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Occupational Exposure and Chronic Respiratory Symptoms
—A Population Based Study in Vietnam—

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Abstract: In order to investigate the relationship between occupational exposure to dust/chemicals (toxic gases/fumes) and chronic respiratory symptoms in Vietnam, the questionnaire standardized by the American Thoracic Society was applied to 368 subjects living in Ha Thai district of Vietnam. According to the results of multiple logistic regression analyses, the odds ratios of chronic respiratory symptoms by occupational exposure are over unity, except for the relationship between chronic cough and occupational exposure to chemicals. Especially for chronic breathlessness, significantly higher odds ratios are observed among people with a history of occupational exposure to dust or chemicals: 2.925 (95% CI: 1.130–7.574) for dust, and 3.721 (95%CI: 1.412–9.803) for chemicals. As for the interaction between occupational exposure to dust and cigarette smoking, it is considered that occupational exposure leads to an increase in chronic respiratory symptoms independent of the effects of cigarette smoking.

Key words: Occupational exposure, Chronic respiratory symptoms, Epidemiological study, Vietnam

Introduction

It has been clarified that occupational exposure to specific agents causes chronic respiratory symptoms[1–5]. In Vietnam, pneumoconiosis and other chronic lung diseases are leading diseases among designated occupational diseases as shown in Table 1[6], but, these statistics apparently underestimate the actuality mainly due to the insufficient monitoring and reporting system. Considering the financial constraints, it is not possible to install a sufficient information system for occupational diseases in the next few years, so that epidemiological studies should be useful in estimating the importance of occupational respiratory diseases in Vietnam. Nevertheless, as in other developing countries, it is very difficult to obtain appropriate information on personal occupational exposure history from the medical records or personnel documents in factories. To overcome this constraint, it is useful to conduct a population-based epidemiological study for this subject. The American Thoracic Society developed a standard questionnaire regarding the relationship between occupational exposure and chronic respiratory symptoms[7]. This paper is the first report in Vietnam which has applied this questionnaire to the general population in order to investigate the relationship

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Table 1. Official statistics of occupational diseases and occupational accidents

Occupational diseases (total number to the end of 1994)	
Silicosis	6,507
Asbestosis	1
Tuberculosis (occupational)	13
Noise-induced hearing loss	840
Lead poisoning	60
Mercury poisoning	6
Others	68
Total	7,495
Occupational accidents (in 1993)	
Fatal cases	212
Number of deceased workers	231

Source: National Institute of Labour Protection (1994).

between occupational exposure to dust/chemicals and chronic respiratory symptoms.

Population Studied and Methods

1) Population studied

The population studied was 500 inhabitants of Ha Thai district, 10 km north of Hanoi city. Five hundred of the inhabitants were randomly selected from the resident register for the study in cooperation with chiefs of the communities, but we did not employ any sophisticated method of sampling such as stratified sampling in order that the distributions of age, sex and educational attainment level be similar to those of the area studied. Furthermore, these communities include some residential zones of workers in factories such as those making paint materials, and mechanics, so that the population studied must be biased in favor of people with occupational exposure. For this reason it is possible to include some types of sampling biases, and we must therefore be cautious in interpreting the results of this study. The questionnaire was distributed to subjects during the second week of August, 1995 and collected after one week. Each person was required to fill in the questionnaire by himself, regarding occupational exposure, life style and chronic respiratory symptoms. It was developed by the American Thoracic Society for a community based epidemiological study and translated into Vietnamese[7]. When subjects complained of any difficulty in filling in some items in the questionnaire, a member of the research team assisted them. Finally, 402 questionnaires were sent back to the research team (80.1%), of which 368 (73.6%) were sufficiently completed for necessary information such as sex, age, educational attainment level, occupational exposure to dust or chemicals, chronic occupational symptoms, and smoking habit. Finally we used these data provided by 368 persons for the analysis.

2) Definition of chronic respiratory symptoms

In this questionnaire, chronic cough was defined as a cough for 3 or more months of the year; chronic phlegm as sputum production for 3 or more months of the year; persistent wheeze as wheezing on most days or nights; and breathlessness as shortness of breath when walking more slowly than others of one's own age on level ground.

3) Occupational exposure

Questions on experience of occupational exposure to dust and chemicals (toxic gases/fumes) were included in the questionnaire. The original questionnaire was designed to calculate the total exposure period in year to these hazards.

