예방의학회지 제42권 제5호(2009년 9월)
J Prev Med Public Health 2009;42(5):293-297
DOI: 10.3961/jpmph.2009.42.5.293

Workplace Smoking Ban Policy and Smoking Behavior

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Objectives : To evaluate the impact of the workplace smoking ban in South Korea, where the male smoking rate is high (57%), on smoking behavior and secondhand smoke exposure.

Methods : A workplace smoking ban legislation implemented in April 2003 requires offices, meeting rooms, and lobbies located in larger than 3,000 square meter buildings (or 2,000 square meter multipurpose buildings) should be smoke free. A representative cross-sectional survey, the third wave (2005) of health supplements in the National Health Nutrition Survey of South Korea, was used to measure the impact of the 2003 workplace smoking ban implementation on smoking behavior. It contained 3,122 observations of adults 20 to 65 years old (excluding self-employed and non-working populations). A multivariate statistical model was used. The self-reported workplace smoking ban policy (full workplace ban, partial workplace ban, and no workplace ban) was used as the key measure.

Results : A full workplace smoking ban reduced the current smoking rate by 6.4 percentage points among all workers and also decreased the average daily consumption among smokers by 3.7 cigarettes relative to no smoking ban. Secondhand smoke showed a dramatic decrease of 86 percent (= -1.74/2.03)from the sample mean for full workplace ban. However, public anti-smoking campaign did not show any significant impact on smoking behavior.

Conclusions : The full workplace ban policy is effective in South Korea. Male group showed bigger impact of smoking ban policy than female group. The public antismoking campaign did not show any effectiveness.

J Prev Med Public Health 2009;42(5):293-297

Key words : Cigarette smoking, Health campaigns, South Korea, Workplace

INTRODUCTION

World Health Organization (WHO) identified tobacco use as one of the biggest public health threats the world has ever faced [1]. U.S. Environmental Protection Agency (EPA), the U. S. National Toxicology Program (NTP), the U.S. Surgeon General and the National Academy of Science/National Research Council, and the International Agency for Research on Cancer (IARC) have classified secondhand smoke as a known human carcinogen (cancer-causing agent) [2-4]. Many state and local governments in U.S. passed the laws prohibiting smoking in public places as well as requiring private workplaces to be non smoking area [5].

South Korean government also changed the "National Health Enhancing Regulation" in April 2003 requiring office buildings bigger than 3,000 square meters (in case of total office building or bigger than 2,000 square meters in case of multipurpose building) to make places such as offices, meeting rooms and lobby as smoke free [6]. Adult smoking rate in South Korea is 30.4% in 2001 and it is one of the highest prevalence among Organization for Economic Co-operation and Development (OECD) member countries based on Health statistics by the OECD reports [7]. Gender specific smoking rate is more striking. Male (female) smoking rate is 57% (7%) in 2005. It is also the biggest gender difference among OECD countries. As another way to lower high smoking prevalence Korean government rapidly increased the spending on public anti-smoking campaign. It was 700 million won ($700,000) in 1998 and then increased to 8 billion won ($8 million) in 2004. In 2006 it even reached 31 billion won ($31 million) [8].

The effects of workplace smoking ban have been evaluated in specific location such as hospitals, an insurance company and in the national level using representative survey in the U.S. [5,9,10]. Some studies also examined outside of U.S. such as Scotland [11], Netherlands [12]. Other studies focused on workplaces like bar where the environmental smoking might be the most severe and found positive impacts of indoor smoke free legislation [13,14]. Even though it has been examined in many places the effectiveness of policy intervention might vary substantially based on previous studies. Therefore, it will be important to evaluate the Korean legislation specifically.

In this paper, I examine the changes of smoking behavior, exposure to environmental tobacco smoke (ETS), and the intention to quit smoking as a result of the strict smoking ban legislation in South Korea. High smoking rate among adult male in Korea and direct self reported measure of ETS in the same data set makes this study unique. In addition, I evaluated the effects of public anti-smoking campaign on smoking behavior which hasn't been examined as far as I know.

