

Influence of personal characteristics, job-related factors and psychosocial factors on the sick building syndrome

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SKOV P, VALBJØRN O, PEDERSEN BV, THE DANISH INDOOR CLIMATE STUDY GROUP. Influence of personal characteristics, job-related factors and psychosocial factors on the sick building syndrome. *Scand J Work Environ Health* 1989;15:286—295. The influence of personal characteristics, life-style, job-related factors, and psychosocial work factors on symptoms of the sick building syndrome was investigated in Greater Copenhagen, Denmark. The buildings were not characterized beforehand as "sick" or "healthy." Of the 4369 employees sent a questionnaire, 3507 returned them. Multivariate logistic regression analyses of the multifactorial effects on the prevalence of work-related mucosal irritation and work-related general symptoms among the office workers showed that sex, job category, work functions (handling of carbonless paper, photocopying, work at video display terminals), psychosocial factors of work (dissatisfaction with superiors or colleagues and quantity of work inhibiting job satisfaction) were associated with work-related mucosal irritation and work-related general symptoms, but these factors could not account for the differences between the buildings as to the prevalence of the symptoms. The building factor (ie, the indoor climate) was strongly associated with the prevalence of the symptoms.

Key terms: general symptoms, mucosal irritation, office workers, prevalence.

An increasing number of complaints about discomfort and health effects in relation to time spent in residences and nonindustrial workplaces has been reported during the last 10 to 15 years. In 1983 the World Health Organization defined the concept of the sick building syndrome (1) as being characterized by an increased frequency of a number of irritative symptoms of the eyes, nose, throat, and lower airways; skin reactions; nonspecific hypersensitivity; mental fatigue; headache; and nausea and dizziness among persons staying in the building in question. Typically, the symptoms grow worse during the workday in the building and disappear or diminish after the workers leave the building. They are thus experienced as work-related. The etiology of this syndrome is currently not fully understood.

Various factors, some chemical (2), physical (3), biological (4), and psychosocial (5), have been related to the syndrome. The relative importance of these factors for the sick building syndrome has been investigated very little thus far. In addition the epidemiology of the sick building syndrome has only been analyzed in a few studies (6—10). Complaints about work-related irritation of the mucous membranes and work-related general symptoms, such as headache, fatigue, and malaise, have been found to be prevalent, and they differed significantly from one building to another without being explainable by the results of a determination of several components of indoor pollution (7—9). However no analysis has been made of the influence of potential confounders such as work functions, psychosocial factors, and life-style.

The purpose of our Danish town hall study was to examine the influence of various indoor climate factors on the prevalence of the symptoms of the sick building syndrome. The study included a large population, many different buildings, and measurements of many indoor climate factors. We have previously reported that sex, job category, photocopying, work at video display terminals, and the handling of carbonless paper were significantly associated with work-related mucosal irritation and work-related general symptoms, such as headache, fatigue, and malaise (11). In this paper we have further analyzed these associations, together with the possibility of additional associations with certain personal characteristics and psychosocial factors, and have considered whether these factors can account for the differences between the prevalence of symptoms among the office workers in the buildings studied.

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Materials and methods

The buildings

Participation in the study was requested of the municipalities of Copenhagen, Frederiksberg, and the County of Copenhagen, the total being 20 municipalities. Thirteen of them entered the study, three were excluded because comprehensive indoor climate studies had been recently carried out or were in progress, one answered too late for it to be included, and three did not want to participate. The town hall in each municipality was selected as the study buildings. In one municipality two buildings (number 120 and 121) were included. Three of the study buildings had minor building construction differences (eg, type of ventilation) and were therefore divided into two parts on the basis of these differences in the multivariate analysis. Among the 14 buildings affiliated with the town halls, two had a population of office workers (168 and 110 for buildings number 61 and 131, respectively) of a size suitable for them to be incorporated into the multivariate analysis, giving a total of 19 buildings in the analysis. The age of the buildings ranged from 1 to 80 (mean 18.8) years. Six buildings were situated in rural areas, six in urban communities, and seven in residential areas. Seven buildings had natural ventilation, and 12 had mechanical ventilation. Of these 12, eight had air intake and four only air exhaust. Of the eight buildings with air intake, two systems provided recirculation and two had humidifiers, of which, however, only one was in use. The floor area ranged from 1250 to 12 900 (mean 4418) m², and the number of employees in the buildings ranged from 84 to 419 (mean 205). The measurements of the indoor climate have already been described previously (11). The many indoor climate factors determined resulted in values mainly at the level normally considered acceptable or in values in accordance with levels previously reported.