4) Smoking habits

As in the case of occupational exposure, because we could not obtain information regarding a life-time history of the smoking habits, therefore, we used information only regarding the current status of the smoking habit of each person.

5) Statistical analysis

At first, rates of chronic respiratory symptoms were calculated for the subjects with and without occupational exposure to dust and chemicals (toxic gases/fumes) respectively. Then in order to adjust the effect of age, gender and the smoking habit on the prevalence of respiratory symptoms, multiple logistic regression analysis was employed to calculate the odds ratio (OR) for each symptom among subjects with any occupational exposure (dust and chemicals, respectively) compared to unexposed subjects. When a 95% confidential interval of OR does not include the unity, we consider it statistically significant at a 5% risk. We could not evaluate the effect of the interaction among smoking, dust and chemical exposure by including interaction terms into the logistic regression equation because of the small number of cases. All these statistical analyses were conducted with SAS software[8].

Results

The prevalence of occupational exposure to dust and chemicals (toxic gases/fumes) for the entire population by

Table 2. Rate of exposure to dust and chemicals by age, sex and educational level

Age	−19	20–29	30–39	40–49	50–59	60–	Total
Dust	0/12	37/84	62/113	67/100	17/36	11/23	194/368
	0.0%	44.1%	54.9%	67.0%	47.2%	47.8%	52.7%
Chemicals	0/12	28/84	52/113	74/100	12/36	5/23	171/368
	0.0%	33.3%	30.7%	74.0%	33.3%	21.7%	46.5%
Smokers	0/12	23/84	37/113	33/100	14/36	7/23	114/368
	0.0%	27.4%	32.7%	33.0%	38.9%	30.4%	31.0%

Sex	Male	Female	Total
Dust	103/184	91/184	194/368
	56.0%	49.5%	52.7%
Chemicals	89/184	82/184	171/368
	48.4%	44.6%	46.5%
Smokers	111/184	3/184	114/368
	60.3%	1.6%	31.0%

Educational level	Primary	Secondary	Tertiary	Total
Dust	61/132	88/163	45/73	194/368
	46.2%	54.0%	61.6%	52.7%
Chemicals	40/132	86/163	45/73	171/368
	30.3%	52.7%	61.6%	46.5%
Smokers	40/132	55/163	19/73	114/368
	30.3%	44.3%	19.8%	31.0%

Smoking	Smoker	Non-smoker	Total
Dust	71/114	123/254	194/368
	62.3%	48.4%	52.7%
Chemicals	62/114	109/254	171/368
	54.4%	42.9%	46.5%

age, gender, educational level, and smoking status are summarized in Table 2. The prevalence of occupational dust exposure was 52.7% for the overall population, 56.0% for men and 49.5% for women. The prevalence of occupational chemical exposure was 46.5% for the entire population, 48.4% for men and 44.6% for women. Interestingly, there is a tendency for people with higher education to have more experience of occupational exposure. These interesting relationships were observed in a similar study conducted in China[5]. Regarding the smoking habit, smoking prevalence shows tendency to increase with age. The most striking feature of the smoking habit in the population studied is the considerable difference between the two sexes in smoking prevalence: 60.3% for men and 1.6% for women. People with the highest educational attainment level shows the lowest smoking prevalence (19.8%).

Rates of chronic respiratory symptoms were calculated for subjects with and without a history of occupational exposure to dust and chemicals and current smoking habit (Table 3). It seems that the prevalence of chronic respiratory symptoms is higher among people with experience of exposure to dust and chemicals, except for chronic cough in the case of chemical exposure, but statistically significant relationships were detected only between occupational exposures and chronic breathlessness (p-values were 0.031 for dust, and 0.016 for chemicals).

