2.1.3 THE USE OF STANDARDIZED QUESTIONNAIRES IN BUILDING-RELATED ILLNESS (BRI) AND SICK BUILDING SYNDROME (SBS) SURVEYS.

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INTRODUCTION

Many occupants in modern buildings are complaining of deteriorated air quality and of subtle medical symptoms that may be related to the indoor climate. The symptoms reported are common in the general population and have many causes apart from factors in problem buildings. Technical investigations of the indoor climate in these buildings mostly show concentrations of chemicals well below levels one would expect to produce any health effects and thermal and ventilation parameters which are within acceptable ranges of the national codes. Therefore, at present, the frequencies of reported symptoms are often the best source when establishing an index of the sickness (or health status) of a building. The occupants perception of the environment can be used as well to describe the indoor climate in terms of odours, perception of dry air, high temperatures etc. The problem is therefore to provide an unbiased estimate of the prevalences of symptoms and environmental perceptions with good reproducibility.

Standardization of the information from the occupants gives possibilities to make comparisons between different population samples and compare the results from different studies. Self-administered questionnaires constitute a cheap, simple and cost-effective technique to get this information and have shown to produce satisfactory estimates of SBS-symptoms removing the potential bias of an interview [1,2].

The need of developing a standardized SBS-questionnaire has been pointed out both at the Healthy Building’s Conference in Stockholm 1988 [3] and the Indoor Air Conference in Toronto 1990 [4]. In this paper a set of standardized questionnaires - the MM-questionnaires where MM stands for Environmental Medicine (Miljömedicin in Swedish) (see Appendix, p.64) - will be described and experiences presented from studies where these questionnaires have been used.

THE QUESTIONNAIRES

When creating a questionnaire it is essential to define what it is supposed to measure. A basic questionnaire used as a practical tool when assessing the indoor climate in different buildings looks different compared to a questionnaire used in an experimentally designed study intended to follow the instant effects after changing some environmental parameters or a questionnaire intended to specifically "diagnose" an illness or disease in a sample of persons.

The questionnaires presented in this paper were intended to be used as one part of a step-by-step WHO-strategy presented in 1984 and of the first type mentioned above [5]. In 1986 the first draft of a questionnaire directed to workplaces was compiled and tested according to principles used earlier [6]. Since then several versions have been tested and final versions are available for workplaces (WP), residential areas (RA) and schools (S). Versions directed to parents of children at day care centres, primary schools and residences are also available but until now not tested enough.
The basic principle used when compiling these questionnaires has been to create simple and short (at the most two pages long) questionnaires with valid and reproducible questions. By using a common core of questions in all questionnaires irrespective of whether the questionnaires are directed to problems in workplaces, homes or schools this opens the possibilities to make fair comparisons. Specific questions are compiled for the different type of environments studied.

In the WP-questionnaire there are questions concerning work conditions (stimulating job, work-load, social support at the workplace), while in the school questionnaire information about the indoor climate at home is requested, etc.

The general core of the available questionnaires have questions about the indoor climate, questions about symptoms and their presumed relation to specific environments and personal characteristics including medical history and family history of atopic diseases.

The environment questions ask "Have you been bothered during the last three months by any of the following factors at your workplace/apartment/school?" The possible categories of answers are "Yes, often" (every week), "Yes, sometimes" and "No, never". The environmental factors used include temperature factors, air quality factors and general physical factors such as noise and lighting.

The symptom questions ask "During the last three months have you had any of the following symptoms?" The symptoms include general symptoms, mucous membrane irritations and skin problems. The categories of answers are the same as mentioned for the environmental questions. In connection to each question the respondent is asked "Do you believe that it is due to your work/living/school environment?"

During the development procedure questions have been cancelled and added. The final core of questions have shown to be the best for solving indoor climate problems in practice and as a suitable base for creating measures and indices.

Psychologic factors might be of importance, especially in workplaces [7]. Our experience is, however, that they seldom are prominent factors. The very few psychosocial questions in our WP-questionnaire cannot give a relevant description of the psychosocial climate at a workplace and are used only as a rough indicator. The questions have been part of another questionnaire system which has been frequently used within the industrial health care system in Sweden [8].