Study population

The study population of 4369 employees from the town halls, the 14 affiliated buildings, and various smaller buildings and rooms (with 47 employees only) were sent a questionnaire. Of these persons, 3507 (2347 women, 1115 men and 45 for whom sex was not stated) returned the questionnaire; 3181 of these were office workers. The other employees worked as nurses, town hall officers, or chauffeurs or had jobs in other nonoffice or unknown job categories. The response ranged between 61 and 93 (mean 80) % for the town halls and between 57 and 100 (mean 79) % for the 14 affiliated buildings. The reasons stated for not participating in the study were sick leave, maternity leave, vacation, and, in about 10 % of the cases, unwillingness to participate. The distribution of participants by sex, age, length of time in office work, and job category is given in table 1.

This analysis deals only with the office workers. The multivariate analysis comprised 2829 office workers from the 19 buildings.

Questionnaire study

The questionnaire included questions on the work, its type, previous and present diseases, presence of symptoms from the mucous membranes, presence of general symptoms, and the frequency and time variations of such symptoms. Questions about various other symptoms, complaints about the indoor climate (draft, low temperature, etc), family and housing conditions, exercise habits, and consumption of tobacco, alcohol and other beverages were also included.

The possible categories of answers to the questions about individual symptoms were: "no," "yes, some times a year," "yes, some times a month," "yes, some times a week," and "yes, daily." We also asked about variation in the degree of symptoms, for which we employed the following categories of answers: "yes, it improves at work," "yes, it improves on days off/during weekends or vacations," "no, it is always the same," and "don't know." If a particular symptom occurred some times a week or more and improved on days off, the symptom was classified as work-related. Besides single symptoms, we employed two groups of work-related symptoms, ie, work-related irritation of the mucous membranes (at least one of the work-related symptoms of irritation or dryness of the mucous membrane of the eye, nose, or throat) and work-related general symptoms (at least one of the

Table 1. Participants by sex, age, length of time in office work, and job category.

	Men		Women	
	N	%	N	%
Age (years)				
<20	8	0.7	34	1.4
20-29	197	17.8	462	19.7
30-39	309	27.9	735	31.3
40-49	267	24.1	610	26.0
50-59	213	19.2	395	16.8
60-69	115	10.4	110	4.7
Total	1109	100	2346	100
Length of office work (years)				
0-9	306	27.8	692	30.1
10-19	324	29.4	755	32.9
20-29	234	21.2	585	25.5
≥30	238	21.6	266	11.6
Total	1102	100	2298	100
Job category				
Mayor, director	85	7.7	6	0.3
Principal	171	15.5	25	1.1
Head clerk	299	27.0	619	26.5
Clerk	163	14.8	1043	44.6
Probationary clerk	70	6.3	201	8.6
Social worker	24	2.2	159	6.8
Technical assistant	25	2.3	47	2.0
Engineer or architect	187	16.9	19	0.8
Other	82	7.4	219	9.4
Total	1106	100	2338	100

work-related symptoms of headache, abnormal fatigue, or malaise.

Statistical methods

The significance of single factors in the total population of office workers was evaluated by the chi-square test.

The multifactorial effects on the prevalences were analyzed in a logistic regression model according to Breslow & Day (12), in which the probability of response is related to a set of regression variables $x = (x_1, \dots, x_p)$ via the following equation:

$$P(x) = \frac{\exp(\alpha + \sum \beta_j x_j)}{1 + \exp(\alpha + \sum \beta_j x_j)}.$$

In our case, the probability for each individual to develop the symptom was expressed as a function of the characteristics of that same person. The betas are parameters to be estimated. These parameters were interpreted via the odds ratio. For individuals with characteristics x and x^* , respectively, the odds ratio was

$$\exp[\sum \beta_j (x_j - x_j^*)].$$

The 95 % confidence interval of the odds ratios was estimated from the corresponding confidence interval of $\hat{\beta}$ [$\hat{\beta} \pm 1.96 \text{ SD}(\hat{\beta})$].

