study had the distinction of being a hospital-based program. Furthermore, nearly all Taiwan government-mandated prenatal care visits are conducted in hospitals. Therefore, while this was a hospital-based investigation, the participants in this study did not elect to visit the hospital on account of a pressing health concern, but rather merely with the intent to attend their government-mandated prenatal care check-up.

One senior nurse was recruited for the program, and was provided training consisting of lectures, discussion, and a one-month internship prior to becoming the intervention manager. The training was delivered by hospital pregnancy psychology advisors that instructed the senior nurse on how to encourage young pregnant women and boost their

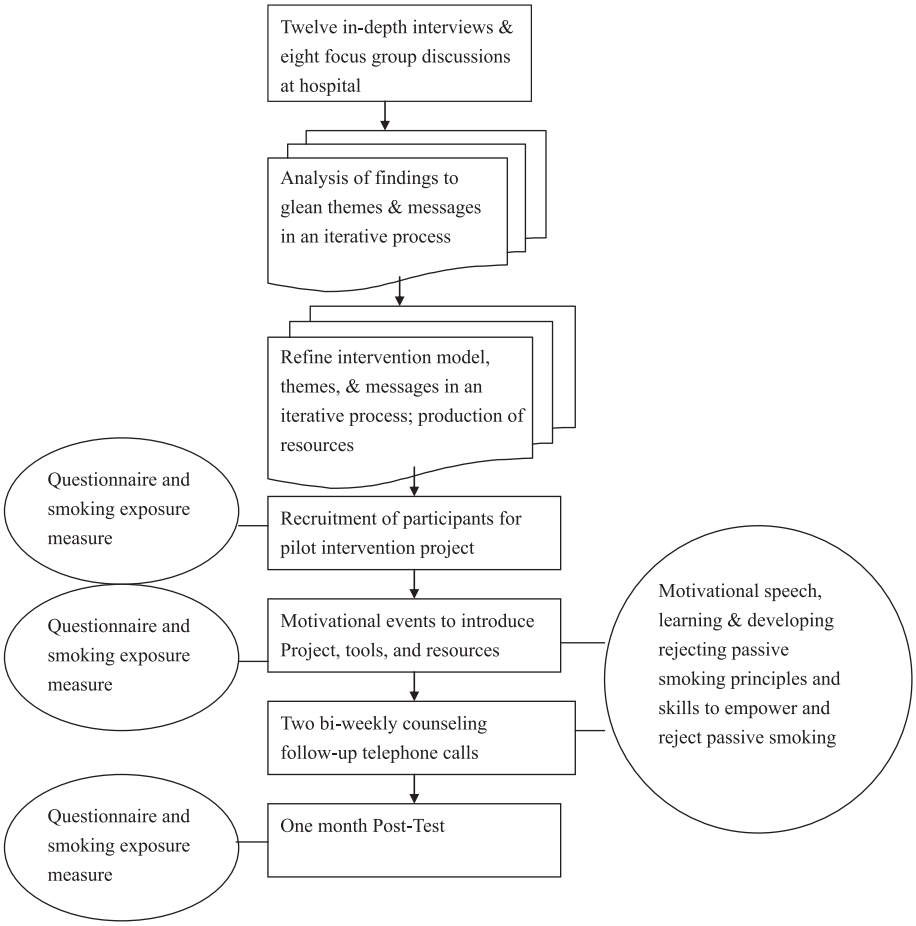

Fig. 2. Flow diagram of the study.

self-efficacy. The senior nurse conducted the interventions during the pregnant women's government-mandated prenatal care visits. The nurse first provided basic information regarding the dangers of SHS for both the mother and the fetus, and then went on to empower the women by explaining what they could do to reduce their SHS exposure.

The nurse then went into detail regarding five tactics aimed at confronting smoking household members and co-workers. These five tactics included: turning their passivity into activity, using a non-aggressive and gentle approach, emphasizing that not smoking around a pregnant women is not the same as quitting smoking, using the baby's health and the status of men as a protector of the family as leverage, and when all else fails leaving the area.

