Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

_____   _____
Tzu-Jung Wong   Date

The Association between Anti-Tobacco Media Exposures and Secondhand Smoking in
Luoyang, China

By

Tzu-Jung (Jennifer) Wong
MSPH

Health Policy and Management

_____
Joseph Lipscomb
Committee Chair

_____
Laura M. Gaydos
MSPH Director

_____
Michelle C. Kegler
Committee Member

The Association between Anti-Tobacco Media Exposures and Secondhand Smoking in
Luoyang, China

By

Tzu-Jung (Jennifer) Wong

Bachelor of Art
Chang Gung University
2010

Thesis Committee Chair: Joseph Lipscomb, PhD

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Sciences in Public Health
in Health Policy and Health Services Research
2013

Abstract

The Association between Anti-Tobacco Media Exposures and Secondhand Smoking in
Luoyang, China

By Tzu-Jung (Jennifer) Wong

The smoking and secondhand smoking (SHS) exposure rates in developed countries have decreased considerably after introducing health education media exposures, whereas the rates in China remain very high. Luoyang, China implemented anti-tobacco media exposures to educate residents on the hazards of smoking and being exposed to SHS in 2011. This study examines the association between anti-tobacco media exposures and residents' SHS knowledge and behaviors. We analyzed the two periods of data (n1=1,016; n2=903) that were collected by the Luoyang Centers for Disease Control and Prevention (CDC) and the Emory Global Health Institute (EGHI). Using logistic regression analysis, we examined if the number of different kinds of anti-tobacco media exposures predicts a respondent's knowledge level of SHS hazards, smoking status, and household SHS exposure status. We found that respondents who were exposed to audio/visual, print, and interactive media were less likely to be a smoker and more likely to have a higher-level of knowledge about SHS hazards. Also, people who had a higher-level of knowledge of SHS hazards were less likely to be a smoker or be exposed to SHS in the home. Our results are consistent with previous studies that indicate the government in China should publicize all types of media, including audio/visual, print, and interactive media, to educate citizens about the hazards of SHS exposure, and to raise awareness about the importance of avoiding household SHS exposure.

ACKNOWLEDGMENT

Contents

Table of Figures

List of Tables

Introduction

Secondhand smoke (SHS) is widely recognized as harmful to people's health. In the United States, there has been a significant reduction in SHS from 87.9% in 1998 to 40.1% 2008, following the implementation of smoke-free home recommendations and education.[1] In contrast, in China, despite persistently high secondhand smoke exposure rates (72.4%), there has been no smoke-free home ban.[2] Additionally, there are limited anti-tobacco campaigns that focus on reducing exposure to secondhand smoke in the household and only a handful of studies that evaluate the association between those few campaigns and residents' knowledge of SHS hazards, residents' smoking status, and household SHS exposure status.

In November 2010, the Luoyang CDC and EGHI collected data from 20 communities to examine residents' knowledge of SHS hazards, smoking status, and household SHS exposure status. After the data collection, Luoyang CDC and EGHI implemented an anti-tobacco media campaign to provide messages about the hazards of tobacco and slogans to reduce passive smoking and change behaviors. The purpose of the present study is to examine the association between anti-tobacco media exposures and respondents' smoking status, household SHS exposure status, and respondents' knowledge of SHS hazards in the communities where this campaign was implemented.

Literature Review

Secondhand smoke (SHS) is widely recognized as dangerous, especially for children. SHS exposure increases the risk of lung cancer, stroke, and coronary heart disease. Exposure to SHS can exacerbate asthma and underlying lung disease, contribute to respiratory problems, and reduce lung function in adults. Exposure is particularly dangerous to children, increasing the risk of respiratory infections, including asthma, bronchitis, and pneumonia, severity of asthma symptoms, middle ear infections, and sudden infant death syndrome.[3-8]

The home is usually a primary location of SHS exposure for children. Therefore, the adoption of a home smoking ban can significantly reduce the level of SHS and thirdhand Smoke (THS) exposure. A home smoking ban refers to rules set up by household residents or other individuals to restrict or ban cigarette smoking inside the home. Previous research has found an association between home smoking bans and a reduction in toddlers' mean urinary cotinine levels, an indicator of exposure to smoke.[9] Studies also suggest that household smoking rules convey an anti-tobacco social norm that help deter adolescents from smoking regardless of their parents or friends' smoking behavior.[10-13]

Rates of secondhand smoke have decreased considerably in developed countries

In some economically advanced countries there have been major efforts to promote smoking cessation and to educate the public about the adverse effects of smoking, as well as the hazards of SHS.[14] As a result, in the United States and other developed nations, rates of secondhand smoke have decreased considerably; for example, in US the secondhand smoke exposure rate decreased from 87.9% to 40.1% from 1988 to 2008.[1] However, the rate of change towards smoke-free homes may vary in different countries depending on regional differences in smoking prevalence, health promotion initiatives and varying types of tobacco control laws.[15-16] For example, research has found an increase in smoke-free homes among adult smokers in the Republic of Ireland following implementation of smoke-free legislation; however, they reported a similar increase in the UK where no such smoke-free laws were in place. This suggests we can use a variety of ways to decrease household secondhand smoke

exposure rates depending on the circumstances in each developed country.

The SHS exposure rates remain very high in developing countries

Conversely, most developing countries have not delivered or promoted educational efforts about smoking risks or SHS exposure. There are a limited number of studies that have examined or measured parental knowledge or beliefs regarding the adverse health effects of SHS exposure in developing nations.[14] Moreover, the SHS exposure rates in Asian are high in part because Asian men have especially high rates of smoking, including in the home.[17] Thus, it may be that unequal power structures between men and women in those countries have led to high smoking rates because it is often hard for women to suggest to men that they quit smoking. In addition, some studies have found unexpected consequences of smoke-free policies, especially for disadvantaged populations, including an increase in SHS at home and a threat to female smokers' safety and public image when smoking on the street.[18]

A recent study showed that in 2010, in China, among non-smokers aged 15 years and older, it was estimated that 72.4% (556 million) of people were exposed to secondhand smoke, with 52.5% (292 million) exposed to secondhand smoke daily. The prevalence of secondhand smoke exposure was 74.1% for men, 71.6% for women, 70.5% for urban populations, and 74.2% for rural populations. The rates were 67.3%, 63.3%, and 72.7% respectively, within the household, indoor workplaces and public places.[19] While these differences are significant, it is also important to note the high overall rates of exposure, which far exceed those in developed nations.

The effectiveness of smoke free home recommendation

After the implementation of national smoke-free legislation in four European countries, the International Tobacco Control Policy Evaluation Project Europe Surveys measured changes in prevalence and predictors of home smoking bans (HSBs) among smokers.[20] The study showed that after implementation of national smoke-free legislation, the proportion of smokers with a total HSB increased significantly in all four countries.[20] Among continuing smokers, the number of cigarettes smoked per day either remained stable or

decreased significantly.[20] The findings suggest that smoke-free legislation does not lead to more smoking in smokers' homes. On the contrary, the findings demonstrate that smoke-free legislation may stimulate smokers to establish total smoking bans in their homes.[20]

Evidence gathered in the context of children's exposure to SHS in Scotland is relevant to our understanding of smoking restrictions in households with children.[21] In the year following implementation of the Scottish smoke-free legislation, there was a dramatic reduction in children's exposure to SHS (39%) at a population level. [21] This change was an order of magnitude higher than the average annual (secular) change seen in two English studies, which covered the 15-year period from 1988 to 2003.[21]

Smoke-free legislation in public and workplaces was also introduced in England in July 2007, and is expected to provide more protection to the general population (smokers and nonsmokers) in public places against the adverse effects of SHS. The social diffusion model suggests that this legislation is likely to encourage additional home restrictions on smoking.[22]

Because the home is generally considered outside the realm of government regulation, and in many cultures it may not be acceptable for a woman to ask her partner or another male to refrain from smoking in the home, many public health and tobacco control organizations have begun to implement educational campaigns to reduce SHS exposure in the home. To provide children a healthier living environment, the U.S. government has implemented a series of smoke-free home recommendations since 1992. As a result of these recommendations and intense educational programs, the SHS exposure rate has decreased from 87.9% to 40.1% in the U.S. While only 5.4% of adult nonsmokers in the United States lived with someone who smoked inside their home, 18.2% of children (aged 3 to 11 years) lived with someone who smoked inside their home in 2007 and 2008.[1, 2]

Furthermore, two community-level educational campaigns were introduced to encourage smoke-free homes and vehicles: the U.S. Environmental Protection Agency's (EPA) National Smoke-Free Homes and Cars Program and the American Legacy Foundation's 2005 "Don't Pass Gas" media campaign.[23, 24] Similar interventions are being implemented in countries around the world. The WHO launched a community-based

intervention that used media campaigns, advocacy, and public events to encourage non-smoking by pregnant women, smoke-free schools, and smoke-free homes. Last of all, the most recent frontier in California's ongoing effort to protect its citizens from SHS is smoke-free multiunit housing (SF-MUH). Drifting smoke from neighboring units, patios, and balconies can seep through openings for electric wiring, light fixtures, plumbing, baseboards, ductwork, ceiling, or wall cracks.[25] This may result in SHS particulate matter sometimes exceeding the U.S. EPA's 24-hour health-based standard.[23]

