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ORIGINAL ARTICLE

Medical and social prognoses of non-specific building-related symptoms (Sick Building Syndrome): a follow-up study of patients previously referred to hospital

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Abstract
Objectives The aim of this study was to describe and analyse the medical and social prognoses of patients with non-specific building-related symptoms.
Methods A follow-up questionnaire focusing on current medical and social status, care, treatment, other actions taken and personality traits was sent to 239 patients with non-specific building-related symptoms assessed during the period between1986 and 1998 at University Hospital in Umeå, Sweden. The response rate was 79%.
Results Fatigue, irritation of the eyes, and facial erythema were the most common weekly symptoms reported at follow-up. As females constituted 92% of the respondents, statistical analyses were restricted to women. The level and severity of symptoms decreased over time, although nearly half of the patients claimed that symptoms were more or less unchanged after 7 years or more, despite actions taken. Twenty-five percent of the patients were on the sick-list, and 20% drew disability pension due to persistent symptoms at follow-up. The risk of having no work capabilities at follow-up was significantly increased if the time from onset to first visit at the hospital clinic was more than 1 year. This risk was also significantly higher if the patient at the first visit had five or more symptoms. All risk assessments were adjusted for length of follow-up. Symptoms were often aggravated by different situations in everyday life.
Conclusions Long-lasting symptoms aggravated by environmental factors exist within this group of patients. The results support that early and comprehensive measures for rehabilitation are essential for the patients.

Keywords Disability pension · Gender · Symptoms · Triggering factors · Work capability

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Introduction

Sick building syndrome (SBS) is a set of non-specific symptoms occurring in a particular building and not caused by specific illness such as allergy or infection. It has been suggested that SBS symptoms should be labelled non-specific building-related illness in contrast to specific building-related illness (Menzies and Bourbeau 1997). Although we agree, due to the widespread use of SBS, this term is used in this paper. The various symptoms can be grouped as dermal, mucosal, and general and there is no universally accepted clinical definition of SBS (WHO 1983). Symptoms normally improve or disappear when people are away from the building, although time for improvement can vary

(Redlich et al. 1997; Åhman et al. 2000; Rudblad et al. 2002). The cause of the syndrome is attributed to factors such as thermal climate and exposure to indoor air chemicals, including those emitted by microorganisms (Apter et al. 1994; Pommer et al. 2004). Psycho-social stress increases the risk of symptoms, and women report SBS symptoms more often than men for reasons not yet fully known (Stenberg et al. 1993; Stenberg and Wall 1995; Brasche et al. 2001; Eriksson and Stenberg 2006).

The durability of SBS symptoms has not been studied extensively. There is, however, evidence for long-lasting symptoms in a study showing slowly decreasing mucosal hyper reactivity, years after working in a school with moisture problems (Rudblad et al. 2002). A follow-up study of the prevalence of work-related SBS symptoms among office workers reported a decrease in symptom prevalence soon after moving to a building with improved ventilation system. Three years later, however, nearly half of the symptom prevalence remained (Bourbeau et al. 1997). Some authors consider persisting SBS symptoms as representing multiple chemical sensitivity (MCS) (Nethercott et al. 1993).

In Sweden, most patients are seen by general practitioners and company doctors. Since the beginning of the 1980s, patients with symptoms suggesting SBS have been referred to Umeå University Hospital in northern Sweden. We have experienced that many such patients have been on the sick list for long periods and have had to change workplace because of long-lasting symptoms. Some patients receive disability pension while others go back to work, despite remaining symptoms. The understanding of factors influencing the prognosis of SBS is necessary for secondary prevention in primary and specialized care.

The aim of this study is to describe and analyse the medical and social prognoses of patients with SBS symptoms expressed as remaining symptoms and work capability with data from medical casebooks and a follow-up questionnaire. Our hypothesis is that personal factors such as previous health, actions taken, time, treatment, personality and coping resources are factors important in influencing the prognosis. Personality and coping resources are focused on in the coming papers. The study is part of a project which investigates prognostic factors of different environmental syndromes.

