

## ASSESSMENT OF HEALTH RISKS BY AIR-CONDITIONING-SYSTEMS IN A PRINTING OFFICE

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### ABSTRACT

Repeated measurements were taken in a printers' office where one case of humidifier lung disease had occurred. In water supplies of the office's air conditioning systems, the number of moulds was mainly below 50 colony-forming units (CFU)/mL, the quantity of anaerobic bacteria mostly below 10,000 CFU/mL. Twenty-nine out of the 120 participating employees complained of symptoms such as dyspnea, cough, malaise whose majority was not associated with the workplace. Twenty-eight had IgG antibodies to humidifier antigens prepared from water supplies of the air conditioning systems. 17 employees had at least one pathological lung function parameter.

There was no significant correlation between complaints, antibody levels and lung function finding. Repeated measurements within two years did not show significant changes in complaints, lung function parameters and antibody concentrations.

We conclude that the described amount of moulds and bacteria in the air conditioning systems did not cause new cases of humidifiers lung. IgG antibodies indicate exposure to antigens which are obviously of no clinical relevance.

**KEYWORDS:** health effects, pulmonary function, preventive, air conditioning, microbial growth

### INTRODUCTION

In Germany, several suspected cases of humidifier lung are every year reported to the responsible Statutory Accident Insurance Institution for Printing and Paper Processing ("Berufsgenossenschaft Druck und Papierverarbeitung"). The cause of this disease is a microbial contamination of air conditioning systems which produce large amounts of antigens distributed by humidified air. It has not been clarified whether diseased individuals can continue working in these areas after decontamination. The risk of the numerous subclinically sensitized people to contract humidifier lung is not known either.

The reason for our investigations was an index case of the humidifier lung disease of a female employee occurring after 13 years of activity in a printer's office. The patient worked in the safety area of cheque card printing of this company.

## METHODS

We performed five repeated measurements within two years comprising 120 out of the 250 employees of the printer's office. The examinations included occupational and medical case history, physical state, lung function tests, measurement of IgG antibodies to antigens present in humidifier water supplies prepared from water supplies of the air conditioning systems of the plant. Further, the number of moulds, aerobic bacteria and the concentration of antigens, proteins and endotoxins in water supplies of the air conditioning systems were quantified. For the determination of protein and antigen content of the water supplies of the air conditioning systems, 250 mL each of them were lyophilized and the dry materials were redissolved in 10 mL Aqua dest. The protein content was measured with the Lowry methods, performed in a micro assay system. The antigen content was determined by an ELISA-method using a serum sample from an employee of this printer's office suffering from humidifier lung disease. Briefly, wells of Micro-ELISA plates were coated with 100  $\mu$ L of the reconstituted dry material and incubated with the diluted serum (1:2500). After washing, the phosphatase-conjugated anti-human IgG and the substrate (p-NPP) were added. In addition, negative controls (two sera obtained from non-exposed healthy volunteers) were used. The optical density (OD) measured by 405 nm was an index for the antibody binding capacity to antigen in the water supplies of the air conditioning system. The antigen content was defined by the OD<sub>405</sub> value of the positive serum.

## RESULTS AND DISCUSSION

In the water supplies of the air conditioning systems installed in four working areas (further processing, raw material store, printer's office, cheque printing) the number of moulds were mainly below 50 CFU/mL; the quantity of anaerobic bacteria mostly below 10,000 CFU/mL. In individual samples, up to 90,000 CFU/mL were detected, however. The antigen content of water supplies did not correlate with the total number of CFU nor with the number of moulds or bacteria.

29 (24%) out of 120 participants complained of symptoms such as dyspnea, cough, malaise whose majority was not workplace-related.

28 (24%) individuals out of 118 had IgG antibodies to humidifier antigens present in the air conditioning system of the respective workplaces (Table 1). 25 among them also reacted to our standardized humidifier water antigen W. Individuals with increased concentrations of IgG antibodies to humidifier antigen (most of them were non-smokers) were more than proportionally employed in the areas "further processing" and "printer's office".

Table 1. Number of employees with specific IgG antibodies to humidifier liquid of the respective air conditioning system area.

Air conditioning area (humidifier antigen)	Number of tested employees	Number of employees with values above the cut-off	Percentage
Further processing	36	12	33.3
Raw material store	3	2	66.7
Printer's office	51	13	25.5
Cheque printing	34	2	2.9
Total		28	24%

\*Sera of 118 subjects were available. Since several employees performed activities in various air conditioning system areas (e.g. skilled manual workers) the sera of these people were tested with several humidifier antigens.

