

THE DEVELOPMENT OF A QUESTIONNAIRE SUITABLE FOR THE SURVEILLANCE OF OFFICE BUILDINGS TO ASSESS THE BUILDING SYMPTOM INDEX A MEASURE OF THE SICK BUILDING SYNDROME

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SUMMARY

Questionnaires used in the assessment of the sick building syndrome vary in their complexity, many being too cumbersome for non research use. We have tried to develop a questionnaire with the minimum number of questions which can reliably estimate the building symptom index, the average number of work-related symptoms per occupant per building. We started with the ten symptoms used in the British Office Environment Survey, and investigated the effect of leaving out successive questions of the ranking on 47 buildings, when the building symptom index was recalculated with the smaller data set. The building symptom index calculated from 5 questions produced the best balance between brevity and reliability, correlating highly with the ten symptom index ($r=0.990$). The 95% confidence intervals for the ranking of the 47 buildings using just 5 questions were less than ± 3.8 ranks.

INTRODUCTION

The sick building syndrome consists of a characteristic group of symptoms which appear to be caused by working in some buildings. Different workers agree on the principal symptoms involved. The most common relate to the central nervous system, often called general symptoms. Lethargy or tiredness and headache were used in the British Office Environment Survey¹, others include nausea and dizziness^{2,3}, forgetfulness and lack of concentration²⁻⁴ and heavy headiness³. There is a high degree of correlation between the responses to these questions, and a group often called mucous membrane symptoms, involving the eye, nose and throat². The eye and nose can be affected in two distinct ways, being dry or blocked, or hypersecreting, causing runny eyes and nose and sneezing. The hypersecretory symptoms are more common in acute allergic and infective conditions, the two not being separable using available questionnaires. Dryness of the skin is also regarded as a feature of the sick building syndrome²⁻⁴. It is the least prevalent of the symptoms described so far, and often takes more than two days to improve when away from a problem building. It is therefore not easy to differentiate between dryness of the skin due to working in a problem building, and that due to other causes. Dryness of the skin was not included in the British Office Environment Survey. Eye nose and throat symptoms are common in the general population⁵. If all those with these

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symptoms are compared between buildings the contribution of the part due to the particular building will be partly obscured by that due to other causes, often 30-50% of the total. Requiring a symptom to improve on days away from the office makes the questionnaire more specific. Questionnaires differ in the frequency with which symptoms are required before being included in the building symptom index. Responses to questionnaires are heavily influenced by recent events, particularly those within the previous 1-2 weeks. The British Office Environment survey¹ and the Dutch study⁴ asked about symptoms that had occurred more than twice in the previous 12 months, to overcome the effect of season, whereas the Swedish study asked about symptoms in the last three months³. It is highly unlikely that workers could recall infrequent symptoms which were not very severe over 3 or 12 months, despite this the British questionnaire was sufficiently reproducible for clinical use. When the building symptom index was calculated on separate random samples of workers from 6 buildings two years apart, the buildings were ranked in the same order on both occasions⁶.

There is a need for a simple, reliable questionnaire for use during routine surveys used to estimate the Building Symptom Index, to compare a particular building with others, and to monitor changes over time. We have tried to develop such a questionnaire, based on the one used in the British Office Environment Survey.

METHODS

The ten individual symptoms used in the British Office Environment Survey were used as the starting point. They are shown in table 1. The responses from all 4373 respondents were used individually. Each symptom which was present and improved on days away from work was scored. The sum of an individual's work-related symptoms (the personal symptom index) was calculated. The personal symptom index was adjusted for sex, job category and VDU use using a multivariate analysis of variance (SPSSX 3.0) to remove the effects of these factors before the Building Symptom Index was calculated, by averaging the adjusted personal symptom indices for the occupants of each building. The building symptom index was then recalculated using a reduced data set and the buildings re-ranked using the new building symptom index. The new Building Symptom Index was then correlated with the ten symptom index using Pearson's correlation coefficient. The limits of agreement between the two indices were then calculated using the method of Bland and Altman. This procedure was then repeated until only two symptoms remained.