Because of the often small populations involved in problem buildings - i.e. day care centres, small offices, etc. - it has shown to be rational to group symptoms together instead of using many questions (i.e. ask for "irritated, stuffy or runny nose" instead of one question for each symptom).

However, a combined question such as "During the last .... months have you had any of the following symptoms which you believe is due to the indoor climate at your workplace?", used in the first WP-questionnaire gave sometimes very confusing results. Dividing the question in two parts gave results possible to assess.

In the very first draft questionnaire the time period chosen was one month. The reason was that such a short period should make it possible to use the questionnaire shortly after sanitation activities had been done. However, several times we found that we had to dismiss people from the study population because of absenteeism during the study period (sick leave, holidays, travelling activities, etc.). We therefore changed the time period to 3 months. In Sweden the weather conditions differ tremendously during winter and summer and mostly our indoor climate problems are exaggerated during the heating-up period. We therefore usually make our indoor climate studies from October to May, but have also used the WP-questionnaire in Switzerland and USA (Salt Lake City) during the summertime [9].

Chosen environmental factors and symptoms are common in the society. We therefore try to find out if the respondents are bothered by some environmental factor or have some symptoms regularly. We usually only analyze the alternative "Yes, often".

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We have chosen not to ask for the intensity of the factors or symptoms. The reason is that it would require one additional dimension and make the questionnaire structure more complicated and this counteract our basic criteria of making simple and short questionnaires.

THE TEST PROCEDURE

The indoor climate description is based on self-reporting of the occupants. The validity of results obtained in this way is difficult to assess, but is usually justified when high test-retest reliability is at hand. Validation against the professional judgement from a physician or industrial hygienist is an accepted method, but external validation made against physical measurements or other "objective" tests are preferable. The problem is, however, that we usually do not have good physical measurements available describing the indoor climate in a comprehensive form, especially when describing air quality or odour. "Dry air" not only means low relative humidity, but a combination of low humidity and emitted gases or particles. In practice, a reversed validation is often made, in the sense that the questionnaire points to some specific environmental factors, which are thereafter verified by measurements.

The last years some interesting methods have been reported which might be used to validate some SBS symptoms. A Danish technique to study the stability of the tear film of the eye can be used in this way - at least on a group basis - and the same holds for a new Swedish technique which makes it possible to study the sensitivity of the mucous membranes of the nose [10,11].

The validity of symptom questions in the first WP-questionnaire was tested by comparing the questionnaire answers to the judgement of a physician. The agreement was acceptable for mucous membrane irritations (kappa-value 0.5-0.7, see below), but low for general symptoms such as fatigue and headache (kappa-value 0.3-0.4). External validity for background factors such as the size of the apartment showed a very high correlation (r=0.97). Test-retest reliability for smoking habits as an indicator of the validity was high for both the WP-questionnaire and the RA-questionnaire. Validating the perception of noise against noise measured by a noise level meter in 74 day-care centres showed a positive correlation [12]. During these measurements no children were inside the building and therefore the noise could be attributed to the ventilation system.

The test-retest reliability for the questions in the final versions have acceptable values presented as kappa-values. The mean for the environmental factors in the RA-questionnaire was 0.58 (with range 0.49-0.70) and for the symptoms 0.57 (range 0.40-0.70) in a study involving 137 persons. Kappa-values greater than 0.75 signifies excellent agreement in most instances, values between 0.40 and 0.75 fair to good agreement and values lower than 0.40 signifies poor agreement [13].

REFERENCE VALUES

It there are no complaints of the indoor climate among the occupants the indoor environment is taken to be healthy. Usually, however, there are some people complaining of symptoms which they presume being related to the indoor climate. The problem therefore is to find out if the prevalences of complaints and symptoms are higher than "normal". Differences in individual sensitivity, attitudes, psychosocial climate and many other factors will effect the outcome of a questionnaire study and it is therefore important to evaluate the impact of these factors whenever possible.

Creating reference values involves many practical problems. Employers or house owners are often not inclined to initiate investigations in areas where there are no apparent problems with the indoor climate. When allowed to make the study in a presumed healthy building our experiences show that it is still possible to find severe problems in the indoor climate.