Because of the very large number of factors investigated, we used a modified backward elimination procedure. First, one set of important variables was analyzed, ie, building, sex, age, job category, seniority, and weekly workhours. The relative importance of these variables was judged from the single factor analysis and from the results of other studies. The model was reduced with a standard backward elimination procedure until only factors jointly significant at the 5 % level were retained. These factors were considered together with the variables on work function, and a similar stepwise reduction was performed. The resulting model was analyzed, together with two different groups of variables, for psychosocial aspects of the work and personal characteristics. Again the same stepwise elimination was carried out. Finally, all independent variables retained in the foregoing analysis at a 5 % significance level were included in the final model, and a last backward elimination was performed. In this last model, only variables with a significant influence at the 1 % level were retained.

For several independent variables, different scorings were tried, but in the final analysis many were dichotomized. Variables such as age, seniority, workhours, and number of clients served per day (and others) were divided into three or five groups and analyzed as continuous variables as well. The job categories, although not all significantly different, were kept separate, as there were no natural combinations and as a combination directly based on prevalences would have been different for the mucosal irritation symptoms and the general symptoms.

Apart from the variables included in this report, many others were investigated, and the interactions between some of the significant variables were tested. For example, it was determined whether the differences between the sexes or between the job categories remained constant across the buildings. There were no marked indications of interactions between the buildings and the other significant effects.

In the analyses, the buildings were separated by a categorical variable (highly significant). In a subsequent paper this variable will be replaced by the measurements of the indoor environment in the individual town halls.

Results

Personal characteristics

In table 2 the association between certain personal characteristics of the subjects and the prevalence of work-related symptoms is shown, together with the estimated odds ratios from the final model of the logistic regression analyses. The factors shown are some basic characteristics and information given by the subjects on diseases relevant to the context of the sick building syndrome (allergy in the family, hay fever, and migraine).

The women had a substantially higher symptom prevalence than the men. Only in the first multivariate model containing the variables of building, sex, job category, and number of workhours weekly or number of hours in one's office per day was the odds ratio for women somewhat reduced compared with the crude odds ratio. In the other models of the multivariate analysis, the odds ratio did not change much during the steps. Other than sex, only hay fever and migraine were significantly associated with the symptoms in the multivariate analysis. Hay fever had an (expected) effect on work-related mucosal irritation, and migraine was associated with the work-related general symptoms (also expected).

Life-style and residential factors

The life-style factors, ie, smoking, alcohol and coffee consumption, and exercise, were only weakly associated with the symptoms. However, there was a somewhat increased frequency of work-related general symptoms among the smokers, whereas coffee drinkers tended to have a lower frequency of work-related mucosal irritation (table 3). People wearing contact lenses had a higher frequency of work-related mucosal irritation than the others.

Housing conditions seemed to have an effect on both work-related mucosal irritation and work-related general symptoms. People living in apartments tended to have a slightly higher prevalence of both work-related mucosal and work-related general symptoms than those living in other kinds of dwellings. Persons with small children or with indoor climate problems

Table 2. Prevalence of work-related symptoms (%) among the office workers by personal characteristics. (N = number of persons in the category, % = symptom prevalence, P = P-value of the chi-square test, OR = odds ratio estimated from the final model of the logistic regression analysis, 95 % CI = 95 % confidence interval, NS = nonsignificant in the multivariate analysis)

	Mucosal irritation					General symptoms				
	N	%	P	OR	95 % CI	N	%	P	OR	95 % CI
Sex			<0.0001					<0.0001		
Male	1024	20		1		1023	26		1	
Female	2118	33		1.6	1.3—2.1	2110	42		1.8	1.5—2.3
Age (years)			0.30					<0.0001		
<40	1646	29		NS		1641	40		NS	
≥40	1493	28				1489	33			
Marital status			0.02					0.13		
Married	2437	27		NS		2430	36		NS	
Single	736	32				735	39			
Allergic disposition			0.47					0.002		
No	2440	28		NS		2433	35		NS	
Yes	693	29				691	42			
Hay fever			<0.0001					<0.0001		
No	2694	27		1		2688	35		NS	
Yes	447	37		1.6	1.2—2.0	445	46			
Migraine			<0.0001					<0.0001		
No	2547	26		NS		2539	33		1	
Yes	604	37				603	52		1.8	1.4—2.2

