



Original Article

## Factors Influencing Exposure to Secondhand Smoke: Passive Inhalation in Student Nurses



Sun-A Park <sup>a</sup>, Do-Hoon Lee <sup>b</sup>, Hee-Su Lim <sup>c</sup>

<sup>a</sup> Division of Nursing Science, University of Suwon, Hwaseong, Korea

<sup>b</sup> Department of Laboratory Medicine, Center for Diagnostic Oncology, Research Institute and Hospital, National Cancer Center, Goyang, Korea

<sup>c</sup> Department of Nursing, Seoul Women's College of Nursing, Seoul, Korea

### ABSTRACT

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**Objectives:** To examine the factors affecting passive exposure to secondhand smoke (SHS) in non-smoking student nurses.

**Methods:** A cross-sectional study was performed in 196 college students who had not smoked cigarettes in the past 12 months. Urinary cotinine levels were examined to identify exposure to SHS, and social factors were identified that influenced exposure to SHS, including requests that smokers extinguish cigarettes. Logistic regression analysis was used to predict the factors influencing SHS.

**Results:** Urinary cotinine measurements showed that 32 students (16.3%) were exposed to SHS. Risk factors that increased exposure to SHS affected 80 students (40.8%) in the previous 7 days. Students who were exposed to SHS were 4.45-times more likely to have increased urinary cotinine levels than those who were not exposed. Students who asked others to extinguish their cigarettes were 0.34 times less likely to test positive than those who did not.

**Conclusion:** Urinary cotinine was a useful biomarker for identifying exposure to SHS, with respect to the influence of demographic, health-related, and smoking-related factors. In non-smoking nursing students, avoiding exposure to SHS was attributed to self-assertive behavior by requesting smokers to extinguish cigarettes.

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## Introduction

Secondhand smoking (SHS), is defined as the smoke inhaled by a non-smoker in the vicinity of a smoker [1]. It can cause diseases such as lung cancer and cardiovascular disorders, which may eventually lead to death. SHS is a preventable cause of disease that has a high impact on public health [2,3]. SHS is comprised of both mainstream smoke which is defined as a bystander's inhalation of smoke from a smoker's exhalations, whereas side stream smoke, is the smoke that rises from the end of a burning cigarette [4]. Side stream smoke accounts for

approximately 80% of the smoke that surrounds a cigarette smoker. Compared to mainstream smoke, side stream smoke contains 2.5 times more carbon monoxide, 4.3 times more tar, 5.6 times more toluene, and 3.4 times more carcinogenic benzopyrene [5]. Thus, the adverse impacts of SHS on bystanders' health are mainly due to the inhalation of large amounts of side stream smoke [6].

In Korea, improvements to SHS prevention policies have been implemented nationally, and in the Health Plan 2020 (HP2020), the non-smoking section contains specific objectives to lower SHS rates. These prevention policies have enabled designated

\*Corresponding author: Hee-Su Lim  
Department of Nursing, Seoul Women's College of Nursing, Seoul, Korea  
E-mail: [ipshee@snjc.ac.kr](mailto:ipshee@snjc.ac.kr)

non-smoking areas in squares and city parks, which have increased in numbers throughout the country. Additionally, newly constructed living spaces and apartments usually include non-smoking areas which underscore policy efforts to reduce exposure to SHS [7].

As with most college students, Korean college students transition from passive and protected lifestyles in middle and high school, to more independent and autonomous lifestyles. Thus, they are easily exposed to unhealthy lifestyles and behaviors [8]. As an addictive behavior, smoking is a difficult habit to give up, and college students are influenced by their peers through diverse associations, activities, and peer pressure [9]. According to Choo and Kim [10], 84% of college students that do not smoke have been exposed to SHS; a higher exposure rate than found in the general population of adults (68%) [11]. Additionally, Choo and Kim [12] reported that the social influence of college students that do not smoke could increase their self-assertive behavior toward SHS.