In Canada, almost 15% of Canadian homes with children under 18 years old reported their children were exposed to secondhand smoke from cigarettes, cigars or pipes.[26] However, most Canadian families agree they should avoid exposure to secondhand smoke in their home and car. Currently, 87% of Canadian homes already restrict smoking in some way, and parents report there is general agreement about these restrictions among family members.[26] Parents also report that the primary reason they want to cut back on the amount of secondhand smoke in their home is because of their children. According to Canada Health, from 2008 to 2009, the proportion of non-smokers aged 12 and older who were regularly exposed to secondhand smoke at home remained relatively stable, settling at 6.2% in 2009.[26]

Different kinds of media programs to reduce smoking in the world

A wide variety of media programs are used to reduce smoking. Community projects to improve individuals' knowledge and skills for conducting interventions on SHS exposure are also useful.[27] A recent study in the nursing literature supported the utility of the internet in mobilizing the community and building capacity for smoke-free policy development in Canada.[28]

Media strategies were found to be equally important in targeting tobacco users in developing countries, such as India, as well. The impact of the national mass media campaign in India was assessed by several researchers and they reported that a high percentage of smokeless-only users (75%) and dual users (77%) were alarmed about their tobacco use habit after being exposed to the campaign. The campaign also had an impact on orientation towards cessation, as 72% of smokeless and dual tobacco users contemplated quitting their habit and

41% tried to convince others to quit tobacco use.[29]

Large anti-tobacco media campaigns, combined with other tobacco-control activities, have been associated with decreased smoking prevalence and reduced cigarette consumption. Media campaigns combined with community programs have been shown effective in increasing public awareness of the harmful effects of smoking and SHS as well as promoting use of smoking-cessation services.[30-33]

One of the previous studies indicated that exposure to secondhand smoke in the workplace fell from 28.5% in July 2008 to 24.9% in December 2008 to 7.3% in March 2009, and household secondhand smoke exposure decreased from 36.8% to 34.3% to 21.3%, respectively, during the same period.[27] The rates of workplace and household SHS exposure for different sociodemographic groups decreased slightly during the media campaigns and decreased even further after implementation of the smoke-free ordinance.[26] For instance, the household SHS rates among men decreased from 41.9% (before media campaigns) July 2008 to 36.5% (during media campaigns) in December 2008, to 22.5% in March 2009 (after law). For employed people, the household SHS exposure rates decreased from 37.7%, in July 2008 to 35.0% in December 2008 to 19.6% in March 2009.[34]

Education programs to reduce smoking in different target populations

Smoking restrictions in the homes of smokers are known to be effectively related to the presence of children, the absence of daily smokers in the home, and awareness of the harm of SHS.[35] Smoke-free homes are associated with decreased tobacco use and increased successful quitting among smokers, [15, 36] a reduction in smoking uptake among children and adolescents, [37-38] and a preference for smoke-free residences among young adults.[39]

One of the previous studies was a household survey in the north of England that showed the prevalence of smoking in the presence of children in households with at least one smoker was also relatively high (42%), despite recent awareness raising campaigns regarding the dangers of passive smoking.[40] Head of household's educational attainment was a significant predictor of whether smoking was allowed in the presence of children. More information about specific health risks to children from SHS was suggested as an effective

6

strategy to motivate parents and caregivers to implement smoking restrictions in the homes. Advice from health professionals and children raising the issue of smoking in the home with their parents was also thought to be an effective measure by 57% of respondents.[40] Evaluation studies of these kinds of programs

Evidence highlights that families and communities play a crucial role in preventing uptake of risk behavior and promoting adoption of health promoting behaviors. "No tobacco use" norms in families and communities, parental monitoring and expectations have substantial influence on promoting health behaviors among adolescents. A community- based tobacco cessation approach has been tested in India through a demonstration project and found to be beneficial. A significant reduction in tobacco use by adolescents was found in the intervention group as compared to the control group. The intervention group also reported significantly lower fresh uptake of tobacco use (0.3 %) in comparison to the control group (1.7 %). [41]

Since a great deal of research has shown that implementing smoke-free home and educational campaigns are effective, the WHO has recommended that countries: (1) implement educational strategies to reduce SHS exposure in the home, recognizing that smoke-free workplace legislation increases the likelihood that both smokers and non-smokers will voluntarily make their homes smoke-free; and (2) develop Tobacco-Free Family campaigns at the community level that include the active participation of girls and women as well as boys and men.

Current household second hand smoke recommendation study in China

In many regions of China, offering cigarettes to guests is a common social custom. Offering and receiving cigarettes are regarded as polite behaviors and necessary forms of social interaction.[29] A qualitative study that explored issues around children's exposure to SHS suggested that there are gaps in knowledge of the health consequences of smoking and SHS among the participants in China. Although residents did not obtain lots of knowledge about the health risk of exposure to SHS, most of them were willing to protect their child from the SHS exposure. [42] However, the authors identified a number of barriers to adopting

smoking bans in the home including. One of the barriers is the smoking expectations of guests when hosting social gatherings at home, and another is that many families do not openly discuss smoking or smoking restrictions at home. [43] The findings of this study showed the importance of designing intervention strategies to reduce SHS exposure at home among children in China.[43]

Additionally, a study has shown that approximately 87% of the smokers smoked in the home and a high percentage of them smoked in front of their children in China. [42] Moreover, most of the non-smokers who have children reported that they were exposed to secondhand smoke in the home. Among those with family members who smoked, most of them would ask the smokers not to smoke in front of them and would try to persuade smokers to quit smoking, and half of them would ask smokers to smoke outdoors. Lastly, the study indicated that people's knowledge about the harms of SHS and their attitudes toward tobacco control are fundamental factors in reducing SHS exposure.[42] Therefore, the study suggested that all types of media should be used to publicize and educate about SHS exposure, warning people about the harms of smoking and SHS exposure, and raising people's level of awareness about avoiding SHS exposure, with the aim of reducing SHS exposure.[42]

The anti-tobacco media exposure analyzed in this study

In China, a limited number of health promotion campaigns focus on reducing exposure to secondhand smoke, and there are only a handful of studies that evaluate the effectiveness of those few campaigns. To fill this gap, the Center for Disease Control and Prevention (CDC) in Luoyang cooperated with nine communities to hold events, display posters, and use bulletin boards to encourage residents not to give cigarettes to visitors and to provide tobacco control information. Also, the CDC worked with television and radio stations, newspapers, and other official media to inform residents of the dangers of smoking and inhaling secondhand smoke. The information provided by the media includes two parts: (1) Messages about the hazards of tobacco, including that smoking causes a variety of fatal cancers, and smoking in the workplace may increase a non-smoking colleague's risk of lung cancer by 12 to 19%, and; (2) Slogans to reduce passive smoking and change behaviors, such

as reduce secondhand smoke to have fresh homes, and to transform social traditions and promote health, do not offer cigarettes to guests.

In China, there are very limited anti-tobacco campaigns that focus on reducing exposure to SHS and only a handful of studies that have evaluated the association of those few campaigns on household SHS exposure status, respondents' smoking status, or respondents' knowledge of SHS hazards. The present study is also the first, to our knowledge, to examine how media exposures may lead to differences in household SHS exposure status, respondents' smoking status, and respondents' knowledge about hazards of SHS in Luoyang. Thus, this study is going to inform government policy on whether to replicate this educational intervention in other regions throughout China.

The anti-tobacco media exposure provided by this study

In China, there are very limited health promotion campaigns that focus on reducing exposure to secondhand smoke and only a handful of studies that evaluate the association of those few campaigns and residents' knowledge of SHS hazards, smoking status, and household SHS exposure status. To fill this gap, the Center for Disease Control and Prevention (CDC) in Luoyang cooperated with 9 communities to hold events, display posters, and use bulletin boards to encourage residents not to give cigarettes to visitors and to provide tobacco control information. Also, the CDC worked with television and radio stations, newspapers, and other official media to inform residents the dangers of smoking and inhaling secondhand smoke.

The information provided by the media includes two parts:

1. Messages about the hazards of tobacco

    1) Smoking causes a variety of fatal cancers, including lung cancer, throat cancer, esophageal cancer, gastric cancer, liver cancer, and breast cancer.

    2) Smoking can harm oneself and also harm others.

    3) Smoking in the workplace may increase a non-smoking colleague's risk of lung cancer by 12 to 19%.

    4) Women with a husband who smokes are 20% more likely to have lung cancer.

5) Secondhand smoke will hinder fetal growth and mental development in pregnant women.

6) Children who inhale secondhand smoke may have asthma, other respiratory diseases, and poor academic performance.

7) A multinational tobacco company boss said: "We produced cigarettes, but we do not smoke. Cigarettes are produced for the poor, foolish, and ignorant people."

2. Slogans to reduce passive smoking and change behaviors

1) Love my family, and everyone please smoke outdoors!

2) Reduce secondhand smoke to have fresh homes.