Subjects and methods

Study population

The source population originated from patients registered at the Department of Dermatology and the Department of Occupational and Environmental Medicine, University Hospital in Umeå, Sweden. From 1986 to 1998, 279 patients with symptoms suggesting SBS were referred from primary health care and occupational health services requesting help with the diagnosis and handling of the patients. To be included in the study, the patient should report at least one typical SBS symptom (WHO 1983) associated with staying in a specified building. The second inclusion criterion was that there had to be signs of Indoor Air Quality (IAQ) problems reported within that building; e.g. water damage, damaged surface materials or abnormal odour. The third criterion was that the possible association between exposure and symptoms could not be ruled out or given an indisputable alternative explanation in the primary investigation. Altogether, 40 referred patients were excluded due to reasons such as missing medical records, no medical examination, lack of exposure–symptom association, and alternative diagnoses. No further selection was induced why this is an investigation of the total stock of patients for the period. Finally, 239 patients (24 men and 215 women) fulfilled the inclusion criteria and received a postal questionnaire. The response rate was 79.1% (174 women and 14 men).

Medical case record and questionnaire

Data from the registered patients' medical casebooks included gender, age, occupation, time of onset of SBS symptoms, signs of IAQ-problems, date of first visit, symptoms, eliciting factors, and sick leaves.

All 239 patients received a postal questionnaire containing questions on civil status, education, present health, care, treatment, other measures taken, consequences of the problem, eliciting factors and current employment situation. The question of rheumatic disease was added due to our hypothesis that mucosal dryness, a common symptom in such syndromes, might increase the risk of persistent mucosal SBS symptoms. The time frame between the first investigation at the hospital to answering the questionnaire (*follow-up time*) ranged from 1 to 13 years. Questions concerning feelings, self-image and coping ability were also included. The latter data is not included in this paper. The questionnaire was based on a previous version used in the "Office Illness Project" in Northern Sweden (Stenberg et al. 1993). Data acquisition occurred from May 1999 to September 2000. The study was approved by the Ethics Committee of the Umeå University, Umeå, Sweden. To enable comparisons; essentially the same questionnaire is used in similar follow-up studies within the project; including patients with "hypersensitivity to electricity" (Stenberg et al. 2002). For comparison with the general population a survey addressing similar symptoms was used. This study, comprising 3,000 randomly selected Swedes, aged 18–64, was conducted in 1998. It addressed 25 symptom questions of which 17 were identical to the questions used in the present study (see Fig. 1). The

remaining symptom questions were more relevant to patients with perceived hypersensitivity to electricity and patients with side effects to dental materials. The survey was distributed and collected by Statistics Sweden (SCB; Eriksson and Stenberg 2006).

Dropout analysis

A total of 50 persons (20.9%) did not return the questionnaire. A dropout analysis was accomplished with similar gender distribution as the response group. Every third patient was contacted for a telephone interview, 3 men and 15 women. The most common reason for no response was "too extensive questionnaire". The most common symptoms reported by one-third of the group were fatigue, heavy headedness, irritation of the eyes, facial skin irritation, and dry mouth. All these symptoms were the source of great annoyance. Feeling heavy headed was more common among non-responders while facial erythema was twice as common in the response group. Half of the patients interviewed had never been on the sick-list due to SBS symptoms, but 7 of the 18 still continued to experience all, or nearly all, of the previously reported symptoms. The dropout analysis confirmed that the results are fairly representative of all patients registered with respect to common symptoms and remaining complaints.

Statistical methods

Comparisons were made using a chi-square or Fisher's exact test. For comparing symptoms among patients at the time of follow-up against symptoms in the general population, the significance level was set at 0.01 due to multiple comparisons. For all other comparisons, the significance level was set at 0.05. When analyzing the association between multiple independent variables and outcome variables, multiple logistic regression was used in SPSS version 10.0®. Results are given as odds ratios (OR) and 95% confidence intervals (95% CI).

Due to the small number of men included in the study, all statistical analyses reported here are restricted to women. To ensure that the small number of men did not change the results, risk assessments were also conducted for the total population.