The 'turning passivity into activity' strategy stressed the importance of speaking up and encouraged women to break the taboo of a woman challenging a man's dominance in the household. However, the second strategy, 'using a non-aggressive and gentle approach', is equally important and was intended to remind women not to step too far out of the bounds of propriety as defined by Chinese culture. This strategy emphasized the importance of maintaining their role as the woman of the household and while pushing the boundaries, to be feminine, non-threatening, and non-confrontational.

The third strategy was included in consideration of the poor results of many prior studies attempting to encourage smoking cessation among the husbands of pregnant women and emphasized that not exposing the mother to SHS does not mean that they have to quit. The main goal of this intervention was risk reduction, which may be a particularly more efficacious strategy for pregnant women in male-dominated Chinese societies we hypothesized. The fourth strategy also played on Chinese cultural themes, and encouraged women to gently remind their husbands and smoking male family members of their role as a protector of their family and that by being conscious of their smoking and health of the mother and child they were honorably fulfilling the culturally defined gender role. The final strategy was truly putting the control of their exposure into their own hands. In the event that they could not reason with or control the behaviors of those around them, they were reminded that they could still control their environment by leaving the immediate area.

Finally, the intervention group was asked to put these tactics into action and role-play various scenarios with the senior nurse. The role-playing demonstrated how to gently broach the topic of SHS exposure indirectly and included culturally appropriate elements of body posturing and tone of voice control.

The intervention had the advantage of being directly linked to the Taipei City Hospital, whose medical personnel command a stronger sense of respect and authority than those involved in community-based interventions. This approach facilitated both the communication of knowledge, and made for a professional and nurturing environment where the role-playing exercises of this intervention could be conducted with efficacy and empowerment.

The intervention was conducted face-to-face and one-on-one for 50 min and was accompanied with an educational booklet that was distributed to participants to be taken home. The booklet highlighted the salient points of the intervention program, and reviewed the conversational tactics that they learned and rehearsed through the intervention. The home educational booklet used simple and pictorial terms to communicate knowledge and skills. This booklet was based on the successful family member support intervention which was part of the Patient High Blood Pressure Control Program conducted by professors Lawrence W. Green and David M. Levine at the Johns Hopkins Medical Institution (Levine et al., 1979; Morisky et al., 1983).

During the intervention period, all the intervention participants received biweekly telephone consultations from the nurse who would ask how they were doing with confronting household members and co-workers regarding their SHS exposure, provided motivation and support, and reminded them about subsequent visits.

2.5. Measurements

The questionnaire had acceptable content validity, with a content validity index of 0.80. A pretest was conducted involving 30 pregnant women taken from the same hospital as the study subjects but who were not recruited for this study. The pretest had consistent Cronbach's α values ranging between 0.75 and 0.95. Knowledge was measured by 16 yes/no items, with scores ranging from 0 to 16. A higher score indicated a better level of knowledge. The internal consistency of the knowledge scale, as assessed by the Kuder–Richardson 20, was 0.814.

Demographic characteristics measured at baseline included age, educational level, monthly family income, gestational week, the smoking status of the participant's husband and household members, as well as whether the participant's home and work environment allowed smoking.

The questionnaire consisted of eight constructs assessing eight domains. These included knowledge, perceived SHS-related disease susceptibility, perceived SHS-related disease severity, perceived benefits of rejecting SHS exposure, perceived barriers to rejecting SHS exposure, cues to action for rejecting SHS exposure, self-efficacy for rejecting SHS exposure, and rejection of SHS behavior.

Exhaled carbon monoxide was measured with the aid of a carbon monoxide meter and used as a proxy for SHS exposure. The study protocol was approved by the Institutional Review Board of the Taipei City Hospital, Taiwan prior to the inception of the study.

2.6. Statistical analyses

The data collected in this study were processed and analyzed using the Statistical Package for the Social Sciences (SPSS) for Windows version 18.0. Study data was first examined by univariate analysis to describe sample characteristics and selected variables. Next, bivariate analysis was used to examine differences between the intervention and comparison groups at baseline. The chi-squared tests and independent samples t-tests employed were appropriate. In addition, repeated measures analysis of covariance (ANCOVA) and Wilcoxon matched-pairs signed-ranks test were used to assess the effects of the intervention on the selected outcome variables. A value of $p < 0.05$ was considered statistically significant.