3) To take good care of your family and friends, do not smoke at home.

4) For your and other people's health, please do not smoke in front of others.

5) For your and other people's health, please do not smoke in the public areas/places.

6) Smoke outdoors, win the respect, and win the health.

7) For our common health, please do not offer cigarettes.

8) Love me, love others, love yourself - please do not offer cigarettes.

9) Please protect our own health rights – dissuade others' smoking behavior.

10) To transform social traditions and promote health, do not offer cigarettes to guests.

11) In this Chinese New Year, do not offer cigarettes to guests and inhale secondhand smoke.

The research questions in this study will examine the association between anti-tobacco media exposures and respondents' knowledge of SHS hazards, smoking status, and household SHS exposure status. The study will conduct three logistic regression analyses for two periods of respondent: (1) residents that participated in the survey conducted in 2010, which is period 1, and ;(2) residents that participated in the survey conducted in 2012, which is period 2. The present study is also the first, to our knowledge, to examine how media exposures may lead to differences in household SHS exposure status, respondents' smoking status, and respondents' knowledge about hazardous of SHS in Luoyang. Thus, this study

may inform government policy on whether to replicate these educational media exposures in other regions throughout China.

METHODOLOGY

This study examines the association between anti-tobacco media exposure in Luoyang and respondent's knowledge of SHS hazards, smoking status, and household SHS exposure status. The overall analysis has two phases: the first phase focuses on cross-sectional analyses to determine what type of factors predict the respondent's knowledge of SHS hazards, smoking status, and household SHS exposure status for the survey conducted in 2010 (Period 1); the second phase focuses on analyzing the results for the survey conducted in 2012 (Period 2).

Study Design

<u>Research Questions</u>

The research questions in this study examined the association between anti-tobacco media exposures and respondent's smoking status, household SHS exposure status, and respondent's knowledge of SHS hazards.

Q1: Do the number of different kinds of anti-tobacco media exposures predict the level of respondent's knowledge of SHS hazards?

H1: Respondents exposed to audio/visual, print, and interactive media are more likely to have a higher level of knowledge of SHS hazards than those exposed to two kinds or any one kind of anti-tobacco media.

Q2: Do the number of different kinds of anti-tobacco media predict the likelihood of being exposed to SHS in the home?

H2: Households exposed to audio/visual, print, and interactive media are less likely to be exposed to SHS in the home than those exposed to two kinds or any one kind of anti-tobacco media.

Q3: Do the number of different kinds of anti-tobacco media predict the likelihood of being a smoker?

H3: Respondents exposed to audio/visual, print, and interactive media are less likely to be a smoker than those exposed to two kinds or any one kind of anti-tobacco media.

Data Source and Sample

　　The dataset, which was collected by the Luoyang CDC and the Emory Global Health Institute (EGHI), includes 1,016 households in 20 representative communities in Luoyang in 2010 (P1 - All) and 903 households in 9 representative communities in Luoyang in 2012 (P2). The interviewers randomly selected the households in period 1 and interviewed residents in person. One adult member of the household was randomly selected to participate in the survey. After conducting the survey in 2010 (P1 - All), eleven communities dropped out (P1 – Group 1), and the rest of nine communities (P1 – Group 2) participated in both period 1 and 2. The Luoyang CDC and EGHI implemented the anti-tobacco media exposures from November 2010 to July 2012. However, in period 2 (P2), the surveyors only went back to the same households for the 9 participating communities interviewed in period 1, as identified by address. The respondent might not have been the same person since there was typically more than one person in each household. Also for period 2, to expand the sample size, approximately 50 new households in each of the 9 communities participated. Thus, among 903 (P2) households, 454 households participated in both the period 1 and period 2 surveys.

Figure 1: Different groups of respondent
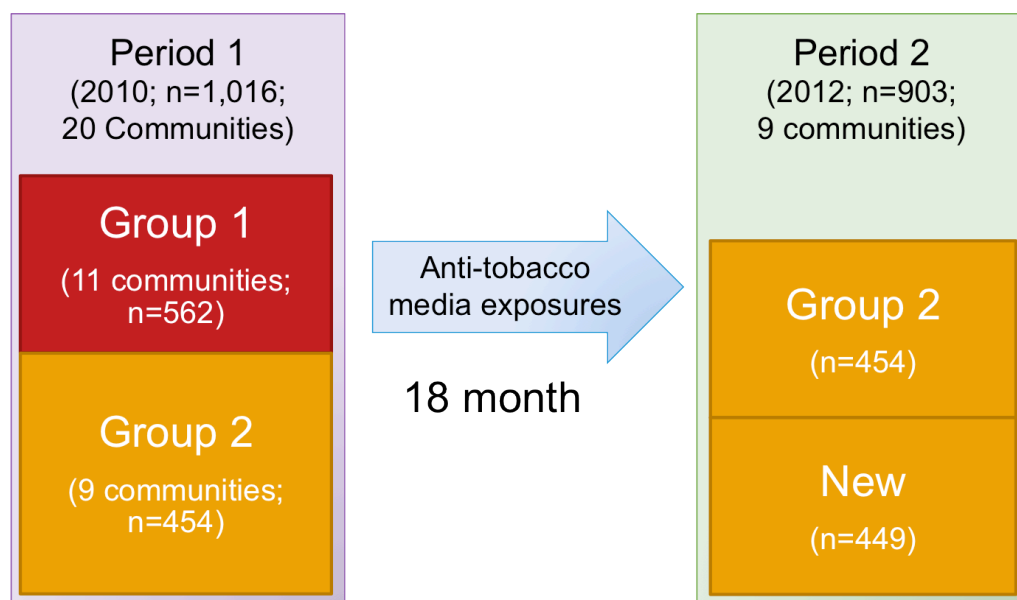
Conceptual Framework

Figure 2: Theoretical Model
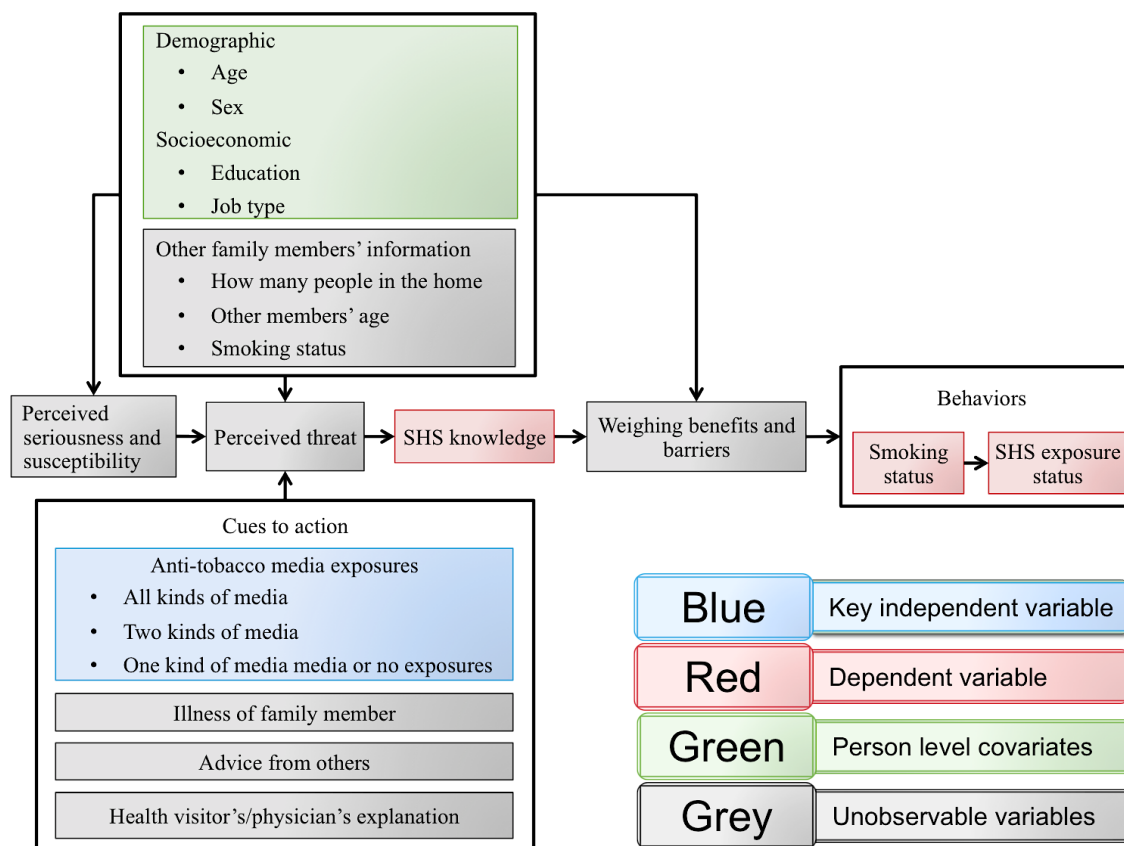
Building upon the health belief model (HBM) [44], the following conceptual framework

(Figure 1) is proposed. The personal level covariates will affect the respondent's perceived

seriousness and susceptibility, which influence the respondent's original health belief,

including how they evaluate the seriousness of smoking-related conditions and the

consequences of the conditions. Next, there are some cues to action, which may change the

respondent's health belief. For instance, these may include anti-tobacco media exposures

provided by our anti-tobacco campaign, illness of family member, or advice from other

people and programs. Thus, the perceived threat indicates how the respondent evaluates the

danger imposed by smoking or being exposed to SHS in the home, which will be influenced

by the respondent's knowledge level about SHS hazards. Given their health beliefs and

knowledge, the respondent will weigh the benefits and barriers to decide if they want to be a

smoker or exposed to SHS in the home.

