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CHRONIC OBSTRUCTIVE PULMONARY DISEASE IN FEMALE ASBESTOS WORKERS

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The symptoms and syndromes characteristic of chronic obstructive pulmonary disease were studied in a group of female asbestos workers and in a group of control women by means of the British Medical Research Council's examination technique. The prevalence rates of all the symptoms and syndromes were higher in exposed women. The differences related to the prevalence of wheezing, dyspnoea of grade 1 and obstructive ventilatory impairment were statistically significant ($P < 0.05$). Taking into account a fair comparability of the contrasted groups with regard to the relevant characteristics these results were considered as suggesting a possible causal relationship between occupational exposure to asbestos dust and chronic obstructive pulmonary disease. Further studies, however, are needed to clarify better the nature of the observed association.

The role of occupational exposure to asbestos dust in the production of chronic obstructive pulmonary disease is not clear. In some studies functional abnormalities indicative of this disease have been demonstrated in up to one half of examined asbestos workers (1–3). Recently *Jodoin* et al. (4) have found that in some workers from asbestos mines there is a decrease in maximal expiratory flow despite an increase in driving pressure (increase in elastic recoil). The authors assumed that the changes responsible for the increased elastic recoil had a peribronchiolar rather than an alveolar location causing in that way an airways narrowing and consequent air flow obstruction. These findings, however, are not in agreement with the results obtained in some other studies (5–10). *Murphy* et al. (5, 6), for example, found that obstructive pulmonary disease was equally common in ship pipe coverers and controls,

In this study the prevalence of symptoms and syndromes characteristic of chronic obstructive pulmonary disease was examined in a group of female asbestos workers and in a group of adequate controls. The purpose of the study was to obtain more data on the relationship between occupational exposure to asbestos dust and this disease.

SAMPLE AND METHOD

Among female workers in a factory of asbestos products (Ploče, Yugoslavia) those employed for 3 or more years were selected for the study. A control group was made up of women who reside in the same geoclimatic region and who have not been exposed to occupational respiratory hazards. These women were wives of a group of industrial workers and their socioeconomic status was similar to that of exposed women. The examinations were done in periods of stable weather in order to avoid as much as possible the influence of climatic factors and acute respiratory infections on the validity of objective findings. Exposed women were examined before, during or after the shift. The data about respiratory symptoms, occupation and smoking habits were obtained by means of the British Medical Research Council Questionnaire. Simple tests of ventilatory lung function were performed on the waterless spirometer Pulmonor. The women were told about the nature of testing and instructed in the way of cooperation. The tests were performed in the standing position and a nose clip was used. Every woman did the forced vital capacity maneuver at least three times. From one of two identical tracings forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1) were measured. The inaccuracy occasionally seen at the beginning of forced expirogram as a consequence of a submaximal effort was corrected by an extrapolation of the steepest portion of the curve on the base line. FEV_1 was read out from this intersection. Observed values of FVC and FEV_1 were expressed as the percentages of the predicted values and FEV_1 was also expressed as the percentage of the observed vital capacity. Predicted values were those developed by *Kory* et al. (11). Physical examination did not disclose the

Table 1.

Physical characteristics and smoking habit in exposed and control group

	Exposed group N = 55		Control group N = 81	
Mean age (years)	38.3 ± 7.8		38.1 ± 9.4	
Mean height (cm)	160.3 ± 6.1		160.4 ± 3.2	
Mean weight (kg)	67.1 ± 9.7		67.2 ± 11.3	
Smoking habit*				
Nonsmokers	47	(83.7)	80	(98.8)
Ex-smokers	1	(1.8)	0	(—)
Present smokers				
light	6	(10.9)	1	(1.2)
moderate	2	(3.6)	0	(—)
heavy	0	(—)	0	(—)

* Smoking categories were done according to the amount of cigarettes consumed during the life time. Criteria used were those developed by Brinkman and Coates (12).