3. Results

3.1. Participant characteristics

The mean age of the study participants was 29.8 years in the intervention group and 30.1 years in the comparison group. The overall mean gestational age was 27.0 weeks. The majority of the participants had a high school level of education or above. Ninety-nine percent of the participants had home environments where smoking was permissible, while 87.0% worked in environments that allowed for smoking.

Comparison of characteristics between the two groups revealed that there was no significant difference in age, education level, gestational week, or the presence of SHS in their home or work environment. However, there were significant differences in terms of monthly family income.

3.2. Baseline characteristics

The mean knowledge scores, cues to action, self-efficacy, behavior, and SHS exposure of the participants at baseline were shown in Table 1. Prior to the intervention, the comparison group had significantly higher ($p < 0.05$) scores for perceived SHS-related disease severity, perceived benefits of rejecting SHS exposure, and cues to action for rejecting SHS exposure.

Table 1
Baseline comparisons of two groups of study participants.

	Intervention (n = 50)	Comparison (n = 50)	t or χ^2	p
Age	29.82 ± 4.27	30.10 ± 2.65	0.394	0.694
Educational level				
Less than senior high school	4	0	0.117[a]	
Senior high school or above	46	50		
Monthly family income				
<NT $80,000	27	42	9.163	0.002
≧NT $80,000	23	8		
Gestational age	27.0 ± 4.88	27.0 ± 1.34	0.028	0.978
Smoking home environment				
Yes	49	50	0.122	
No	1	0		
Smoking work environment				
Yes	40	47	3.183	0.074
No	10	3		
SHS knowledge	1.7 ± 1.76	2.2 ± 3.30	0.83	0.408
Perceived SHS-related disease susceptibility	18.7 ± 4.64	21.7 ± 5.20	3.05	0.003
Perceived SHS-related disease severity	19.4 ± 4.45	23.6 ± 4.05	4.87	<0.001
Perceived benefits of rejecting SHS exposure	13.6 ± 3.56	16.8 ± 3.29	4.75	<0.001
Perceived barriers to rejecting SHS exposure	33.2 ± 4.88	33.3 ± 4.25	0.09	0.931
Cues to action for rejecting SHS exposure	2.7 ± 1.88	3.8 ± 0.96	3.48	0.001
Self-efficacy for rejecting SHS exposure	8.4 ± 0.94	8.4 ± 1.05	0.01	0.122
Rejecting SHS behavior	19.0 ± 2.06	19.4 ± 4.39	0.53	0.601
SHS exposure	3.8 ± 2.43	3.8 ± 2.24	0.04	0.966

[a] Fisher's exact test.

3.3. Immediate post-intervention effect

Table 2 shows the immediate post-intervention results. As monthly family income was significantly different between the two groups at baseline, we utilized an ANCOVA model treating family income as a fixed covariate.

The intervention group's immediate post-intervention scores all indicated a higher capacity to confront SHS and reduce their exposure than the comparison group ($p < 0.001$).

3.4. One month post-intervention effect

We also utilized ANCOVA to control for baseline differences when assessing the effect one month following the intervention. The difference between the two groups remained significant for SHS knowledge, perceived SHS-related disease susceptibility, perceived SHS-related disease severity, perceived benefits of rejecting SHS exposure, perceived barriers to rejecting SHS exposure, self-efficacy for rejecting SHS exposure, and rejection of SHS behavior, and SHS exposure (Table 3) ($p < 0.001$).

Since the regression coefficients of the variable, "cues to action for rejecting SHS exposure" did not meet the group regression coefficient homogeneity test ($F(2/94) = 4.95$, $p < 0.001$) for the two groups in the pretest and post–post test, we were unable to utilize ANCOVA to explore this parameter. Therefore, we used the nonparametric method Wilcoxon matched-pairs signed-rank test to explore the differences between groups for this variable. Table 3 presents that in the post follow-up test, "cues to action for rejecting SHS exposure" scores were higher among the intervention group in both income categories ($p < 0.001$).

4. Discussion

SHS has no risk-free level of exposure with non-smokers exposed to SHS being at an increased risk of developing cancer, cardiovascular disease and chronic respiratory illness (U.S. Department of Health & Human Services, 2006). These increased risks are also experienced by fetuses in utero which are most immediately at risk for impaired fetal growth, low birth weight, preterm delivery, as well as neonatal and perinatal morbidity and mortality (Hackshaw et al., 2011), and later in life are more likely to suffer from psychological distress, drug consumption, eating disorders, and body image problems (Omoloja et al., 2013). While these risks are well-known, SHS remains a major obstacle in Taiwan and abroad.

