RESEARCH COMMUNICATION

Children's Exposure to Secondhand Smoke at Home in Seoul, Korea

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Abstract

There is little information about Korean children's secondhand smoke (SHS) exposure at home. This paper examines the extent and determinants of their SHS exposure at home. A population-based random digit dial telephone survey was conducted in 2002 with 500 adults in Seoul. We analyzed data for 207 adults with children living in the household. Thirty-one percent of respondents reported children's SHS exposure at home. The mean weekly dose was 5 cigarettes among exposed children. Multiple logistic regression results showed that children's odds of SHS exposure at home increased if the respondent or spouse smoked, if the respondent's parent smoked, if smoking was allowed in the home, and if fewer groups discouraged smoking. Stronger protective measures are urged, such as widespread increase in home smoking bans and discouragement of smoking.

Key Words: Children - environmental tobacco smoke - secondhand smoke - home - Korea -smoking ban

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Introduction

Children's exposure to secondhand smoke (SHS) has been linked to many illnesses, including low birthweight, sudden infant death syndrome, asthma, bronchitis, and pneumonia (U.S. Department of Health and Human Services, 2006). Children's SHS exposure is a worldwide public health problem (World Health Organization, 1999). According to the Global Youth Tobacco Survey of 43 countries, conducted in 1999 and 2001, 49% of students 13-15 years old were exposed to SHS at home (Global Youth Tobacco Survey Collaborative Group, 2002).

Children in Western Pacific countries with high smoking rates are particularly at risk for SHS exposure. For example, in the Republic of Korea, the male smoking prevalence was among the highest at 67% in 2000 (Mackay and Eriksen, 2002; World Health Organization, 2002) and reflected cultural acceptance of male smoking. During their mandatory military service, men were given free cigarettes. At work and socially, smoking was a common ritual among men. Recently, the government has banned smoking in government and large office buildings, schools, hospitals, and public spaces. However, smoking continues in private homes and there is little information about Korean children's SHS exposure at home. The Global Youth Tobacco Survey did not include the Republic of Korea. We found only two studies of Korean children's SHS exposure at home, and they were restricted to children 12-16 years old: among preteens, 28% of boys and 32% girls reported SHS exposure at home (An and Hong, 2001) and among a sample of 125 adolescents 14-16 years old, 24% reported SHS exposure at home (Lee et al., 2002). Few studies, if any, have included children of preschool age. Furthermore, the dose of children's exposure to SHS at home is unknown.

It is unclear which Korean children are more likely to be exposed to SHS at home. According to the Behavioral Ecological Model (BEM), a behavior is a product of the physical, social, political, and legal environment (Hovell et al., 2002b). Thus, children's SHS exposure might be explained by influences within their environment, such as relative's smoking status, home smoking policy, anti-SHS messages from the media, and discouragement of smoking. Using this theoretical framework, the present study attempted to address some of the gaps in the literature regarding Korean children's SHS exposure at home. The aims were 1) to estimate the prevalence of SHS exposure at home among children of all ages in Seoul; 2) to quantify the amount of cigarettes of SHS exposure; and 3) to identify determinants of SHS exposure. The present study is one of few using multivariate analyses to examine children's SHS exposure.

Materials and Methods

The Sample

The data came from a larger study of tobacco and health behaviors (Hofstetter et al., 2004). Telephone

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interviews were conducted with 248 male and 252 female adults in households with residential telephones in metropolitan Seoul. Seoul, the capital of the Korea, is among the largest cities in the world, with approximately 10 million residents in 2002 (STAT-KOREA, 2002). A list of telephone numbers was created by random sampling of residential numbers from 27 Seoul regional telephone directories. Stratified by gender, interviews in targeted households were conducted with the adult who had the most recent birthday. Interviews were conducted by a trained staff at Myongi University in 2002. Up to five callbacks were made to each number. Approximately 50% of eligible respondents provided consent and completed the interview. The study was approved by the institutional review board.

Sampling procedures resulted in a slight overrepresentation (not more than 3%) of younger women, those with some college education, and a slight under-representation of middle-aged males, college graduates, and females over 40, compared to Korean population data for the Seoul metropolitan area (STAT-KOREA, 2002). The distribution for age by gender of the sample data did not deviate significantly from the population distribution when the survey distribution was standardized to the census distribution.