Table 3. Prevalence of work-related symptoms (%) among the office workers by life-style and residential factors. (N = number of persons in the category, % = symptom prevalence, P = P-value of the chi-square test, OR = odds ratio estimated from the final model of the logistic regression analysis, 95 % CI = 95 % confidence interval, NS = nonsignificant in the multivariate analysis)

	Mucosal irritation					General symptoms				
	N	%	P	OR	95 % CI	N	%	P	OR	95 % CI
Smoking (g/d)			0.36					0.0004		
<10	1992	28		NS		1986	34		1	
≥10	1142	30				1139	41		1.3	1.1—1.6
Alcohol on weekdays (drinks/d)			0.19					0.18		
0	1532	30		NS		1527	38		NS	
1—4	1346	27				1343	35			
>4	74	23				74	38			
Coffee (cups/d)			0.0009					0.22		
0	478	34		1		477	40		NS	
1—6	2005	26		0.6	0.5—0.8	1997	36			
>6	666	31		0.8	0.6—1.1	666	36			
Regular exercise			0.33					0.02		
No	1443	28		NS		1435	39		NS	
Yes	1659	29				1658	35			
Contact lenses			0.03					0.95		
No	2964	28		NS		2955	37		NS	
Yes	164	36				164	37			
Residence			0.004					0.0004		
Flat	1154	31		NS		1153	40		NS	
Other	2018	27				2011	35			
Household with children <3 years of age			0.48					0.01		
No	2885	29		NS		2878	36		NS	
Yes	285	27				284	44			
Indoor climate problems in the residence			0.34					<0.0001		
No	2825	28		NS		2820	35		1	
Yes	339	31				336	48		1.6	1.3—2.2

in their residence seemed to suffer from more work-related general symptoms than other persons. However, the effect of these housing conditions was insignificant in the multivariate analysis, except for indoor climate problems in the residence (table 3).

Job category

Table 4 shows that work-related mucosal irritation and work-related general symptoms were frequent in the clerk categories. The effect of job category gradually diminished during the steps of the multivariate analysis when information on the type of work, etc., was included in the model, especially for the clerk categories and social workers. For work-related mucosal irri-

tation, the reduction was the most marked when the covariates for type of work and workhours in the office were added to the model. For work-related general symptoms, the most marked reduction was seen when the psychosocial factors of work were added. The odds ratio for work-related mucosal irritation among the clerks was, for example, reduced from 5.2 to 3.1 and that of work-related general symptoms among the social workers from 3.8 to 2.1.

Seniority, type of office and workhours

The small and weak effect of length of time in office work and number of occupants in the office was insignificant in the multivariate analysis (table 5). Num-

Table 4. Prevalence of work-related symptoms (%) among the office workers by job category. (N = number of persons in the category, % = symptom prevalence, OR = odds ratio estimated from the final model of the logistic regression analyses, 95 % CI = 95 % confidence interval)

	Mucosal irritation				General symptoms			
	N	%	OR	95 % CI	N	%	OR	95 % CI
Mayor or director	91	10	1.0		91	19	1.0	
Principal	198	20	2.5	1.0–6.1	198	23	1.1	0.5–2.1
Head clerk	927	29	2.7	1.2–6.1	923	35	1.2	0.6–2.3
Clerk	1222	35	3.1	1.4–7.3	1218	42	1.6	0.8–3.0
Probationary clerk	277	27	1.7	0.7–4.2	276	43	1.9	0.9–3.8
Social worker	186	23	1.8	0.7–4.5	186	51	2.1	1.0–4.3
Technical assistant	73	18	1.1	0.3–3.7	73	19	0.8	0.3–2.2
Engineer or architect	206	10	1.7	0.7–4.4	206	18	1.0	0.5–2.1

Table 5. Prevalence of work-related symptoms (%) among the office workers by seniority, type of office, workhours, time spent in the office, and hours working outside the town hall. (N = number of persons in the category, % = symptom prevalence, P = P-value of the chi-square test, OR = odds ratio estimated from the final model of the logistic regression analyses, 95 % CI = 95 % confidence interval, NS = nonsignificant in the multivariate analysis)