In the USA, approximately 1,700 colleges have implemented a no smoking campus policy where smoking has been banned from all indoor and outdoor spaces, and in facilities such as dormitories within the campus [13]. However, in Korea, the National Health Promotion Act (2017) [14] has banned smoking in all middle and high school facilities and grounds, but only in the classroom facilities of colleges. As Korea's future cohort of nurses, nursing college students will play an important role in contributing to national public health.

Previous studies on SHS exposure have generally focused on subjective reports of study participants regarding their exposure to SHS [12,15], most lack quantitative measurements of the actual exposure to SHS. Quantitative measurements of SHS exposure include biomarkers, such as cotinine in hair and urine, and nicotine-derived nitrosamine ketone in urine. Measuring cotinine in urine and hair is accurate and non-invasive, and is an effective indicator of exposure [2]. The purpose of this study was to measure exposure to SHS among non-smoking nursing college students by measuring urinary cotinine, and to analyze the demographic, health-related, and smoking-related factors that influence SHS exposure. The objective of this study was to determine if exposure of Korean nursing students to SHS could be identified by measuring urinary cotinine levels. It was hypothesized that logistic regression analysis would allow the identification of smoking-related factors that affect exposure to SHS.

## Materials and Methods

### 1. Study design and data collection

The participants of this cross-sectional study were 196 non-

smoking college students residing in Korean cities who had no experience of smoking in the past year. This study was reviewed and approved by the Institutional Review Board of the researchers' affiliate university (1603-045-01). Between May 1, 2016 and May 31, 2017, the researchers explained the purpose of the study, distributed surveys, and explained the urine collection process to those who had agreed to participate. School dust was collected in collaboration with the administrators of each college. Subjects were informed that the participation in the research was strictly voluntary, and that they could withdraw their participation either after or before beginning the study, with no disadvantages to follow as a result. Furthermore, they were informed that the study data are confidential and that all personal information was coded before being stored, and that it would not be used for any other purpose aside from that of the present study. The subjects were also informed that the collected surveys would be stored by the researcher for 5 years, after which they would be destroyed using a paper shredder. Subjects provided written informed consent to participate in the study.

### 2. Study instruments

The concentration of urinary cotinine is reported as  $> 100$  ng/mL in smokers and 1–10 ng/mL in secondhand smokers [2]. Therefore, we defined urinary cotinine levels as  $\geq 1$  ng/mL as an indication of being exposed to SHS.

Self-assertive behavior is defined as expressing one's thoughts, opinions, and feelings in a transparent manner without violating others' rights or making others uncomfortable [16,17]. We measured self-assertive behavior in this study according to the Assertiveness Scale [18] as modified by Ha et al [17] for Korean culture. This tool is composed of 30 items measured in 5-point scales, where 5 points indicate self-assertiveness and 1 point indicates the absence of such behavior. High scores indicate high self-assertiveness. The test-retest reliability at the time of development by Rathus [18] was found to give a Cronbach's  $\alpha = 0.78$ . The reliability of the tool in this study was Cronbach's  $\alpha = 0.83$ .

### 3. Statistical analysis

This study used G\*Power 3.1.7 [19] to calculate the sample size required for statistical analysis (based on an effect size of  $d = 0.15$ , significance level  $\alpha = 0.05$ , test power  $(1-\beta) = 0.80$ , and the number of predictors as 12). The minimum sample size required for analysis was 127. Data analysis of this study was performed using SPSS version 24.0 (IBM Corp., Armonk, NY, USA), and the general characteristics of the subjects were analyzed using frequency and percentages. The differences in each variable related to SHS were analyzed using the  $\chi^2$  test. Logistic regression analysis was used to predict factors influencing SHS.