For this paper, the data were analyzed for 207 respondents who reported at least one child below 18 years of age living in the household.

Survey Items Analyzed

Child's SHS Exposure. The dependent variable was SHS exposure for the child whom the respondent thought had the highest exposure. Respondents estimated the number of cigarettes to which the child was exposed during a typical week at home, and in other locations. Respondents estimated the child's daily exposure in a car, which was converted to a weekly estimate. Similar reported measures have been reliable and valid (Maziak et al., 2006; Wagenknecht et al., 1992; Wagenknecht et al., 1993). The prevalence of SHS exposure was defined as the percent of respondents reporting that the child was exposed to any cigarettes/week at home, in a car, and in other locations. The dose of SHS exposure (number of cigarettes/week) was calculated for exposed children.

Demographics. Respondents reported their gender, age, marital status, occupation, years of education, household income, number of household members, and ages of household members.

Social and Behavioral Characteristics. Respondents were asked about social and behavioral variables that might influence SHS exposure, based on the BEM and studies of tobacco use among Korean immigrants to the United States (Hofstetter et al., 2004). These variables included the respondent's and relative's smoking status, home smoking policy, the respondent's knowledge about the effects of SHS, their exposure to anti-SHS media messages, discouragement of smoking from others, and the respondent's confidence to protect children from SHS exposure.

Respondents were classified as smokers if they had smoked 100 or more cigarettes and were currently smoking (U.S. Department of Health and Human Services, 1996). Respondents indicated whether there were any smokers among their friends whom they saw regularly, whether other family members smoked regularly (parents, siblings, children, grandparents, and aunts/uncles), and whether their spouse smoked. Additionally, the respondent's and spouse's smoking status were combined into a dichotomous variable (yes = the respondent and/or spouse smoked; no = neither smoked or the respondent was a single nonsmoker).

Respondents indicated where smoking was permitted in their home: nowhere, only certain areas, only special guests allowed to smoke, or anywhere. Home smoking policy was dichotomized to smoking allowed versus no smoking allowed.

Respondent's knowledge and sources of anti-SHS media messages were assessed. Respondents answered two true/false questions: whether "inhaling smoke from other persons' cigarettes is harmful to one's health" and "inhaling smoke from other persons' cigarettes causes lung cancer". They reported whether they had received impressions that secondhand smoke is harmful, from each of the following sources during the past three months: television, radio, internet, newspapers/magazines, billboards, and videotapes. The number of different sources was summed to create an anti-SHS media source score which was dichotomized to 0 source and 1-6 sources.

Respondents indicated which of the following 7 groups regularly discouraged them from smoking: their spouse, parents, siblings, children, grandparents, aunts/uncles, and friends. The individual variables were summed to create an ordinal variable (range 0 to 7) comprising the number of different groups discouraging smoking.

Self-efficacy was measured by asking the respondent their level of confidence, on a scale of 0 (no chance at all) to 10 (absolute certainty), that they could protect children from household SHS exposure. Lastly, respondents indicated how concerned they were about their health (not at all, not much, some, or greatly).

Data Analysis

The data were analyzed with SPSS 14.0 (SPSS, Inc., Chicago, IL). The chi-square test evaluated whether children's home SHS exposure (yes/no) differed by respondent characteristics. Multiple logistic regression analyses examined correlates of home SHS exposure. The initial model included all variables that were significant ($p<0.15$) in the bivariate analyses. Respondent's age (Wakefield et al., 2000), education (Berman et al., 2003; Lund and Helgason, 2005; Mannino et al., 2001; Schuster et al., 2002), and gender (Chen et al., 2005; Misra and Nguyen, 1999; Soliman et al., 2004) were included since they correlated with SHS exposure in previous studies. Education was used as a continuous variable and the number of groups discouraging smoking was used as an ordinal variable. Respondent's confidence level was not included in the logistic regression models because of its close link with the outcome variable. The independent variables were sequentially removed until only significant variables remained, with age forced into the model. One-way interactions between all significant independent

Table 1. Prevalence of Home SHS Exposure Among Children, by Adult Respondent Characteristics