14

The gray boxes represent unobservable variables, such as family composition, that might affect household secondhand smoke exposure status. The perceived seriousness and susceptibility indicate the smoker's perceived chances of developing smoking-related conditions, and their beliefs regarding seriousness of various smoking-related conditions and the consequences of these conditions. Additionally, this study does not obtain information on the smoker's belief in the efficacy of quitting smoking, the smoker's opinion of the tangible and psychological costs of the advised action for quitting smoking, or whether the perceived danger imposed by smoking or being exposed to SHS is great. The study also cannot measure other simultaneous policies or programs that might change the household secondhand smoke exposure status and the intensity of anti-tobacco campaign activities (i.e., how often exposed or for how long) in our program. Finally, the particular phrasing of the question, "In the past 30 days, did you see or hear tobacco control propaganda in following ways?", may also capture and not differentiate other media exposures (unrelated to the anti-tobacco media exposures). Although to our knowledge the anti-tobacco media exposures were the only sources that provided SHS knowledge, it is possible that respondents received information from different sources.

Measures

<u>Dependent variable</u>

The dependent variables for this analysis are multiple measures of smoking knowledge and behaviors, as depicted by a series of survey questions.

Dependent Variable 1: Respondent's knowledge of SHS hazards (dichotomous yes/no) was assessed by asking respondents, "Is inhaling second-hand smoke (passive smoking) hazardous to your health?" If the respondents reported "Not hazardous", "Mildly hazardous", or "Don't know/Not sure", they were defined as having lower level of knowledge of SHS hazards. However, if the respondents reported "Moderately hazardous" or "Severely hazardous", they were defined as having higher level of knowledge of SHS hazards.

Dependent Variable 2: Respondent's smoking status (dichotomous yes/no) was assessed by asking respondents, "Are you a smoker?" If the respondents answered yes, they were coded as yes – was a smoker. Note that this variable is at the individual level and refers only to the respondent him/herself.

Dependent Variable 3: Household SHS exposure status (dichotomous yes/no; Figure 2) was assessed via a decision tree (Figure 2) that includes several survey questions.

Figure 3: Household SHS exposure
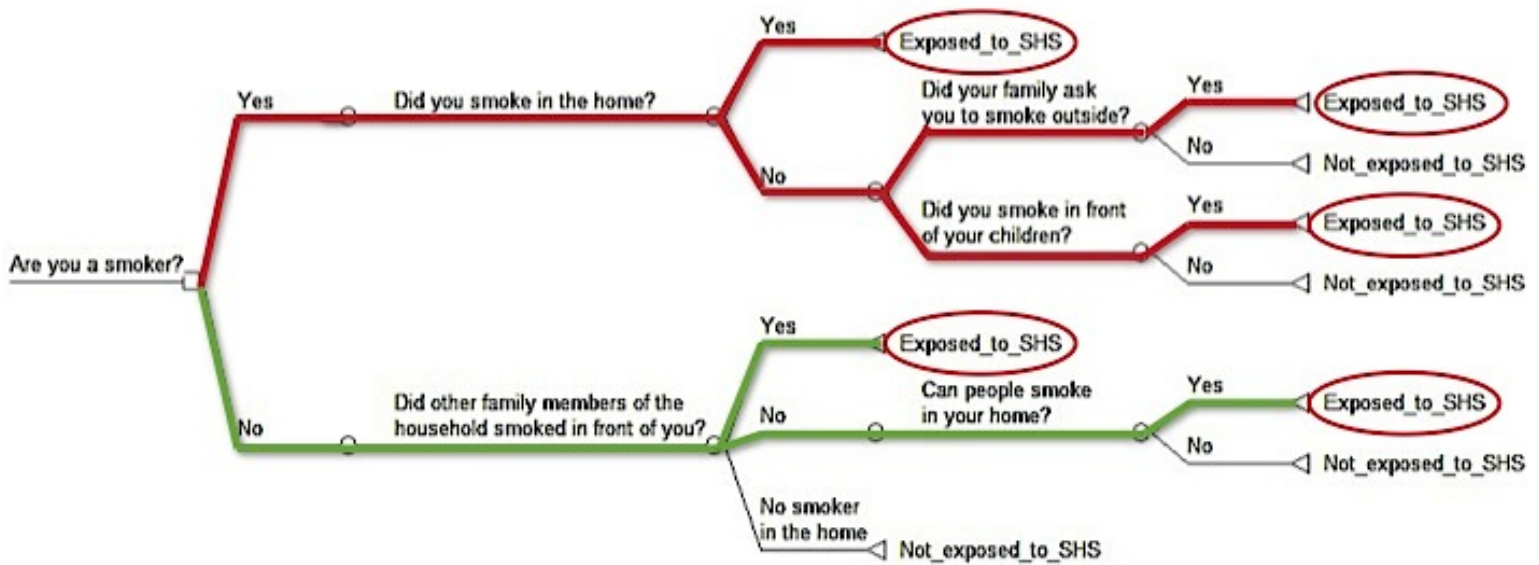
As shown in Figure 2, for smokers who reported that they often or sometimes smoked in the home, the household was defined as "exposed to SHS." Similarly, if the smokers reported they often or sometimes smoked in front of their children, the household was defined as "exposed to SHS." Finally, if the smokers reported they never smoked, but also reported their family usually, often, or sometimes asked them to smoke outside, the household was defined as "exposed to SHS".

For non-smokers who reported that there were no smokers at home, the household was defined as "not exposed to SHS". For non-smokers who reported that other members of the household smoked in front of them in the home, the household was defined as "exposed to SHS". Additionally, the previous studies estimated approximately 72.4% of people were exposed to SHS, with 67.3% of people exposed to SHS within the household in China.[15] However, there is no prohibition on smoking in the home. Thus, to develop the household

SHS exposure status, this study also looked at whether nonsmokers reported that no one smoked in front of them in the home but that people can smoke anywhere in the home or can smoke in some places in the home; if either of the latter two statements is indicated, the household was defined as "exposed to SHS".

Key Independent variable

The anti-tobacco media exposures (categorical) were assessed by asking respondents, "In the past 30 days, did you see or hear tobacco control propaganda in the following ways?" First, the study categorized the respondents into three groups: (1) audio/visual media - people who were exposed to TV or radio; (2) print media – people who were exposed to posters or brochures; and/or, (3) interactive media – people that were categorized as exposed to events held by the communities or people who were not exposed to any media. Notably, while it is expected that much of the media seen by respondents was tied to the specified anti-tobacco media exposure, the question asked in the survey does not specify this. Therefore, it is possible that respondents saw the information outside of the anti-tobacco media.

Next, respondents were categorized into three groups depending on how many kinds of media they were exposed to: (1) one kind of media; (2) two kinds of media; or (3) three kinds of media.

Respondent's *knowledge of SHS hazards* (categorical) was assessed by asking respondents, "Is inhaling second-hand smoke (passive smoking) hazardous to your health?". Respondents were categorized into four groups: (1) if respondents reported "Mildly hazardous", or "Don't know/Not sure"; (2) if respondents reported "Moderately hazardous"; and (3) if respondents reported "Severely hazardous".

Covariates

In addition to the key independent variable of interest, we controlled for several demographic measures, including those shown in the table below (Table 1).

Table 1: Covariates

Variable Name	Variable Type	Description
Age	Continuous	Ranging from 12 to 100 at baseline and

		11 to 99 at follow-up survey
Gender	Dichotomous	Female or male
Educational level	Categorical	Elementary school or Don't know (DK)
		Junior high school
		Senior high school
		Undergraduate+
Current Occupational level	Categorical	Government
		Professional/technical
		Business person-employee
		Salesperson, no formal occupation, unemployed, or homemaker
		Medical staff, educator, or transportation personnel
		Business owner or other

Statistical Analysis

To examine whether the anti-tobacco media exposures were associated with respondent's knowledge of SHS hazards, respondent's smoking status, and household SHS exposure status, we conducted three logistic regression analyses. We conducted the regression analyses for four groups of respondents, which were P1 (N=1,016), P1 – Group 1 (N=562), P1 – Group 2 (N=454), and P2 (N=903) by using the following three models.