The reference values for the final WP-questionnaire presented in Table 1 show the outcome from nine "healthy" buildings in Sweden (7 offices and 2 schools). The variability of the prevalences of single symptoms or
complaints is large when based on the nine buildings. It is therefore necessary to expand this reference data base. Differences in cultural and national habits probably make it necessary to create different reference values for different countries.

A general question is if you need different reference values for different occupations. Our strategy so far is to use just one type of reference values.

Reference values are available also for dwellings and schools although in an even more preliminary stage. A national survey in progress will give us more accurate values [16].

<table>
<thead>
<tr>
<th>SYMPTOMS</th>
<th>SYMPTOMS RELATED TO THE ENVIRONMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference values SD Range</td>
<td>Reference values SD Range</td>
</tr>
<tr>
<td>Fatigue</td>
<td>10 7.0 (4-21) 6 6.2 (0-17)</td>
</tr>
<tr>
<td>Feeling heavy-headed</td>
<td>5 5.4 (0-17) 4 5.3 (0-17)</td>
</tr>
<tr>
<td>Headache</td>
<td>5 4.4 (0-11) 4 3.4 (0-10)</td>
</tr>
<tr>
<td>Nausea/dizziness</td>
<td>1 1.4 (0-3) 1 1.1 (0-3)</td>
</tr>
<tr>
<td>Difficult concentrate</td>
<td>2 3.4 (0-10) 2 3.4 (0-10)</td>
</tr>
<tr>
<td>Itching ... eyes</td>
<td>6 5.4 (0-14) 5 5.2 (0-14)</td>
</tr>
<tr>
<td>Irritated nose</td>
<td>9 3.3 (0-14) 5 5.2 (0-14)</td>
</tr>
<tr>
<td>Hoarse, dry throat</td>
<td>5 3.2 (0-8) 4 2.6 (0-7)</td>
</tr>
<tr>
<td>Cough</td>
<td>3 4.1 (0-10) 2 2.6 (0-7)</td>
</tr>
<tr>
<td>Dry .. facial skin</td>
<td>5 4.0 (0-14) 2 3.6 (0-10)</td>
</tr>
<tr>
<td>Scaling .. cars</td>
<td>6 2.8 (0-14) 2 2.0 (0-4)</td>
</tr>
<tr>
<td>Hands dry .. red skin</td>
<td>4 2.8 (0-5) 2 2.0 (0-5)</td>
</tr>
</tbody>
</table>

**EFFECT MEASURES**

When assessing the results of a questionnaire study different effect parameters are used such as prevalences of specific symptoms (headache, cough, etc.), symptoms grouped together (general symptoms, mucous membrane irritations, skin problems) or different indices (building symptom index, etc) and measures (average number of symptoms per person, etc). Analyses of symptom pattern is another technique well established in the neuro-psychological litterature. The use of some of the parameters mentioned will be demonstrated later in this paper. So far no general view has emanated which is the most relevant measure.

**STRATEGY**

Especially when evaluating indoor climate problems in situations where the occupants are frustrated and where no positive communication exists, it is important to administer the questionnaire with care, so as not to get to many drop-outs or overreports in the study. Informing and motivating the occupants are very important, also the involvement of those who are financially responsible for the building. Offering secrecy is crucial for getting high
participation. Giving the results back without unnecessary delay is also essential, especially if a follow-up investigation is planned. The key point is many times to initiate a process where the interests of the occupants are taken in account.

It is important to present the results obtained in such a way that they are easily understood. One effective way is to present the results in the form of graphs giving the prevalence figures for environmental factors and symptoms. In the same graphs the reference values are plotted. This technique is in reality a pattern analysis and one of the most valuable tools to make people accept the use of questionnaires.

The questionnaires should be recognized as one part of the basic study and must be completed by technical assessments and/or measurements.

Originally the questionnaire compiled was planned as a basic instrument for surveying the indoor climate. However, after five years of experience from many studies we think it is possible to use this set of standardized questionnaires, when:

- surveying the indoor climate in a building or in a sample of buildings,
- comparing the indoor climate in one building with the climate in other buildings, or from different studies where the same questionnaire has been used,
- directing the technical efforts and exposure measurements, and
- follow-up after restoring activities.