Characteristic		N	P*	P-value
Overall		207	31%	---
Gender	Male	88	32%	
	Female	119	30%	0.929
Age category	18-35	84	29%	
	36+	123	32%	0.652
Married	Yes	172	28%	
	No	35	43%	0.140
Job class	At home	57	35%	
	White collar	120	29%	
	Blue collar	18	39%	0.581
Education	≤High school	117	35%	
	≥College	90	26%	0.189
Smoking	Smoker	66	41%	
status	Nonsmoker	140	26%	0.041
Spouse	Yes	60	38%	
smokes	No	147	28%	0.190
Either respondent or spouse smokes				
	Yes	121	39%	
	No	86	20%	0.006
Respondent's				
parent/s smoke	Yes	105	39%	
	No	97	20%	0.004
Friends	Yes	140	33%	
smoke	No	66	26%	0.384
Smoking policy in the home				
	Allowed	167	36%	
	Not allowed	40	8%	0.001
Any children < 6 years old in household				
	Yes	78	24%	
	No	129	35%	0.152
# of anti-SHS message sources				
	0	59	32%	
	1-6	148	30%	0.931
# of groups discouraging smoking				
	0-4	66	50%	
	5-7	141	22%	<0.001
Spouse discourages smoking				
	Yes	164	27%	
	No	43	46%	0.021
Siblings discourage smoking				
	Yes	185	28%	
	No	22	59%	0.005
Confidence in protecting child from SHS				
Low/medium (0-7)		54	68%	
High (8-10)		124	10%	<0.001

*Prevalence of child's SHS exposure at home

variables in the final model were tested and none were significant at the p<0.05 level.

Results

Characteristics of the Study Sample

The respondents' mean age was 38 years and 58% were female. Most were married, nonsmokers, employed outside the home, and had high school or lower education (Table 1).

Although 98% of respondents agreed that SHS is harmful and causes lung cancer, 58% smoked or reported that their spouse smoked. Furthermore, while more than two-thirds of respondents were concerned or greatly concerned about their health, only 19% banned smoking in the home.

Prevalence and Dose of SHS Exposure

Thirty-six percent of respondents reported that the children were exposed to SHS weekly, either at home, in the car, or another location. At home, the prevalence of children's SHS exposure was 31%, with a mean weekly dose of 5 cigarettes among exposed children. Fewer children were exposed weekly in a car (6%), but their average weekly exposure was higher (16 cigarettes/week). The prevalence of SHS in other locations was 20%, with a mean dose of approximately 2 cigarettes/week.

SHS Exposure by Selected Characteristics

Table 1 shows the bivariate associations between respondent characteristics and children's SHS exposure at home. Respondents who smoked were more likely to report that their child was exposed to SHS than respondents who did not smoke (41% versus 26%, p=0.041). The association between children's SHS exposure and the smoking status of the respondent's spouse was not statistically significant. However, when the respondent and/or spouse smoked, they were more likely to report that the child was exposed to SHS at home than if neither smoked, or if the respondent was a single, nonsmoker (39% versus 20%, p=0.006). Similarly, if the respondent's parents smoked, respondents were more likely to report that the child was exposed to SHS at home than if the respondent's parents did not smoke (39% versus 20%, p=0.004). The smoking status of other relatives and friends was not statistically significant (not shown).

Respondents who had home smoking bans were significantly less likely to report that the child was exposed to SHS at home (8%) than respondents who allowed smoking (36%). Report of children's SHS exposure decreased as more groups (parents, siblings, grandparents, etc.) discouraged smoking. When individual relationships were examined, spouse's and sibling's discouragement of smoking were associated with lower SHS, but discouragement by parents, aunts/uncles, grandparents, or friends was not.

Respondents' mean level of confidence in their ability to protect children from SHS in the home was 7, on a scale of 0 to 10. Respondents with high (8 to 10) confidence were less likely to report children's SHS exposure at home than respondents with lower confidence (10% versus 68%, respectively, p<0.001).