Received : 11 May 2009, Accepted : 8 July 2009
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MATERIALS AND METHODS

I. Data

I used data from National health and nutrition survey of South Korea. This representative repeated cross section survey has been collected four times (1998, 2001, 2005, and 2007). The 3rd wave fielded in 2005 has questions related to individual workplace smoking ban policy in the health behavior supplements. The main survey contains 34,145 observation but health behavior supplements were asked 7,802 people among them. I further restrict the sample based on a few categories. First, observations aged less than 20 and older than 65 are dropped since they are mostly non working population. Second, self employed people and non working population such as housewife, students are also not included in the sample. Final observation after restricting sample with these categories and losing 63 additional observations with missing information is 3,122.

The survey asked basic demographic questions such as age, gender, educational level ($\leq$ middle school graduates, high school dropouts and graduates, and > college), marital status (never married, married, widow, and divorced/separated), household income, and occupation (executive or administrative, administrative support, sales, farming or fishery, low skilled worker, and military). Table 1 report the mean age for the sample as 39.5. Since I restrict the sample as working adult 59 percent of sample is male. Forty three percent of sample had higher than college education and high school graduates and drop out consists of 38 percent. Marital status is composed of never married (24%), married (67%), widow (3%), and divorced/separated (6%). low skilled worker is the most popular occupation (40%) and administrative support follows it as 22%. There are very few respondents with farming or fishery or working for military.

The survey also asked the following question "How many cigarettes did you smoke throughout your lifetime?" The possible answers were: less than 5 packs, more than 5 packs, and never. For those who answered that they had smoked (less than 5 packs or more than 5 packs), the subsequent question was asked: "Are you a current smoker?" The choices are yes (all the time, sometimes) or smoked previously but not currently smoke. Based on these questions I constructed a dummy variable, current smoker. If the respondent chose "never" in the first question or answered not currently a smoker in the follow-up question, then I recorded "not a current smoker." The survey, then, asked average cigarettes smoked per day for a current smoker and I use this to measure smoking amount. It also surveyed hours exposed to second hand smoke per day in work area specifically.

I use workplace smoking ban policy as a key independent variable (There is another question asking common area smoking ban policy. To save space I am not reporting common area ban results here which are similar to that of workplace ban. It is available based on request to the author). The possible answers are full workplace smoking ban, partial workplace smoking ban (some area is allowed to smoke), or no smoking ban. No other waves collected this information except the 3rd on workplace smoking ban policy. The other key independent variable is anti-smoking campaign exposure in the last year on TV or radio. I constructed a dummy variable of 1 if someone was exposed to the public campaign.

II. Analysis

Table 2 shows that more than half of respondents reported having full workplace smoking ban policy. Partial workplace smoking ban and no workplace smoking ban was reported as twenty six and twenty two percent respectively. For anti-smoking campaign exposure ninety five percent of respondents answered that they have seen or heard anti-smoking campaign.

I ran probit for limited dependent variables and Ordinary Least Squares (OLS) for continuous variables such as cigarettes per day, secondhand smoke hour per day. The other covariates are demographic information such as age, age squared, gender and log transformed household income. In addition, three educational levels, four marital statuses and six occupations were included as fixed effects. By including these fixed effects I am not comparing smoking behavior across different categories but within the same categories. For example, I examine smoking

Table 1. Sample characteristics

Variable	Mean	Standard deviation
Age	39.46	10.55
Income	279.46	194.84
Observations (N)	3,122	
Variable	**Frequency**	**Percentage**
Gender		
Male	1,829	58.58
Female	1,293	41.42
Education		
$\leq$ Middle school graduates	593	18.99
High school dropouts / Graduates	1,190	38.12
> College	1,339	42.89
Marital Status		
Never married	740	23.70
Married	2,088	66.88
Widow	106	3.40
Divorced/Separated	188	6.02
Occupation		
Executive or Administrative	610	19.54
Administrative support	691	22.13
Sales	548	17.55
Farming or Fishery	7	0.22
Low skilled worker	1,244	39.85
Military	22	0.70
Observations	3,122	100.00

National health and nutrition survey wave 3 (2005) is used. Samples are restricted to worker age between 20 and 65. Household monthly income in the unit of 10,000 won. Sample weights are used for all calculations.