In this longitudinal study, we demonstrated that an intervention utilizing role-playing exercises and built on the conceptual framework of the HBM aimed at empowering pregnant women to confront their household members and co-workers was successful at significantly increasing their SHS knowledge scores, SHS-related perceived disease susceptibility scores, disease severity scores, benefits of rejecting SHS exposure scores, barriers to rejecting SHS, cues to action scores, self-efficacy and rejection of SHS behavior scores more than the comparison group. This study also detected that the women in the intervention group successfully reduced their SHS exposure as measured by exhaled carbon monoxide.

Table 2
Comparison of ANCOVA results for the post test.

Intervention (n = 50)	Comparison	(n = 50)	F	p
SHS knowledge	16.1 ± 4.06	4.1 ± 5.02	258.05	<0.001
Perceived SHS-related disease susceptibility	51.7 ± 1.86	20.7 ± 6.17	990.86	<0.001
Perceived SHS-related disease severity	52.0 ± 0	21.9 ± 5.52	1126.34	<0.001
Perceived benefits of rejecting SHS exposure	36.0 ± 0	16.2 ± 3.86	1200.92	<0.001
Perceived barriers to rejecting SHS exposure	10.3 ± 3.10	33.7 ± 3.30	1171.97	<0.001
Cues to action for rejecting SHS exposure	7.8 ± 2.13	3.8 ± 0.96	187.43	<0.001
Self-efficacy for rejecting SHS exposure	37.8 ± 4.10	8.2 ± 0.82	2217.69	<0.001
Rejecting SHS behavior	87.0 ± 6.40	20.7 ± 5.68	2646.09	<0.001
SHS exposure	1.5 ± 1.53	4.9 ± 2.11	82.48	<0.001

Table 3
Comparison of ANCOVA & Wilcoxon matched-pairs signed-rank test for the post–post test.

	Intervention (n = 50)	Comparison (n = 50)	F	p
SHS knowledge	16.0 ± 0.20	5.2 ± 3.63	400.25	<0.001
Perceived SHS-related disease susceptibility	49.7 ± 1.43	23.7 ± 3.72	1697.49	< 0.001
Perceived SHS-related disease severity	49.6 ± 1.21	23.3 ± 3.26	2076.72	<0.001
Perceived benefits of rejecting SHS exposure	36.0 ± 0	16.2 ± 3.86	1200.92	<0.001
Perceived barriers to rejecting SHS exposure	11.1 ± 4.35	27.2 ± 3.40	384.80	<0.001
Self-efficacy for rejecting SHS exposure	36.4 ± 3.21	9.6 ± 1.11	2754.21	<0.001
Rejecting SHS behavior	83.6 ± 5.37	30.2 ± 5.48	2145.02	<0.001
SHS exposure	1.4 ± 1.47	4.5 ± 1.91	84.44	<0.001
Cues to action for rejecting SHS exposure				
<NT $80,000	9.0 ± 0.12	4.0 ± 0.12	−4.7[a]	<0.001
≧NT $80,000	9.0 ± 0.05	4.0 ± 0.07	−4.46[a]	<0.001

[a] Z value.

Although indoor smoking has been banned or significantly limited in many workplaces and public settings, the home remains one location not under the jurisdiction of government policy. Smoke-free rules in homes have been shown to reduce the risk of children becoming smokers (U.S. Department of Health & Services, 2010), but little is known about the extent to which pregnant women can control their SHS exposure at home. This is particularly important in Han Chinese cultural circles on account of the larger burden of disease associated with tobacco harm stemming from male family members, yet particularly difficult as Han Chinese men may be less amendable to their wives' encouragement than their western counterparts.

