
Original article

Application of the MM040 in the diagnosis of “sick house syndrome,” a Japanese concept derived from sick building syndrome

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Abstract

Sick house syndrome (SHS), a Japanese concept derived from sick building syndrome (SBS), is a broad scope of sickness by various causes such as chemicals at low levels depended on a specific place, and was proposed as a concept classified with various types. A chemical-associated SHS as “sick house syndrome in a narrow sense” (nSHS) is important and distinguished from other types. The nSHS has been diagnosed by inquiry; therefore, it is useful to establish a standard questionnaire for it. Andersson’s MM040 questionnaire, originally designed for SBS, is also useful and can also be used as a standard questionnaire for SHS. We conducted a questionnaire survey with Andersson’s MM040 questionnaire and the definition of nSHS. We examined the relation between a diagnosis using that definition and the MM040 questionnaire. Responses from 66 SHS suspected-subjects and 227 people from a healthy population were obtained. Thirty-one of 39 subjects who were diagnosed as having nSHS had at least one symptom on the MM040 that depended on a specific place. On the other hand, 17.2% of the healthy population had at least one symptom on the MM040 questionnaire that depended on a specific place. This suggested that the MM040 questionnaire was at least partially helpful to diagnose SHS and can detect SHS sufferers even in a general population. (Jpn J Clin Ecol 27 : 1 – 14, 2018)

《Key words》 sick house syndrome, MM040, sick building syndrome, diagnosis

Introduction

Sick house syndrome (SHS) is a distinctively Japanese concept derived from sick building

syndrome (SBS). SBS has been a social and medical problem since the 1970’s in Europe and the United States due to the oil crisis encourag-

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ing the development of excessive airtight buildings.¹⁾ SBS is characterized by nonspecific complaints, such as mucous membrane irritations, skin symptoms, headache, and dizziness, due to problems with the office building. The environment in the office building is considered to be the cause of the symptoms.²⁾ Several chemical components such as formaldehyde are thought to relate to symptoms in those specific buildings.

While SHS has been a social and medical problem in Japan since the 1990's, it is one of the "general health disturbances of residents which are induced by the indoor environmental pollution of houses."^{3, 4)} The definition of SHS has not clearly been elucidated, and other diseases such as allergies are involved in SHS. Therefore, the definition of SHS must be clarified.⁵⁾

The first step toward establishing the definition of SHS is that it has been classified into four distinct categories.^{6, 7)} Those classifications are: type 1 (symptoms of chemical intoxication), type 2 (symptoms likely due to chemical exposure), type 3 (symptoms not likely because of chemical exposure but most likely because of psychological factors), type 4 (symptoms due to allergies or other diseases). Type 2 SHS has been proposed as "SHS in a narrow sense" (nSHS).

Moreover, a study group aided by the Ministry of Health, Labor and Welfare in Japan proposed a working definition of nSHS. "nSHS is a syndrome which has various non-specific symptoms including mucous membrane irritation, skin complaints, headache, and general fatigue which are related to chemical substances. Intoxication and allergies, which are elucidated medically regarding their causes and mechanisms, are excluded from nSHS."³⁾ Based on this definition, the diagnostic criteria of nSHS are proposed as the following. 1. The cause of the onset of a dis-

ease relates to a move, a new house or building, the reconstruction of a house or building, and/or the use of new or different daily toiletries. 2. Symptoms appear within a particular room and/or a particular house/building. 3. When a patient leaves the house/building, symptoms improve or disappear. 4. When indoor environmental pollution is detected, it is critical evidence. When subjects meet the 1st to 3rd diagnostic criteria, they are diagnosed as having nSHS.

After adding more detailed explanations to these criteria,⁶⁾ in order to examine the effectiveness of these diagnostic criteria, a study in which 5 clinical ecologists and 5 general physicians independently classified patients into the 4 types was carried out. Using the detailed criteria, general physicians who were not familiar with SHS could diagnose nSHS as well as clinical ecologists; however, inquiries for patients suspected of having nSHS are difficult. Because the diagnosis of SHS is based on inquiries, it is useful to establish a standard questionnaire for its diagnosis.