Results

Personal characteristics and symptoms at the time of onset

Information was collected from the questionnaire and from medical casebooks. Some characteristics of the study population are shown in Table 1. Of the responding 189 patients, 92% were woman and 8% were men. The mean age at the time for onset was 43 years.

Table 1 Characteristics of the patient group at the time for onset stratified for gender

Characteristic	Men		Women		Total	
	N	%	*N*	%	*N*	%
Gender	15	7.9	174	92.1	189	100
Age						
0–29 years	–	–	11	6.4	11	5.9
30–39 years	3	21.4	48	28.1	51	27.6
40–49 years	5	35.7	74	43.3	79	42.7
50–59 years	6	42.9	35	20.5	41	22.2
60 years	–	–	3	1.8	3	1.6
Previous health						
Asthma	3	1.6	8	4.4	11	6.0
Allergic rhino-conjunctivitis	4	2.2	23	12.6	27	14.8
Atopic dermatitis	2	1.1	16	9.0	18	10.2
Rheumatic disease	–	-	9	5.1	9	5.1
Occupation						
Legislators, senior officials and managers	–	–	–	–	–	–
Members of the armed forces, students, unemployed	1	6.7	–	–	1	0.5
Professionals with university degree	4	26.7	35	20.1	39	20.6
Technicians and officers	6	40.0	12	6.9	18	9.5
Clerks	–	–	59	33.9	59	31.2
Service workers and shop sales workers	1	6.7	52	29.9	53	28.0
Craft and related trades workers	1	6.7	1	0.6	2	1.1
Plant and machine operators and assemblers	–	–	1	0.6	1	0.5
Workers in occupations for which no training is required	2	13.3	14	8.0	16	8.5
Skilled agricultural and fishery workers	–	–	–	–	–	–

Previous atopic illnesses are reported as they are often associated with an increased risk of SBS. In this study *atopy* means past or present asthma, allergic rhinitis or atopic dermatitis. At first clinical examination, there was no methodical questioning of symptoms at onset; thus making data from casebooks unreliable. According to questionnaire data, the most prevalent starting symptoms were sensation of heat in facial skin and dry/irritated throat (one-fifth of the patients), itching, pain, irritation of the eyes, and fatigue (one-third of the patients).

Characteristics in the first investigation

The mean age at first visit to the hospital was 46 years, and mean time interval from onset to hospital visit was

3.8 years (median 2.0 years). Two-thirds of the patients visited the hospital within 3 years of the symptoms onset. The clinical examination revealed 15 different symptoms and signs: 5 general, 7 mucosal and 3 dermal. Fatigue (67.1%), dry/irritated/red eyes (68.2%), and facial erythema (71.1%) predominated. Headache (39.9%), nasal symptoms (46.2%), dry/irritated throat (30.1%), and body itch (26.6%) all had prevalence over 20%. Other health problems recorded were symptoms attributed to dental fillings (4.0%), visual display terminal (VDT)-related skin symptoms (VS) (12.7%), and hypersensitivity to electricity (HE) (6.9%). Almost half of the patients had been exposed to environments with visible water damages according to their medical records. Other commonly noted problems with indoor air quality were "well-known sick building" and insufficient ventilation.

Situation in the follow-up

Symptoms

At the time of the questionnaire, 1–13 years after the first clinical investigation, the most prevalent symptoms perceived weekly over the previous 3 months was fatigue (49.7%), eye irritation (36.4%), facial erythema (33.7%), and irritated/stuffy/runny nose (33.7%). All these symptoms, except nasal symptoms, were the source of great annoyance to more than half of these patients.

We compared symptom prevalence with results from a random sample of the Swedish population using identical questions. We also compared symptom prevalence with a group of HE-patients, and another group with VS. Data for comparison were gathered in a follow-up study within the same project (Stenberg et al. 2002).