	Mucosal irritation					General symptoms				
	N	%	P	OR	95 % CI	N	%	P	OR	95 % CI
Length of time in office work (years)			0.76					0.01		
<20	1880	29				1875	39			
≥20	1284	28		NS		1280	34		NS	
Number of occupants in the office			<0.0001					<0.0001		
1	947	24				944	33			
2–4	1393	27		NS		1389	35		NS	
≥5	831	36				829	44			
Workhours (h/week)			0.93					0.02		
<20	202	28				200	29		1 ^a	
21–39	580	28		NS		579	40			
≥40	2380	29				2374	37		1.6 ^a	0.8–3.5
Length of time in the office (h/d)			<0.0001					<0.0001		
≤6	944	23		1		941	31			
7	1012	33		1.5	1.2–1.9	1008	37		NS	
≥8	1199	30		1.1	0.9–1.4	1197	41			
Length of time working outside the town hall (h/week)			<0.0001					<0.0001		
≤5	2875	30				2866	38			
>5	235	14		NS		235	22		NS	

^a Analyzed as a continuous variable: the OR for a full-time (40 h) compared with a part-time (20 h) office worker is 1.6 ($\beta = 0.023774/h$).

ber of workhours per week, when analyzed as a continuous variable, and hours in one's office during the day had a significant effect on the prevalence of work-related mucosal irritation and work-related general symptoms. These two covariates were significant in the multivariate analysis when added separately to the model. When they were added together, only number of workhours per week had an effect on work-related general symptoms, whereas hours in one's office per day had an effect on work-related mucosal irritation (table 5). The effect of number of hours worked outside the town hall building became insignificant in a model containing workhours per week and hours in one's office per day.

Type of work

Various common types of work in a town hall office, other than writing and typing (which were not asked about) were related to the prevalence of symptoms (table 6). It was found that the handling of carbonless paper and the handling of carbon paper were significantly associated with the occurrence of work-related mucosal irritation and work-related general symptoms, as were photocopying and work at video display terminals. The number of clients was clearly associated with the occurrence of work-related general symptoms, but not with work-related mucosal irritation.

In the multivariate analysis, the handling of carbonless paper was the only covariate with a significant effect on work-related general symptoms.

Handling carbonless paper weekly or daily, photocopying more than 25 sheets weekly, and working at a video display terminal more than 1 h some times a week or daily had a significant effect on work-related mucosal irritation.

Psychosocial factors

All the psychosocial factors of work examined are shown in table 7. They were all strongly associated with either work-related mucosal irritation or work-related general symptoms in the multivariate analysis when added separately to the model. When all the psychosocial factors were included in the analysis, only dissatisfaction with one's superior and the feeling that the quantity of work inhibits one's job satisfaction had a significant effect on work-related mucosal irritation. The possible mental strain of the combination of little influence on the organization of the daily work and a high workplace has been suggested by Karasek et al (20). In the present study it was self-assessed, and office workers considering their workplace too fast and feeling that they had only some or little influence on the organization of their daily work had a significantly higher odds ratio for general symptoms. The test probability for the effect of job category and the com-

Table 6. Prevalence of work-related symptoms (%) among the office workers by work function. (N = number of persons in the category, % = symptom prevalence, P = P-value of the chi-square test, OR = odds ratio estimated from the final model of the logistic regression analyses, 95 % CI = 95 % confidence interval, monthly or less = no, sometimes a year or sometimes a month, weekly or daily = some times a week or daily, NS = nonsignificant in the multivariate analysis)

	Mucosal irritation					General symptoms				
	N	%	P	OR	95 % CI	N	%	P	OR	95 % CI
Handling carbonless paper			<0.0001					<0.0001		
Monthly or less	1648	24		1		1643	31		1	
Weekly or daily										
≤25 forms	1290	32		1.3	1.1—1.6	1288	41		1.4	1.1—1.7
>25 forms	183	43				181	56		1.6	1.1—1.7
Handling carbon paper			<0.0001					<0.0001		
Monthly or less	1855	25		NS		1849	33		NS	
Weekly or daily										
≤25 forms	1243	33				1240	41			
>25 forms	67	39				67	52			
Photocopying			<0.0001					0.002		
Monthly or less	233	22		1		233	30			
Weekly or daily										
≤25 sheets	2490	27		1.5	1.2—2.0	2484	36		NS	
>25 sheets	447	37				444	43			
Work at video display terminals			<0.0001					0.02		
Monthly or less	2005	26		1		2001	35			
Weekly or daily										
≤1 h	849	30		1.6	1.2—2.1	845	40		NS	
>1 h	308	41				307	41			
Number of clients per day			0.18					0.008		
0	872	27				870	33			
1—5	1313	28		NS		1310	37		NS	
6—10	384	30				383	41			
>10	325	33				325	41			