## Results

### 1. Demographic characteristics

A total of 196 of college nursing students participated in this study. The majority of participants were women (182, 92.9%); 112 students (57.1%) were freshmen and sophomores; 180 subjects responded that they were presently healthy (91.8%), whereas 27 had health problems (13.8%); and 30 subjects had a patient in their family (15.3%). Urinary cotinine analysis indicated that 32 subjects were exposed to SHS (16.3%). Questions about smoking-related factors showed that 80 subjects were exposed to SHS in the past 7 days (40.8%),

177 subjects had a smoker in the family (90.3%), and 86 had a friend who smoked (43.9%). Sixty-nine students reported that their school had a no-smoking policy (35.2%), 52 students reported smoking areas (26.5%), and 75 students reported that their school enforced no specific limitations regarding smoking (38.3%). Furthermore, 175 students reported seeing anti-smoking advertisements (89.3%). Only 35 students had received smoking cessation education (17.9%). Fifty students reported an experience of asking someone to extinguish their cigarettes (25.5%), and 127 students reported polluted air on the school grounds (64.8%). The average assertiveness of the subjects was 3.14 (Table 1).

Table 1. Demographics and characteristics (N = 196).

Variable	Category	n (%)
SHS exposure	Yes	32 (16.3)
	No	164 (83.7)
Age (y)		21.13 (3.08)
Gender	Male	14 (7.1)
	Female	182 (92.9)
Grade	Freshman-Sophomore	112 (57.1)
	Junior-Senior	84 (42.9)
Healthy	Yes	180 (91.8)
	No	16 (8.2)
Disease	Yes	27 (13.8)
	No	169 (86.2)
Patient in family	Yes	30 (15.3)
	No	166 (84.7)
Exposure in the past 7 days	Yes	80 (40.8)
	No	116 (59.2)
Smoker in family	Yes	177 (90.3)
	No	19 (9.7)
Smoker among friends	Yes	86 (43.9)
	No	110 (56.1)
School policy	No smoking	69 (35.2)
	Designated smoking areas	52 (26.5)
	Not limited	75 (38.3)
Exposure to anti-smoking advertising	Yes	175 (89.3)
	No	21 (10.7)
Smoking cessation education	Yes	35 (17.9)
	No	161 (82.1)
Have asked a smoker to extinguish their cigarette	Yes	50 (25.5)
	No	146 (74.5)
School dust pollution	Yes	127 (64.8)
	No	69 (35.2)
Assertiveness	Mean (SD)	3.14 (0.41)

## 2. SHS risk factors

Risk factors related to SHS did not reveal any statistically significant differences in demographic or health-related factors; however, there was a statistically significant increase after exposure to SHS in the past 7 days ( $X^2 = 15.27$ ,  $p < 0.01$ ). The experience of asking someone to extinguish their cigarette was

significantly low compared with non-SHS ( $X^2 = 4.60$ ,  $p < 0.05$ ). Self-assertiveness was higher in non-SHS than SHS [3.09 (0.50) and 3.15 (0.39)] but was not statistically significant (Table 2).

## 3. Factors influencing SHS

The risk factors for SHS exposure were analyzed using

Table 2. Risk factors for SHS ( $N = 196$ ).