On the average, lung function values were normal in all working areas (Fig. 1). 17 employees had, at least one pathological lung function parameter (14 times bronchial obstruction, three times restriction). Five people among them reported workplace-related complaints.

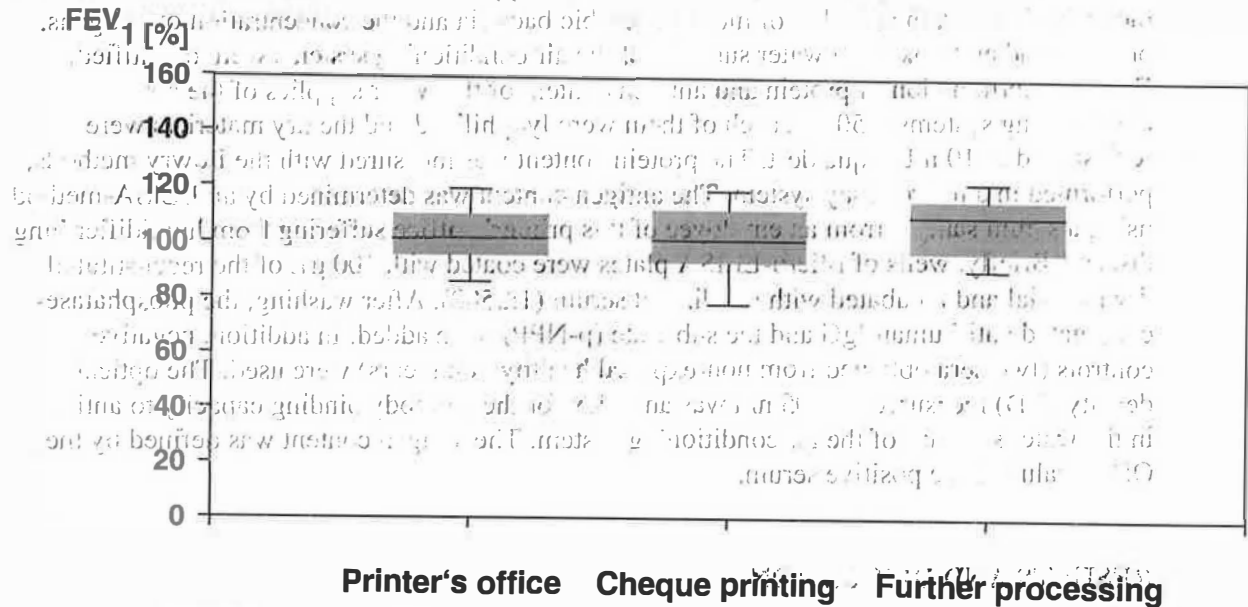


Figure 1. FEV<sub>1</sub> in per cent of the reference mean value according to Quanjer et al. (1993) in per cent in the three air conditioning areas: Box plot presentation of FEV<sub>1</sub> values in per cent of reference mean values (first examination) of subjects in the areas: printer's office; n = 53, cheque card printing; n = 32, further processing; n = 33. Significant differences do not exist.

The statistical analysis showed that there is no significant correlation between complaints, antibody state and lung function finding ( $p > 0.05$ ). The follow-up study did not indicate significant changes in complaints. Lung function parameters and antibody levels showed only in a few cases significant changes during the follow-up. A newly occurring humidifier lung was not found.

It is well known that water supplies of air conditioning systems and humidifiers are frequently contaminated by moulds and bacteria if not adequately maintained. This leads to high concentrations of antigens which are distributed in the air of ventilated rooms resulting in the risk of humidifier lung or humidifier fever [2]. The majority of exposed people may develop specific IgG antibodies to these antigens, some develop unspecific symptoms whereas the complete picture of humidifier lung is rare. Our results of this follow-up study are in accordance with the findings of previous studies [1, 3, 4]. The load of moulds (mainly below 50 CFU/mL) and of anaerobe bacteria (mostly below 10,000 CFU/mL) is obviously not associated with the risks of humidifier lung. IgG antibodies, however, indicate a clinically non-relevant antigen workplace exposure. Further follow-up investigations will show whether the clinical innocuousness also refers to long-term exposure.

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