The general regression model to predict respondent's knowledge of SHS hazards:

Respondent's knowledge of SHS hazards $= b_0 + b_1$ *(Anti-tobacco media exposures) $+ b_2$ (Person level covariates) $+ b_3$ (communities of respondent)$+ e_i$,*

The general regression model to predict respondent's smoking status and household SHS exposure status:

Outcome variables $= b_0 + b_1$ *(Anti-tobacco media exposures) $+ b_2$ (Respondent's knowledge of SHS hazards) $+ b_3$ (Person level covariates) $+ b_4$ (communities of respondent)$+ e_i$,*

❖ *Note: Outcome variables includes respondent's smoking status and household SHS exposure status*

Results

We compared the descriptive statistics for four groups of respondents: (1) P1 – All; (2) P1 – Group 1; (3) P1 – Group2, and; (4) P2. Next, we estimated logistic regression models to evaluate if there is any association between the anti-tobacco media exposures and respondent's knowledge of SHS hazards, smoking status, or household SHS exposure status.

Descriptive Statistics

The P1 – All data came from 1,016 households in 20 communities, 562 of which lived in the eleven communities that dropped out after period 1. Participants (N=562) residing in the eleven communities were categorized as group 1 (P1 – Group 1), and those (N=454) residing in the nine communities were categorized as group 2 (P1 – Group 2). The demographics of these households were compared with the households in period 2, and the descriptive statistics are summarized in Table 2.

Table 2: Descriptive Statistics for Four Study Samples

Factor	P1 - All N=1,016 (%)	P1 – Group1 N=562 (%)	P1 – Group2 N=454 (%)	P2 N=903 (%)
SHS basic knowledge				
Not hazardous	4.92	4.98	4.85	3.77
Mildly hazardous	14.67	15.48	13.66	8.75
Moderately hazardous	29.43	30.07	28.63	21.93
Severely hazardous	50.98	49.47	52.86	65.56
Respondents' smoking status				
No	75.1	79.54	69.60	69.77
Yes	24.9	20.46	30.40	30.23
Household exposed to SHS				
No	37.99	43.77	30.84	29.13
Yes	62.01	56.23	69.16	70.87
(External) media exposures				
One kind of media/no exposure	23.43	25.62	20.70	6.87
Print/interactive	3.74	2.49	5.29	9.08
A/V & interactive	3.35	1.96	5.07	4.21
A/V & print	17.72	17.62	17.84	4.54
All kinds of media	51.77	52.31	51.10	75.3
Gender				
Female	48.43	52.31	43.61	45.29
Male	51.57	47.69	56.39	54.71
Education				

Elementary or DK	6.69	6.58	6.83	5.87
Junior High School	17.81	14.77	21.59	16.61
High School	35.53	34.34	37.00	31.34
Undergraduate +	39.96	44.31	34.58	46.18
Job				
Government	10.14	6.76	14.32	15.95
Professional/technical	9.45	12.99	5.07	12.29
Business person - employee	25.49	24.56	26.65	18.72
Salesperson, no formal occupation, unemployed, or homemaker	17.03	15.66	18.72	18.27
Medical staff, educator, or transportation personnel	13.98	15.66	11.89	18.94
Business owner or other	23.92	24.38	23.35	15.84

The descriptive statistics indicate that within approximately one and half years (from November, 2010 to July, 2012), the respondent's knowledge of SHS hazards increased. Comparing P1 – All and P2, we find that people who think SHS is severely hazardous increased from 51% to 66%. The results also show that only 52% of respondents received the information from external media exposures in P1 – All, whereas 75% of respondents received the information from anti-tobacco media exposures in P2. However, more respondents reported that they were a smoker or were exposed to SHS, in the home, comparing P2 to P1 – All.

More specifically, focusing on P1 – Group 2 and P2, the statistics indicate that the respondents' knowledge of SHS hazards increased from 53% to 66%. Additionally, 75% of respondents in P2 reported they were exposed to anti-tobacco media, whereas only 51% of people in P1 – Group2 received the information from external media exposure.

Multivariate analysis

Multivariable regression analyses of media exposures on respondent's knowledge of SHS hazards, smoking status, and household SHS exposures for each of the defined samples are presented in the following tables.

Analysis 1: The whole sample at baseline (P1 - All)

Table 3: Multivariate Logistic Regression Analysis for P1 – All

	Knowledge of SHS hazards[1]	Smokers[2]	Exposed to SHS[3]
External media exposure			
One kind of media or no exposure	0.563**	0.671	0.971
	(0.1076)	(0.1545)	(0.1648)
Two kinds of media	1.049	0.836	0.839
	(0.2207)	(0.1877)	(0.1399)
All kinds of media	Reference	Reference	Reference
Knowledge of SHS hazards			
Not hazardous		1.790	1.905
		(0.7567)	(0.6376)
Mildly hazardous		2.518***	1.665*
		(0.6525)	(0.3352)
Moderately hazardous		1.793**	2.158***
		(0.3769)	(0.3518)
Severely hazardous		Reference	Reference
Respondent's age	0.997	0.982*	0.988*
(Continuous)	(0.0066)	(0.0072)	(0.0053)
Male	0.665*	78.83***	1.081
	(0.1110)	(33.6654)	(0.1490)
Education			
Elementary or DK	0.541	1.017	1.383
	(0.1844)	(0.4409)	(0.4193)
Junior High	0.591*	1.694	1.182
	(0.1459)	(0.4770)	(0.2494)
Senior High	0.855	1.383	1.123
	(0.1785)	(0.3030)	(0.1894)
Undergraduate +	Reference	Reference	Reference
Job type			
Government	Reference	Reference	Reference
Professional/technical	0.808	0.680	1.216
	(0.2413)	(0.2236)	(0.2986)
Business person - employee	0.858	1.608*	1.419*
	(0.1730)	(0.3509)	(0.2439)
Salesperson, no formal occupation, temporarily employed, unemployed, or homemaker	1.139 (0.6417)	0.819 (0.4746)	1.082 (0.4547)
Medical staff, educator, or transportation personnel	0.663 (0.2086)	1.465 (0.5658)	1.487 (0.3870)
Business owner or other	1.209	0.464	1.422
	(0.7802)	(0.5208)	(0.6081)
P1 – Group 2	1.164	1.569*	1.888***
	(0.1941)	(0.2896)	(0.2636)
Observations	1009	1009	1009
Pseudo R^2	0.026	0.351	0.044

Odds ratio with standard errors in parentheses
$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
1   Knowledge of SHS hazards: 0 = lower-level of knowledge of SHS hazards; 1= higher-lever of knowledge of SHS hazards
2   Respondent's smoking status: 0 = non-smoker; 1= smoker
3   Household SHS exposure status: 0 = Not exposed to SHS; 1 = Exposed to SHS

The first model shows that respondents exposed to one kind of media had 44% lower odds of asking other members to quit smoking than respondents exposed to all kinds of media, and that males have 33% lower odds of having a higher-level knowledge of SHS hazards than females, controlling for other factors. The results also indicate that the second and third models were driven by knowledge of SHS hazards. Controlling for other factors, respondents who reported SHS is mildly hazardous to human's health were 2.5 times more likely to be a smoker and were 1.7 times more likely to be exposed to SHS in the home than respondents who reported SHS is severely hazardous. Respondents who reported SHS is moderately hazardous to human's health were 1.8 times more likely to be a smoker and were 2.2 times more likely to be exposed to SHS in the home than respondents who reported SHS is severely hazardous. Additionally, the results indicate that males were 79 times more likely to be a smoker than females. Compared to the P1 – Group 1, the P1 – Group 2 had 57% higher odds of being a smoker and 89% higher odds of being exposed to SHS in the home.

The results indicate that males have a lower-level of knowledge of SHS hazards and that a higher percentage of smokers are male. The results also indicate that which community the respondent live plays an important role because the results show that the smoking and household SHS exposure issue was significantly more severe among P1- Group 2. The pseudo R2 indicates that the first regression model accounted for 2.6% in respondent's knowledge level of SHS hazards, and the third regression model accounted for 4.4% in household SHS exposure status. This implies that a low percentage of variance in the model can be explained by those outcome variables. However, the second model accounted for 35% of the variance in respondent's smoking status, indicating a stronger overall model from a goodness-of-fit standpoint.

<u>Analysis 2: P1 – Group 1 and P1 – Group 2</u>

Analysis 2 compares Group 1 and Group2 in period 1. We estimated three logistic

regressions by analyzing each dependent variable, in turn.

Table 4: Multivariate Regressions of Media Exposures on SHS Knowledge level

	Group 1	Group 2
External media exposure		
One kind of media or no exposure	0.950	1.659
	(0.3178)	(0.6460)
Two kinds of media	0.867	1.479
	(0.2822)	(0.4887)
All kinds of media	Reference	Reference
Respondent's age (Continuous)	1.005	0.998
	(0.0094)	(0.0122)
Male	0.472**	0.856
	(0.1158)	(0.2324)
Education		
Elementary or DK	0.574	0.404
	(0.2913)	(0.2243)
Junior High	0.672	0.474
	(0.2599)	(0.1845)
Senior High	0.795	0.998
	(0.2359)	(0.3678)
Undergraduate+	Reference	Reference
Job type		
Government	Reference	Reference
Professional/technical	1.050	0.744
	(0.4066)	(0.4812)
Business person - employee	1.004	0.766
	(0.3323)	(0.2694)
Salesperson, no formal occupation, temporarily employed, unemployed, or homemaker	0.692 (0.4920)	2.933 (3.2647)
Medical staff, educator, or transportation personnel	0.775 (0.4170)	0.495 (0.2416)
Business owner or other	1.471	0.489
	(1.1980)	(0.6103)
Observations	558	451
Pseudo R^2	0.154	0.119

Odds ratio with standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Note: The study controlled for community level variables with the inclusion of community dummy variables

The results indicate that males had a 53% lower odd of having a higher-level of

knowledge of SHS hazards, all else equal. However, most of the covariates were not

significant associated with the respondents' SHS knowledge level.

