

Confounding by variable smoking habits in different occupational groups

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ASP A. Confounding in occupational lung cancer studies: What is the variability in smoking habits across different occupations? *Scand J Work Environ Health* 10 (1984) 325—326. Smoking habits of different occupational groups were studied in a sample of persons who participated in health screening examinations carried out by the mobile clinic of the Institute of Occupational Health (Helsinki, Finland). The sample consisted of 1 990 men and 1 044 women. The smoking habits of the study population as a whole conformed with those of the entire Finnish population. Distinct differences in smoking habits were found, however, in different occupational groups. The effect of smoking habits on tentative rate ratios of lung cancer in occupational groups were estimated with a procedure presented by Olav Axelsson. The groups were selected from extreme ends of the smoking habit variable. Extreme estimates were taken to maximize the confounding effect of smoking. When occupational groups were contrasted with the general population, the confounding effect was found to be smaller than usually believed.

Key terms: occupational groups, smoking.

Smoking habits may confound the results of studies on lung cancer mortality and morbidity in various occupational groups. Information on smoking habits is particularly hard to obtain in studies based on register data. Methods of control for smoking in occupational cohort mortality studies have been discussed recently in this journal (6). Therefore I would like to present some data on the variability of smoking habits among various occupational groups and to discuss their confounding impact on tentative lung cancer mortality data.

The material is a sample of persons who participated in health screening examinations carried out by the mobile clinic of the Institute of Occupational Health (Helsinki, Finland) between 1970 and 1975. In all, 1 990 men and 1 044 women were included. Information on smoking was collected by questionnaire. The subjects were asked whether they were currently smokers and, on an average, how many cigarettes they smoked daily. Persons who had stopped smoking were asked at what age they stopped and the reason for quitting.

The smoking habits of the study population conformed with the smoking habits of the entire Finnish population (1, 3, 4, 5). The men smoked more than the women, and young persons smoked more than older persons. Women in urbanized areas smoked more than women in rural areas, but the men's

smoking habits did not vary according to geographic district.

As can be seen from table 1, distinct differences in smoking were found for different male occupational groups. The percentage of smokers was the lowest for civil servants, business executives, and office workers and the highest for heavy occupations such as mining, basic metal industry, and construction work. These findings concern both the percentage of smokers in the groups and the number cigarettes smoked daily. As the women of the sample fell into only a few occupational categories, no clear conclusions about their smoking habits across occupational groups could be drawn. The responses indicated however that female industrial workers smoke more than female office workers.

When the procedure presented by Axelsson (2) and discussed in a later article in this journal (6) is applied to the present data, the effect of smoking habits on tentative rate ratios of lung cancer in occupational groups can be estimated (table 2). The occupational groups shown in table 2 were selected from the extreme ends of the smoking habit variable. The calculations were performed with the data of the male workers only. Smoking habits were divided into the categories of nonsmokers, exsmokers, and smokers, and the proportions in each occupational group were standardized to the age distribution of the total material. The rate ratios so obtained show the confounding effect of the real smoking differences in a situation where it is assumed that the unconfounded rate ratios are the same, ie, 1.0, for all the occupational groups.

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Table 1. Percentage of male nonsmokers, exsmokers, and smokers in the various occupational groups.

Occupational group	Number	Percentage of group		
		Non-smokers	Ex-smokers	Smokers
Scientific and engineering personnel	53	27	37	36
Technical assistants	112	21	40	39
Other professionals	23	13	20	67
Civil servants	47	41	37	22
Business executives	69	30	40	30
Office workers	41	21	45	34
Custom-house personnel	114	27	30	43
Officials in post offices	32	32	32	36
Mail carriers	108	22	25	53
Miners and workers in the basic metal industry	79	20	17	63
Mechanics	104	30	28	42
Workers in the metal product industry	165	22	26	52
Carpenters and painters	81	27	23	50
Construction workers	32	10	16	74
Electricians and workers in power stations	197	24	32	44
Industrial workers				
Chemical industry	164	28	30	42
Rubber and plastic industries	39	18	26	56
Printing industry	52	27	32	41
Foodstuff industry	41	17	44	39
Other industries	50	14	19	67
Operators and repairmen of stationary machines	94	25	25	50
Packers, loaders and depot workers	65	13	22	65
Operators of mobile machines	47	7	25	68
Truck drivers	44	22	25	53
Farmers and animal tenders	47	49	11	40
Other miscellaneous occupations	90	26	27	47
Total	1 990	24	28	48

Table 2. Estimated tentative rate ratios of lung cancer in relation to the percentage of nonsmokers, exsmokers, and smokers in various occupational groups.

Occupational group	Percentage of group			Estimated rate ratio ^a
	Non-smokers (R = 1)	Ex-smokers (R = 10)	Smokers (R = 20)	
<i>Least proportion of smokers</i>				
Civil servants	41	37	22	0.67
Business executives	30	40	30	0.81
Scientific and engineering personnel	27	37	36	0.88
Total study population ^b	24	28	48	1.00
<i>Greatest proportion of smokers</i>				
Miners and workers in the basic metal industry	20	17	63	1.15
Packers, loaders and depot workers	13	22	65	1.21
Operators of mobile machines	7	25	68	1.28
Construction workers	10	16	74	1.31

^a The estimated rate ratios were calculated with the following procedure: If I = total incidence, I_0 = incidence among nonsmokers, I_S = incidence caused by smoking, P_S = proportion of smokers or exsmokers in the material, and R = assumed effect of smoking expressed as a risk ratio, then

$$I = I_S P_S + I_0 (1 - P_S),$$

in which $I_S P_S$ can be expressed as $R I_0 P_S$. There are two smoking categories in the example; thus the model is expanded to

$$I = R_1 I_0 P_{S1} + R_2 I_0 P_{S2} + I_0 (1 - P_{S1} - P_{S2})$$

$$I_0 = I / [R_1 P_{S1} + R_2 P_{S2} + (1 - P_{S1} - P_{S2})].$$

I_0 of the whole material is divided by the I_0 of each occupational group.

^b Includes all groups listed in table 1.

The rate ratios applied in the example are extreme. For example, it has often been stated that the lung cancer risk for exsmokers approaches that for nonsmokers. Extreme estimates were taken to maximize the confounding effect of smoking. This exercise showed that, when occupational groups are contrasted with the general population, the confounding effect in occupational lung cancer studies is smaller than usually believed. In this study the extreme was an effect of 0.31 upon the rate ratio for construction workers, when compared with an approximation of the rate ratio of the general population.

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Received for publication: 30 August 1984