Table 2. Prevalence of experiencing smoking ban in workplaces in South Korea

Variable	Frequency	Percentage
No workplace ban	674	21.59
Partial workplace ban	826	26.46
Full workplace ban	1,622	51.95
Have seen or heard anti-smoking Campaign in previous year	2,970	95.13
Observations	3,122	100.00

National Health and nutrition survey wave 3 (2005) is used. Samples are restricted to worker age between 20 and 65.

Table 3. Impact of smoking ban on smoking, all workers

	Current smoker*	Cigarettes/day †, smokers only	Cigarettes/day †, all workers	Secondhand †, Smoke hour/day	Plan to quit*, smokers only
Partial workplace ban	0.019 (-0.039 to 0.077) [0.526]	-2.683 (-4.110 to -1.256) [0.000]	-1.653 (-2.749 to -0.556) [0.003]	-1.356 (-1.706 to -1.007) [0.000]	0.106 (0.030 to 0.181) [0.006]
Full workplacebBan	-0.064 (-0.119 to -0.086) [0.024]	-3.749 (-5.208 to -2.291) [0.000]	-2.807 (-3.805 to -1.809) [0.000]	-1.744 (-2.092 to -1.395) [0.000]	0.085 (0.006 to 0.165) [0.036]
Observations	3,122	1,111	3,121	1,414	1,111
Anti-smoking campaign	0.002 (-0.090 to 0.094) [0.960]	0.734 (-1.934 to 3.402) [0.590]	0.261 (-1.308 to 1.830) [0.744]	-0.023 (-0.663 to 0.617) [0.945]	0.022 (-0.109 to 0.154) [0.741]
Dependent variable mean	0.38	15.31	5.81	2.03	0.74
Observations	3,122	1,111	3,121	1,414	1,111

National Health and nutrition survey wave 3 (2005) is used. Samples are restricted to worker age between 20 and 65. Current Smoker is binary variable (1 if smoking currently). Secondhand smoke hour excludes who did not experience secondhand smoke.
95% confidence intervals are in parenthesis. p-values are in square bracket. Sample weights are used for all regressions.
Age, age square, gender, log (household income), education level ($\leq$ middle school graduates, high school dropouts and graduates, and > College), marital status (never married, married, widow, and divorced/separated), occupation (executive or administrative, administrative support, sales, farming or fishery, low skilled worker, and military) are included as covariates.
* Probit model is used for estimated and marginal effects evaluated at the mean of other covariates are reported, †The ordinary least squares model is used for estimation.