In the following examples are given where the MM-questionnaires have been used in different studies with indoor climate problems or where they have served instrument.

PRACTICAL EXPERIENCES

A. Surveys

A1. Work places, apartment houses or school buildings

(Example 1)

Shortly after the residential area with 1400 apartments close to Stockholm was built 1979-81 complaints about poor indoor air and negative health effects were reported. Technical investigations showed a lot of deficiencies in the construction and ventilation and efforts were made to solve the problems. In spite of this, the occupants continued to complain. Questionnaire studies were also carried out and showed high prevalence figures for complaints and symptoms, but besides this no assessable clues could be found.

In March 1989 a questionnaire study was initiated with the MM-questionnaires. 1809 adults answered the questionnaires (response rate 84%). The results were depicted in graphic form for the complete area. The complaints focused especially on poor air quality with unpleasant odour and dust and dirt. The symptom prevalences were generally increased in comparison to the reference area, supposed to be without larger indoor climate problems (figure 1). Especially prominent were mucous membrane irritation symptoms. Technical investigations showed that emissions from floors with self-leveling concrete with casein content was one important causing factor, but there were also other insufficiencies in the indoor climate. Special electronmicroscopic investigations of the dust showed a dust probably of textile material and particles with dimension of 10 to 30 µm of with unknown origin.
(Example 2)

In a residential area with 120 apartments the occupants complained about darkened oak parquet floor and adverse health effects. The company owning the buildings had also noticed the same discolourating effect in an area close to the target area, but no complaints had been put forward. It was decided to make a questionnaire study in both these areas and also in a neighbouring control area with different construction and with no known complaints.

The results of the study (with response rate 84% in total) are presented in figure 2. The target area had a symptom pattern close to that of the control area, but the second area had obvious problems with the indoor climate. Technical investigation showed very poor ventilation in many of the houses in the second area and in some buildings the mechanical ventilation was not working at all. Problems existed also in some houses in the target area, but not to the same extent. The ventilation systems was carefully repaired in both areas. The very quick response from the houseowner resulted in a good psychological effect and no further complaints have been reported since then.

(Example 3)

In a school with wall to wall carpet both pupils and teachers were complaining of bad indoor climate. The school building had plain roofs and several water leaks had occurred. A questionnaire study with MM-questionnaires also showed high prevalences of complaints (Fig.3). In the control school - assumed to be healthy - however, the same symptom prevalences were seen. In fact, pupils with allergic problems had even higher symptom prevalences in the control school in comparison to the target school.

From the environmental factor pattern and symptom pattern it was obvious that the main problem in the control school was poor ventilation. Carbon dioxide measurements in one of the "best" rooms also showed levels exceeding 2500 ppm. The room had hardly any ventilation at all, except when the windows were open. Unfortunately surveys in schools during the last years have shown this situation to be common.

Based on these results the local politicians have supported a restoration program of the school buildings in the community despite financial problems.

In this study it was possible to compare the symptom pattern for adult employees and pupils (Figure 3b). The presented differences can be seen in almost all investigations. Pupils very seldom report high levels of irritation of mucous membranes or skin problems even if high prevalences are seen among the adults in the same environments.

Supporting communities all over Sweden with this type of studies has given us a lot of experience and also possibilities to construct a data base for further analyses.

A2. Parts of buildings or single houses in residential areas

Within an office building, a school or a residential area there could be large differences in the indoor climate. It is therefore necessary wherever possible, to select for study logical parts within a building or an area, often different floors, rooms served by different ventilation systems, rooms with different geographic locations, different houses in residential areas etc. One problem especially in offices, is the relatively low numbers of persons in the localities. In schools this can be handled by asking the pupils - at least if they are 12 years of age or older.

(Example 4).