Andersson's MM040 SBS questionnaire^{8, 9)} is a questionnaire to diagnose SBS from the aspect of symptoms and the place where the symptoms occurred. Both SBS and nSHS are characterized as non-specific syndromes, which are related to low-level chemical compounds in indoor environments. The difference between SBS and nSHS is that SBS is caused by environments in office buildings while nSHS is caused by environments in the subjects' houses. We considered that it is reasonable to use the MM040 to diagnosis nSHS. Therefore, in the present study, we determined whether or not the diagnosis of nSHS based on the Japanese version of Andersson's MM040 SBS questionnaire⁹⁾ was matched to the diagnosis by the detailed criteria when all three conditions were met in both the patient group and the healthy group. In the healthy group, we counted

how many people were considered as potential SHS sufferers by both the diagnostic criteria of nSHS and the MM040 questionnaire. Also, the questionnaire used in this study included psychological symptoms.

The objective of the present study was to get basic information as to whether or not the MM040 questionnaire was useful to diagnose subjects of nSHS.

Subjects and Methods

Subjects

The patient group consisted of 66 subjects who presented for the first time at a clinical ecology medical institute in Minato-ku, Tokyo complaining of SHS symptoms from 2015 to 2016 and agreed to participate in this study with written informed consent. The healthy group consisted of 260 people working in the Tokyo Health Service Association in Shinjuku-ku, Tokyo, in December 2013 and agreed to participate in this study with written informed consent. Among them, 33 subjects were excluded because they did not complete the form correctly. Therefore, the remaining 227 subjects were analyzed.

Questionnaires

An anonymous and self-administered questionnaire was distributed to the subjects who agreed to join the study with written informed consent. The questionnaire included sex, age, and the questions related to SHS symptoms based on the original MM040 questionnaire (Table 1), the place where the symptoms occurred (their residence, office, school or others), whether or not the symptoms disappeared after leaving the place. For the symptoms on the original MM040 questionnaire, there are 13 categories of symptoms and others. On the questionnaire, the answers for the frequencies of the symptoms were: "Yes, often," "Yes, sometimes," and "No, never."

In addition, the contents regarding the diagnostic criteria of nSHS were included: 1. whether or not the chief complaints occurred within a specific place and improved after leaving the place; 2. whether or not the symptoms occurred after a move to a new house/building or newly reconstructed house/building; 3. after using daily toiletries, whether or not chemicals were determined at the specific place where the symp-

Table 1 The questionnaire based on Andersson's MM040 SBS questionnaire

Symptoms	Symptoms occurred in specific places		Symptoms disappeared after leaving those places	
	Yes	No	Yes	No
1) Fatigue	Yes	No	Yes	No
2) Feeling heavy headed	Yes	No	Yes	No
3) Headache	Yes	No	Yes	No
4) Nausea	Yes	No	Yes	No
5) Dizziness	Yes	No	Yes	No
6) Difficulties concentrating	Yes	No	Yes	No
7) Irritation of the eyes	Yes	No	Yes	No
8) Irritated, stuffy, or runny nose	Yes	No	Yes	No
9) Hoarse, dry throat	Yes	No	Yes	No
10) Cough	Yes	No	Yes	No
11) Dry or flushed facial skin	Yes	No	Yes	No
12) Scaly/itchy scalp or ears	Yes	No	Yes	No
13) Dry hands	Yes	No	Yes	No
14) Others	Yes	No	Yes	No

toms occurred; and 4. whether or not chemicals at the place were determined to be over the guideline value for the concentrations of indoor air pollutants in the environment according to The Ministry of Health, Labour and Welfare.¹⁰⁾ The questions also included nine psychological symptoms, which were based on opinion by a specialist and used since 2009 by the committee of the study group aided by Grants-in-aid for Scientific Research of The Ministry of Health, Labour and Welfare as follows. 1. I feel depressed almost all day. 2. I lose interest in almost everything or do not enjoy what I previously enjoyed. 3. I suddenly feel anxious, lightheaded, dyspnea, palpitations, and so on, twice in 10 minutes with no apparent causes. 4. Because I seriously feel afraid in situations in which I cannot get help when I feel uneasy, dyspnea, and palpitations, I have intentionally avoided those situations. 5. I felt afraid and/or ashamed when I was just looked at or stared at by someone this month. 6. I suffered from repeated thinking, images, and impulsions this month. 7. There is something I cannot stop repeating. 8. I feel excessively anxious or worry about things that never happen. 9. I feel sure that someone put thoughts into my head and someone makes me do something that I do not usually do.

