

RESEARCH PAPER

Decline in respiratory symptoms in service workers five months after a public smoking ban

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Accepted 20 March 2006**Objective:** To evaluate the effect of a total ban on smoking indoors in restaurants and other hospitality business premises in Norway, on respiratory symptoms among workers in the industry.**Methods:** Phone interviews with 1525 employees in the hospitality business were conducted immediately before the enacting of the law. In a follow-up study five months later, 906 of the workers from the baseline sample participated. Questions were asked on demographic variables, passive smoking exposure, personal smoking, attitudes towards the law, and five respiratory symptoms. Change in symptom prevalence was analysed with McNemar's test and with analysis of variance (ANOVA) for repeated measures.**Results:** The prevalence of all five symptoms declined after the ban; for morning cough from 20.6% to 16.2% ($p < 0.01$); for daytime cough from 23.2% to 20.9%; for phlegm cough from 15.3% to 11.8% ($p < 0.05$); for dyspnoea from 19.2% to 13.0% ($p < 0.01$); and for wheezing from 9.0% to 7.8%. ANOVA showed that the largest decline in symptom prevalence was seen among workers who themselves gave up smoking, and subjects with a positive attitude towards the law before it took effect.**Conclusion:** A significant decrease in respiratory symptoms among service industry workers was found five months after the enacting of a public smoking ban.

An increasing number of studies point to the adverse health effects of exposure to environmental tobacco smoke (ETS). ETS has been shown to be a likely risk factor for coronary artery disease,¹ stroke,³ lung cancer,⁴ and obstructive lung disease.^{5–7} Respiratory symptoms are associated with both personal smoking⁸ and ETS.^{10–11} Most studies on the effect of ETS on respiratory health show a higher effect of ETS at the workplace compared with ETS at home,^{10–12} usually interpreted as a dose response effect as the level of ETS is higher at work than at home for most subjects.

Employees in the hospitality business are exposed to some of the highest levels of ETS measured in workplaces.¹⁴ The prevalence of respiratory symptoms among workers in the hospitality industry who are exposed to ETS has been found to be higher than among non-exposed workers.¹⁵

Recently, the tobacco and health legislation in Norway was strengthened. A total ban on smoking indoors in restaurants, bars, and hotels came into force on 1 June 2004. The primary motive behind the smoking ban was to protect workers in the hospitality industry from the adverse health effects of ETS. Total smoking bans have been enacted in some areas of the United States, Ireland, Bhutan, and New Zealand, and near total bans in South Africa, Italy, Malta and Sweden. Other countries are considering enacting similar laws. However, the lack of studies documenting a reversal of the adverse health effects with a ban has been an argument against such laws.

Showing the effects of decreasing ETS on development of chronic obstructive pulmonary disease (COPD) or lung cancer is difficult due to the long time period between exposure and disease. However, the effects on respiratory symptoms may be more readily apparent. One previous study on 53 bartenders in California examined the effects of a reduction in ETS on respiratory symptoms.¹⁶ Even though the study sample was small, the study indicated a rapid decline in respiratory symptoms among bartenders after establishment of smoke-free bars.

The aim of the current study was to examine the prevalence of respiratory symptoms among employees in

the Norwegian hospitality industry, before and after the enacting of the smoking ban. Further, we wanted to see how personal smoking habits, level of ETS exposure before the smoking ban, and attitudes towards the law affected any change in reported levels of respiratory symptoms before and after the ban.

METHODS

Study population

All companies in the Norwegian hospitality industry are subject to a public register. A random sample of companies defined as belonging to the target industries were contacted by telephone in May 2004. A strictly standardised telephone interview was conducted with one employee willing to participate from each company. To ensure a random selection of employees within companies, a procedure with random selection by the first letter of surname was adopted. The interview was scheduled to last approximately 10 minutes. The participants were given the choice to respond by telephone or on an internet website. All participants were made aware that they would receive a new call later for a follow-up interview. A prize of NOK10000 for a vacation would be offered to one randomly selected participant.