Complaints had been frequent for many years in an office building constructed in the beginning of the 1980s [14]. Different consultants had suggested different solutions but nothing had changed the situation. The employees were very frustrated. A study with the very first version of the WP-questionnaire was done at the same time as a
throughout a technical investigation started. The symptom pattern differed substantially in the three floors (Figure 4). By reading the diary books from the building period of the building, it was obvious that the carpets were laid on floor 1 and 2 when the slabs were still wet, but on floor 3 and 4 the slabs had possibilities to dry at least to some degree and no smell was noticeable. The floors 3 and 4 had no customers, partly because of the known problems in the building and therefore it was not possible to investigate these floors with the questionnaire technique.

The reason why the problems was much less prevalent in the basement floor was, in contrast to information in the construction papers, that another type of floor concrete was used which could be discovered in the building diaries. However, the air quality was poor even here and cold days 100% recirculated air was used.

(Example 5)

The residential area in example 1 had 14 blocks with roughly 100 apartments each. The results from the questionnaire study showed large differences in symptom prevalences between the different blocks, even if the basic symptom pattern was very similar.

An index was created as an attempt to grade the sickness of the different houses. This index called SBS3-index was defined as "the percentage of persons giving positive answers to at least one general symptom question, one question about mucous membrane irritation and one question about skin problems and presuming the symptoms being related to the indoor environment".

In figure 5 SBS3-indices are presented from this area and from some other residential areas with analogous problems. The symptom patterns are similar for the different areas, but there are substantial differences between the blocks. It is interesting to note that all control areas studied have SBS3-indices below 5%, even those objects which have been renovated. Levels higher than 10% usually indicate serious problems.

A3. Populations studies

(Example 6)

6000 office workers were selected from all office employees in workplaces with more than ten office workers in a county in the north of Sweden [15]. The second version of the WP-questionnaire was used and completed with questions about paper and VDU use besides building characteristics at work and at home. The response rate was very high (95%).

Based on this screening study case-control studies have been performed about SBS (n=450) and on skin symptoms in VDU users (n=150) with equal numbers of cases and controls. The case-control studies included a clinical and a technical part and all employees involved were examined by a dermatologist and subjected to a sociological study of the psychosocial work load.

All SBS-symptoms were more prevalent among women in comparison to men. Fatigue, feeling heavy-headed, irritated eyes, dry facial skin and headache had the highest prevalences attributed to the indoor climate.

The design of this study makes it possible to validate the skin questions, but such results are not yet published.

(Example 7)

A nationwide indoor climate survey is presently carried out in Sweden as one part of a research program "Conservation of energy in existing buildings" (ELIB). Modified versions of the RA-questionnaires are used (the modifications don't effect the standardized core of questions). Approximately 30 000 persons living in 5000 randomly sampled houses in Sweden form the study base.
The postal questionnaire study is supplemented by technical inspections on site and measurements (indoor air temperature, ventilation rate and relative humidity of the indoor air) in a subsample of 1200 houses (800 small houses and 400 apartment houses). In 200 houses more extensive measurements of the indoor climate are done, including formaldehyde and volatile organic compounds in indoor air. All measurements are of the passive, integrating type and are judged to be simple, cheap and accurate enough to be used in the present large-scale survey [16].

The design of the study will give prevalence values related to personal characteristics, building characteristics, geographic situations, etc. It also gives the possibility to validate the questions and study interrelations between indoor climate variables and variables describing the technical characteristics of a house.

(Example 8)

A 2197 person sample representative of the Norwegian population was interviewed in early spring 1990 about the indoor climate in homes and workplaces. The questions used were translations of the core questions of the RA-questionnaire completed by 24 additional questions. A majority of the persons involved were satisfied with the indoor climate at home (89%) while 57% gave the same opinion about the indoor climate at their workplace. Women reported more SBS symptoms than men. Thirty-five per cent related the symptoms to the indoor climate while 75% related them to the workplace.

Most complaint were reported by the allergic. Dry air, stuffy "bad" air and noise were the most disturbing environmental factors.

In comparison to the Swedish reference values for workplaces (Table 1) this study showed higher prevalences of workplace related symptoms and complaints.