Table 4 shows the results of logistic regression analyses concerning the relationships between occupational exposure to dust or chemicals and chronic respiratory symptoms, adjusted for age, gender and smoking habit. Except for the odds ratio for chronic cough caused by occupational exposure to chemicals, the odds ratios for chronic respiratory symptoms caused by occupational exposure are over unity. Especially

Table 3. Rate of prevalence of chronic respiratory symptoms according to dust and chemicals exposure

	Chronic cough	p-value	Chronic phlegm	p-value	Chronic wheezing	p-value	Chronic brea-thlessness	p-value
Dust								
Non-exposed	8/174		7/174		4/174		7/174	
	4.6%		4.0%		2.3%		4.0%	
Exposed	14/194		15/194		10/194		19/194	
	7.2%		7.7%		5.2%		9.8%	
		0.290		0.134		0.153		0.031
Chemicals								
Non-exposed	12/197		8/197		7/197		8/197	
	6.1%		4.1%		3.6%		4.1%	
Exposed	10/171		14/171		7/171		18/171	
	5.9%		8.2%		4.1%		10.5%	
		0.922		0.096		0.787		0.016
Smoking								
Non-smoker	14/254		14/254		9/254		20/254	
	5.5%		5.5%		3.5%		7.5%	
Smoker	8/114		8/114		5/114		7/114	
	7.0%		7.0%		4.4%		5.7%	
		0.573		0.573		0.770		0.643

p-values were calculated by Chi-square testing.

Table 4. Effects of occupational exposure to dust and chemicals on respiratory symptoms (adjusted for sex, age and smoking status)

	Chronic cough	Chronic phlegm	Chronic wheezing	Chronic breathlessness
Dust				
OR	1.547	0.982	2.223	2.925
95%CI	0.617–3.879	0.762–5.152	0.672–7.349	1.130–7.574
Chemicals				
OR	0.983	2.411	1.169	3.721
95%CI	0.402–2.400	0.927–6.270	0.393–3.481	1.412–9.803

for chronic breathlessness, significantly higher odds ratios are observed among people with a history of occupational exposure to dust or chemicals: 2.925 (95% CI: 1.130–7.574) for dust, and 3.721 (95% CI: 1.412–9.803) for chemicals.

Table 5 shows the results of logistic regression analyses concerning the relationships between occupational exposure to dust or chemicals and chronic respiratory symptoms among smokers and non-smokers adjusted for age and gender. Although significant odds ratios were detected for chronic phlegm and occupational exposure to dust (95% CI of OR: 1.079–15.406) and chemicals (1.031–12.298) in the case of non-smokers, there is a tendency for the odds ratios to be systematically smaller among smokers than non-smokers. For the symptom of chronic breathlessness in smokers, the odds ratios were not calculated because of unstable estimation by logistic regression models.

Discussion

Similar to previous studies using this method, we also detected a positive relationship between occupational exposure to dust or chemicals and chronic respiratory symptoms, although we could not show statistically significant relationships in most cases, possibly due to the

Table 5. Effects of occupational exposure to dust and chemicals on respiratory symptoms among smokers and non-smokers (adjusted for sex and age)

	Chronic cough	Chronic phlegm	Chronic wheezing	Chronic breathlessness
Smoker (114)				
Dust				
OR	1.196	0.704	1.392	Not calculated
95%CI	0.251–5.694	0.151–3.288	0.181–10.705	
Chemicals				
OR	0.308	1.457	1.003	Not calculated
95%CI	0.057–1.679	0.284–7.482	0.127–7.916	
Non-Smoker (256)				
Dust				
OR	1.884	4.078	3.670	6.870
95%CI	0.594–5.976	1.079–15.406	0.743–18.138	1.837–25.690
Chemicals				
OR	1.796	3.561	1.565	9.903
95%CI	0.578–5.579	1.031–12.298	0.407–6.022	2.448–40.064

small number of subjects studied. Compared with previous studies conducted in other countries[3, 5], our study used a small size population. For example, a study in the United States engaged 8,515 white adults[3], and a study in China included 3,606 persons[5]. If we want to detect statistically a significant difference at a 5% α risk and 10% β risk between the exposed group (the supposed prevalence rate for symptoms is 8%) and non-exposed group (the supposed prevalence rate is 6%), at least 1,294 subjects (647 in each group: see appendix) should be included[9].

According to the present results, there appears to be a higher odds ratio of dust exposure for symptoms associated with obstruction (persistent wheeze and breathlessness) than for symptoms associated with mucus hypersecretion (chronic cough and chronic phlegm). This interesting finding was also reported by Korn *et al.*[3] These obstructive symptoms are considered to reflect hypertrophy of mucous glands in airways which may occur as a result of long continuous exposure to dust[10]. It was reported that the ventilation capacity was inversely related to lifetime cumulative exposure to dust[10]. It is, therefore considered that these obstructive symptoms could reflect a chronic effect of exposure to dust. It must be noted, however, that the results of previous studies concerning the net effect of chronic exposure to dust on the occurrence of obstructive symptoms have been controversial[10].

