

# Comparison of Self-Administered Questionnaire with Physician Diagnosis in the Diagnosis of the Sick Building Syndrome

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## Abstract

*The aim of the study was to compare the results of a self-administered questionnaire, designed to estimate the prevalence of the sick building syndrome, with an independent medical interview and clinical opinion. Six buildings were chosen for study from a sample of 47 with known measurements of the building symptom index. One building with a high and one with a low score was selected from each of three ventilation classes (natural ventilation, air-conditioning with induction units and air-conditioning with variable air volume systems). A stratified random sample of 160 workers in these buildings was studied. Each received, in random order, a self-administered questionnaire, and a medical opinion based on a free medical history. The doctor had no access to the self-administered questionnaire at the time. The average number of work-related symptoms per worker (the building symptom index), which is used to compare one building with another, showed a good agreement between the two methods. There were, however, consistent differences between the two assessments in individual symptoms. The self-administered questionnaire produced a higher prevalence of work-re-*

*lated runny nose and flu-like symptoms, which were often regarded as being due to infections in the medical opinion. In individuals, work-related symptoms on the self-administered questionnaire were validated by the medical opinion in over 75% of cases for eye and throat symptoms, lethargy and headache. Only 31% of work-related runny nose and 21% of work-related flu-like symptoms were thought by the medical opinion to be work-related. The medical opinion identified an extra 5% of work-related symptoms that were missed on the self-administered questionnaire. The self-administered questionnaire therefore produced a satisfactory estimate of the building symptom index, removing the potential bias of an interviewer. The questions on runny nose and flu-like symptoms would be improved by including only those that occurred more frequently. The building symptom index was calculated for the six buildings twice, with separate random samples of workers completing the questionnaire two years apart. The buildings were ranked in the same order (for the building symptom index) on both occasions, again confirming the validity of the self-administered questionnaire.*

## KEY WORDS:

Sick building syndrome, Questionnaire, Medical interview, Validation, Building symptom index, Methods.

Manuscript received: 7 February 1991

Accepted for publication: 31 October 1991

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## Introduction

Questionnaires can be used either to identify individuals with particular diseases, or to provide an estimate of the prevalence of that disease for comparison between different population samples. The type of questionnaire needed for these two situations may be different. The aim of the first is to provide a sensitive and specific ascertainment of a particular disease, while the latter aims to pro-

# Diagnosis in Sick Building Syndrome

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vide an unbiased estimate of the prevalence of the disease, where sensitivity and specificity are less important than reproducibility and lack of bias. The sick building syndrome consists of a large number of symptoms which are common in the general population, and have many causes apart from working in problem buildings. We have designed a simple questionnaire to provide unbiased estimates of the prevalence of symptoms that may be due to the sick building syndrome, rather than to make specific diagnoses in each individual respondent. Our questionnaire has its main use in comparisons of one building's occupants with another, where the occupants are being used as an index of the "sickness" (or health) of the building. Nevertheless such a questionnaire has validity only if it is related to the specific diagnoses in individual respondents.

The use of standardized questionnaires is fundamental to the study of the sick building syndrome. The type of question used may alter the study result. For instance the Danish workers use a questionnaire which requires the symptoms to have been present in the last three months (Valbjorn et al., 1990), and the Dutch study included symptoms only when they were present at least weekly (Preller et al., 1990). If the cause is intermittent, such as a humidifier used only in the cold winter months, such a questionnaire may produce different results depending on its timing. Questionnaires may be self-administered or administered by an interviewer. Some have more faith if the responses are interpreted by an interviewer. Interviewers can easily introduce bias into a questionnaire by placing different emphasis on the questions, or even subtly altering the wording. It is very difficult to read the same question fifty times in one day in the same way. Studies using interviewer techniques have shown lower symptom prevalences than studies using self-administered questionnaires, raising doubts about their validity. We have developed a questionnaire designed to be sensi-