For the healthy group, an anonymous and self-administered questionnaire was distributed at the periodical medical check-ups. The contents of the questionnaire included: sex, age, the questions based on the MM040 questionnaire, which are common questions for the patient group, contents related to the nSHS diagnostic criteria 1-3, and the history of the present illness.

Statistical analyses

The patient group

We counted the subjects who answered either, “Yes, often” or “Yes, sometimes” for the MM040 symptoms as those who exhibit symptoms. Among those, we counted the subjects who have at least 1 of the 13 symptoms of the MM040 that occur in specific places and improved or disappeared when the subjects left those places. We counted the numbers of the symptoms related to the places in the questionnaire as the MM040 symptom score for each subject. The distribution of the symptom scores was summarized.

We regarded the subjects as having nSHS, who presented at a hospital with chief complaints that appeared in specific places and when the symptoms improved or disappeared when the subjects left those places. We also counted the number of symptomatic subjects and whether or not chemicals were determined to be above guideline value levels at the specific places where those symptoms occurred. Also whether or not the determined values were over the guideline value of those chemicals, and whether or not the onset of the disease related to a move to a new house/building or newly reconstructed house/building, and/or if the symptoms appeared after using daily toiletries were checked. We examined the relation between subjects who were diagnosed as having SHS by the MM040 and subjects who were diagnosed as having nSHS by the nSHS diagnostic criteria by the χ^2 test. Moreover, we counted the frequency of psychological symptoms among the groups. The χ^2 test regarding the relation between each psychological symptom and the diagnosis of nSHS was performed.

The healthy group

We counted the number of the subjects who presented with SHS symptoms according to the

Table 2 Subjects with 1 or more of 13 symptoms related to specific places on the MM040 questionnaire in the patient group

Groups	n (%)
With SHS symptoms	46 (70.8%)
Without SHS symptoms	19 (29.2%)
Total	65 (100%)

Note) One subject who did not reply any questions for the MM040 was excluded.

MM040. For this group, we also counted the numbers of the symptoms related to the places in the questionnaire as the MM040 symptom score for each subject. The distribution of the symptom scores was summarized.

We counted the number of subjects that met the nSHS diagnostic criteria. For these subjects, we described the specific places where the subjects met the diagnostic criteria of nSHS and complained of such.

The relation between subjects regarded as exhibiting the SHS symptoms related to places revealed by the MM040 and who met the nSHS diagnostic criteria was performed by the χ^2 test. Moreover, we compared the symptom scores between subjects who met or had not the diagnostic criteria of nSHS by the Mann-Whitney U test. SPSS 21.0 (SPSS Japan Inc., Tokyo) was used for all the analyses.

Comparison between the patient group and the healthy group

We compared the distribution of the symptom scores between the patient group and the healthy group.

Ethics

This study was approved by the Ethics Committee at the Kitasato Institute Hospital, Kitasato University School of Medicine, and the Tokyo Health Service Association.

Results

The basic characteristics of 66 subjects who visited the clinical ecology medical institute and 227 subjects who worked in the Tokyo Health Service Association were as follows. Among the patient group, a subject did not answer her age. So the mean age of 65 subjects was 48.9 ± 15.9 (standard deviation [SD]). Besides, a subject did not reply for sex, there were 21 men (mean age, 45.0 ± 12.7), 43 women (mean age, 50.4 ± 17.0).

Among the healthy group, the mean age was 42.8 ± 11.8 (SD). There were 65 men (mean age, 45.6 ± 10.0), 162 women (mean age, 41.7 ± 12.3). Thirty-nine among 227 subjects (17.2%) were regarded as having SHS by their replies to the MM040. Twenty-seven among 227 subjects (11.9%) met the nSHS criteria.