The follow-up interview was conducted in September/October 2004, when only participants at baseline were contacted. Altogether 1525 employees agreed to participate in the baseline survey—1337 responded by telephone, and 188 responded on the website. Attempts were made to reach all 1525 at follow-up, and 906 (59%) were found and agreed to participate.

Questionnaires

The telephone interviewers followed a strict set up for what questions to be asked in what order, and all questions were read from manuscript to ensure a similar and unbiased wording of each question. The baseline interview included questions on demographic variables, exposure to ETS at work, personal smoking habits, respiratory symptoms, and

attitudes towards the upcoming public smoking ban. The wording of the questions on respiratory symptoms was identical at baseline and follow-up and is given in the appendix. The analyses are based on exposure variables obtained at the baseline interview, and smoking and symptom variables obtained at both time points.

Educational level was defined as the highest level of obtained education in three categories; up to nine years of schooling (primary), a degree requiring 12 years of schooling (secondary), and a higher degree of education (college or university).

The questions on smoking allowed three categories for response; never, occasional, and daily smoking. Occasional smokers were grouped with daily smokers when defining the four-category variable describing changes in smoking habits (non-smokers, smokers, former smokers, and starters).

For each symptom, the subjects were given five response alternatives, depending on frequency of experiencing the symptom. The questions on respiratory symptoms were adapted from a Norwegian translation of the Medical Research Council questionnaire on respiratory symptoms.¹⁷ A total of 1502 subjects completed the questions regarding respiratory symptoms at baseline, whereas 878 subjects completed all questions on respiratory symptoms at follow-up.

Statistical analyses

Differences in baseline characteristics by response or non-response at follow-up were tested by χ^2 for the exposure variables, and test for trend for the symptom variables. For the univariate analyses on prevalence of symptoms, prevalence of a symptom was defined as having the symptom at least weekly. Differences in prevalence of the five respiratory symptoms between baseline and follow-up were tested with McNemar's test. Based on the five categories of response to the respiratory symptom questions, a sum score was calculated for all symptoms combined. Analyses of variance (ANOVA) with repeated measures were conducted to test overall change in sum score between baseline and follow-up

Table 1 Characteristics of study sample

	n	%
Sex		
Women	470	51.9
Men	436	48.1
Age (years)		
15-29	344	38.0
30-39	274	30.0
40+	288	31.8
Educational level		
Primary	151	16.7
Secondary	509	72.9
University	246	27.2
Personal smoking habits*		
Persistent non-smokers	335	38.1
Persistent smokers	466	53.0
Quitters	49	5.6
Starters	29	3.3
Percentage of guests who usually smoked before ban*		
<50%	243	27.0
≥50%	656	73.0
Time spent in an exposed environment*		
No degree	25	2.8
Small degree	168	18.6
Some degree	193	21.3
Large degree	519	57.4
Personal attitude towards ban before taking effect*		
Negative	256	28.3
Neutral	192	21.2
Positive	457	50.5
Total	906	

*Due to some missing values, the sum is not 906 for all variables.

Table 2 Response at follow-up by baseline characteristics

	Response (%)	p Value*
Sex		0.36
Women	58.3	
Men	60.6	
Age (years)		0.72
15-29	60.0	
30-39	60.2	
40+	58.0	
Educational level		0.09
Primary	58.8	
Secondary	57.6	
University	64.2	
Personal smoking habits		0.04
Smoker	57.4	
Non-smoker	62.6	
Percentage of guests who usually smoked before ban		0.60
<50%	60.5	
≥50%	58.9	
Time spent in an exposed environment		0.96
No degree	58.1	
Small degree	58.5	
Some degree	58.8	
Large degree	60.1	
Personal attitude towards ban before ban		0.12
Negative	56.8	
Neutral	57.1	
Positive	62.1	
Total	59.4	

* χ^2 .

as well as interactions between change and the following variables: sex, age, educational level, personal smoking habits, exposure to ETS at the workplace, and personal attitude towards the upcoming ban on smoking. Significance