RESULTS

The first questions to be omitted were those related to humidifier fever and asthma (Question 8,9 and 10), as these were the least prevalent, and individual clinical opinions of exposed workers did not show these diseases in general to be a problem. The correlation between the BSI's using 10 and 7 symptoms was 0.996 (Pearson's correlation coefficient). Runny nose (question 7) was the next symptom to be omitted as this had been shown to correlate least well with clinical opinion of building related symptoms⁷. The correlation coefficient between the 10 and six symptom BSI was 0.992. The questionnaire now contained two eye symptoms, and one from each other group. Itching and watering of the eyes was therefore omitted (Question 6), giving a correlation coefficient of 0.990. The relationship between the 10 and 5 symptom BSI's are shown in fig 1. Blocked nose (question 2) was omitted to give a 4 symptom BSI ($r=0.984$) compared with the 10 symptom BSI; Dryness of the throat was omitted next (Question 3) to

give a 3 symptom BSI ($r=0.979$). Lethargy or tiredness (Question 4) was omitted to give a two symptom BSI using the questions on dry eyes and headache ($r=0.967$). The rank order of the buildings using the BSI's based on a reducing number of symptoms was then compared, using Spearman's rank correlation coefficients, the correlations are shown in table 2.

Table 2

Spearman's correlation coefficients comparing the ranking of the Building Symptom Indices using the reduced questionnaire with the original 10 symptom questionnaire.

Number of symptoms included	r
10	1
7	.990
6	.991
5	.990
4	.983
3	.979
2	.962

data from UK office environment survey

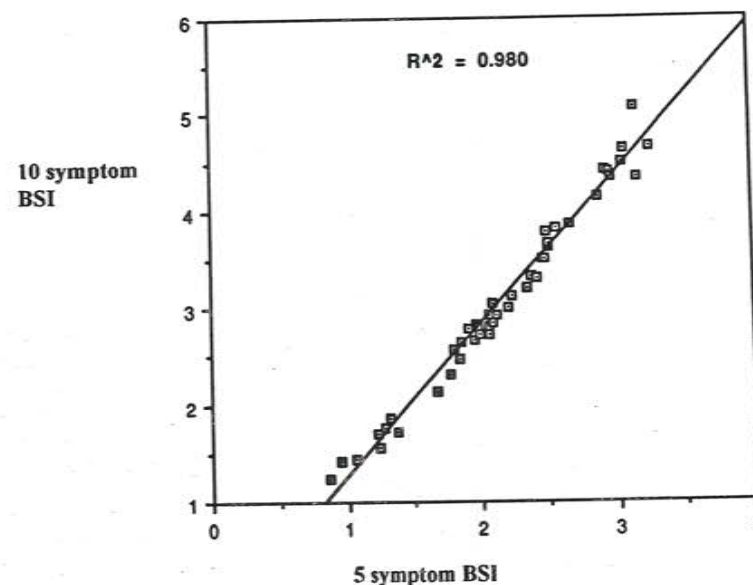


Figure 1. Relationship between the 5 and 10 question Building Symptom Indices.

Table 1. The Medical Questionnaire. The following questions ask about your general well-being over the last 12 months. Please put a circle around the number representing your answer to each question. If you are undecided about your answer to any of the questions then please circle the number 2 to indicate a NO answer for that question

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

	YES	NO
1. Dryness of the eyes If YES, was it better on days away from the office?	1	2
2. Blocked or stuffy nose If YES, was it better on days away from the office?	1	2
3. A dry throat If YES, was it better on days away from the office?	1	2
4. Lethargy and/or tiredness If YES, was it better on days away from the office?	1	2
5. Headache If YES, was it better on days away from the office?	1	2
6. Itching or watering of the eyes If YES, was it better on days away from the office?	1	2
7. Runny nose If YES, was it better on days away from the office?	1	2
8. Flu-like illness (including aches in limbs and/or fever) If YES, was it better on days away from the office?	1	2
9. Difficulty in breathing If YES, was it better on days away from the office?	1	2
10. Feeling of chest tightness If YES, was it better on days away from the office?	1	2

The questionnaire based on five questions was thought most suitable for general use, as the amount of information lost was minimal, and it still contained one question based on each main symptom group. Reducing the questionnaire further would still provide a good estimate of the BSI, but would potentially be more liable to influence from an unusual factor affecting one organ system (such as environmental tobacco smoke affecting the eyes).