tive rather than specific, which can separate buildings according to the prevalence of its occupants' symptoms with a difference between the best and worst of more than fourfold (Burge et al., 1987). As our analysis includes symptoms which can be very infrequent (occurring more than twice over the last twelve months, and improving on days away from work), we have needed to investigate its reproducibility, and the meaning of a positive response. To achieve these aims we have used the same questionnaire to estimate the building symptom index (the average number of work-related symptoms per occupant of a building) in a different random sample of workers from six buildings measured two years apart. We have also compared the self-administered questionnaire with an independent medical interview on the same day. The aims of the study were to compare the results of a self-administered questionnaire, designed to estimate the prevalence of the sick building syndrome, with an independent medical interview and clinical opinion.

## Methods

Six buildings were chosen for study from a sample of 47 with known measurements of the building symptom index (Burge et al., 1987). One building with a high and one with a low score was selected from each of three ventilation classes (natural ventilation, air-conditioning with induction units and air-conditioning with variable air volume systems). In this way both naturally ventilated and air-conditioned buildings were studied, and buildings with symptom prevalences varying more than threefold were included. A stratified random sample of 160 workers in these buildings completed the medical interview; on the same day a larger sample of around 100 workers in each building (including the subgroup having medical interviews) completed self-administered questionnaires. If the building contained less than 120 work-

ers, all were studied. If larger numbers were employed, the sample to be studied was stratified for floor, facing and distance from the window before sampling. Each received, in random order, a self-administered questionnaire, and a medical opinion based on the same questions administered by interview followed by a free medical history. The doctor had no access to the self-administered questionnaire at the time. At the end of the interview the doctor was asked to state whether each symptom was present, and whether it was work-related, probably work-related, or not related to work. This was based on his clinical judgement after any investigation that he thought appropriate. In general, symptoms were classed as work-related if they had no other identifiable cause (such as infection or allergy to identifiable agents outside the building), occurred with reasonable frequency, regularly improved away from the building with a time course appropriate to the symptom with deterioration in the building again with an appropriate time course. He was also asked whether occupational asthma was present.

The self-administered questionnaire included the following medical section amongst 23 questions that took between 5 and 12 minutes to self-complete. It had the following preamble.

The following questions ask about your general well-being over the past 12 months. If you are undecided about your answer to any of the questions then please answer "no" to that question.

The following questions were asked.

In the past 12 months have you had more than TWO episodes of any of the following symptoms:

1. Dryness of the eyes?
2. Itching or watering of the eyes?
3. Blocked or stuffy nose?
4. Runny nose?
5. A dry throat?
6. Lethargy and/or tiredness?

7. Headache?
8. Flu-like illness (including aches in the limbs and/or fever)?
9. Difficulty in breathing?
10. Feeling of chest tightness?

After any positive answer the following question was asked: If "yes", was this better on days away from the office? Symptoms that were better on days away from the office were classed as work-related. The building symptom index is defined as the mean number of work-related symptoms per worker in each building.

**Table 1** Comparison of the prevalence of work-related symptoms between the self-administered questionnaire and the medical opinion.

	Medical opinion	Self-administered questionnaire
Dry eyes	21	24
Itchy eyes	25	25
Stuffy nose	29	21
Runny nose	13	41
Dry throat	32	32
Lethargy	45	48
Headache	35	40
Flu	4	14
Difficulty breathing	0*	4
Chest tightness	0*	5

\* the medical opinion diagnosed occupational asthma.

## Results

All workers selected for the medical interview completed the interview and self-administered questionnaire. The overall prevalence of work related symptoms is shown in Table 1, comparing the medical opinion with the questionnaire. The mean prevalence of each work-related symptom was 28.6% for the medical opinion and 33% for the self-administered questionnaire. There were very similar estimates for headache, lethargy, dry throat, eye symptoms and stuffy nose. The medical opinion assessed flu-like symptoms and runny nose as due to infection in the

**Table 2** The results of the medical assessments in individuals reporting work-related symptoms on the self-administered questionnaire.