Table 3 Prevalence (%) of respiratory symptoms among workers in the hospitality industry before and after the smoking ban

		Before smoking ban	After smoking ban	Difference	McNemar*
Morning cough	Smokers	28.5	25.9	-2.6	0.29
	Non-smokers	10.6	4.9	-5.8	<0.01
	Former smokers	20.8	2.1	-18.8	0.00
Daytime cough	Smokers	28.9	32.0	3.1	0.24
	Non-smokers	14.9	7.3	-7.6	<0.01
	Former smokers	27.1	8.3	-18.8	0.01
Phlegm cough	Smokers	18.3	17.4	-0.9	0.74
	Non-smokers	9.8	5.2	-4.6	0.01
	Former smokers	20.8	4.2	-16.7	0.02
Dyspnoea	Smokers	25.4	19.8	-5.7	0.01
	Non-smokers	10.7	5.2	-5.5	<0.01
	Former smokers	20.8	6.3	-14.6	0.07
Wheezing	Smokers	12.4	12.4	0.0	1.00
	Non-smokers	4.3	2.7	-1.5	0.36
	Former smokers	14.6	0.0	-14.6	0.02
Any symptom	Smokers	50.1	48.2	-2.0	0.49
	Non-smokers	26.4	14.6	-11.9	<0.01
	Former smokers	50.0	16.7	-33.3	<0.01

*Exact McNemar significance probability.

tests were performed for the interaction between each variable and change in score as well as in an all inclusive multivariate model. SPSS 11.0 and Stata 9.0 were used for computation.^{18, 19}

RESULTS

Characteristics of the study sample at baseline are presented in table 1. There was a larger percentage of smokers among the workers in the hospitality industry compared with similar age groups in the population as a whole (53% versus approximately 30%). The study sample reported a reasonably large exposure to ETS, where more than half of the responders chose the category for the longest time spent in an exposed environment. Almost 75% of the responders estimated that more than half of the customers smoked. A positive attitude towards the upcoming smoking ban was reported by half of the responders.

The response rate at follow-up did not vary according to baseline characteristics, except for personal smoking habits where subjects who smoked were somewhat less likely to respond (table 2). There was no difference between responders and non-responders in prevalence at baseline for any of the five respiratory symptoms, when analysed with a test for trend (data not shown).

The prevalence of respiratory symptoms among smokers, non-smokers, and former smokers before and after the smoking ban is shown in table 3. Subjects who gave up smoking had the largest decrease in prevalence of all respiratory symptoms. Non-smokers had a smaller but significant decrease in prevalence of all respiratory symptoms except wheezing. Among the smokers, only the prevalence of dyspnoea was significantly reduced after the smoking ban

(table 3). The prevalence of having any symptom decreased from 40.6% to 32.9% among all subjects ($p < 0.001$).

The analyses of changes in symptom score by potential explanatory factors are presented in table 4. There was a pronounced and significant decrease in mean score from baseline to follow-up ($p < 0.001$). The decrease remained significant after controlling for other relevant independent variables. Personal smoking habits and personal attitude towards the ban before the ban were the only explanatory variables for which the interaction (with change) terms were significant. This was shown in analyses with each independent variable separately (first column of p values in table 4), and was confirmed in an analysis of variance model with all independent variables included (data not shown). The largest decrease in symptom score was seen among subjects with a positive attitude towards the upcoming ban and subjects who gave up smoking by follow-up.

The effect of the smoking ban on respiratory symptoms among non-smokers was of particular concern. The analyses of changes in symptom score were also conducted for each category of smokers separately. The decrease in sum score was significant among non-smokers ($p = 0.042$) and quitters ($p = 0.001$), but not among smokers or starters, after adjustment for all independent variables.