Variable	Category	SHS		$X^2$ or $t$	$p$
		Yes	No		
		32 (16.3)	164 (83.7)		
Gender	Male	0 (0.0)	14 (100.0)	2.94	0.08
	Female	32 (17.6)	150 (82.4)		
Grade	Freshman-Sophomore	17 (15.2)	95 (84.8)	0.25	0.62
	Junior-Senior	15 (17.9)	69 (82.1)		
Healthy	Yes	28 (15.6)	152 (84.4)	0.96	0.33
	No	4 (25.0)	12 (75.0)		
Disease	Yes	5 (18.5)	22 (81.5)	0.11	0.74
	No	27 (16.0)	142 (84.0)		
Patient in family	Yes	5 (16.7)	25 (83.3)	0.00	0.96
	No	27 (16.3)	139 (83.7)		
Smoker in family	Yes	29 (16.4)	148 (83.6)	0.00	0.95
	No	3 (15.8)	16 (84.2)		
Smoker among friends	Yes	13 (15.1)	73 (84.9)	0.16	0.69
	No	19 (17.3)	91 (92.7)		
Exposure in past 7 days	Yes	23 (28.8)	57 (71.3)	15.27	0.00**
	No	9 (7.8)	107 (92.2)		
School policy	Limited	19 (15.7)	102 (84.3)	0.09	0.764
	Not Limited	13 (17.3)	62 (82.7)		
School dust pollution	Yes	24 (18.9)	103 (81.1)	1.75	0.19
	No	8 (11.6)	61 (88.4)		
Smoking cessation education	Yes	6 (17.1)	29 (82.9)	0.02	0.89
	No	26 (16.1)	135 (83.9)		
Anti- smoking advertising	Yes	29 (16.6)	146 (83.4)	0.07	0.79
	No	3 (14.3)	18 (85.7)		
Have asked a smoker to extinguish their cigarette	Yes	13 (26.0)	37 (74.0)	4.6	0.03*
	No	19 (13.0)	127 (87.0)		
Assertiveness	Mean (SD)	3.09 (0.50)	3.15 (0.39)	0.77	0.44

Data are presented as  $n$  (%).

\* $p < .05$ , \*\* $p < .01$

Table 3. Logistic regression analysis of the predictive factors of SHS (N = 196).

Variable	OR	95% CI	p
Gender (ref: male)	0	0	0
Grade (ref: Junior-Senior)	1.013	0.229 - 4.475	0.987
Health (ref: Yes)	2.646	0.597 - 11.725	0.2
Disease (ref: No)	1.001	0.267 - 3.749	0.999
Patient in family (ref: No)	0.823	0.236 - 2.875	0.761
Smoker in family (ref: No)	1.113	0.230 - 5.387	0.894
Smoker among friends (ref: No)	0.792	0.320 - 1.962	0.615
Exposure in past 7 days (ref: No)	4.446	1.812 - 10.912	0.001 **
School policy (ref: Limited)	1.118	0.179 - 6.961	0.905
School dust pollution (ref: No)	1.882	0.424 - 8.343	0.405
Smoking cessation education (ref: Yes)	1.584	0.505 - 4.968	0.43
Anti- smoking advertising (ref: Yes)	0.853	0.191 - 3.805	0.835
Have asked a smoker to extinguish their cigarette (ref: No)	0.343	0.123 - 0.962	0.042*

\* $p < 0.05$ , \*\* $p < 0.01$

logistic regression analysis, and demonstrated that the group with exposure to SHS in the past 7 days was 4.45-times more likely to test positive for SHS as measured by an increased level of urinary cotinine ( $p < 0.01$ ). Students with the experience of asking someone to extinguish their cigarette were less likely to test positive for SHS through urinary cotinine (odds ratio of 0.34 when compared to those that did not ask; ( $p < 0.05$ , Table 3).

## Discussion

This study used urinary cotinine as a biomarker to identify quantitative exposure to SHS, and analyze exposure to SHS in relation to demographic, health-related, and smoking-related factors in order to identify influencing factors. Thirty-two students who did not smoke were exposed to SHS, representing 16.3% of the population. Eighty students responded that they had been exposed to SHS within the past 7 days (40.8%), which is similar to the 37% exposure rate to indoor SHS among the general Korean adult population [20]. However, there were differences in quantitative exposure to SHS based on smoking experience and urinary cotinine levels. Urinary cotinine levels were significantly higher among participants in our study who were exposed to SHS in the past 7 days. Urinary cotinine, which has been used as a quantitative marker of SHS in infants [21], can also be used as a quantitative marker of SHS in adults [22]. Urinary cotinine effectively reflected SHS exposure in this study, in accordance with existing studies that reported urinary

cotinine as a biomarker in former smokers [23].