Multivariable Results

Table 2 shows the final model for children's SHS exposure at home. After adjusting for other covariates in the model, children's odds of home SHS exposure were 2.6 times higher if either or both the respondent or their spouse smoked, compared to nonsmoking respondents and spouses. Similarly, children's odds of home SHS exposure were approximately 2.5 times higher if the respondents' parent/s smoked than if they did not smoke. Children living in homes without a complete home smoking ban had 9 times greater odds of SHS exposure than children living in homes where smoking was banned. With each

Table 2. Multiple Logistic Regression Model of Child's SHS Exposure at Home, by Adult Respondent Characteristics (n=202)

Variables in the model	OR* (95% Confidence Interval)
Respondent or spouse smokes	
Yes	2.65 (1.29-5.43)
No	Reference
Respondent's parent/s smoke	
Yes	2.51 (1.26-5.00)
No	Reference
Home smoking ban	
No	9.13 (2.06-40.4)
Yes	Reference
# of groups discouraging smoking	0.78 (0.64-0.95)

*Odds ratio adjusted for other variables in the table and age

additional group of related people that discouraged smoking, the odds of children's SHS exposure decreased by 27%.

Discussion

Almost one-third of Seoul respondents reported children's exposure to SHS at home during a typical week. This report of children's SHS exposure at home was more similar to those of female adult respondents (29%) than of male respondents (19%) that have been reported previously, although the analyses were limited to nonsmoking men and women (Hughes et al., 2008a). This finding is expected since women were more likely than men to be married to a smoker given the high rates of smoking among Korean men and low rates of smoking among Korean women. Our rates of SHS exposure for children aged 0 to 17 years is higher than reported for Korean elementary school children (28-32%)(An and Hong, 2001) and for middle school children in Busan, Korea (24%) (Lee et al., 2002). Future studies should continue to track SHS exposure among Korean children of all ages to assess the impact of ongoing tobacco control initiatives and determine the necessity of stronger interventions.

Whereas some studies in other countries have found that parental education level was associated with children's SHS exposure (Schuster et al., 2002; Lund and Helgason, 2005), our study and others have not (Bakoula et al., 1997; Berman et al., 2003; Boyaci et al., 2006). In the present study, the respondent's gender was not associated with SHS exposure among children.

The present study suggests that children's SHS exposure at home was influenced mainly by behavioral and social factors. For example, their odds of exposure were greater if the respondent or his/her spouse smoked or if the respondent's parent/s smoked. Similarly, a study of Korean elementary school students and adolescents showed that the main smoker was a parent (An and Hong, 2001).

The presence of a home smoking ban was a strong determinant of children's SHS exposure even after adjusting for other characteristics. In other countries, complete home smoking bans have reduced asthmatic, Hispanic, and adolescent children's SHS exposure (Wakefield et al., 2000; Hovell et al., 2002a). Partial home smoking bans, such as restricting smoking to designated areas, were ineffective in reducing SHS exposure (Blackburn et al., 2003; Boyaci et al., 2006; Hughes et al., 2008b). It is encouraging that social discouragement of smoking was associated with lower odds of SHS exposure among children in a society where smoking by men was common. We are unaware of other studies of this social contingency for reducing children's SHS exposure.

The study limitations include a cross-sectional design, allowing only associations to be explored. The adult respondent estimated SHS exposure for the child with the greatest exposure at home, thus reporting and recall biases were possible. Respondents may have underestimated SHS exposure that was not very visible or did not have a strong odor, or that occurred in their absence. In general, parental report has correlated well with environmental or biological measures such as children's urinary cotinine levels and air nicotine concentration (Hovell et al., 2000; Gehring et al., 2006; Wilkinson et al., 2006). Verification of exposure was not possible in this study, but should be considered for future studies. The results may have limited generalizeability to other populations. Finally, non-response bias was possible despite the sample's similar composition to the census population (STAT-KOREA, 2002).

Although there is no safe level of SHS exposure, a considerable proportion of children were exposed at home, to an average of 5 cigarettes weekly. At these levels, exposures spanning 18 years of childhood represent a very large cumulative dose with significant health burden and economic costs. Additionally, when parents and other family members smoke at home, it sensitizes children to smoking, sends the message that smoking around others is acceptable, and increases children's likelihood of trying smoking and becoming smokers, thus perpetuating the cycle of smoking.

The study findings can be used to devise prevention programs, especially since the risk factors (family members' smoking status, social discouragement of smoking, allowing smoking at home) are modifiable. Because knowledge of the general effects of SHS was already high, family-level education regarding the harm of SHS exposure to children specifically are needed. Health professionals can help by screening parents for smoking and advising them to quit and to ban smoking at home since most children cannot remove themselves from the home or are not in a social position to ask their elders to refrain from smoking in the home. These efforts will augment tobacco control measures already underway in public spaces and workplaces in Korea.

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