As opposed to other countries, such as the United States where 19.8% of women between 25 and 44 years smoke (U.S. Department of Health & Human Services, 2011), the Taiwanese Bureau of Health Promotion currently reports that only 4.6% of pregnant Taiwanese women are estimated to smoke during pregnancy. However, the same Bureau also estimates that over half of pregnant Taiwanese women are exposed to SHS in their homes (Bureau of Health Promotion, 2012). One prior investigation reported similar statistics, citing 44% of pregnant women to be exposed to SHS from their spouses, and an additional 10% from other family members (Lin, 2004). But, while the brunt of tobacco harm experienced by pregnant women and their unborn children stems from male family members, as discussed above, Chinese men are likely to represent a group that is not easily amendable.

Thus, while the mitigation or elimination of SHS at home may be difficult to achieve it is critical to reduce the burden of disease associated with smoking among Han Chinese. Unfortunately, very little research has been performed evaluating the effect of SHS prevention interventions among pregnant women as researchers generally do not perceive smoking as a problem among this population due to its low prevalence.

The one study in the literature most similar to the present investigation was a pilot study conducted in Sichuan, China, and thus being situated in a Han Chinese-dominated region its results should be at least relatively comparable to our own. Like our study it utilized the HBM as a framework to design an intervention and included motivational and patient communication activities, a resource booklet, clinician counseling, telephone hotline, and regular telephone counseling. It demonstrated that educating non-smoking pregnant women about SHS and arming them with positive communication skills led to increased knowledge, a change in attitudes towards strong disapproval of SHS and more self-reports of assertive actions against SHS exposure (Lee, 2008). However, the results of that study were based on a convenience sample, and therefore may not have been representative of the overall population, and on account of logistical difficulties did not utilize a comparison group. Therefore, they were unable to rule out the possible effects of multiple threats to internal validity.

The design for the present study builds on this pilot study, and incorporated both a random sample and a comparison group thus providing results from a study with a higher level of evidence, demonstrating that educational interventions can be successfully utilized to educate and empower pregnant women to defend themselves against SHS.

One reason for the success of this intervention may include the effect pregnant women have on behavioral change (Kazemi, Ehsanpour, & Nekoei-Zahraei, 2012). Pregnancy is an opportune time to institute preventive approaches against SHS as women are most conscientious about the health of their baby. This may be because pregnancy motivates women to become more concerned with their health and to take action to avoid such health risks as exposure to SHS (Haug, Fugell, Aaro, & Foss, 1994). Moreover, families are motivated to ensure for the health of the baby during pregnancy, thus giving pregnant Han Chinese women a stronger voice. This also offers them the opportunity to encourage behavioral change with a longer-term goal being the maintenance of a smoke-free environment for the whole family and the promotion of women's rights.

As the one month post-intervention assessment results support, this would be an opportune time to reduce not only exposure during pregnancy, but also the children's exposure during their childhood. SHS has been shown to have the greatest effect on the health of children. Given that this group of individuals likely spends a great deal of time at home, they are particularly vulnerable to the effects of familial smoking (Conway, Woodruff, Edwards, Hovell, & Klein, 2004; Groner, Hoshaw-Woodard, Koren, Klein, & Castile, 2005).

4.1. Limitations

This study suffered from several limitations which may have affected the outcomes. First, the comparison group did not receive a placebo-like intervention in addition to the standard government-mandated prenatal care, which may have introduced a degree of bias. Second, the sample size was small and further research with a larger sample size is needed to better ascertain the validity of these findings. However, with an alpha value of 0.05 and a power of 80% we calculated that we needed 42 participants in each group to detect the minimum predicted difference between groups. As we oversampled to account for loss to follow-up, even after losing five participants (9%) from the intervention group and 15 (23%) from the comparison group we still had 50 participants in each group. Thus, despite the abovementioned limitations this study can provide important qualitative and initial quantitative results regarding an intervention aimed at empowering pregnant women sourced from maternity hospitals to take control of their own SHS exposure.

It is the hope of the authors that these results encourage researchers to better explore interventions aimed at reducing SHS exposure among pregnant women and policymakers to use those results to further refine health education aimed at achieving the goal of mitigating SHS exposure.

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Contributors

YCC and CLW designed the study and wrote the protocol. YCC and CLW conducted literature searches and provided summaries of previous research studies. CYC conducted the statistical analysis. YCC wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript. SYL and DEM oversaw the revisions for intellectual content to the first draft of the manuscript.

Conflict of interest

No authors declare that they have any conflicts of interest.

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