Variables that were statistically significant as risk factors for positive SHS exposure included exposure to SHS in the past 7 days ( $p < 0.01$ ) and asking a nearby smoker to extinguish their cigarette ( $p < 0.05$ ). In this study, 25.5% of subjects experienced asking someone to extinguish their cigarette, which is lower than previous reports of 56.1% and 62.4% [12,15]. This may indicate low levels of assertive behavior among nursing college students. These results indicate that greater efforts are required to advance the self-assertive behavior of nursing college students. Korean men aged 20 to 29 years have a high rate of exposure to SHS (Ministry of Health and Welfare, 2017), and men with high SHS exposure were found to engage in more assertive behavior [11,12]. Although one study reported that young women had a negative perception of smoking [24], another study found that women were less likely than men to verbally ask someone to extinguish their cigarette when exposed to SHS [25]. Nursing colleges tend to have a high female population, and there may be gender-based differences that impact this study.

In Korea, policies related to no-smoking zones within schools are outlined by the National Health Promotion Act; however, the lack of funding and human resources makes it difficult to practically implement these norms [15]. In this study, there were no significant differences among schools with and without restrictions. The influence of peer groups on adolescence is remarkable [26].

The results of regression analysis indicated a 4.45-times

( $p < 0.01$ ) higher influence for subjects with exposure to SHS in the past 7 days than for those without exposure, indicating that exposure to SHS increased urinary cotinine. The group with an experience of asking someone to extinguish their cigarettes had a 0.34-times lower ( $p < 0.05$ ) SHS positivity than did those who did not make such requests, indicating that self-assertive behavior of non-smokers is an important variable in SHS.

The assertive behavior of non-smokers is related to socioecological factors, influenced by environmental and regional policies [27], and is characterized by rejecting an environment that encourages smoking. There have been reports that no-smoking policies and social norms can encourage smoking cessation [28,29]. These policies can also enable the assertive behavior of asking a smoker to extinguish their cigarette as adherence to public rules for non-smoking become more widely accepted in the general population. Additionally, the level of adherence by smokers to no-smoking zones was found to correlate with the response of non-smokers to those smoking in no-smoking zones [15]. As assertive behavior has reported to have a 25% power for predicting adolescent health [30], assertive behavior is expected to influence the health behaviors and choices of college students as they enter early adulthood.

Assertive behaviors may be particularly important among nursing college students, as they are the future managers of health. Being assertive towards non-smoking is a very important aspect for nurses, as they will operate health promotion programs in the future. Nurses can resolve conflicts and issues in healthcare through assertive behavior, which can positively improve a patient's relationship with nurses and ultimately have a positive effect on the patient's health. However, lack of assertive behavior makes it difficult to maintain a trustworthy relationship with patients [31]. Since there are limitations to actively engaging in assertive behavior, education must be provided on the effective implementation of such behaviors. Previously, self-assertive behaviors have been viewed from the perspective of an individual's capacity; however, these behaviors also extend to nurses that influence patient safety as health practitioners and require systematic education [32]. Therefore, the significance of our study is that it provides basic data for the development of systematic educational programs to advance assertive behavior by analyzing the level of exposure of non-smoking nursing college students to SHS.

In conclusion, our results indicate that the most influential factors related to SHS exposure among nursing college students, were experience of being exposed to SHS and asking a smoker to extinguish their cigarettes. We suggest that systematic support for the enforcement and expansion of no-smoking zones is required in colleges; furthermore, it is important to advance self-assertive behavior related to SHS

among nursing college students. The self-assertive behavior of asking a smoker to extinguish their cigarette was an important behavior for avoiding SHS exposure among non-smoking nursing college students. To promote self-assertive behavior, we need to develop curriculum or extracurricular activities and it would be possible to provide experience to lead non-smoking activities in conjunction with community or school health centers.

Therefore, this study recommends the development of environments where SHS can be socially rejected, and further studies on nursing strategies that advance self-assertive behavior of nursing college students are needed.

## Conflicts of Interest

The author has no conflicts of interest to declare.

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