All three patient groups differ from the control population, and SBS patients have symptom prevalence in patients with hypersensitivity to electricity and patients with VS-related skin symptoms. Symptoms from mucous membranes were more frequent in SBS patients. In comparison with the general Swedish population, fatigue, vertigo, difficulties concentrating, eye irritation, dry eyes, nasal symptoms, dry facial skin, facial erythema, facial sensory symptoms, burning mouth, and dry mouth were significantly more prevalent ($P < 0.01$) among our female patients with SBS symptoms (Fig. 1). The same pattern was seen among men (results not shown).

Half of the women had a follow-up time within 5 years or less. Most of these women reported the same symptoms as in the first investigation. Only 7.5% of the total group of women had no remaining symptoms, while 59.8% had all or nearly all their symptoms unchanged. In general symptoms decreased over time. For comparison, 7.1% of female HE patients had no remaining symptoms at follow-up. The corresponding figure for female VS patients was 15.0%. Unchanged or almost unchanged symptoms were reported by 71.5% of female HE patients and 38.1% of female VS patients at follow-up.

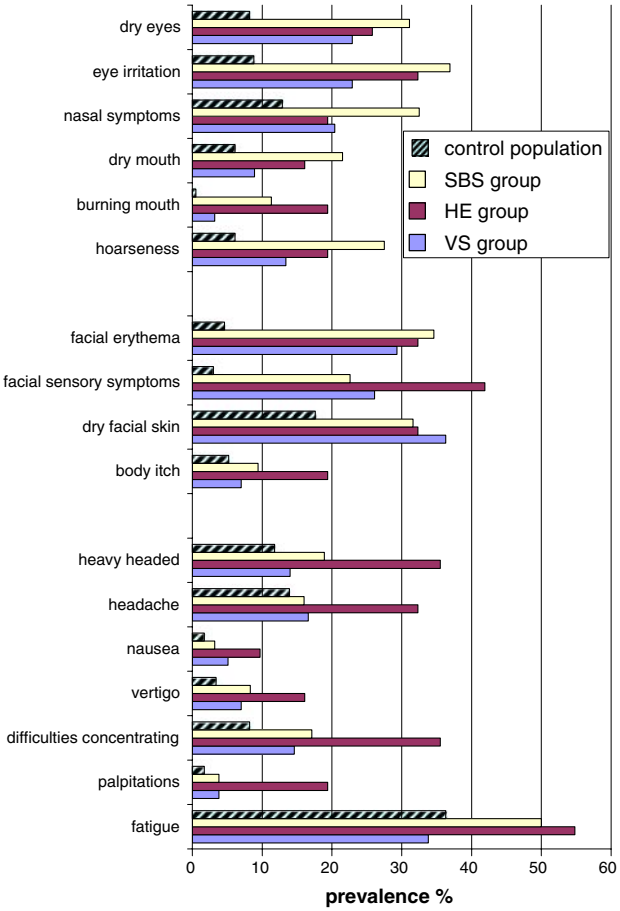

Fig. 1 Weekly symptoms among female patients with SBS symptoms, VDT-related skin symptoms (VS) and perceived hypersensitivity to electricity (HE) at follow-up and in a female control population

We stratified our SBS patients into groups of approximately similar size with regards to time of onset to first investigation and follow-up time (Table 2). In the analysis of the risk of having unchanged or almost unchanged symptoms at follow-up, we adjusted for follow-up time. The risk of having symptoms today was greater among those patients which were referred late to the hospital after onset, and among those with short follow-up time. Despite previous reports of high prevalence of SBS symptoms among office workers, we did not detect any differences with regard to occupation. Age at follow-up and previous atopic diseases had no influence on risk figures. Previous rheumatic disease indicated an increased but not significant risk of remaining symptoms. Risk analysis including men did not change the results.