Table 2 shows the number of subjects in the patient group who had at least 1 of 13 symptoms on the MM040 questionnaire that occurred in a specific place and improved or disappeared when the patient left those places. Although there were 66 subjects who were diagnosed as having SHS by their chief complaints, a subject did not reply for the questions of the MM040 questionnaire and was excluded from this analysis. Forty-six of 65 subjects (70.8%) had one or more symptoms on the MM040 that occurred in specific places and improved or disappeared when the subjects left those places.

Table 3 shows the numbers of subjects in the patient group who were diagnosed as having nSHS, for whom their chief complaints occurred

Table 3 Subjects diagnosed as having nSHS according to the nSHS diagnostic criteria in the patient group

Subjects	n (%)
With nSHS	39 (59.1%)
Chief complaints occurred in specific places and symptoms did not improve or disappear when the subjects left those places	9 (13.6%)
Chief complaints not related to a specific place	18 (27.3%)

Table 4 MM040 symptoms and frequency related to specific places of subjects who suspected SHS in the patient group

Symptoms	n (%)	n (%)
Fatigue	55/63 ^a (87.3%)	24/63 ^b (38.1%)
Feeling heavy headed	53/64 (82.8%)	25/64 (39.1%)
Headache	53/65 (81.5%)	25/65 (38.5%)
Nausea	44/63 (69.8%)	24/63 (38.1%)
Dizziness	46/62 (74.2%)	21/62 (33.9%)
Difficulty concentrating	53/64 (82.8%)	23/64 (35.9%)
Irritation of the eyes	51/65 (78.5%)	19/65 (29.2%)
Irritated, stuffy, or runny nose	41/64 (64.1%)	18/64 (28.1%)
Hoarse, dry throat	47/65 (72.3%)	21/65 (32.3%)
Cough	41/65 (63.1%)	26/65 (40.0%)
Dry or flushed facial skin	38/60 (63.3%)	14/60 (23.3%)
Scaly/itchy scalp or ears	34/61 (55.7%)	8/61 (13.1%)
Dry hands	40/60 (66.7%)	12/60 (20.0%)

Note) a: Subjects who answered "Yes" for the symptom(s) / subjects who suspected SHS (Subjects who did not answer were excluded.)

b: Subjects who answered "Yes" for the symptom(s) related to specific places / subjects who suspected SHS (Subjects who did not answer were excluded.)

Thirty subjects answered "Yes" for other symptom(s), and 13 subjects among them answered "Yes" for the symptom(s) related to specific places.

in specific places and the symptoms improved or disappeared when the subjects left those places. Thirty-nine of 66 subjects were diagnosed as having nSHS under these criteria. The specific places were the subjects' residences for 22 subjects, their offices for 8 subjects, and the school for 1 subject. Six subjects answered "others," and 2 subjects did not reply to this question.

Table 4 shows the symptoms on the MM040 and the frequency of the symptoms related to specific places of the subjects who suspected SHS in the patient group. The frequencies of the

subjects who complained of each symptom according to the MM040 questionnaire ranged from 55% to 87%. However, when the frequencies were limited to the symptoms that appeared in specific places and improved or disappeared when the subjects left those places, the range of frequencies of the subjects who complained of SHS symptoms was 13%–40%. Among these, the most frequent symptoms were: coughing (40%), followed by feeling heavy headed (39.1%), and headache (38.5%).

