SICK BUILDINGS: PHYSICAL AND PSYCHOSOCIAL FEATURES, EFFECTS ON HUMANS AND PREVENTIVE MEASURES

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The Symposium on Sick Buildings contained five papers, three dealing with field studies in sick buildings, and two dealing with chemical sources in the indoor environment.

The first field study (5) was performed as a case-control study with interviews of occupants of two buildings, one ventilated with mechanical ventilation, and the other not. The two buildings were situated close to each other, the occupants were of the same social class and carried out similar work. There was a high prevalence of ocular, nasal, oropharyngeal and systemic symptoms in the air-conditioned building and statistically significant excesses of these symptoms when compared with the non-airconditioned building. No environmental measurements were performed.

The second field study (4) was also performed in a sick office building. A comprehensive investigation of the thermal and atmospheric environment was performed, and it showed that these parameters were within accepted limits, so evidently the present requirements concerning thermal indoor climate and air quality are not sufficient to ensure acceptable comfort.

The two first field studies were European studies. The third was an American study (2). It appeared that in the US about one third of occupational hygiene investigations now involve sick office buildings. In most cases air monitoring with the traditional industrial hygiene methods has proven to be unproductive.

The last two studies were dealing with pollution sources. One study was performed in a factory producing vinyl floor tiles, and the workers in this industry had upper airway irritation due to a contamination of the plasticizer by benzyl and benzal chloride (6). The supplier of the plasticizer was able to have these contaminants removed, and then the symptoms disappeared.

The second study about sources measured phtalate esthers in several rooms (8). Phtalate esthers are used as plasticizers in different plastics, and they constitute up to 50% of the weight of these. They are used especially for floor- and wallcoverings, paints and electrical lines. It appears that from these materials there is a leakage of phtalate esthers into the environment. There were no studies of the complaints in these buildings.

The possible causes for the sick building syndrome have to be either psychosocial, chemical, physical or biological factors.

The symptoms of the sick building syndrome (SBS) are different from the symptoms of the masspsychogenic illness (MPI). SBS is characterized by symptoms from mucous membranes, a gradual onset and a long duration, whereas MPI is characterized by general symptoms such as headache, a sudden onset preceded by a triggering event and a delimited duration of days to weeks. SBS and MPI therefore seem to be two different syndromes with different causes.

Most of the SBS symptoms can be explained by irritation of sensory nerve fibres in the upper airways and in the face, the socalled common chemical sense. The sensory response is elicited by the fifth cranial nerve, the trigeminus. This way of action explains that irrespective of the pollutants, the same response may be reported by the occupants. Any response from these nerve fibres in the nose gives rise to a dry feeling or a burning sensation.

It is recommended that a standard questionnaire be developed. Today everybody who wants to perform an investigation of indoor air pollution has to make her own questionnaire. In other research areas, like in studies of lung disease standarized questionanires has been of great value, e.g. the British Medical Research Council's questionary on airways symptoms.

It is recommended that questionnaires and measurements in the indoor environment are performed simultaneously, so that a time lag between filling in the questionnaire and the measurements is avoided.

In the Symposium on Formaldehyde it was demonstrated that it is possible also to have objective measurements of the effects of formaldehyde on the external eye, on the upper airways and on the skin (1,3). It is recommended that objective measurements on the occupants are included in indoor air pollution studies. In studies of eye irritation the blinking frequency has proven to be of value. Other objective methods are the measurements of nasal resistance and the cytology of nasal scrapings, etc.

There is a need for objective characterization of the strength of irritants. It appears that suitable animal models exist, e.g., using the reduction in the respiratory rate of mice as a measure of sensory irritation strength. It is recommended that the most common indoor air pollutants are investigated with such methods to obtain knowledge about their relative irritation potency.

In most cases there is no obvious cause for the SBS symptoms. and in most cases the environmental measurements have revealed very small concentrations of indoor pollutants. Thus it is unproductive to perform measurements of the normal industrial air pollution type. More than 800 substances have now been described in the indoor nonindustrial environment. Strong potentiation effects in this "cocktail" are expected to take place, as the concentrations are so low that even if they are added they should not be able to cause irritation. The possibility that new pollutants may be generated in the "cocktail" should be considered. It could also be that some chemicals not yet identified are strong irritants.

Many building materials and household products contain impurities which are irritants, mutagens, or carcinogens. From a study of floor

tiles (6) it appeared that it is possible to have such impurities removed by approaching the manufacturer.

It is a difficulty that most toxicological studies are performed (only) with pure substances. In laboratory experiments analytical grade chemicals are used, but in the workplace bulk chemicals are used with impurities up to 10%. It means that most daily life exposure situations are much more complex than the exposure chamber studies with only one or a few chemical substances.

It is concluded that the present building codes do not include adequate air quality requirements. It is recommended that the industrial thresholds limit values be supplemented with lower non-industrial threshold limit values for institutions, offices, schools, etc. In such rooms no industrial processes take place, for which reason the concentrations of pollutants in the air in any case will be lower than in the classic industrial environment, where the technical processes make it impossible to avoid higher concentrations. An evaluation of indoor air pollution concentrations in the non-industrial environment using the industrial threshold limit values thus has very little meaning.

Future studies on air pollution in non-industrial indoor environments should be preceeded by a check that thermal conditions, noise and other physical parameters are within comfort limits. Except for formaldehyde we do not know today the cause of the SBS, for which reason more research has to be conducted. This research should be interdisciplinary and include measurements in the environment as well as measurements on the occupants.

Conclusions

1. The cause of the sick building syndrome (SBS) must be psychosocial, physical, chemical, or biological factors.

2. SBS symptoms are different from symptoms of mass psychogenic illness.

3. A standard questionnaire is needed. The questionnaire investigation and the measurements in the indoor environment should preferably be performed simultaneously.

4. Most SBS symptoms could be explained by irritation of sensory nerve fibers in the upper airways and in the face (common chemical sense).

5. Nerve fibers can only respond in one way. This explains why SBS cases largely have the same symptoms irrespective of the cause - formaldehyde, volatile organic compounds, dust, etc.

6. There is a great need for objective measurements of mucosal irritation in the external eyes, in the upper airways and on the skin of the occupants.

7. There is a need for screening methods to characterize irritants. Suitable animal models exist and should be used to find structure-activity relationships for relevant series of indoor air pollutants.

8. In most cases no obvious cause of the SBS symptoms is found. For example, air monitoring only shows low concentrations. Extensive air monitoring should therefore be restricted in the practical investigations.

9. Many building materials and household products contain impurities which are irritants, mutagens, or carcinogens.

10. Future studies of air pollution in the non-industrial indoor environments should only be performed after a check has been made that thermal conditions, noise, etc., are within comfort limits.

11. Except for the cases with high formaldehyde concentrations, the cause of SBS is not known.

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