B. Questionnaire as a tool directing technical measurements and activities

Structuring the information from the occupants early in an investigation makes it possible to use it for directing the often expensive technical measurements in an efficient way. By analyzing the graphs from the questionnaire study it is often possible to give a first judgement of possible causes to indoor climate problems. Suspected ventilation deficiencies can often be diagnosed by high prevalences of general symptoms and complaints of stuffy "bad" air, sometimes combined with dry air and unpleasant odour complaints.

If there are chemical emissions the environmental graph shows high prevalences of unpleasant odour, dry air and sometimes stuffy "bad" air combined with increased frequencies of mucous membrane irritation symptoms as in example 1. Often, however, there are a combination of ventilation and emission factors which give a more complicated pattern.

Sometimes it is possible to discover even rather subtle problems. In a study in Switzerland the questionnaire study showed very limited problems in the indoor climate in a high rise office building [9]. However, on one of the floors there was a somewhat increased prevalence of eye irritation problems and complaints of passive smoking as well as lighting. A visit to this floor clearly pointed out lighting problems with lack of good local lighting at the desks and glares in the displays of the computers.

Even if causal relation is unknown it is important to carefully observe and analyze all "signals" before more sophisticated efforts and measurements are carried out.

C. Follow-up studies

One basic principle in the WHO strategy discussed earlier, is to follow up after efforts have been made to restore the indoor climate. The standardized questionnaire described in this paper have been used in many practical
situations. Sometimes the solutions have been very cheap (1000 dollars), mostly however, the costs to restore the indoor climate can be extremely high [17].

(Example 9)

In a preschool building the personnel and the parents of the children had complained for years about poor indoor climate. A general technical assessment and some simple physical measurements combined with a questionnaire study indicated apparent insufficient ventilation but other causes could not be ruled out because of high prevalences of mucous membrane irritations. The results are shown in figure 6 before and three weeks after restoring activities were done. The general symptoms decreased quickly while especially skin problems persisted. Follow-up on two occasions after efforts had been made to dry the building construction showed only slightly better conditions and this building is still not a healthy one.

(Example 10)

In a residential area (example 1) very large resources have been allocated to restore the indoor climate (40 000 dollars per apartment). In one block with approx. 100 apartments the ventilation system was changed and some months later a follow-up study was made. It showed some improvements but still the basic problems were present, especially the complaints of odour and dust.

In another block the ventilation system was changed, the self-leveling concrete removed and the apartments fully repaired. Some months afterwards a follow-up study was made showing much better indoor climate and these changes have persisted when followed up later. Still there are some problems in this house, especially in some basement apartments where there are high humidity in the slab.

In some other blocks within the same area with smaller problems, the restoring activities have resulted in both symptom pattern and environmental factor pattern similar to what we find in "healthy" areas.

COMMENTS

Since 1983 a set of standardized questionnaires has been extensively used within the Industrial Health Care system (IHC) in Sweden. Roughly 10% of the Swedish labour forces have answered these questionnaires at least once. The comprehensive data bases created have been used to produce several reference manuals for more than 100 occupational titles. The experience from compilation and testing of these questionnaires have formed the base for the MM-questionnaires.

There is a variation in the range of symptoms covered by questionnaires used in indoor climate studies. However most questionnaires ask about general symptoms (headache, fatigue), mucous membrane irritations (eye, nose and throat) and skin problems. The wording of the questions in the MM-questionnaires are based on our experience from the IHC-system. Asking questions such as "Have you often been bothered by ...?" or "Do you often have ...?" showed to be sensitive and have acceptable specificity[6].

The ASTM draft standard proposes a symptom scale of frequencies for a six-month period using 5 response categories: never; less than once per month; 1-3 times per month; 1-3 times per week; almost every day [4]. Based on our experiences a 6-month period is too long. Because of Swedish climate conditions this would give a possible investigation period from March to May and diminish the usefulness considerably. Having 5 response categories might give more information but would also make the structure of the questionnaire more compact. This might lead to lower response rates. In most practical situations it is, anyhow, necessary to aggregate several categories in the analysis because of too low numbers in each cell.