	Medical opinion		
	work-related	possibly work-related	not work-related
Dry eyes	73%	5%	22%
Itchy eyes	75%	12%	13%
Stuffy nose	61%	28%	11%
Runny nose	31%	19%	50%
Dry throat	84%	3%	13%
Lethargy	86%	5%	9%
Headache	84%	6%	10%
Flu	21%	7%	72%

**Table 3** Symptoms identified during medical interview, which were assessed as not present from the self-administered questionnaire.

	Medical opinion	
	work-related	possibly work-related
Dry eyes	5%	3%
Itchy eyes	7%	8%
Stuffy nose	18%	21%
Runny nose	2%	22%
Dry throat	6%	4%
Lethargy	7%	6%
Headache	8%	6%
Flu	1%	1%

majority of cases. The assessment of work-related wheeze and chest tightness on the self-administered questionnaire was compared with a medical diagnosis of asthma, which is not strictly comparable. No workers were thought to have occupational asthma from the interview. The response of each individual to each question was compared with the medical opinion in the same individual. The results are shown in Table 2. The agreement in individuals was not as close as in the group as a whole. More than 70% of self-administered questionnaire responses were validated by the medical interview for work related headache, lethargy, dry eyes, itchy eyes and dry throat. Blocked nose was thought to be definitely work-related in 61%, increasing to 89% when the medical assessment of probably work-related was included. Flu-like symptoms were thought to be work-related in only 21% and runny noses in 31% of those with positive self-administered questionnaire responses.

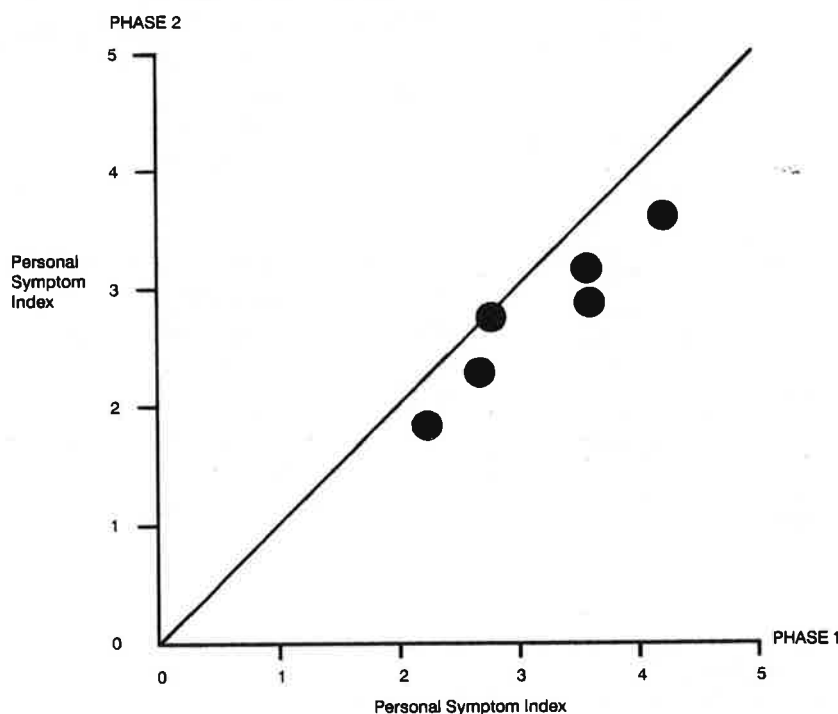
The medical assessment found work-related symptoms in some workers who did not record these symptoms on the self-administered questionnaire. This might occur if the respondent used a different but similar term for their symptom, which required interpretation by the doctor, or because they regarded the symptom as normal (particularly blocked nose). The frequency of missed diag-

noses is shown in Table 3. The nasal symptoms are responsible for the largest number of discrepancies.

The building symptom index, calculated for the six buildings using separate random samples of around 100 workers from each building completing the self-administered questionnaire two years apart, showed a good correlation between the two assessments. The building symptom index had improved in each building over the two years, perhaps due to the feedback from the original study. The six buildings were ranked in the same order on both assessments, as shown in Figure 1.