conditions which might cause the symptoms and/or ventilatory impairments similar to those found in chronic obstructive pulmonary disease. Physical characteristics and smoking habit in the two groups of women are presented in Table 1. As can be seen there was practically no difference in age, height and weight between two groups. All control women, except one, were nonsmokers. Among exposed women there were eight present smokers and one ex-smoker. The following symptoms and syndromes were studied:

1. increased phlegm production in the morning and during the day or night for three winter months longer than the last two years (in further text: chronic phlegm),
2. wheezing in the chest not necessarily associated with colds (in further text: wheezing),
3. shortness of breath only when hurrying on the level or climbing up the hill (in further text: dyspnoea grade 1),
4. shortness of breath when walking at own pace on the level or doing any effort smaller than that one (in further text: dyspnoea grade 2–4,
5. FEV_1/FVC ratio from 70 to 75%,
6. FEV_1/FVC ratio below 70%,
7. FEV_1/FVC ratio above 75% and one or more symptoms under numbers 1, 2 and 4 (in further text: $FEV_1/FVC > 75\%$ with symptom/s/),
8. FEV_1/FVC ratio from 70 to 75% and one or more symptoms under numbers 1, 2 and 4 (in further text: $FEV_1/FVC = 70–75\%$ with symptom/s/),
9. FEV_1/FVC ratio below 70% and one or more symptoms under numbers 1, 2 and 4 (in further text: $FEV_1/FVC < 70\%$ with symptom/s/).

The prevalence rates of these symptoms and syndromes and also the mean values of the ventilatory function tests were compared in exposed and control women and also in women exposed up to 10 years and in those exposed over 10 years. The significance of the differences was examined by Student t-test.

The concentration of dust particles in all departments where women were employed was above maximally permitted levels in Yugoslavia. The degree to which each woman was exposed was difficult to estimate. The mean duration of exposure for all women was 9.7 years with a range from 3–14 years. Twenty three women were exposed from 3–9 years and 32 were exposed from 10–14 years.

RESULTS

As seen from Table 2, the prevalence of all the symptoms and syndromes was higher in the exposed group than in controls. The differences related to the prevalence of wheezing, dyspnoea grade 1 and ob-

structive ventilatory impairment were statistically significant ($P < 0,05$). The mean values of all the ventilatory function tests were significantly lower in the exposed group ($P < 0,01$) (see Table 3). In Tables 4 and 5 the prevalence of symptoms and syndromes and mean values of ventilatory function tests respectively are presented in two groups of women with different duration of exposure in asbestos plant. The prevalence

Table 2.

*Respiratory symptoms and syndromes in exposed and control group**

Symptoms & Syndromes	Exposed group N = 55		Control group N = 81		P
Chronic phlegm	4	(7.3)	1	(1.2)	> 0.10
Wheezing	9	(16.4)	2	(2.5)	< 0.01
Dyspnoea grade 1	37	(67.3)	17	(21.0)	< 0.01
Dyspnoea grade 2–4	2	(3.6)	1	(1.2)	> 0.10
FEV_1/FVC ratio regardless of symptoms					
70–75%	19	(34.5)	10	(12.3)	< 0.01
< 70%	14	(25.4)	9	(11.1)	< 0,05
FEV_1/FVC ratio with symptom/s/					
> 75%	5	(9.1)	3	(3.7)	> 0.10
70–75%	2	(3.6)	0	(—)	
< 70%	4	(7.3)	0	(—)	

* Symptoms and syndromes are fully described in text. In this table and in Table 4 numbers of observations are outside parentheses and percentages are in parentheses.

Table 3.

Pulmonary function data in exposed and control women

	Exposed Group N = 55 Mean	SD	Control Group N = 81 Mean	SD	P
FVC (liter)	3.06	± 0.54	3.32	± 0.56	< 0.01
FVC (% predicted)	94.7	± 14.0	102.9	± 15.1	< 0.01
FEV_1 (liter)	2.22	± 0.48	2.81	+ 0.50	< 0.01
FEV_1 (% predicted)	79.3	± 13.1	91.5	± 13.8	< 0.01
FEV_1/FVC%	72.8	+ 7.2	78.2	± 8.6	< 0.01

of chronic phlegm, wheezing and obstructive ventilatory impairment was higher and the mean values of FVC and FEV_1 were lower in women with longer exposure. The differences, however, were not statistically significant.