Fig. 1 shows the distributions of the MM040

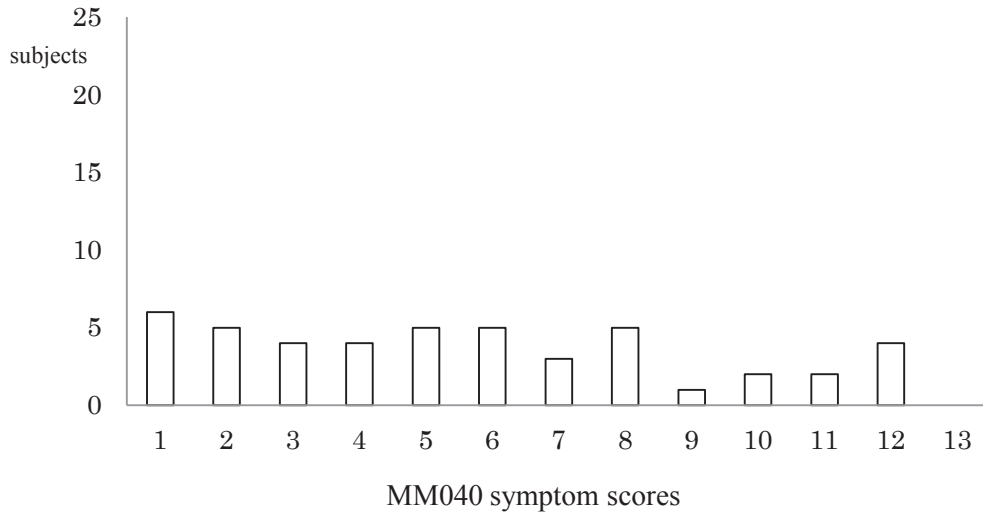


Fig. 1 Distributions of the MM040 symptom scores for subjects who have SHS symptoms in the patient group

scores of subjects who complained of the SHS symptoms related to specific places. The scores among those subjects were almost equally distributed from 1 to 13. The percentage of the scores of 4 and over was 67.4% (31/46). Six people had a score of 1; however, 4 person had a score of 12.

The number of subjects whose chief complaints occurred in specific places but whose symptoms did not improve or disappear when the subject left those places in the patient group was 9 (13.6%). The number of subjects whose chief complaints did not relate to specific places was 18 (27.3%).

There were 36 subjects who replied to questions about determination of chemicals. Among those, 10 subjects answered that chemicals were detected, and 7 of those 10 replied that the values were over the guideline value of those chemicals. Twenty-two subjects answered that chemicals were not determined, and 4 subjects answered, "Unknown." There were 22 subjects whose onset of symptoms was related to a move to a new house/building or newly reconstructed house/building, and/or after using daily toilets. There were 9 subjects reported that their

symptoms were not related to a move, and 5 subjects answered, "Unknown." Three subjects did not reply to this question.

Table 5 shows the relation between the subjects diagnosed as having nSHS and subjects as having nSHS according to the MM040 in the patient group. The relation was significant ($P < 0.001$). Among 39 subjects of diagnosed as having nSHS by the diagnostic criteria, 31 also had SHS according to the MM040. Therefore, the sensitivity was 79.4%. However, 8 subjects did not have SHS according to the MM040. Moreover, among 26 subjects who were not diagnosed as having nSHS, 15 had SHS according to the MM040, and 11 did not have SHS according to the MM040. Therefore, the specificity was 42.3%.

Table 6 shows the frequencies of psychological symptoms of each subject in the patient group who presented for the first time at the clinical ecology medical institute. The most frequent was, "Because I seriously feel afraid in situations in which I cannot get help when I feel uneasy, dyspnea, and palpitations, I have intentionally avoided those situations." More than 40% subjects complained of three psychological symptoms. There were 55 subjects (83.3%) who

Table 5 Relation between the diagnosis according to the nSHS diagnostic criteria and that according to the MM040 in the patient group

	Subjects who met the nSHS diagnostic criteria	Subjects who did not meet the nSHS diagnostic criteria	Total
Subjects who had ≥ 1 symptom ^a	31	15	46
Subjects without symptoms or whose symptoms were not related to a place ^b	8	11	19
Total	39	26	65

Note) $P < 0.001$ by the χ^2 test

One subject who did not reply any questions for the MM040 was excluded.

a: Subjects who had at least 1 of 13 symptoms on the MM040 questionnaire, which occurred in specific places and improved or disappeared when they left those places.

b: Subjects whose chief complaints occurred in specific places and the symptoms improved or disappeared when they left those places.