## Discussion

The study of the sick building syndrome requires the identification of relevant work-related symptoms in building occupants. There is general agreement about the group of symptoms that are included in the term sick building syndrome (Finnegan et al., 1984, Burge et al., 1987, Skov and Valbjorn, 1987, Preller et al., 1990, Stenberg et al., 1990, Hedge, 1990). The inclusion of other symptoms makes little difference to the building symptom index (the average number of work-related symptoms per occupant of a building). As many of the symptoms are subjective, and common in the general popula-



**Fig. 1** The relationship between the building symptom index calculated for the six buildings from separate random samples of workers two years apart.

tion, there are those who question the reliability of questionnaires in the definition of the sick building syndrome. There are no reliable objective tests for validating a number of the symptoms, such as lethargy or headache, and no methods applicable for use in epidemiological studies in the workplace for any of the diagnoses except asthma, which was not found in the workers studied here. Where objective tests have been used they have validated the symptoms studied, such as the validation of dry eyes by timing the break-up of a film of fluorescein on the cornea (Franck, 1986, Franck and Skov, 1989, 1991). The most widely available confirmation has come from the use of serial measurements of peak expiratory flow in workers with occupational asthma in buildings supplied with air from microbiologically contaminated humidifiers (Burge et al., 1985). There are no previous studies comparing medical interviews with self-administered questionnaires in the sick building syndrome.

Questionnaires used in the diagnosis range from the complex, taking around 30

minutes to complete (Fidler et al., 1990), to the simple questionnaire described here. The questions have been developed to reduce ambiguity, particularly by trying to avoid asking for two different items at once, and avoiding unnecessary qualifications. This approach is only valid if it measures the relevant disease states satisfactorily. The questions on lethargy, headache, eye and throat symptoms correlated satisfactorily with the medical opinion. There was substantial confusion between the symptoms of the sick building syndrome and those due to the common cold in this study. The symptoms are in general the same, the difference being that those due to the common cold usually develop rapidly and improve over a few days, whereas those due to the sick building syndrome usually improve each evening while away from work. If the individual takes time off work with their respiratory infection it could also be regarded as being better away from work. The average child has about seven upper respiratory infections per year, while adults have between two and five depending on the



diagnostic criteria used; if the nasal symptoms of the sick building syndrome are included only if they are recalled as occurring more often than this, there is a danger of missing seasonal causes of the sick building syndrome. There is evidence that recall of symptoms falls off substantially after 14 days. It is likely that the enquiry about symptoms over the previous 12 months, as in this study, would produce different results from prospectively collected symptoms. Despite this, the questionnaire provided reproducible estimates of the building symptom index, and ranked six buildings in the same order when different random samples of workers completed questionnaires two years apart, which is a powerful test of any questionnaire.

The present study has tried to validate the questionnaire in a wide range of different office workers, including those with high and low prevalences of symptoms, those working in naturally ventilated as well as air-conditioned offices, with and without humidification. The average number of work-related symptoms (the building symptom index), used for comparing different buildings, was very similar whether the self-administered questionnaire or the medical opinion was used. The medical opinion diagnosed more work-related stuffy nose, and less work-related flu and runny nose than the questionnaire; these two effects tended to cancel each other out. We have used a short questionnaire which has previously been tested for reproducibility to estimate the prevalence of the sick building syndrome in representative samples of occupants of different buildings. The medical questions comprised about one quarter of a questionnaire which in total took between 5 and 12 minutes to complete. The medical questions were necessarily brief. It is likely that fuller questions would have provided closer correlations with the medical diagnoses at the expense of less fully completed questionnaires and a more intrusive study. By keeping the questionnaire short we have avoided much disruption of the work routine and

have been able to study a much wider sample of buildings than would have been possible with a longer questionnaire, and have achieved response rates averaging over 90%.

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