DISCUSSION

A significant decrease in the occurrence of respiratory symptoms was seen among workers in the hospitality industry, five months after a public smoking ban was enacted. The decrease was significantly associated with personal smoking habits, and personal attitude towards the ban before its effect. The largest decrease in occurrence of

Table 4 Changes in sumscore* of five respiratory symptoms among workers in the hospitality business, before and after the enactment of a public smoking ban. Separate analyses of variance with repeated measures for each independent variable

	n	Baseline sumscore	Follow-up sumscore	Difference	p Value (within subjects)†	p Value (between subjects)
Sex					0.613	0.133
Women	439	1.67	1.57	0.11		
Men	422	1.76	1.63	0.13		
Age					0.712	0.236
15–29	325	1.76	1.65	0.11		
30–39	259	1.69	1.59	0.10		
40+	277	1.69	1.54	0.15		
Educational level					0.281	0.540
Primary	146	1.66	1.55	0.11		
Secondary	481	1.75	1.60	0.15		
University	234	1.68	1.62	0.06		
Personal smoking habits					<0.001	<0.001
Non-smokers	327	1.44	1.29	0.15		
Smokers	458	1.91	1.85	0.06		
Quitters	48	1.85	1.30	0.55		
Starters	28	1.56	1.53	0.03		
Percentage of guests who usually smoked before ban					0.599	0.002
Less than 50%	230	1.58	1.48	0.10		
50% or more	626	1.77	1.64	0.13		
Time spent in an exposed environment					0.387	0.011
No degree	24	1.51	1.32	0.19		
Small degree	161	1.61	1.57	0.04		
Some degree	183	1.62	1.52	0.10		
Large degree	492	1.80	1.65	0.15		
Personal attitude towards ban before ban					0.001	0.004
Negative	246	1.78	1.78	0.00		
Neutral	187	1.67	1.62	0.06		
Positive	427	1.70	1.48	0.21		
Total (main effect)	861	1.72	1.60	0.12	<0.001	

*The sumscore is based on a graded response regarding degrees of having five respiratory symptoms.

†Interaction between within subjects effects and predictors, without control for other predictors.

symptoms was found among those who reported a positive attitude to the smoking ban and among those who reported to have stopped smoking. Of the workers smoking before the smoking ban, more than 9% had quit at follow-up after the smoking ban.

There are some methodological issues to consider. First, since the public smoking ban came into effect in all of Norway at the same time, there was no room for a control group in the study design. Obviously, this is by design a weakness, as one would want to compare the prevalence change in symptoms with a population where no action had taken place. One could argue that comparison could be made with a neighbouring country, such as Sweden or Denmark. However, since there are differences in smoking habits as well as contextual factors and legislation, the comparability across countries would still be a major problem. Such a design may not be stronger than the simple pretest-posttest design applied in this study.

Second, the results could have been influenced by subjects lost to follow-up. For the respiratory symptoms, approximately 57% of the original subjects responded at both time points. Subjects in the hospitality industry are often young, and change employment more often than other workers. Compared with other studies on working populations, a response rate of more than 56% is acceptable, if not ideal. Except for personal smoking habits, neither the explanatory variables nor the symptoms at baseline differed by participation at follow-up. The finding that subjects who smoked were less likely to respond at follow-up is in accordance with earlier studies.²⁰⁻²² This could have led to an underestimation of the symptom prevalence at follow-up, however the difference in the response rates between smokers (57.4%) and non-smokers (62.6%) was small and is unlikely to have changed the main findings.

There are very few similar studies with which to compare. One recent study in Galway, Ireland showed a significant reduction in exposure to ETS among hotel workers, after a public smoking ban.²³ Tobacco smoke is an aetiological agent in a vast number of serious chronic disorders including lung cancer, COPD, and coronary heart disease.²⁴⁻²⁶ A number of studies have implicated ETS as a risk factor for many of the same diseases,^{1 2 4 5 27} and this is the rationale for a public smoking ban. However, it will take time to demonstrate the protective effect of removing a risk factor for a chronic disease like lung cancer, COPD, or coronary heart disease. One notable exception is a study from Montana, United States, where a significant decrease in hospital admissions for acute heart disease was seen during a six month period in which there was a public smoking ban, compared to neighbouring areas where such a ban did not exist.²⁸ Apart from pointing at ETS as a possible trigger for acute coronary emergencies, this study showed that the effect could be demonstrated in the population as a whole, not just among employees who presumably had a higher exposure.