Table 6 Frequencies of psychological symptoms in the patient group

Psychological symptoms	Subjects with symptoms	Valid answers	(%)
1. I feel depressed almost all day.	27	64	40.9%
2. I lose interest in almost everything or do not enjoy what I previously enjoyed.	22	64	33.3%
3. I suddenly feel anxious, lightheaded, dyspnea, palpitations, and so on, twice in 10 minutes with no apparent causes.	30	63	45.5%
4. Because I seriously feel afraid in situations in which I cannot get help when I feel uneasy, dyspnea, and palpitations, I have intentionally avoided those situations.	32	62	48.5%
5. I felt afraid and/or ashamed when I was just looked at or stared at by someone this month.	14	63	21.2%
6. I suffered from repeated thinking, images, and impulsions this month.	23	62	34.8%
7. There is something I cannot stop repeating.	7	64	10.6%
8. I feel excessively anxious or worry about things that never happen.	26	63	39.4%
9. I feel sure that someone put thoughts into my head and someone makes me do something that I do not usually do.	12	64	18.2%

reported having at least one psychological symptom. For the comparison between the subjects who met and did not meet the criteria, the percentage of subjects who met the nSHS criteria complained, "Because I seriously feel afraid in situations in which I cannot get help when I feel uneasy, dyspnea, and palpitations, I have intentionally avoided those situations," was 40.5% (15/37), which was significantly lower than the

percentage of subjects who did not meet the criteria (68.0%, 17/25). Four subjects who did not reply to this question about this psychological symptoms were excluded from this analysis. The other psychological symptoms did not relate to the nSHS criteria.

Fig. 2 shows the distribution of MM040 symptom scores of subjects regarded as having SHS in the healthy group. Among 39 subjects regard-

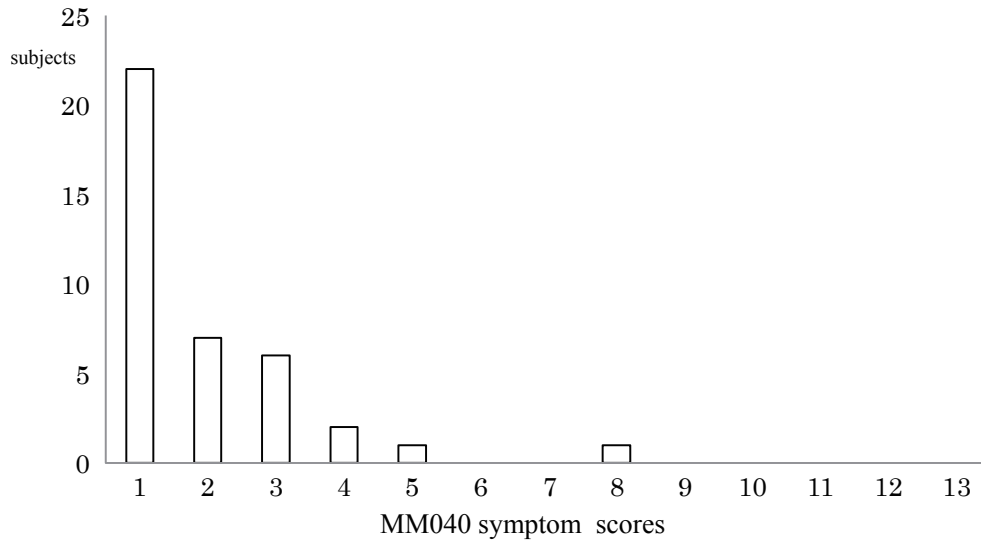


Fig. 2 Distribution of the MM040 symptom scores of subjects regarded as having SHS symptoms in the healthy group

ed as having SHS according to the MM040, 22 subjects each had a score of 1 (56.4%), and 89.7% of those had scores ranging from 1 to 3. The most frequent symptoms were nasal symptoms, such as nasal discharge, stuffy nose, and/or itching (51.2%, 20/39), followed by fatigue (36.0%, 14/39) and coughing (23.1%, 9/39). The specific places where the symptoms occurred were the workplace for 12 subjects. Among them, 4 had cough, 3 had nasal symptoms or fatigue, and 1 subject complained of feeling heavy headed and headache. Seven subjects replied places with dust as specific places where symptoms occurred. Among those, 4 had nasal symptoms, and 2 had eye symptoms. Five subjects replied interior finish work as specific places. Among those, 1 subject complained of fatigue, feeling heavy headed, headache, dizziness, and poor concentration. There were no participants who were found as having SHS symptoms as a history of the present condition.