Table 2 Crude and adjusted risk (OR, CI 95%) of having unchanged or almost unchanged symptoms at follow-up, female patients ($N = 104$ cases). Adjustment for follow-up time

Risk indicators		Crude risk		Adjusted risk	
		OR	CI 95%	OR	CI 95%
Age at follow-up	<42 years	0.81	0.44–1.49	0.87	0.46–1.64
	>42 years	1		1	
Previous health[a]	Any atopic illness	0.82	0.39–1.72	0.74	0.34–1.59
	Asthma	1.13	0.26–4.9	1.15	0.25–5.2
	Allergic rhino-conjunctivitis	0.56	0.23–1.36	0.48	0.19–1.21
	Atopic dermatitis	0.85	0.30–2.4	0.80	0.28–2.3
	Rheumatic disease	5.61	0.69–45.9	4.64	0.55–39.0
Time	*Onset-first investigation*				
	0–1 years	1		1	
	2–3 years	1.04	0.50–2.2	1.21	0.56–2.6
	4–21 years	**2.48**	**1.14–5.4**	**2.7**	**1.21–6.2**
	Follow-up time				
	0–4 years	**3.05**	**1.41–6.6**		
	5–7 years	1.12	0.52–2.4		
	8–13 years	1			
No of symptoms at first visit	1–4 symptoms	1		1	
	5–8 symptoms	0.91	0.49–1.67	0.92	0.49–1.72

Statistically significant results are indicated with bold figures

[a] Persons without any of the mentioned diseases constitute reference category

Actions taken

The most prevalent measures taken to relieve symptoms included change of workplace (63.2%) and improved ventilation (40.2%). Half of those patients who changed their workplace thought it was of great importance, while 30.0% stated that it was of no importance at all. The proportion of persons who perceived they took advantage of the actions taken due to indoor air quality problems are shown in Fig. 2.

Other self-rated important changes included being on the sick-list and temporary or permanent disability pension due to SBS symptoms. Other actions were also taken. Twelve percent of the female patients reported that they had replaced dental filling materials due to symptoms, and 60% of these thought this action was of importance for their well being.

Work capability

One-fifth of the patients had received disability pension due to the symptoms; 14.0% of those were totally unable to do work. In comparison, 29.0% of female HE patients and 8.3% of female VS patients received disability pension. Of female SBS patients 57.9% were considered fully capable

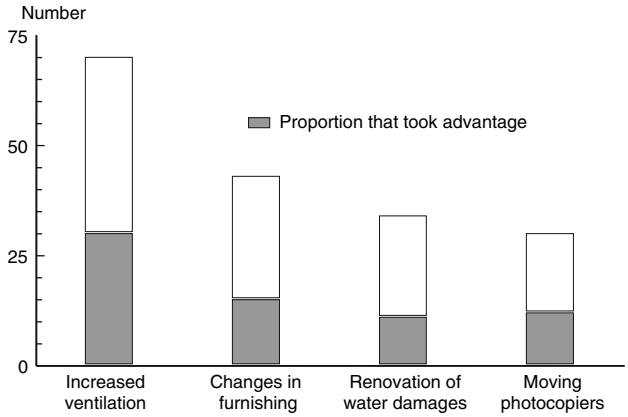

Fig. 2 Actions taken at the workplace. Proportion of persons that perceived taking advantage of the actions is indicated

of working and 24.4% were partially capable. The corresponding figures for female HE patients were 17.9 and 35.7%, and for female VS patients 70.0 and 21.4% (Stenberg et al. 2002).

We refrained from analysing disability pension as an outcome variable because the system and the criteria for receiving this pension changes over time due to economy and law adjustment. During the year 1999, 63.6% women in the age group 60–64 years drew disability pension due to SBS symptoms. For comparison, during the same year 41.0% of women of similar age and living in the same region received disability pension (for any reason) according to official statistics from the Swedish Social Insurance agency. Differences in other age groups were minor. Data for statistical analysis are not available.

Patients with previous rheumatic disease had an increased risk of having no work capability at follow-up (Table 3). The risk was also significantly increased if the time of onset to first investigation at the hospital was more than 1 year, and if the patient at first investigation had five or more symptoms. Risk analysis including men did not change the results.

Triggering factors

Nearly 60% of the female group of patients perceived worsening of symptoms when visiting a shop, and as shown in Fig. 3, the most prevalent symptom in all kind of situations was eye symptoms. Data shown in Fig. 3 illustrate consequences for the ability to work, as well as in social life.