The results also indicate that respondents' knowledge level of SHS hazards was

associated with the smoking and SHS status in Group 1, but not associated with the smoking

and SHS status in Group 2. Additionally, females were more likely to have higher-level

knowledge of SHS hazards in Group 1.

Table 5: Multivariate Regressions of Media Exposures on Smoker

	Group 1	Group 2
External media exposure		
One kind of media or no exposure	1.238	0.926
	(0.5321)	(0.3725)
Two kinds of media	0.970	1.254
	(0.4018)	(0.4261)
All kinds of media	Reference	Reference
Knowledge of SHS hazards		
Not hazardous	7.204**	0.590
	(4.7954)	(0.4405)
Mildly hazardous	6.477***	2.207
	(2.8691)	(0.9151)
Moderately hazardous	3.754***	1.238
	(1.3717)	(0.4004)
Severely hazardous	Reference	Reference
Respondent's age (Continuous)	0.987	0.972*
	(0.0108)	(0.0129)
Male	130.0***	65.61***
	(95.7457)	(35.6870)
Education		
Elementary or DK	0.722	0.582
	(0.5422)	(0.3784)
Junior High	1.980	0.964
	(0.9225)	(0.4088)
Senior High	1.695	0.985
	(0.5747)	(0.3445)
Undergraduate +	Reference	Reference
Job type		
Government	Reference	Reference
Professional/technical	0.576	1.425
	(0.2586)	(0.9145)
Business person - employee	1.719	1.863
	(0.6455)	(0.6621)
Salesperson, no formal occupation, temporarily employed, unemployed, or homemaker	0.891	0.774
	(0.8092)	(0.6436)
Medical staff, educator, or transportation personnel	1.454	3.032
	(0.9516)	(1.8606)
Business owner or other	0.625	.
	(0.7571)	.
Observations	558	445
Pseudo R^2	0.416	0.367

Odds ratio with standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: The study controlled for community level variables with the inclusion of community dummy variables

Table 5 indicates that males were 130 and 65.6 times more likely to be a smoker than females in both Group 1 and Group 2. The results also indicate that respondents who think SHS is not hazardous, mildly hazardous, and moderately hazardous were 7.2, 6.5, and 3.8 times more likely to be a smoker in Group 1. However, in Group 2, respondents' knowledge of SHS hazards were not significantly associated with the smoking status.

Table 6: Multivariate Regressions of Media Exposures on Exposed to SHS

	Group 1	Group 2
External media exposure		
One kind of media or no exposure	1.146	1.659
	(0.3150)	(0.6460)
Two kinds of media	0.817	1.479
	(0.1988)	(0.4887)
All kinds of media	Reference	Reference
Knowledge of SHS hazards		
Not hazardous	5.172**	0.885
	(2.6472)	(0.4349)
Mildly hazardous	3.304***	1.022
	(0.9900)	(0.3486)
Moderately hazardous	3.362***	1.596
	(0.7926)	(0.4468)
Severely hazardous	Reference	Reference
Respondent's age (Continuous)	0.990	0.998
	(0.0071)	(0.0122)
Male	0.841	0.856
	(0.1622)	(0.2324)
Education		
Elementary or DK	0.975	0.404
	(0.4063)	(0.2243)
Junior High	1.181	0.474
	(0.3621)	(0.1845)
Senior High	1.089	0.998
	(0.2558)	(0.3678)
Undergraduate +	Reference	Reference
Job type		
Government	Reference	Reference
Professional/technical	1.098	0.744
	(0.3297)	(0.4812)
Business person - employee	1.566	0.766
	(0.4219)	(0.2694)
Salesperson, no formal occupation, temporarily employed, unemployed, or homemaker	0.836 (0.4726)	2.933 (3.2647)
Medical staff, educator, or transportation personnel	1.814 (0.6678)	0.495 (0.2416)
Business owner or other	2.294	0.489
	(1.2284)	(0.6103)
Observations	558	451
Pseudo R^2	0.089	0.119

Odds ratio with standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Note: The study controlled for community level variables with the inclusion of community dummy variables

The results illustrate that in Group 1, respondents who think SHS is not hazardous, mildly hazardous, and moderately hazardous were 5.2, 3.3, and 3.4 times more likely to be exposed to SHS in the home compared to those who thought it was severely hazardous. But, in Group 2, respondents' knowledge of SHS hazards was not significantly associated with the household SHS status.

Analysis 3: Period 2

For the Period 2 analyses, for each of the 9 communities, the sample includes respondents from the original 50 households that participated the survey in period 1 and an additional 50 new households that participated in period 2 only.

Table 5: Multivariate Logistic Regression Analysis for P2

	Knowledge of SHS hazards[1]	Smokers[2]	Exposed to SHS[3]
Anti-tobacco media exposure			
(Any) One kind of media	0.381**	3.153**	0.890
	(0.1356)	(1.2098)	(0.3165)
Two kinds of media	0.807	1.093	1.386
	(0.2242)	(0.2767)	(0.3094)
All kinds of media	Reference	Reference	Reference
Knowledge of SHS hazards			
Not hazardous		1.491	4.552*
		(0.6640)	(2.9576)
Mildly hazardous		1.774	2.169*
		(0.6224)	(0.6916)
Moderately hazardous		1.698*	1.323
		(0.3987)	(0.2633)
Severely hazardous		Reference	Reference
Respondent's age (Continuous)	1.019*	0.993	0.989
	(0.0090)	(0.0076)	(0.0067)
Male	0.780	30.46***	1.292
	(0.1827)	(9.7590)	(0.2237)
Education			
Elementary or DK	0.230**	1.056	1.035
	(0.1048)	(0.5380)	(0.4095)
Junior High	0.489	1.560	1.810
	(0.1793)	(0.5249)	(0.5647)
Senior High	0.746	1.448	1.375
	(0.2099)	(0.3449)	(0.2834)
Undergraduate+	Reference	Reference	Reference
Job type			
Government	Reference	Reference	Reference

Professional/technical	2.336	0.692	0.859
	(1.0433)	(0.2535)	(0.2821)
Business person - employee	1.661	0.668	1.450
	(0.6565)	(0.2214)	(0.4798)
Salesperson, no formal occupation, temporarily employed, unemployed, or homemaker	1.795 (0.7278)	0.446* (0.1667)	0.933 (0.3126)
Medical staff, educator, or transportation personnel	1.342 (0.5242)	0.577 (0.1970)	1.056 (0.3242)
Business owner or other	2.465*	0.555	0.947
	(1.0269)	(0.1927)	(0.3117)
Observations	893	893	893
Pseudo R^2	0.114	0.371	0.142

Odds ratio with standard errors in parentheses
1   Knowledge of SHS hazards: 0 = lower-level of knowledge of SHS hazards; 1= higher-lever of knowledge of SHS hazards
2   Respondent's smoking status: 0 = non-smoker; 1= smoker
3   Household SHS exposure status: 0 = Not exposed to SHS; 1 = Exposed to SHS
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: The study controlled for community level variables with the inclusion of community dummy variables

The Period 2 analyses indicate that respondents who received information from (any) one kind of media or no exposure were 3.15 times more likely to be smokers and had 62% lower odds of higher-level knowledge of SHS hazards than the respondents that received information from all kinds of media. Compared to respondents who reported SHS is severely hazardous, people who reported SHS is moderately hazardous to human's health were 1.7 times more likely to be smokers. Respondents who reported SHS is not hazardous or mildly hazardous to human's health were 4.55 and 2.17 times more likely to expose to SHS in the home than respondents who reported SHS is severely hazardous. Additionally, males were about 30 times more likely to be smokers than females controlling for other factors, which is consistent with findings in the baseline analysis.

The pseudo R2 indicates that the first regression model accounted for 11.4% in respondent's knowledge level of SHS hazards, and the third regression model accounted for 14.2% in household SHS exposure status. This indicates that compared to P1, a much higher percentage of variance in these outcome variables is being explained in P2. The second model here accounted for 37.1% of the variance in respondent's smoking status, which is only slightly higher than in P1.

The results indicate that respondents who were exposed to more kinds of anti-tobacco media were less likely to be a smoker and more likely to have a higher-level knowledge of

SHS hazards. Also, people who had a higher-level of knowledge of SHS hazards were less likely to be a smoker or be exposed to SHS in the home. The results are consistent with the conclusion that by promoting more kinds of anti-tobacco exposures, the individual's knowledge of SHS hazards may be improved, and that this may be associated with reductions in the likelihood of smoking or being exposed to SHS in the home.

