

DECREASED LUNG FUNCTION AND EXPOSURE TO FORMALDEHYDE IN
THE WOOD WORKING INDUSTRY. A FIVE-YEAR FOLLOW-UP.

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In an earlier cross-sectional study 47 formaldehyde glueing workers and 20 non-exposed control subjects were examined. In a follow-up study, five years later, 13 subjects had been transferred to other jobs whereas 21 were still occupationally exposed to formaldehyde. The results indicate a slow progress of lung function impairment in excess of the one due to normal ageing, at an average exposure to formaldehyde of 0.4-0.5 mg/m³ of air. The progress was significant for the FEV₇₅₋₂₅ variables. These values returned to normal among non-smokers during a four-week vacation but remained unchanged among the smokers. A dose-effect relationship was found between exposure to formaldehyde and decrease in lung function among smokers.

The present study was initiated in 1979 owing to increasing complaints about irritation of mucous membranes and respiratory passages among employees in newly-built day nurseries (the Swedish day-nursery debate) with inner walls made of chip board, and among formaldehyde exposed industrial employees. The aim of the study was to find out if formaldehyde exposure in the wood working industry can give rise to effects in the airways of acute, passing or persistent nature.

SUBJECTS AND METHODS

A total of 47 formaldehyde-exposed gluers and 20 non-exposed control subjects were examined in 1980, on a Monday before work and after an exposed workday. Thirty-four gluers and 18 control subjects were examined five years later in a longitudinal study. In the follow-up study the two groups were reexamined after five years on a Monday before work and after a four-week absence from work. The mean values for age and exposure time were the same for the three studied groups: 37 (age) and 11 (exposure) years (Table 1). Exposure to formaldehyde was measured with a portable chemisorption equipment.

Table 1
Subjects' data

	N	Smokers	Non-smokers	Age years
Study group	34	17	17	37
– currently exposed	21	10	11	37
– transferred	13	7	6	37
Controls	18	6	12	37

Air concentrations of total and respirable dust, temperature and relative humidity were measured with stationary equipment. The exposed and control subjects were interviewed using a standardized questionnaire and lung function was examined by spirometry and single breath nitrogen washout (1). Differences between exposed workers, local controls and external reference data (2-4) were analysed by Student's t-test (5). Two-tailed tests were performed.

RESULTS AND DISCUSSION

At first examination acute lung function effects mainly of obstructive nature were demonstrated with a decrease in FEV₁ of 0.17 (p=0.002) and an increase in CV% of 3.4% (p=0.002) over a workshift. However, the differences between the exposed and control workers on Monday morning before shift were not significant (p=0.08). The

Table 2
Changes over five years in excess of the ones due to normal ageing and after four weeks without exposure

	FVC L	FEV ₁ L	FEV %	MMF L/sec
Change – five years				
– All workers	-0.06	-0.12	1.5	-0.67**
– Smokers	-0.06	-0.08	-0.9	-0.35
– Non-smokers	-0.07	-0.18	-2.1*	-0.99*
Change – four weeks without exposure				
– All workers	-0.30*	0.33**	1.4	0.44
– Smokers	-0.10	0.24	2.3	0.54
– Non-smokers	-0.50*	0.40*	-0.3	0.24

* p < 0.05; ** p < 0.01

Table 3
Second examination. Differences from reference values (2)

	N	FVC L	FEV ₁ L	FEV %	MMF L/sec
Exposed	21	-0.52**	-0.43**	-	-0.42**
Transferred	13	-0.32	-0.15	0.25	0.11
Controls	18	0.03	0.15	0.08	0.37

** p < 0.01

question therefore arose whether the lung function changes demonstrated were of progressive nature or not. Five years later, 13 subjects were transferred to other jobs without exposure to irritants, whereas 21 still worked in exposure to formaldehyde. The results indicate a slow progress of lung function impairment in exposed workers as compared to local controls and to external reference data, at an average exposure to formaldehyde of 0.4-0.6 mg/m³ and about 0.3 mg dust/m³ in the air. This progress dominated among non-smokers and was significant for the MMF variables with a yearly reduction of 0.2 L/sec and a yearly increase of FEV% of 0.4%, in excess of the one caused by normal ageing (Table 2). At second examination, after five years of follow-up, the total reduction in lung function was about 0.4-0.5 L in the variables FVC, FEV₁ and MMF (Table 3) whereas CV% values were higher by 2.7% and phase III by 0.07% compared to normal values. These values returned to normal among the non-smokers during a four-week vacation but remained unchanged among the smokers (Table 2). A significant dose-effect relationship was found between exposure to formaldehyde and decrease in lung function among smokers. Thirty per cent of the transferred group had raised IgE values (> 122 kU/mL) compared to 5% in the group with ongoing exposure and 6% in the local controls. There were no differences in IgG between the three groups.

The results indicate that industrial exposure to formaldehyde in concentrations around 0.4-0.5 mg/m³ air in combination with small amounts of wood dust caused acute effects and a slow progress of lung function impairment over five years. The changes normalized over four weeks without occupational exposure in non-smokers but not in smokers indicating a chronic lung function impairment in the latter.

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Sažetak

PETOGODIŠNJA STUDIJA ISPITIVANJA FUNKCIJE PLUĆA I IZLOŽENOST FORMALDEHIDU U DRVNOJ INDUSTRIJI

U prethodnoj studiji ispitivano je 47 osoba koje su bile izložene ljeplju s formaldehidom i 20 osoba koje su poslužile kao kontrola. Pet godina kasnije ponovno su ispitivani isti radnici, što je opisano u ovoj studiji. Od početne grupe 13 radnika bilo je premješteno na druge poslove, dok je 21 radnik još uvijek bio profesionalno izložen formaldehidu. Rezultati upućuju na polagano smanjenje plućnih funkcija koje je veće od uobičajenih posljedica starenja, pri ekspoziciji formaldehidu od 0,4 do 0,5 mg/ml³ zraka. Proces je statistički značajan za varijablu FEV_{75–25}, a reverzibilan je u nepušača za vrijeme 4-tjednog godišnjeg odmora, za razliku od pušača u kojih je ireverzibilan. U pušača je nađena povezanost smanjenja plućnih funkcija ovisna o izloženosti formaldehidu.

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