Whether occupational exposure leads to an increase in chronic respiratory symptoms independent of the effects of cigarette smoking is a topic of current interest[3, 5]. As point estimates of odds ratios among smokers are smaller than among non-smokers (Table 5), it is suggested that smokers do not appear to be more susceptible to the effects of dust or chemicals (gases/fumes) on respiratory symptoms than do non-smokers. Previous studies also reported that there was no interaction between smoking status and occupational exposure to dust on the prevalence of chronic respiratory symptoms[3, 5]. By contrast, in the case of the interaction between smoking and gas/fume exposure, there are several reports which indicate a positive interaction[11–13]. So far as the effects of dust are concerned, it is considered that the mean effects of dust are about equal to one third to one fifth of those of cigarette smoke[10].

Misclassification of exposures, recall bias, selection bias or healthy workers effect could have affected the results of our study. In this analysis, as we conducted a cross-sectional study, where exposure information and respiratory symptoms were investigated at the same time, there is the possibility of recall bias. Recall bias could produce a positive association between occupational exposure and respiratory symptoms if subjects with a history of such exposure reported more symptoms. Although this bias cannot be prevented with certainty in a cross-sectional study[14], objective history-taking and measurement of ill-health, such as a pulmonary function test, is essential in order to minimize the effects of recall bias[7].

We also used a standardized questionnaire which was developed by the American Thoracic Society in order to achieve comparability of the results with other studies, but the content of the questionnaire was too complicated for use in the population studied who were being investigated with this kind of questionnaire for the first time. For example, most of them expressed some difficulty in differentiating chronic cough from wheezing, and the style of the questionnaire, especially the part on the duration of occupational exposure, was much too complicated for them, although the literacy rate of the population studied was 100%. The present results may therefore be biased in favor of people with higher educational levels who could respond to the questionnaire correctly. It will be necessary to simplify this questionnaire in order to adapt it to the local situation for use in future investigations.

Because subjects were selected randomly from the community studied regardless of their occupational exposure status, it is unlikely that a selection bias towards workers with more significant occupational exposure would affect the results, but it is possible that the healthy workers effect could have affected the results. The industrialization of Vietnam has been facilitated quite recently since the introduction of a market economy in 1987, so that occupational exposure to dust and chemicals is probably a new experience for inhabitants who were formerly farmers, but we could not obtain appropriate information regarding the duration of exposure for all subjects. It is therefore possible that our study included healthier workers who were recently employed by various kinds of factories. The result in Table 5 in which there is a general tendency for the odds ratios to be systematically smaller among smokers than non-smokers, strongly suggests the existence of the healthy workers effect. According to Vietnamese law, workers must receive a pre-employment health examination. It is therefore also possible that healthier people are systematically employed in factories and are being exposed to dust and chemicals, which may lower the prevalence rate of chronic respiratory symptoms among workers with exposure to dust and chemicals.

Although it is not possible to definitively evaluate the effect of occupational exposure to dust and chemicals on the prevalence of chronic respiratory symptoms in the present study, our results have suggested that occupational exposure to dust and chemicals (gases/fumes) could be a major risk factor in the prevalence of chronic respiratory illness, which is the most important occupational disease in Vietnam. And at the same time, it is considered that we could demonstrate the feasibility of conducting this kind of epidemiological study in Vietnam. Taking into account the problems we noticed in the present project, we are planning to conduct another study with a simplified questionnaire based on a larger population with more appropriate characteristics in order to evaluate the effects of occupational exposure to dust and toxic gases/fumes on the prevalence of chronic respiratory symptoms.

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Appendix

Calculation formula for sample size for test of differences in the prevalence rate in two groups[9)]

$$n > 2\pi(1 - \pi)(Z_{\alpha/2} + Z_{\beta})/\delta^2$$

where n = sample size in each group, $\pi = (\pi_1 - \pi_2)/2$,
π_1 = prevalence rate in one group,
π_2 = prevalence rate in another group,
$Z_{\alpha/2}$ = a value of $\alpha/2$ risk level, $\delta = |\pi_1 - \pi_2|$

Correction of continuity

$$n' = n + 2/\delta$$