Table 7. Prevalence of work-related symptoms (%) among the office workers by psychosocial factors. (N = number of persons in the category, % = symptom prevalence, P = P-value of the chi-square test, OR = odds ratio estimated from the final model of the logistic regression analyses, 95 % CI = 95 % confidence interval, NS = nonsignificant in the multivariate analysis)

	Mucosal irritation					General symptoms				
	N	%	P	OR	95 % CI	N	%	P	OR	95 % CI
Influence on organization of the daily work			<0.0001					<0.0001		
High	1384	25				1380	32			
Some/little	1778	31		NS		1773	40		NS	
Varied work			<0.0001					<0.0001		
Yes	2039	26				2035	34		1	
No	1128	33		NS		1123	42		1.3	1.1—1.6
Satisfaction with superior			<0.0001					<0.0001		
Yes	2296	26		1		2290	34			
No	829	36		1.7	1.4—2.0	826	44		NS	
Satisfaction with colleagues			0.002					<0.0001		
Yes	2226	27				2720	34		1	
No	437	35		NS		434	52		2.0	1.6—2.6
Work speed			0.11					<0.0001		
Not too fast	2236	28				2230	34			
Too fast	923	30		NS		920	43		NS	
Quantity of work inhibits job satisfaction			<0.0001					<0.0001		
No	1610	25		1		1606	30		1	
Yes	1547	32		1.4	1.1—1.7	1544	44		1.7	1.4—2.1
Little influence and high workspace			0.002					<0.0001		
No	2666	27				2658	34		1	
Yes	476	34		NS		475	50		1.4	1.1—1.7

bination of little influence and high work speed varied just about 0.01 in the last step of the stepwise procedure of the multivariate analysis (2572 persons) and in the final model (2597 persons). Thus both were retained in the model.

The buildings

In figure 1 the crude odds ratios for the occurrence of work-related mucosal irritation and work-related general symptoms in the 19 buildings included in the study are shown along with the adjusted odds ratios. The adjusted odds ratios were derived from the final model in the multivariate analysis. Some buildings changed their rank order, and in some cases the difference between the crude and adjusted odds ratio was substantial in comparison with the variation between the buildings. But the odds ratio between the buildings with the highest prevalence and those with the lowest prevalence was still about three.

Discussion

This study was not undertaken at the request of either the management or the employees, as most studies of the sick building syndrome have been (13, 14). The buildings and their employees were chosen because we wanted to examine a uniform population with equal socioeconomic status and type of work, but exposed to different indoor climate conditions.

We have previously reported that the many indoor climate factors determined in this study resulted in values mainly at the levels normally considered acceptable or in values in accordance with levels previously reported. However, there was a considerable variation between the buildings as to some of the indoor climate parameters (11). The prevalence of work-related mucosal irritation and work-related general symptoms differed between the buildings too, and the symptom prevalence was significantly associated with sex and some job-related factors.

Using multivariate logistic regression analyses, we have studied these and other potential risk factors for the symptoms. An important finding was that, although work-related mucosal irritation and work-related general symptoms were significantly associated with some of the personal characteristics, job-related factors, and psychosocial factors of work, there was still a highly significant association between the symptoms and the building factor. Thus the observed differences in prevalences among the populations in the buildings cannot be explained by different compositions of employees.

Among the many personal characteristics, life-style factors, and residential factors analyzed, sex seemed to be the most important risk factor. In common with other studies, our investigation revealed that women had a higher prevalence of work-related mucosal irritation and work-related general symptoms than men

(10, 15), even when other important factors, such as job category, were taken into consideration.

Persons with a medical history of hay fever (14 %) had a higher risk for work-related mucosal irritation, probably owing to the nonspecific hypersensitivity of the mucous membrane connected with this disease.

