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THE SICK BUILDINGS - A SUBPOPULATION AMONG THE PROBLEM BUILDINGS?

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1987
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Abstract

It is suggested, that the term "problem building" in relation to indoor climate should be used to describe any building, in which the occupants are dissatisfied with their atmospheric indoor environment. The term "the sick building", should be restricted to multifactorial problems, where no single factor exceeds the limits of generally accepted recommandations or thresholds. The sick building syndrome, may be compressed a set of criteria. a) Five general types of complaints should cover the complaints found in the building. b) Sensoric irritation must be dominating. c) Systemic symptoms e.g. from lower airways or stomach should be infrequent, d) no single cause for the problem should be identified neither in relation to the indoor environment not to the occupants, and the complaints should occur only in certain indoor environments.

Introduction

The "sick building" is one of many synonym one terms used for buildings in which the occupants report comfort or health problems, which they assign to the indoor atmospheric environment. Another use of the term is related to the problems of the investigators or engineers who are dealing with the building. A generally accepted definition of the term sick building and other terms related to problem buildings is still missing. Some investigators describe succesfully handled problems, whereas others are unable to reduce the number of complaints from the occupants. Further, a number of the terms are merely synonyms used by different groups of experts. Each of these synonyms are poorly defined and many of them have been used by different investigators to describe more than one type of buildings or complaints.

The problem buildings

The confusion around the definition and use of the terms related to buildings with indoor climate problems may have several causes. One reason is that the different groups of indoor climate experts use different definitions of the variables related to the indoor environment. For the medical experts "irritation" may be a synonym of toxic skin damages as it is known from occupational exposures. For the technical and engineering experts "irritation" may be a measure of unspecified complaints indicating the acceptance or non-acceptance of the indoor environment. For the occupants "irritation" may be a synonym for the subjective feeling of reduced comfort due to dry nose, dry eyes, dryness or stuffiness of the air. All three groups use the term "irritation" and other related terms to describe indoor air quality, but they don't necessarily understand each other.

Another problem arises as most experts is experts on one field only. Only one group of experts is normally called in for the investigation of the indoor environment in a problem building. This group is selected by the occupants or the house owner in accordance with their personal opinion about the ethiology for the problems in the building. If the problem is ex-

pected to be related to the ventilation system, engineers are contacted. If the problem is suspected to be related to sources for pollutants or to the building materials, the construction engineers contacted. If the problems are thought to be related to sensitivity of the occupants then a medical group is contacted. Normally each of these groups will be able to solve only those cases which are related to their specific expertise. They will leave a number of unsolved cases which eventually could have been solved by others. The different groups of experts further tend to use terminology specific for their area. In consequence most reports from problem buildings will be anecdotic, incomplete and uncomparable.

In conclusion each expert group will have two types of problem buildings. The first group includes those problem buildings which the expert can not handle with his/hers special knowledge. These buildings have traditionally been called the problem buildings or sick buildings. The second group includes those problem buildings which they can handle. These last problem buildings are tradionally given names, referring to an excessive exposure, a known dose-response factor, or a mechanism responsible for the specific problem. This group of buildings has too been called the sick buildings by some authors.

A more systematic classification of the different problem buildings is suggested (1). First of all, the term problem building should be used to describe buildings in which the occupants are dissatified with the atmospheric indoor environment. The term should not be used in the sence: buildings causing the investigators problems.

The multifactorial sick building syndrome

When different expert groups have filtered away from the group of problem buildings all buildings in which a causality could be identified, a group of buildings remains in which no such specific factor can be identified as causing the problems. This last group of buildings includes the sick buildings. These sick buildings have no exposure factor exceeding any generally accepted threshold of any known dose-response relation and therefore the causality may be supposed to be multifactorial. Two types of causalities may exist in this group of unsolved problem buildings. They are the unknown exposure factor and the unknown reaction due to an already known exposure factor. These two types of cases may be uncovered and at a later stage then turn up to belong to either the first catagory with a single factor problem or to the multifactorial sick buildings.

In the exposure ranges relevant for the occupational medicine, each type of exposure is normally evaluated without regard to any coexposure. Only exposure levels high enough to justify this approximation is considered. In the low exposure range usally found in the non-industrial environment, no single type of exposure may be able to cause a significant effect. The non-significant number of reactions caused by each of these low exposures may, however, add up to a significant total reaction. Furthermore an interaction between the many different exposure factors known to occur in the indoor environment may increase both the number of effects and their intensity.

Two thresholds may be relevant for evaluation of multifactorial relationships. Below a level L_1 for a given exposure factor no variation in the effect is expected due to variations of this factor. This exposure level L_1 may be called "the highest no-effect" exposure. The factor will not act as a cofactor for any other exposure factor below this level.