Discussion

Our results show that many patients still suffer from SBS symptoms several years after our initial investigation, but many of them nevertheless are capable of working. Time is

Table 3 Crude and adjusted risk (OR, CI 95%) of being unable to do work at follow-up, female patients ($N = 29$ cases). Adjustment for follow-up time

Risk indicators		Crude risk		Adjusted risk	
		OR	CI 95%	OR	CI 95%
Occupation	Professional with university degree	1		1	
	Technicians and officers	1.64	0.39–6.8	2.2	0.49–10.3
	Clerks	0.65	0.22–1.89	0.57	0.19–1.72
	Service workers and shop sales workers	0.51	0.16–1.65	0.49	0.15–1.60
	Workers in occupations. for which no training is requested	0.27	0.03–2.4	0.24	0.03–2.2
Age	<42 years	0.73	0.33–1.64	0.67	0.29–1.52
	>42 years	1		1	
Previous health[a]	Any atopic disease	0.36	0.10–1.28	0.36	0.10–1.28
	Asthma	0.77	0.09–6.7	0.78	0.09–6.8
	Allergic rhino-conjunctivitis	0.46	0.10–2.1	0.50	0.11–2.3
	Atopic dermatitis	–	–	–	–
	Rheumatic disease	**4.07**	**1.02–16.3**	**4.2**	**1.01–17.3**
Time	*Onset-first investigation*				
	0–1 year	1		1	
	2–3 years	2.94	0.96–9.0	**3.2**	**1.01–9.9**
	4–21 years	2.74	0.89–8.4	**3.1**	**1.00–9.9**
	Follow-up time				
	0–4 years	0.68	0.27–1.70		
	5–7 years	0.49	0.17–1.43		
	8–13 years	1			
No of symptoms at first visit	1–4 symptoms	1		1	
	5–8 symptoms	**2.9**	**1.23–6.6**	2.8	**1.22–6.6**

Statistically significant results are indicated with bold figures

[a] Persons without any of the mentioned diseases constitute reference category

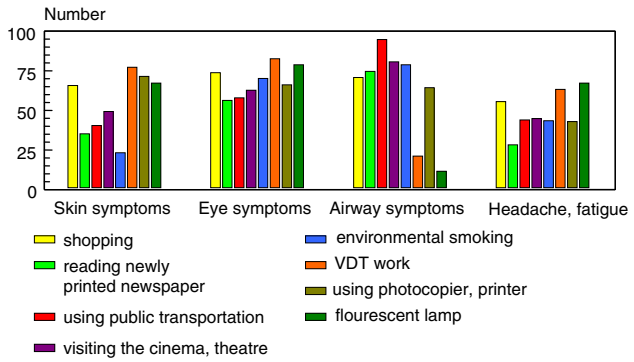

Fig. 3 Triggering environmental factors for symptoms at follow-up. Prevalence in percent

an important factor; in general symptoms decrease over time to follow-up. Clearly, the studied symptoms have an important impact on patients' normal life.

A number of methodological problems are worth considering. Patients were not examined according to a standardized procedure but were subject to different investigations guided by their symptoms. In some cases skin testing and methacohline testing were performed. Different doctors have examined the patients at two separate clinics. There is, however, a long-standing concordance in investigation routines between the clinics. Some data from the medical records were not used for analysis. As there is no recommendation agreed upon for classification of SBS in medical records, we decided to use WHO's description of SBS (WHO 1983) when classifying SBS symptoms in the inclusion criteria.

Selection bias within the patient group due to response rate is less likely because the participation rate was fairly high and the drop-out analysis confirmed representative results with respect to symptoms at follow-up and duration of the initial complaints. The patients studied constitute a selected proportion of all persons experiencing SBS symptoms. There is, to our knowledge, no published follow-up studies on incident cases. It can be assumed that our patients have more unfavourable medical and social prognoses than those who are not referred to hospital clinics. The increased risk associated with long medical history from onset to first investigation and number of symptoms at

first visit is probably explained by the fact that patients with persistent and multiple symptoms are more likely to be referred. In a forthcoming paper personality characteristics and coping resources will be analysed more thoroughly. To ensure that our risk analyses were not confounded by such factors we confirmed that there was no statistical association between personality factors or coping resources and the analysed risk indicators. Furthermore, adjusting for these factors did not change our multiple regression analyses substantially.