In order to classify the symptoms as work related (or related to other specific environments) or not, at least two possibilities are available. The first one is to ask if the symptoms disappear when away from work (or specific environments), the other - as in the MM-questionnaires - to ask the respondents directly if they presume the
symptoms being related to work or specific environments. Our experience is that many times the respondents have difficulties to answer this type of questions. We usually therefore use these questions to roughly quantify the problem size in a building, but in the analysis use the symptom prevalences in total. In buildings with large indoor climate problems, 70 to 90% of those with symptoms relate them to the indoor climate, while in "healthy" buildings the analogous figures are mostly lower than 50%.

Few questionnaires have questions about the severity of symptoms. One reason is of course, that this should add another dimension to the questionnaire and counteract the wish of having a short and simple questionnaire. For us the latter principles have the highest priority. We believe that this has been the prerequisite for response rates of 85% and even higher on postal questionnaires in residential areas.

When using the questionnaire as a survey instrument, to give signals and directing technical investigations and for follow-up studies, this demands stability and reproducibility. It must be possible to make people answer the questionnaire several times. It should also be resistant against conditions outside the indoor climate sphere. In a residential area the mass media impact was very strong. Based on measurements of chemicals under the carpet (2-ethylhexanol and ammonia), one part of the area was classified as an internal control area without anybody outside the research team being informed of this. This latter area had the same type of symptom pattern as an external control area without the same floor covering material. The mass media impact did not affect the possibilities to make decent assessments.

In a residential area (example 10) activist groups gave a distinct opinion that the restoring activities with very high costs had failed. The questionnaire study (with 84% response rate) however showed almost the same complaint pattern as for the reference area - and this situation was persistent nine months later.

If the study is done in a correct way and the respondents well informed of the purpose of the study, we state that the questionnaire technique can resist effects from mass media and confounding factors.

A striking feature in the literature dealing with indoor climate problems is the suspicion of overreporting of complaints and symptoms in environments with poor indoor climate. Our experience is in contradiction to this. Validation studies from the IHC-system showed remarkably low prevalences of complaints in environments assessed by industrial hygienists to be even health threatening. An interview study made by a behaviour scientist in a residential area before the questionnaire study was made, showed that many residents - mostly elderly ones - simulated because they feared the restoration.

A study investigating the histamine-sensitivity of the mucous membrane in the nose in a residential area with high chemical exposure, showed that even people denying problems had sensitive membranes in the test [11].

It is important to analyze the effects from many individual factors (age, sex, atopic constitution, occupational status, etc.). Sometimes we see different correlations in the workplace and in homes. In a study husbands and wives in homes agreed in 85% about the indoor climate, but the wives had higher prevalences of symptoms and the symptom agreement was therefore less than 60%. In the workplace we often see large differences in how men and women judge their indoor climate. One reason for this could be that the work situation and work status is so different between men and women even if they work in the same local [9].

REFERENCES


FIG. 1  INDOOR CLIMATE

DALEN  \( n = 1809 \)
REF  \( n = 282 \)

SYMPTOMS
(yes, often) %

FEELING HEAVY-HEADED
HEADACHE
NAUSEA/DIZZINESS
DIFFICULTIES CONCENTRATING
ITCHING, BURNING OR IRRITATION OF THE EYES
IRRITATED, STUFFY OR RUNNY NOSE

FATIGUE
FEELING HEAVY-HEADED
HEADACHE
NAUSEA/DIZZINESS
DIFFICULTIES CONCENTRATING
ITCHING, BURNING OR IRRITATION OF THE EYES
IRRITATED, STUFFY OR RUNNY NOSE

HANDS DRY, ITCHING, RED SKIN
SCALING/ITCHING SCALP OR EARS
DRY OR FLUSHED FACIAL SKIN
COUGH
HOARSE, DRY THROAT

OTHER
FIG. 2

SYMPTOMS
(yes, often) %

Hands dry, itching, red skin
Scaling/itching scalp or ears
Dry or flushed facial skin
Cough
Hoarse, dry throat
Irritated, stuffy or runny nose

Other
Fatigue
Feeling heavy-headed
Headache
20%
Nausea/dizziness
40%
Difficulties concentrating
20%
Itching, burning or irritation of the eyes

TARGET AREA n=31
SECOND AREA n=15
FIG. 3A INDOOR CLIMATE Work environment MM 340 EA