Table 4. Impact of smoking ban on smoking, by gender

	Current smoker*	Cigarettes/day †, smokers only	Cigarettes/day †, all workers	Secondhand †, Smoke hour/day	Plan to quit*, smokers only
Male					
Partial Workplace Ban	-0.005 (-0.076 to 0.066) [0.880]	-2.461 (-3.945 to -0.977) [0.001]	-1.809 (-3.272 to -0.347) [0.015]	-1.331 (-1.752 to -0.910) [0.000]	0.102 (0.024 to 0.179) [0.010]
Full Workplace Ban	-0.095 (-0.164 to -0.025) [0.008]	-3.763 (-5.293 to -2.333) [0.000]	-3.760 (-5.198 to -2.323) [0.000]	-1.606 (-2.031 to -1.182) [0.000]	0.072 (-0.011 to 0.154) [0.090]
Observations	1,829	1,018	1,828	967	1,018
Dependent Variable Mean	0.57	15.86	8.97	1.95	0.74
Female					
Partial Workplace Ban	0.037 (-0.015 to 0.089) [0.103]	-4.233 (-9.581 to 1.116) [0.119]	-0.059 (-0.851 to 0.732) [0.883]	-1.430 (-2.054 to -0.806) [0.000]	0.107 (-0.256 to 0.470) [0.560]
Full Workplace Ban	0.005 (-0.030 to 0.040) [0.780]	-2.927 (-8.053 to 2.199) [0.259]	-0.315 (-1.038 to 0.409) [0.394]	-2.041 (-2.649 to -1.433) [0.000]	0.175 (-0.193 to 0.542) [0.347]
Observations	1,293	93	1,293	447	93
Dependent Variable Mean	0.07	8.50	0.64	2.21	0.71

See notes on Table 3.

behavior between full workplace smoking ban policy and no workplace smoking ban policy within administrative support occupation. Assuming that different smoking ban policy in the same occupation is due to smoking ban legislation. There are other factors which will change the smoking behavior. For example, cigarette price (tax) is typical one. However, I do not include cigarette price (tax) since there is no cross sectional variation of these variables in my data. For multivariate probit models I calculated and reported marginal effects and it means a percentage point change in the smoking prevalence of certain smoking ban policy compared with places without any smoking ban policy. The coefficient in OLS models means changes of cigarettes per day as a result of workplace smoking ban policy compared to no ban at all.

RESULTS

Table 3 shows the impacts of workplace smoking ban policy on smoking. In the upper block of the Table 3 I report estimates for workplace smoking ban policy. No smoking ban is the omitted category. In the first column partial workplace ban increases the current smoker but it is statistically insignificant and small in magnitude. When workplace enforces stricter rule which is full workplace ban current smoker decreases by 6.4 percentage point compared to no workplace ban and it is significant at 95 percent confidence level. In the second column I regress cigarettes per day among smokers on smoking policy. Even though partial workplace ban did not change current smoker it lowered cigarettes smoked per day by 2.7 cigarettes. Full workplace ban makes people smoke 3.7 less cigarettes per day. It is 24 percent reduction out of average 15 cigarettes per day. Both partial workplace ban and full workplace ban show statistically significant reduction for cigarettes smoked per day. In the third column I report cigarettes per day for whole population including non smokers. This also shows statistically significant results and smaller magnitude compared with the second column. However, it is not easy to interpret since this includes non smokers. In the fourth column, dependent variable is secondhand smoke hour per day among positive exposures. The secondhand smoke hour decreases 1.4 (1.7) hours when workplace has partial workplace ban (full workplace ban). In the last column dependent variable is whether respondent has plan to quit smoking in the next 6 months questioned to current smokers only. People working with

partial workplace ban show 10.6 percent point higher plan to quit smoking compared with no workplace ban. This is statistically significant and current smokers working in full workplace ban have 8.5 percentage point higher plan to quit. Partial workplace ban and full workplace ban impacted similarly on plan to quit smoking among current smokers. Full workplace ban show slightly small magnitudes since people who quitted smoking as a result of work place smoking policy are excluded already.

In the lower block I report the impacts of public anti-smoking campaign on smoking. None of the dependent variable showed statistically significant change and the magnitude are very small compared to that of workplace smoking ban reported in the upper block. Current smoker and cigarettes smoked per day even showed opposite sign to the expectation.