Persons suffering from migraine had a higher risk for work-related general symptoms, a reasonable finding, since work-related headache is one of the symptoms in the group of work-related general symptoms. In an interview study of a random sample of the adult Danish population, smoking was significantly associat-

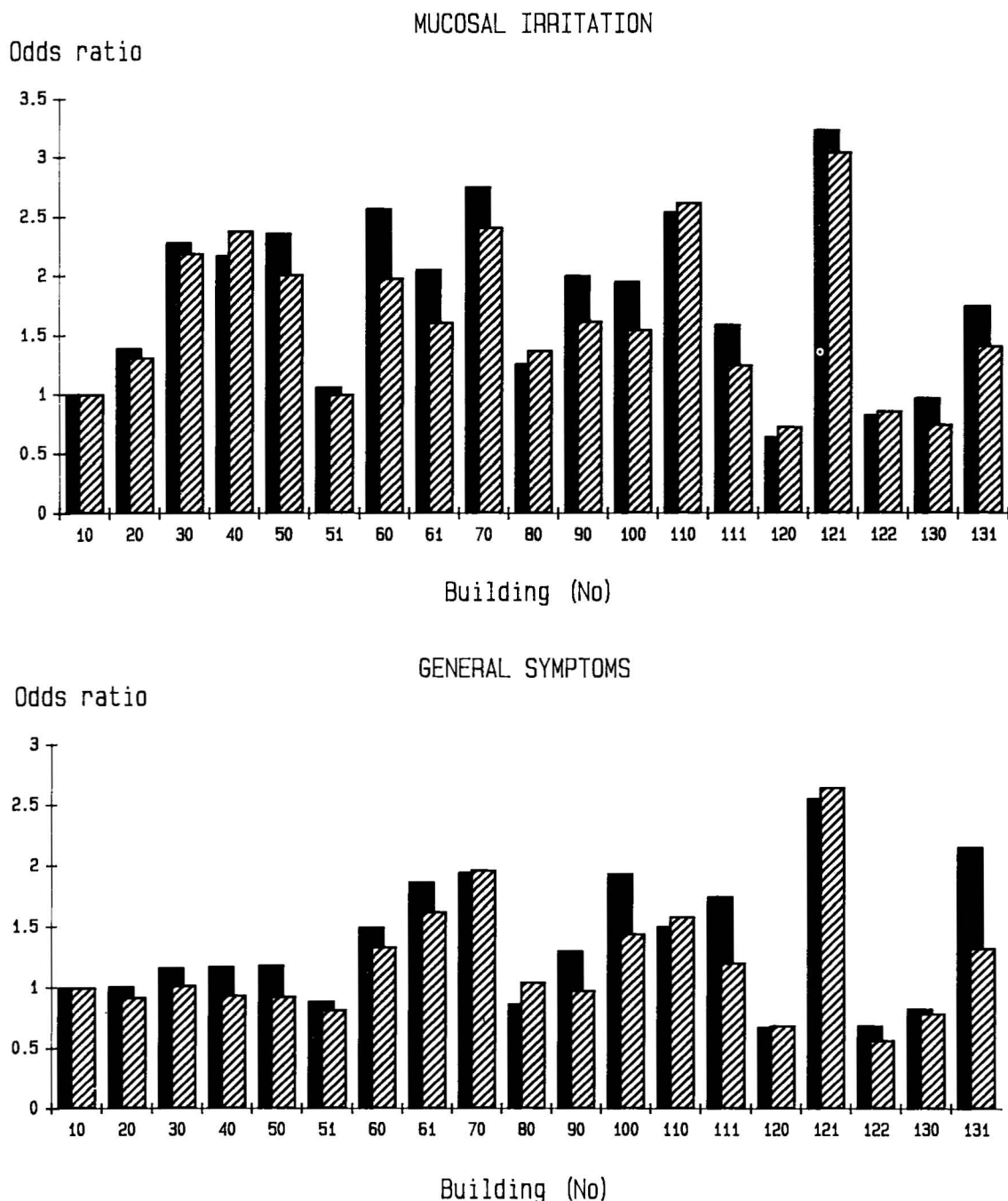


Figure 1. Crude and adjusted odds ratio determined for work-related mucosal irritation (upper figure) and work-related general symptoms (lower figure) among the office workers in 19 buildings. (The crude odds ratio is shown by the filled-in bars and the adjusted odds ratio by the hatched bars). The adjusted odds ratio was estimated from the final model of the logistic regression analysis.

ed with both work-related mucous membrane irritation and work-related headache (10). In this study, smoking more than 10 g of tobacco a day was significantly associated only with the occurrence of work-related general symptoms, and the effect was weak (odds ratio 1.3).