The other threshold, L_2, is "the lowest exposure causing a significant effect". Above L_2 a significant effect is always expected due to the exposure. Any other simultaneously occurring exposure may modify this effect, but never remove it. In a monofactorial occupational exposure L_1 and L_2 are expected to coincide. In a multifactorial exposure an exposure range exists between L_1 and L_2 in which a significant effect dependends on the added effect of simultaneous occurring exposure to other environmental factors. It is not essential that these added exposures exceed their own threshold for significant effect.

A multifactorial dose-response model for the sick building syndrome, must describe the relation between the many simultaneously occurring exposure factors in the environment, the human organisms and the observed symptoms. The atmospheric environment should be described by physical, chemical and biological variables. These variables may interact and change the exposure level of some of the factors. Increased temperature may e.g. increase the emission of certain air pollutants from building materials. The response of the human body to the combined multifactorial exposures is modified by the psychological or physical status and other contributing factors and mediating variables. The result of the total exposure is the observed symptoms and their intensity. These symptoms may be divided into sensoric, systemic, social and performance symptoms.

In the multifactorial environment, a number of feed-back mechanisms should be included in the model. One is the changed human behavior. If the environment is too hot the occupants will try to cool it etc. Depending on their knowledge or previous experiences with indoor climate, each occupants will have a set of personal opinions about the symptoms and their causes and for him there is a number of actions which correctly or not are believed to mitigate the symptoms. The occupants will initiate these actions within the limits given by the structure of the building and the room, the type of organisation, and the social, economical environment etc. As a result of such feed-back actions any indoor environment at any time will be an equilibrium between human activities to control the environment and the building itself. Very few measurements can be done without disturbing this equilibrium.

Any measure of comfort is a measure of subjective attitudes and changed attitudes may cause another feed-back mechanism such as increased attention the observed symptoms. These reactions cause the occupants to focus on certain symptoms and forget others. The sensitivity of the subjects to these symptoms is consequently changed. This mechanism may be initiated by rumours or through the investigator asking questions about specific symptoms within the building. Other examples of the psychological feed-back mechanism are changes in expectation and motivation among the exposed population. An example of this is the difference in sensitivity to the noise of a typewriter between the typists and the persons next to.

Further psychological strains exist due to economical, structural limitations within the building, the organization or the company. These limitations indicate the possible range in personal engagement and desire to change the indoor environment. If the limits are reached too often the increased attention to the problems causing the conflict will decrease the occupant's sensitivity of this problem.

The possibility of a multifactorial relationship has a number of conse-

quence for the planning of investigations in problem buildings. A complete investigation must be multidisciplinary and include analytical techniques, biological, medical expertise, as well as engineering, psychological, or even economical expertises.

The definition of the sick building syndrome suggested by a WHO expert group (2,3) includes symptoms which have been repeatedly seen in problem buildings. Buildings with this spectrum of symptoms are suggested to form a sub-group of problem buildings, which the WHO expert group called the sick buildings.

This WHO definition has never been used or tested systematically. No conclusive evidence for the existence of the syndrome or the completeness of the list of symptoms is therefore available, and for reasons mentioned previously the list of symptoms may not be understood by all in the same way. At the present stage it seems fair only to consider very general symptoms shown in table 1 and it is suggested in future work to use only these five classes of complaints. These are sensoric irritation in the upper airways and the eyes, skin irritation, neurotoxic symptoms, unspecific hyperreactions and odour and taste complaints. A number of symptoms have been used unsystematically as indicators for subjective complaints related to these five blocks of symptoms. A revised simplified definition of the sick building syndrome, therefore, may be reduced to five criteria. The above mentioned spectrum of complaints must cover the complaints found in a sick building. Sensoric irritation must be one of the dominating complaints. Systemic symptoms e.g. from lower airways or stomach should not be dominating in the spectrum of complaints and no single cause for the problem should be identified neither in relation to the indoor climate nor to the occupants. Finally the complaints should be exposure related e.g. by being related to occupancy of one specific building.

References

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Table 1. FIVE GENERAL CLASSES OF SYMPTOMS RELATED TO THE SICK BUILDING SYNDROME WITH EXAMPLES OF SYMPTOMS BELONGING TO EACH CLASS

1. Sensoric irritation in eye, nose or throat
   - dryness
   - stinging, smarting, irritating sensation
   - hoarseness, changed voice
2. Skin irritation
   - reddening of skin
   - stinging, smarting, itching sensation
   - dry skin
3. Neurotoxic symptoms
   - mental fatique
   - reduced memory
   - lethargy, drowsiness
   - reduced power of concentration
   - reduced memory
   - headache
   - dizziness, intoxication
   - nausea
   - tiredness
4. Unspecific hyperreactions
   - running nose and eye
   - asthma-like symptoms in non asthmatic persons
   - respiratory sounds
5. Odour and taste complaints
   - changed sensitivity
   - unpleasant odour or taste