Table 4.

Respiratory symptoms and syndromes in nonsmoking female asbestos workers by duration of exposure

	Exposed < 10 years N = 22		Exposed > 10 years N = 24		P
Chronic phlegm	1	(4.5)	3	(12.5)	> 0.10
Wheezing	2	(9.1)	6	(25.0)	> 0.10
Dyspnoea grade 1	14	(63.6)	17	(70.8)	> 0.10
Dyspnoea grade 2–4	1	(4.5)	1	(4.2)	
FEV_1/FVC ratio regardless of symptoms					
70–75%	12	(54.5)	7	(29.2)	> 0.10
< 70%	5	(22.7)	9	(37.5)	> 0.10
FEV_1/FVC ratio with symptom/s/					
> 75%	1	(4.5)	4	(16.7)	> 0.10
70–75%	0	(—)	1	(4.2)	—
< 70%	2	(9.1)	2	(8.3)	—

Table 5.

Pulmonary function data in nonsmoking female asbestos workers by duration of exposure

	Exposed < 10 years N = 22		Exposed > 10 years N = 24		P
FVC (% predicted)	95.2	± 14.3	92.0	± 15.9	> 0.10
FEV_1 (% predicted)	79.5	± 13.0	76.4	± 14.2	> 0.10
FEV_1/FVC%	72.0	± 5.0	72.8	± 9.8	—

DISCUSSION

If one assumes that symptomatic or asymptomatic women with FEV_1/FVC ratio below 70% have obstructive pulmonary disease, then the difference in the prevalence of this finding between the exposed and control group suggests clearly that an association between occupational exposure in this factory and chronic obstructive pulmonary disease does exist. A higher prevalence rate of this finding in women with longer exposure than in women with shorter exposure suggests further a certain strength of the association observed, particularly if one assumes that the prevalence in women with longer exposure was underestimated due to a stronger effect of self-selection process in this group. The possible role of smoking as a cause of this association can be neglected. Among 14 women with FEV_1/FVC ratio below 70% there was only one smoker.

The role of other factors such as age and those related to socioeconomic status and geoclimatic characteristics of the residence place is probably not significant since the contrasted groups were fairly comparable with regard to these factors. In considering occupational factors as possible causes of this association asbestos dust should be in the first place. Other inorganic dusts, such as that of talc, kaolin, graphite, barite and iron oxide and some vegetable dusts, though present in much lesser concentrations, should also be taken into account. Further studies are, therefore, needed to clarify better the nature of the association observed.

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Sažetak

KRONIČNA OPSTRUKTIVNA BOLEST PLUĆA U RADNICA IZLOŽENIH AZBESTNOJ PRAŠINI

U skupini radnica zaposlenih više od tri godine u tvornici azbestnih proizvoda u Pločama i u odgovarajućoj kontrolnoj skupini žena ispitana je prevalencija simptoma i funkcijskih oštećenja karakterističnih za kroničnu opstruktivnu bolest pluća. Primjenjena je tehnika ispitivanja koju je preporučio Britanski savjet za medicinska istraži-

vanja. Stopa prevalencije ispitivanih simptoma i nalaza bila je veća u eksponiranoj skupini. Razlike koje se odnose na prevalenciju fićukanja u prsima, otežanog disanja prvog stupnja i opstruktivnog poremećaja ventilacije bile su staistički značajne ($P < 0.05$). S obzirom na to da su žene u uspoređenim skupinama bile približno jednake dobi, sličnog ekonomskog stanja i uglavnom nepušači, uočena povezanost ovih simptoma i nalaza s ekspozicijom radu u tvornici azbestnih proizvoda, upućuje na mogućnost postojanja uzročne veze između azbestne prašine i kronične opstruktivne bolesti pluća. Narav ove povezanosti potrebno je, međutim, dalje istraživati.

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