Coffee is known to have a symptom-relieving effect on headache, but there was no association between coffee consumption and work-related general symptoms in our analyses. However, people drinking coffee had a lower risk for work-related mucosal irritation than those not drinking coffee. This is probably a casual finding; it might also be that those who do not drink coffee form a sensitive section of the population.

A minor portion (11 %) of the office workers reported a variety of indoor climate problems in their residence. Generally, they had a higher risk for work-related general symptoms than those without such problems.

The job-related factors seem to be important risk factors for work-related mucosal irritation and work-related general symptoms. Workhours per week and the average hours per day which the office worker stayed in the same office during a workweek somehow reflect the same job-related factor, since in the multivariate analyses they were mutually exchangeable. People staying 7 h/d had more work-related symptoms than those staying less and also more work-related symptoms than those staying 8 h or more; this finding suggests that the problem was not merely a matter of the number of hours spent in the office.

Handling carbonless paper, photocopying, and working with video display terminals have previously been found to be associated with work-related mucosal irritation and work-related general symptoms (16, 17). Although this population of office workers handled only minor quantities of carbonless paper, photocopied few sheets of paper, and worked few hours at a terminal, these factors were significantly associated with the work-related symptom prevalence. This finding emphasizes the importance of considering these factors in the study of indoor climates.

Some of the influence of job category on the prevalence of work-related mucosal irritation and work-related general symptoms could be ascribed to work function and psychosocial factors of work, but, even when adjusted for these covariates, job category still showed a highly significant association with this prevalence. The effect of job category could either be due to uninvestigated work functions and psychosocial factors or to a general tendency to allocate a different indoor climate to the different job categories.

Social and psychological aspects of work have been related to complaints about indoor climate and work-related symptoms (5), and in some cases employees have been accused by employers of being hysterical. The symptom pattern of the sick building syndrome is not very typical for mass psychogenic illness, and the course of the sick building syndrome is endemic

rather than epidemic in contrast to mass hysteria (18, 15), even though the possibility of major psychogenic factors has to be considered.

Indeed, highly significant associations between the work-related symptom prevalence and the psychosocial factors were found, and, as expected, the impact on the occurrence of work-related general symptoms was more pronounced than that on work-related mucosal irritation. However, the psychosocial factors asked about in this study could not explain the overall variation between the buildings as to work-related symptom prevalence, but the multivariate analyses indicated that these factors had a substantial impact on the recorded differences between the job categories. It is interesting to note that the adjusted odds ratios for work-related general symptoms were higher for persons who felt that their workplace was high and that they had little influence on work organization, a combination which is considered to produce mental stress (20).

The symptoms and the independent variables were derived from the questionnaire, but information about age, sex, job category, and building was checked from the data of the clinical study and employment lists. The other factors were based on self-reported information, and people suffering from symptoms may be highly aware of what they are exposed to or those exposed to suspected factors may report symptoms more frequently. In both cases the associations between the occurrence of symptoms and the exposure to carbonless paper, photocopying, and video display terminals would be explained. However, the study was introduced as a general study of the indoor environment that especially emphasized the measurement of the indoor climate, and the results are in accordance with those of other such studies.

This study dealt with a selected population of office workers in a geographically selected population of buildings and thus was not intended to be a representative sample of all office workers or even civil servants. Nevertheless, the prevalence of work-related mucosal irritation reasonably agrees with that of a study of a representative sample of the adult Danish population (10), in which the estimated prevalence of work-related mucosal irritation at work for office workers was 44 % for women and 25 % for men, in comparison with 21 % for women and 12 % for men in the general population.

In conclusion, the building factor was strongly associated with the prevalence of work-related mucosal irritation and work-related general symptoms, and the results supported the concept of using the term "sick building syndrome," but other factors such as sex, job-related factors, and psychosocial factors must be accounted for. Whether the building factor is related to special characteristics of the building or to the measurements of the indoor climate will be discussed in a subsequent paper.

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