In the healthy group, the number of subjects who met the nSHS diagnostic criteria was 27 of 227 (11.9%). For the specific place where the symptoms appeared, 12 subjects answered, “their

residence,” followed by, “their office” for 4 subjects. Two subjects answered, “both residence and office,” “school,” and “a new car.” One participant answered, “residence, school, and office,” and another participant answered, “the smell of a new car.”

Table 7 shows the relation between the subjects regarded as having the SHS symptoms related to places according to the MM040 and those who were diagnosed as having nSHS according to the nSHS diagnostic criteria. The χ^2 test showed they were significantly related. For the past diagnosis of SHS, 33% of the subjects who had at least one symptom according to the MM040 and met the nSHS diagnosis criteria, which was significantly higher than that of subjects who did not have symptoms according to the MM040 and who met the nSHS diagnostic criteria (7.4%).

Table 8 shows the distribution of symptom scores according to the MM040 questionnaire among the subjects who met and did not meet the nSHS diagnostic criteria. The symptom scores among the subjects who met the nSHS diagnostic criteria were significantly higher than

Table 7 Relation between the diagnosis according to the nSHS diagnostic criteria and that according to the MM040 in the healthy group

	Subjects who met the nSHS diagnostic criteria	Subjects who did not meet the nSHS diagnostic criteria	Total
Subjects who had ≥ 1 symptom ^a	13 (33.3%)	26 (66.7%)	39(100%)
Subjects without symptoms or whose symptoms were not related to a place ^b	14 (7.4%)	174 (92.6%)	188(100%)
Total	27	200	227

Note) $P < 0.001$ by the χ^2 test

a: Subjects who had at least 1 of 13 symptoms on the MM040 questionnaire, which occurred in specific places and improved or disappeared when they left those places.

b: Subjects whose chief complaints occurred in specific places and the symptoms improved or disappeared when they left those places.

Table 8 Distribution of symptom scores among subjects who met and did not meet the diagnostic criteria of nSHS

Symptom scores	nSHS in the healthy group n (%)	
	Subjects who met the nSHS diagnostic criteria	Subjects who did not meet the nSHS diagnostic criteria
0	14 (7.4)	174 (92.6)
1	5 (22.7)	17 (77.3)
2	2 (28.6)	5 (71.4)
3	4 (66.7)	2 (33.3)
4	1 (50.0)	1 (50.0)
5	1 (100.0)	0 (0.0)
8	0 (0.0)	1 (100.0)
Total	27 (11.9)	200 (88.1)

among those who did not meet the diagnostic criteria (median, 0.68 and 0.14, respectively, $P < 0.001$). However, even among the subjects who met the nSHS diagnostic criteria, 25/27 (92.6%) had scores of 3 or less.

Discussion

The patient group consisted of 66 subjects who presented at the clinical ecology hospital for the first time. In the patient group, the percentage (and number) of subjects diagnosed as having SHS according to the MM040 was 70.8% (46/65). One subject did not reply to some of the questions on the MM040 questionnaire and was therefore excluded. While that of the subjects di-

agnosed as having nSHS according to the nSHS diagnostic criteria was 59.0% (39/66). These were significantly related, and 79.4% (31/39) of the subjects who met the diagnostic criteria were diagnosed as having SHS according to the MM040. Therefore, the MM040 is a useful supplemental diagnostic tool. However, 32.6% (15/46) of the SHS subjects, according to the MM040, were not diagnosed as having nSHS according to the nSHS diagnostic criteria. Conversely, 20.5% (8/39) of the nSHS subjects according to the diagnostic criteria were not diagnosed as having SHS according to the MM040. It is, therefore, inappropriate to diagnose SHS by only using the MM040. The reason

for this discrepancy was perhaps because the chief complaints were not listed among the 13 complaints in the MM040 or because the symptoms related to specific places were not chief complaints for subjects diagnosed as having SHS according to the MM040. Further studies are warranted to determine whether or not the MM040 should be modified and more detailed, and to determine how symptoms related to specific places, but not listed as chief complaints, are handled.