A number of our patients suffer from other idiopathic environmental syndromes. According to our medical records 4% of female patients had reported health problem from dental fillings, 12.7% reported skin symptoms from VDT use, and 6.9% reported electrical hypersensitivity. We decided not to exclude these patients because they are part of the clinical spectrum seen in this type of patients.

Most of the symptom questions used in the questionnaire are either validated or widely used. The question on previous "rheumatic disease" was used based on clinical experience. There has long been a network of different disciplines handling SBS patients in Umeå. We have experienced that persons with previous diseases such as rheumatic arthritis and Sjögren's syndrome who develop building-related symptoms are likely to have longstanding worsening of symptoms from the eyes and upper airways. We are aware of this question being unspecific and not validated. Our findings, however, suggest that this association should be further studied.

In previous studies in office workers (Stenberg et al. 1993) and in the general population (Eriksson and Stenberg 2006), we have reported that women have 2–3 times higher prevalence of SBS symptoms than men. In this study, the male to female ratio was 1:12. We know that women are more healthcare seeking than men (Sen et al. 2002), but whether this explains the shift to an extreme female dominance, or if factors such as worse prognosis in women cause a higher referral rate, we are unsure. This is an important question for future research.

Some researchers suggest that SBS is a form of MCS (Arnetz 1999). MCS is characterized by heightened self-reported sensitivity to low concentrations of chemicals; and the criteria also include low levels of exposure, resolving symptoms when incitants are removed, and response to multiple, chemically unrelated substances. MCS symptoms are typically related to more than one organ system and overlap the symptoms from SBS (Kipen and Fiedler 2002). A study conducted to identify major clinical diagnostic criteria of MCS reported that a majority of medical practitioners selected "symptoms are reproducible" and "condition is chronic" as major criteria (Nethercott et al. 1993). Whether chronic SBS symptoms and MCS are overlapping or identical phenomena should be researched further.

Atopy has been suggested to predispose SBS (Norbäck and Edling 1991; Redlich et al. 1997; Skyberg et al. 2003). Our own previous research (Stenberg et al. 1994) and clinical experience suggest that it is not the case. We have suggested that the association between SBS and atopic disease might be due to an artefact. SBS symptoms are non-specific, and as persons with asthma, rhinitis, and eczema normally experience general, mucosal, and skin symptoms that are very close to SBS symptoms, most questionnaires will not be able to discriminate the two conditions from each other. The prevalence of asthma and rhino-conjunctivitis in this group of patients was similar to what we found earlier in a random sample of office workers (Stenberg and Wall 1995), among HE patients and among VS patients (Stenberg et al. 2002). We have no relevant reference figures for atopic eczema in an unselected population using the same phrasing in a questionnaire. The prevalence of eczema did not statistically differ from that in HE and VS patients. The results, thus, support our clinical impression.

The effect of actions cannot be assessed in this study. As data from medical casebooks are not comparable to questionnaire data this is not a cohort or intervention study. False associations can be obtained between actions or treatments and symptoms as those patients with worst prognosis probably have been subject to most extensive actions. The effect of such actions can only be assessed in intervention studies.

To our knowledge, this is the first clinical study reporting the prognosis of SBS patients. In comparison with a similar follow-up study of HE patients and VS patients, the prognosis for SBS patients is better than the prognosis for the first-mentioned but worse than that of the latter group. As these results are from a selected group of patients, our findings should be supplemented by studies of early incident cases to reveal the full spectrum of prognostic outcomes.

Our findings show that a subgroup of patients who clinically are diagnosed as having non-specific building-related illness have long-lasting symptoms with significant impact on their social life. The results support that early and comprehensive measures for rehabilitation are essential for these patients, and knowledge of aggravation of symptoms in daily life can contribute to a broader understanding of the nature of this syndrome. This must be a consideration both of primary and specialized care.

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