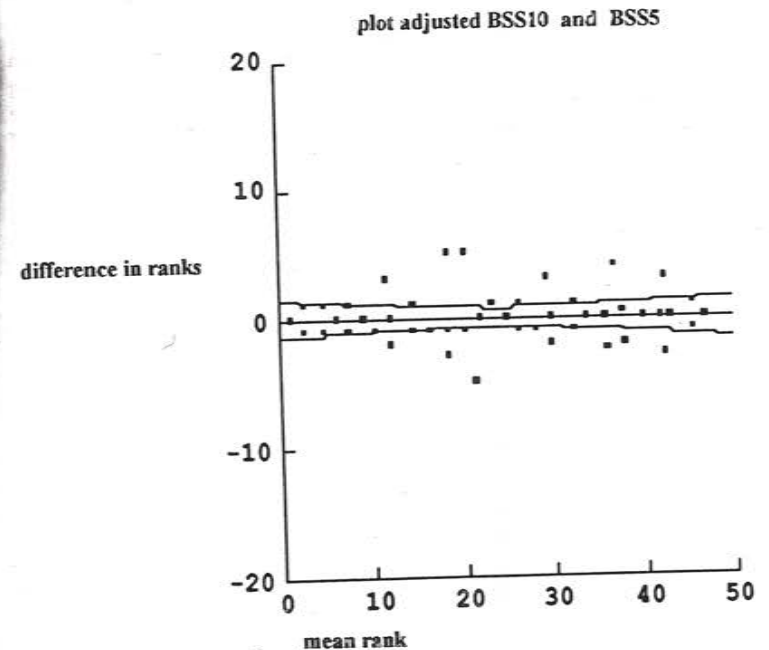


Figure 2. The limits of agreement between the ranking using the 10 and 5 symptom BSI's using a Bland and Altman plot.

DISCUSSION

The sick building syndrome is defined in terms of questionnaire responses from building occupants. So far all the questionnaires have been designed to probe the causes of the sick building syndrome, some taking up to one hour to complete⁸. All contain a series of questions on health complaints, demographic questions including the main confounding factors of job category and sex, and questions on environmental assessment. Responses from environmental assessments in general correlate with the building symptom index¹, but correlate poorly with environmental measurements^{9,10}. The symptoms of the sick building syndrome are all non-specific, having many other causes apart from working in a problem building. At present the underlying mechanisms for the symptoms are not known, which makes it more difficult to create specific questions for their identification. It is however clear that there is a characteristic temporal relationship between the symptoms of building sickness and occupancy of a building. Symptoms always start at work and are relieved within a few hours of leaving (and often much sooner). To date there is no evidence for delayed reactions such as are common in occupational asthma^{11,12}, where symptoms are often at their worse during the night after work, and sometimes do not start before leaving work. Requiring a symptom to improve on days away from the office therefore makes the questionnaire more specific. The reliability of the current

questionnaire has been assessed by comparing the responses to a self-completed questionnaire, with an independent medical opinion⁷. The questions on runny eyes and noses were often thought by the doctors to be due to infections or seasonal allergy, rather than the sick building syndrome; their removal from our short questionnaire should improve its specificity. Positive answers to the other questions were thought to be due to building sickness in 61-86% of respondents depending on the specific question.

For surveillance use a simple reliable repeatable questionnaire is required. We have tried to provide the medical part of such a questionnaire including only five symptoms. There appears to be very little loss of information by doing this, as responses to many of the questions are highly correlated. The objective of our questionnaire is not to identify individuals for whom more specific intervention is needed, but to use the building occupants to measure the sickness or health of their building environment. Using five questions the BSI's of the best buildings are less than 1.5. Buildings with BSI's over 2.6 are in the worst 25% of the buildings studied.

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