Discussion

Study Implications

The aim of this study was to examine whether anti-tobacco media exposures were associated with respondents' smoking status, household SHS exposure status, and respondents' knowledge of SHS hazards. The external media exposures provided by other programs at P1, which may have educated and informed the public of the hazards of smoking and inhaling SHS smoke, were in existence before the anti-tobacco media exposures implemented by the Luoyang CDC. The results at P1 indicate that the external media exposures did not statistically influence the respondents' smoking status, household SHS exposure status, or respondents' knowledge of SHS hazards at baseline.

Yet, our P2 findings show that there was a statistically significant association between anti-tobacco media exposures and respondents' smoking status and respondents' knowledge of SHS hazards, with respondents exposed to only one type of media having lower SHS knowledge and being more likely to smoke than those exposed to all three types of media. Not surprisingly, the results also indicate that respondents who have a lower level of knowledge of SHS hazards are more likely to smoke themselves, and to be exposed to SHS in the home than those who have a higher-level of knowledge of SHS hazards. Hence, the key finding of this study is that the respondents' smoking status and respondents' knowledge of SHS hazards are associated with how many kinds of media exposures the respondents reported receiving. Exposure to more kinds of media may lead the respondents to be less likely to smoke and more likely to have a higher-level of knowledge of SHS hazards. The findings are also consistent with previous research, which illustrates that people with a higher-level of knowledge are less likely to be a smoker or be exposed to SHS.[45]

Since there are only a handful of studies that have evaluated the association between the anti-tobacco campaign and respondent's smoking knowledge or behaviors in China, the present study's findings contribute an additional understanding of household SHS status and the association between anti-tobacco media exposures and respondents' smoking status,

household SHS exposure status, and respondents' knowledge of SHS hazards in China. Furthermore, the present study is the first, to our knowledge, to examine the association between media exposures and smoking or SHS status in Luoyang. Therefore, the contribution of this study can be separated into two parts: (1) providing descriptive data about current smoking and household SHS exposure status in Luoyang; and (2) suggesting whether the current community-based anti-tobacco media exposures in Luoyang are associated with residents' smoking knowledge and behaviors.

The present study's findings about the prevalence of smoking rates in the home and household SHS exposure rates are similar to results from a previous study in which approximately 90% of smokers smoked in the home and 46% of households were exposed to SHS in the baseline.[24] After implementing an anti-tobacco campaign, the rate of smoking in the home and exposure to SHS decreased to 85% and 41%, respectively, which is slightly lower than the nationally representative household survey in China.[13] When it comes to the implementation of anti-tobacco campaigns or mass media to publicize the hazards of smoking and exposure to SHS smoke, previous studies and the present study's results all indicate that the government in China should employ all types of media, including audio/visual, print, and interactive media to educate citizens about the hazards of SHS exposure, and to raise awareness about avoiding household SHS exposure.[42]

Limitations

This study did face some limitations. In the questionnaire, the respondent only reported if he or she had received the information from each kind of media. Thus, the study cannot control how frequently the respondents received the information from the anti-tobacco campaign. The study also did not obtain the documents or information on how each community transmitted the massages to the residents. The phrasing of the question(s) does not allow one to distinguish several things, including the timing of the media exposures and the exact sources of the exposures for P2. Because some level of (undocumented) anti-tobacco exposures already existed prior to the CDC/EGHI campaigns, the phrasing of the question(s) also makes it difficult to determine whether the exposures were provided by CDC/EGHI

campaigns or other programs. Further information should be obtained from the respondents and communities in the future.

Another limitation is that this is a self-reported study, which is thus subject to memory and recall bias. Additionally, the outcome variable "household SHS exposure status" was generated by combining several questions that may make the measurement imprecise. Additionally, part of the information about the family component for each household was missing. Although the questionnaire did ask the respondents information about their family members, such as age and smoking status, the surveyors did not enter the data. Without obtaining the information, this study cannot examine directly if there was any other source of SHS in the home. For example, if the respondent was a smoker who did not smoke in the home or in front of their children and their family did not ask them to smoke outside, this study defined the household as not exposed to SHS. However, it is possible that other members in the home were smokers and smoked in the home and the household was exposed to SHS. The study also cannot control if guests smoked in the respondents' home because the questionnaire did not provide enough information. Last, in this study, there was no control group, which limits the generalization of the findings.

Future Study

Although this study is able to provide important descriptive data on smoking knowledge and behaviors in Luoyang, and offers preliminary data that increased media exposures is positively associated with improving these outcomes, the data limitations are such that we cannot truly evaluate the impact of the specific media intervention. To build on the findings of this study and evaluate this and other interventions, future studies should improve the precision of data collection tools and processes, so that they can more accurately collect data and continue to follow-up with the communities in this study. Future interventions designed to improve anti-tobacco knowledge and behaviors should focus on evaluation methodology as well as implementation of the programs. This will allow for a true evaluation of the programs. Once the methodology has been improved and follow-up data has been collected, the researchers can conduct longitudinal analyses to evaluate the effectiveness

of the anti-tobacco campaign.

The questionnaire should also be revised. Some questions are not accurate or clear enough in this version to obtain the household SHS exposure status. For instance, for non-smokers, SHS exposure was accessed with the question "Did other family members smoke in front of you?" It is more precise to ask, "Did other family members smoke in the home?" Moreover, to have a more accurate result, it would be better for the researchers to conduct the questionnaire with every family member, or conduct the questionnaire with the same person that participated in the previous surveys and enter all the information they provide. Another example is that this study determined how many kinds of media the respondents were exposed to by looking at the question, "In the past 30 days, did you see or hear tobacco control propaganda in following ways?" The question did not specify if the tobacco control propaganda was provided by the anti-tobacco campaign. Although we assume that the surveyors did mention that tobacco control propaganda was provided by the anti-tobacco campaign when interviewing the participants, this is not stated in the question and we cannot know how the influence of other, external media impacted this intervention. Finally, the program needs to improve the skip pattern regarding the presence of a smoke-free home rule, as the skip pattern in current questionnaire leads to high levels of missing data. For instance, by asking the respondent, "In the following description related to smoke free rule in your home, which best describes your situation?", researchers could determine if the household have certain smoker free rule. However, because of the current skip pattern, smokers who did not smoke in the home skipped the question. Thus, in this study we cannot predict if there is any association between the media exposures and a smoke free home rule.

Once more detailed longitudinal data has been collected, researchers should be tasked with estimating if families with non-smoking seniors are more likely to cease exposure to SHS after being exposed to the anti-tobacco campaign. Such a study might provide China's government with the impetus to implement a home smoking ban or smoker free home recommendation and pay more attention to anti-tobacco programs since currently there is no policy position regarding smoking and second-hand smoke in Luoyang, China.

Conclusion

The present study is the first, to our knowledge, to examine how media exposures may lead to differences in household SHS exposure status, respondents' smoking status, and respondents' knowledge about hazardous of SHS in Luoyang. This study provides descriptive data about respondents' SHS knowledge and behaviors in Luoyang and examines whether anti-tobacco media exposures in Luoyang are associated with respondents' SHS knowledge and behaviors. Our results are consistent with previous studies in China, which indicate that those who received audio/visual, print and interactive media exposures are significantly more likely to have a higher-level of knowledge of SHS hazards. The findings also demonstrate that people with a higher-level of knowledge are less likely to be a smoker or be exposed to SHS in the home. While these descriptive findings suggest that media campaigns may be helpful in changing SHS knowledge and behaviors, we cannot demonstrate causality. The government in Luoyang should continue to consider media interventions; however, future research is needed to improve the data collection process and the intervention design to provide more accurate and causal information. This will allow the researchers to analyze the true evaluation of the program.

Reference

1. U.S. Department of Health and Human Services. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2006 [accessed 2013 Apr 4].
2. Institute of Medicine. Secondhand Smoke Exposure and Cardiovascular Effects: Making Sense of the Evidence 🔗 (PDF–93.63 KB). Washington: National Academy of Sciences, Institute of Medicine, 2009 [accessed 2013 Apr 4].
3. A. K. Hackshaw, M. R. Law, and N. J. Wald, "The accumulated evidence on lung cancer and environmental tobacco smoke," British Medical Journal, vol. 315, no. 7114, pp. 980–988, 1997. View at Scopus
4. United States Department of Health and Human Services, The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinated Center for Health Promotion, Offfice on Smoking and Health, Atlanta, Ga, USA, 2006.
5. R. Taylor, F. Najafi, and A. Dobson, "Meta-analysis of studies of passive smoking and lung cancer: effects of study type and continent," International Journal of Epidemiology, vol. 36, no. 5, pp. 1048–1059, 2007. View at Publisher · View at Google Scholar · View at Scopus
6. X. Zhang, O. S. Xiao, G. Yang et al., "Association of passive smoking by husbands with prevalence of stroke among Chinese women nonsmokers," American Journal of Epidemiology, vol. 161, no. 3, pp. 213–218, 2005. View at Publisher · View at Google Scholar · View at Scopus
7. International Agency for Research on Cancer (IARC), Evaluating the Effectiveness of Smoke-Free Policies, in Handbooks of Cancer Prevention, Tobacco Control, World Health Organization, Lyon, France, 2009.
8. M. R. Law, J. K. Morris, and N. J. Wald, "Environmental tobacco smoke exposure and ischaemic heart disease: an evaluation of the evidence," British Medical Journal, vol. 315, no. 7114, pp. 973–980, 1997. View at Scopus