I present the results by gender. In South Korea smoking rate shows dramatic differences by gender. Male smoking rate is 57 percent and female smoking rate is only 7 percent. Table 4 as we saw in previous work the impacts of smoking ban policy varies quite depending on population [5]. In the upper block I report male and female is reported in the lower block. Full workplace ban policy lowers current smoker by 9.5 percentage point among males but did not change current smoker for females. In the second column, male sample shows statistically significant reduction of 2.5 cigarettes (3.8 cigarettes) per day when partial workplace (full workplace) ban applied. Even though the point estimate for male for current smoker is bigger for full workplace ban the rest of point estimates are in the similar magnitude compared with Table 3. Most of female estimates are imprecisely measured due to small number of observations. Workplace smoking ban reduced secondhand smoke hour for both male and female. Full workplace ban decreases female secondhand smoke hour by 2.0 which is 91 percent from sample mean of 2.2 hours per day.

DISCUSSION

Smoking ban policy showed its effectiveness in various settings even though the magnitude varies quite depending on populations. South Korea is one of rare developed country which has very high smoking rate and smoking rate differs a lot across gender. Therefore, it is really interesting to see how workplace smoking ban policy influence on smoking behavior in South Korea. Previous research in Korea examined government antismoking policy on socioeconomic disparities in cigarette smoking [15] but they did not focus on various smoking behavior that this paper observes. Using representative data of South Korea, I found significant decrease of current smokers and cigarettes per day, and second hand smoking hour per day. People showed an intention to quit smoking in a similar magnitude for both partial workplace ban and full workplace ban but full workplace smoking ban showed bigger drop in current smoker and cigarettes smoked per day. In this paper I also found reduced self reported secondhand smoke exposure among positive exposures after the implementation of workplace smoking ban.

There are a few limitation of this research design. First, self selection can be a concern. For example, if smoker moves his job based on smoking ban policy then we will find lower smoking rate on smoking ban workplaces. In other words, if smokers sort into work place with no smoking ban policy and non smokers sort into full smoking ban workplace then we will see the similar results that we are observing here even without any impacts of workplace smoking ban policy. The critical assumption to interpret this result as causality is that people are randomly assigned to the job independent of smoking policy of workplaces or people do not consider workplace smoking ban policy when they were looking for a job. In the similar setting Evans et al. used econometric technique to see whether sorting is serious concern and they found self selection does not change their results much [16].

Second, data on workplace smoking ban policy is only available in 2005 survey. One of basic assumption in this model is that workplaces are adopting partial or full workplace smoking ban as a result of government legislation. There are some possibilities that this assumption might be strong. If some workplaces are adopting smoking ban even though they are not required by the law and all required workplaces follows the law then this paper is over estimating the impacts of legislation. In other cases, if the new law was not strictly enforced and workplace decision is purely endogenous decision within workplace then this paper only estimates high correlation between workplace smoking decision and employee' s smoking behavior. Then, this should not be interpreted as causality. The ideal data to examine the above question needs building size where the workplace is located (since the requirements by the law are based on the building size), self-reported workplace smoking ban and smoking behavior before and after the law change. Unfortunately, there is no data with all these information. So we cannot measure how strictly workplace smoking ban has been enforced. However, it is also likely that strict legislation happened in Korea will increase workplaces smoking ban. Therefore, identification strategy applied in this paper is the best one based on my knowledge with the limited data available currently.

The results of this paper confirm many previous findings. The magnitude of the results is big but in a reasonable range compared to previous researches (current smoker decreased from 1.0 percentage point to 7.9 percentage point and cigarettes per day varied from 1.37 cigarettes decrease to 3.9 cigarettes decrease per day, [5]). This paper found that smoking ban policy is effective in South Korea as it has been shown in other countries in the sense of lower current smoker, cigarettes per day as well as second hand smoke exposure. Second hand

smoke exposure showed dramatic decrease and it measures the magnitude in better ways compared to other surveys. Unlike other surveys measuring second hand exposure as categorical variable (never, sometimes, and always in case of Netherland [12]) this survey measured second hand exposure as continuous variable of hours of exposure per day. As a result, I found bigger impacts of smoking ban on second hand smoke exposure. As a policy implication even though Korean government increased the expenditures for public campaign I did not find any significant impact of anti-smoking campaign on smoking behavior.

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