Several studies have shown ETS to be a risk factor for respiratory symptoms.^{6 10 11} It is attractive to examine changes in respiratory symptoms, as symptoms are more transient by nature, and may be more linked with immediate exposure. The only previous study examining the health of workers in the hospitality industry after a smoking ban was among 53 bartenders in San Francisco, California.¹⁶ The study by Eisner *et al* examined the same five respiratory symptoms as the current study. Although the sample was small, a significant decrease of respiratory symptoms was found between one and two months after the ban was enacted.¹⁶

In the current study, a significant decrease in respiratory symptoms was seen regardless of whether the variables were treated as a dichotomous prevalence variable or a sum score was calculated. The largest decrease in sum score was seen

What this paper adds

Several countries are enacting legislation to protect service workers from the harmful effects of environmental tobacco smoke at the workplace. Studies evaluating the health effects of such policies are scarce.

The prevalence of respiratory symptoms decreased among non-smoking workers in the service industry in Norway, after a total smoking ban was introduced 1 June 2004.

among subjects who quit smoking. However, a decrease in sum score was observed also among the persistent smokers and persistent non-smokers, indicating a positive effect also independent of personal smoking cessation. Out of the 517 subjects who smoked at baseline, 48 subjects (9.3%) quit during follow-up. This is a high quit rate, and likely to have been influenced by the smoking ban. A change in personal smoking habits was not the prime motive for the smoking ban. However, it could have important implications for public health, if proven to persist over time.

There is reason to believe that there is a dose-response relationship between ETS and respiratory symptoms.^{12 29 30} In the current study, neither time spent in an exposed environment nor the percentage of guests usually smoking before the ban were significantly associated with a decrease in prevalence of symptoms, although the trend was toward a larger sum score difference in workers with greater exposure. With a study sample of 906, we must caution that lack of study power could be the reason no dose-response relationship was found in this study.

The Norwegian smoking ban was well advertised, and debated in all major media before coming into effect. County officials visited many restaurants and bars immediately after it took effect, to ensure compliance with the ban. In the current study sample, 43.8% of the workers reported that they had been bothered by secondhand tobacco-smoke before the ban, whereas only 6.5% reported that they had been bothered by it after the ban. This is in accordance with the study from Galway, Ireland, where the exposures for hospitality workers decreased greatly after a smoking ban, but was not completely eliminated.²³

Subjects with a positive personal attitude towards the smoking ban before it took effect reported a larger decrease in symptoms. Obviously, this could be due to a reporting bias of symptoms at follow-up. However, it is likely that the subjects who had the most positive attitude towards the ban were those who were the most bothered by ETS at their workplace, either by prevalence or intensity of symptoms or disease. These subjects would then be more likely to have a real benefit from the smoking ban. Furthermore, a response bias in the opposite direction could explain the less pronounced decrease in symptoms among those who were less positive towards the ban.

In conclusion, the current study indicates a beneficial effect of the public smoking ban with a reduction in symptom load among workers in the hospitality industry. There is a need to replicate this study when similar smoking bans are introduced in other countries, and the factors behind the reduction in symptom prevalence need closer examination.

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APPENDIX

Wording of the questions on respiratory symptoms was similar at baseline and follow-up:

“Within the last two months: How often have you experienced the following symptoms?”

- Coughing or having to clear your throat in the morning
- Coughing during the day
- Phlegm when coughing
- Breathlessness
- Wheezing sound in your chest”

To all questions five response categories were used:

About each day, more than once per week, about every week, more seldom, and never.

At baseline the subjects were asked:

“Approximately what percentage of your guests smoke?”

The answer was reported as a percentage from 0 to 100.

“To what degree are you present in rooms where others are smoking during the workday?” Four reply categories were used: To a large degree, to some degree, to a small degree, and to no degree.