9. Spencer N, Blackburn C, Bonas S, et al. *Parent reported home smoking bans and toddler (18-30 month) smoke exposure: a cross-sectional survey. Arch Dis Child 2005;90:670–4.*
10. Rainio SU, Rimpela AH. *Home smoking bans in Finland and the association with child smoking. Eur J Public Health 2007;18:306–11.* [Medline][Web of Science]
11. Szabo E, White V, Hayman J. *Can home smoking restrictions influence adolescents' smoking behaviors if their parents and friends smoke? Addict Behav 2006;31:2298–303.* [CrossRef][Medline][Web of Science]
12. Clark PI, Schooley MW, Pierce B, et al. *Impact of home smoking rules on smoking patterns among adolescents and young adults. Prev Chronic Dis 2006.* http://www.cdc.gov/pcd/issues/2006/apr/05_0028.htm *(accessed 28 Feb 2011).*

13. Farkas AJ, Gilpin EA, White MM, et al. *Association between household and workplace smoking restrictions and adolescent smoking. JAMA 2000;284:717–22.*

14. Gharaibeh, H., Haddad, L., Alzyoud, S., El-Shahawy, O., Baker, N. A., & Umlauf, M. (2011). Knowledge, attitudes, and behavior in avoiding secondhand smoke exposure among non-smoking employed women with higher education in Jordan. International journal of environmental research and public health, 8(11), 4207-4219.

15. Shields M. Smoking - Prevalence, bans and exposure to second-hand smoke. Health Rep 2007;18(3):67-85.

16. Trosclair A, Babb S, Murphy-Hoefer R, Asman K, Husten C, Malarcher A. Statespecific prevalence of smoke-free home rules – United States, 1992-2003. MMWR Morb Mortal Wkly Rep 2007; 56(20):501-504.

17. Ernster V. Impact of tobacco use on women's health. In: Samet J, Yoon S-Y, eds. Women and the tobacco epidemic: challenges for the 21st century. Geneva: WHO, 2001:1–16.

18. University of Otago, Wellington (9 July, 2012 Published). Smoking on footpaths increases hazardous air pollutants. [accessed 2013 Apr 29], http://www.otago.ac.nz/wellington/departments/publichealth/news/otago0341 86.html.

19. Xiao L,Li Q,Yang Y,et al.Population-based survey of secondhand smoke exposure in China.Biomed Environ Sci,2010,23:341-347

20. Mons, U., Nagelhout, G. E., Allwright, S., Guignard, R., van den Putte, B., Willemsen, M. C., . . . Breitling, L. P. (2012). Impact of national smoke-free legislation on home smoking bans: findings from the International Tobacco Control Policy Evaluation Project Europe Surveys. *Tobacco control*. doi: 10.1136/tobaccocontrol-2011-050131

21. Sims, M., Mindell, J. S., Jarvis, M. J., Feyerabend, C., Wardle, H., & Gilmore, A. (2012). Did smokefree legislation in England reduce exposure to secondhand smoke among nonsmoking adults? Cotinine analysis from the Health Survey for England. [Research Support, Non-U.S. Gov't]. *Environ Health Perspect, 120*(3), 425-430. doi: 10.1289/ehp.1103680

22. Shields, M. (2007). Smoking bans. Health Reports, 18(3).

23. United States Environmental Protection Agency (September, 2009 Published). Secondhand Tobacco Smoke and the Health of Your Family Brochure (Bilingual). [accessed 2013 Apr 4], http://www.epa.gov/smokefre/publications.html.

24. American Legacy Foundation (November 28, 2006 published). Public Health Foundation Warns Against "Passing Gas". [accessed 2013 Apr 4], http://multivu.prnewswire.com/mnr/adcouncil/25956/.

25. Bohac, D. L., Fitzgerald, J. E., Hewett, M. J., & Grimsrud, D. (2007, December). Measured change in multifamily unit air leakage and airflow due to air sealing and ventilation treatments. Paper presented at the Thermal Performance of the Exterior Envelopes of Whole Buildings X International Conference, Clearwater Beach, FL.

26. Health Canada (published by authority of the Minister of Health, 2008). Make your home and car smoke-free: A guide to protecting your family from second-hand smoke. [accessed 2013 Apr 4], http://www.hc-sc.gc.ca/hc-ps/pubs/tobac-tabac/second-guide/index-eng.php#a3.

27. WHO Training Package for the Health Sector World Health Organization (Oct, 2011) Second-hand Tobacco Smoke and Children. [accessed 2013 Apr 4], http://www.who.int/ceh/capacity/tobacco1.pdf.

28. Hahn, E. J., Ashford, K. B., Okoli, C. T., Rayens, M. K., Ridner, S. L., & York, N. L. (2009). Nursing research in community-based approaches to reduce exposure to secondhand smoke. [Review]. *Annual review of nursing research, 27*, 365-391.

29. Murukutla, N., Turk, T., Prasad, C. V., Saradhi, R., Kaur, J., Gupta, S., . . . Wakefield, M. (2012). Results of a national mass media campaign in India to warn against the dangers of smokeless tobacco consumption. [Evaluation Studies Research Support, Non-U.S. Gov't]. *Tob Control, 21*(1), 12-17. doi: 10.1136/tc.2010.039438

30. Tichenor PJ, Donohue GA, Olien CN. Mass media flow and differential growth in knowledge. Public Opin Q. 1970;34:159–170.

31. Ceci SJ, Papierno PB. The rhetoric and reality of gap closing: when the "have-nots" gain but the "haves" gain even more. Am Psychol. 2005;60:149–160. [PubMed]

32. Viswanath K, Emmons KM. Message effects and social determinants of health: its application to cancer disparities. J Commun. 2006;56(suppl 1):S238–S264.

33. Meara E. Education, infant health, and cigarette smoking. Ann N Y Acad Sci. 1999;896:458–460. [PubMed]

34. Chang, F. C., Chung, C. H., Chuang, Y. C., Hu, T. W., Yu, P. T., Chao, K. Y., & Hsiao, M. L. (2011). Effect of media campaigns and smoke-free ordinance on public awareness and secondhand smoke exposure in Taiwan. [Evaluation Studies]. *Journal of health communication, 16*(4), 343-358. doi: 10.1080/10810730.2010.535110

35. Pizacani BA, Martin DP, Stark MJ, Koepsell TD, Thompson B, Diehr P. Household smoking bans: which households have them and do they work? Prev Med 2003; 36:99-107.

36. Farkas AJ, Gilpin EA, Distefan JM, Pierce JP. The effects of household and workplace smoking restrictions on quitting behaviours. Tob Control 1999; 8:261-65.

37. Rainio SU, Rimpelä AH. Home smoking bans in Finland and the association with child smoking. Eur J Public Health 2008; 18(3) 306-311.

38. Farkas AJ, Gilpin EA, White MM, Pierce JP. Association between household and workplace smoking restrictions and adolescent smoking. JAMA 2000; 284(6):717-722.

39. Albers AB, Biener L, Siegel M, Cheng DM, Rigotti NA. Impact of parental home smoking policies on policy choices of independently living young adults. Tob Control 2009; doi: 10.1136/tc.2008.025478.

40. Alwan, N., Siddiqi, K., Thomson, H., & Cameron, I. (2010). Children's exposure to second-hand smoke in the home: a household survey in the North of England. [Research Support, Non-U.S. Gov't]. *Health & social care in the community, 18*(3), 257-263. doi: 10.1111/j.1365-2524.2009.00890.x

41. Arora, M., Mathur, M. R., & Singh, N. (2012). A Framework to Prevent and Control Tobacco among Adolescents and Children: Introducing the IMPACT Model. *Indian journal of pediatrics*. doi: 10.1007/s12098-012-0768-y

42. Wang, C. P., Ma, S. J., Xu, X. F., Wang, J. F., Mei, C. Z., & Yang, G. H. (2009). The prevalence of household second-hand smoke exposure and its

correlated factors in six counties of China. [Research Support, N.I.H., Extramural]. *Tob Control, 18*(2), 121-126. doi: 10.1136/tc.2008.024836

43. Abdullah, A. S., Hua, F., Xia, X., Hurlburt, S., Ng, P., MacLeod, W., . . . Zhang, Z. (2012). Second-hand smoke exposure and household smoking bans in Chinese families: a qualitative study. [Research Support, Non-U.S. Gov't]. *Health Soc Care Community, 20*(4), 356-364. doi: 10.1111/j.1365-2524.2011.01035.x

44. Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education & Behavior, 11(1), 1-47.*

45. Xuan et al. Prevalence of Waterpipe Tobacco Smoking Among Population Aged 15 Years or Older, Vietnam, 2010. Prev Chronic Dis (2013) vol. 10 pp. E57