TARGET SCHOOL
\[ n = 362 \]

CONTROL
\[ n = 220 \]

SYMPTOMS
(yes, often) %

Hands dry, itching, red skin
Scaling/itching scalp or ears
Dry or flushed facial skin
Cough
Hoarse, dry throat
Irritated, stuffy or runny nose

Feeling heavy-headed
Headache
Nausea/dizziness
Difficulties concentrating
Itching, burning or irritation of the eyes
Figure 5. The result of investigation of symptoms on the three floors.
FIG. 5

**SBS3 (%) SYMPTOM INDEX**

- **AREA C**
  - **PARON**
- **STOLPLYDE AREA**
  - **DOK**
  - **LÖHN**
- **GRAN, HAGSTRÖM**
- **APPAL**
- **HASSEL**
- **LÅK**
- **PLÖMMON**
- **KÖNGBÄR, KASTANJE**
- **OLVEGÅRD**

**CONTROL AREA A**

- **GÅRD 1, 4**
- **GÅRD 2, 3**
- **GÅRD 12**
- **GÅRD 14, 17**
- **GÅRD 6, 7**
- **GÅRD 8, 9**
- **GÅRD 10, 11**

**GÅR** 1 - 87
**GÅR** 2 - 89
**GÅR** 1 - 89

FIG. 6

--- BEFORE RESTORING
--- AFTER (3 WEEKS)

- Fatigue
- Heavy head
- Headache
- Nausea/dizziness
- 20% Concentration difficulties
- Itching, burning, irritation of the eyes
- Irritated, stuffy or runny nose
- Frequent colds
- Sinus problems
- Hand dry skin
- Facial dry skin
- Hacking cough
- Drying, hoarseness
- Other skin problems
- Sealing, itching, scratching
- Facial flushed skin
- Fatigue

Reference: n = 196
INDOOR CLIMATE  

BACKGROUND FACTORS  

Year of birth: 19____
Sex: male [ ] female [ ]

Do you smoke? Yes [ ] No [ ]

Work environment
Company/Institution: ____________________________
Department: ____________________________
Occupation: ____________________________
Number: ____________________________
User: ____________________________
Group: ____________________________

This questionnaire concerns your indoor climate and possible symptoms you may be experiencing.

Work environment
Have you been bothered during the last three months by any of the following factors at your work place?

Yes, often: [ ]
Yes, sometimes: [ ]
No, never: [ ]

Drainage
Room temperature too high
Varying room temperature
Room temperature too low
Stuffy "bad" air
Dry air
Unpleasant odour
Static electricity, often causing shocks
Passive smoking
Noise
Light that is dim or causes glare and/or reflections
Dust and dirt

Do you regard your work as interesting and stimulating? Yes, often: [ ]
Yes, sometimes: [ ]
No, seldom: [ ]
No, never: [ ]

Do you have too much work to do? [ ]

Do you have any opportunity to influence your working conditions? [ ]

Do your fellow workers help you with problems you may have in your work? [ ]

APPENDIX

INDOOR CLIMATE QUESTIONNAIRE  

PAST/PRESENT DISEASES/SYMPTOMS

Yes [ ] No [ ]

1. Have you ever had asthma problems?
2. Have you ever suffered from hay fever?
3. Have you ever suffered from eczema?
4. Does anybody else in your family suffer from allergies (e.g., asthma, hay fever, eczema)?

PRESENT SYMPTOMS

During the last 3 months have you had any of the following symptoms?

Yes, often (every week) [ ]
Yes, sometimes [ ]
No, never [ ]

Fatigue
Feeling heavy-headed
Headache
Nausea/dizziness
Difficulties concentrating
Itching, burning or irritation of the eyes
Irritated, stuffy or runny nose
Nose, dry throat
Cough

Dry or flushed facial skin
Scaling/itching scalp or ears
Hands dry, itching, red skin

Other

Thank you!

Translator: Cheryl Sanborn

S.N. Fagerlund, J. Backoe, C. Stenberg
Questionnaire as an instrument when evaluating indoor climate. 
Heatly Buildings. IBH, vol 3, p. 128-145