There were 18 subjects whose chief complaints did not relate to specific places, and 9 subjects whose chief complaints related to special places but their symptoms did not improve or disappear when they left those places. Therefore, they might have been suffering from multiple chemical sensitivity (MCS) because their symptoms were not related to specific places. The possibility of MCS for 3 subjects should be examined using the QEESI (Quick Environmental Exposure and Sensitivity Inventory) questionnaire by Miller and Prihoda,¹¹⁾ and chemical determinations of places where those subjects developed symptoms are also required for proper diagnoses.

Only 10 of the 39 subjects who met the nSHS diagnostic criteria replied that chemicals were determined for specific places. However, 7 of those 10 replied that the determined chemicals were over their guideline value. This suggests that the determination of chemicals, and their toxic levels, in places where symptoms occur is useful to diagnose nSHS. However, it is also taken into consideration that the guideline value for all the various chemicals have not yet been standardized. It is essential to check whether or not toxic chemicals were determined to be in those places and their toxic levels. However, as Miyajima et al.¹²⁾ reported, it is inappropriate to exclude SHS related to chemicals when those

chemicals are determined to be under the guideline value.

Among 39 subjects who met the diagnostic criteria, 22 subjects answered that their residences were the specific places where their symptoms occurred and 9 subjects answered that it was their offices. This is reasonable because the subjects spent most of their time either in their residences or in their offices.

Twenty-two of the 39 subjects answered that the onsets of their nSHS symptoms were synonymous with, "a move to a new house /building," "the reconstruction of a house /building," and/or "the use of new or different daily toiletries." From these results, the significance of examining the nSHS diagnostic criteria is warranted. However, these onsets may also cause, or be due to, psychological or mental diseases and/or allergies.

There were 9 subjects in the patient group who answered that their chief complaints occurred in specific places but their symptoms did not improve or disappear when they left those places. Depending on the criteria, too many subjects may lead to exclusion from the diagnosis of SHS. Therefore, there still remains a difficulty to diagnose nSHS by the diagnostic criteria.

For psychological symptoms, we included 9 questions on the questionnaire. A diversity of psychological symptoms was observed among the subjects. The frequency of agoraphobia, measured by answers to the statement, "Because I seriously feel afraid in situations that I cannot get help when I feel uneasy, dyspnea, and/or palpitations, I intentionally avoid those situations," was 48.5% among the subjects who met the nSHS diagnostic criteria, while that among subjects who did not meet the criteria was 68.0%, which was significantly higher. The other psychological symptoms did not relate to the nSHS criteria. From these results, it is consid-

ered agoraphobia is useful to distinguish nSHS and type 3 SHS (symptoms not likely because of chemical exposure but most likely because of psychological factors). When we diagnose subjects who have agoraphobia, we have to be especially careful in the diagnosis of nSHS.

In the healthy group, there were 227 subjects, and 17.2% (39/227) were regarded as having SHS according to the MM040, and 11.9% (27/227) answered they had met the nSHS diagnostic criteria. The frequencies might indicate a prevalence of nSHS that is not serious.

In the healthy group, the number of subjects regarded as having SHS symptoms according to the MM040 was significantly related to that of those who met the nSHS diagnostic criteria. However, no participant was diagnosed as having SHS as a present illness. In addition, although the symptom scores among subjects who met the diagnostic criteria was significantly higher than those among subjects who did not meet the criteria, approximately 90% of the subjects had symptom scores of 3 or fewer points. From these results, subjects who met the nSHS diagnostic criteria do not require medical treatment because of fewer symptoms, and they were not diagnosed as having nSHS. However, they may be potential nSHS sufferers and should be careful.

The most frequent symptoms complained of among the 39 subjects in the healthy group were nasal symptoms, followed by fatigue, and coughing. In the healthy group, the place where the most symptoms occurred according to the MM040 was in the workplace; however, where most symptoms occurred according to the nSHS diagnostic criteria was in the subjects' residences. The reason for this discrepancy is most likely that the MM040 was originally a questionnaire designed to help diagnose SBS, while, the nSHS diagnostic criteria was developed to diagnose

SHS. There were 5 subjects who answered that interior finishing work at specific places was responsible for the onset of their symptoms according to the MM040. The concentration of chemicals at places undergoing interior finishing work may rapidly increase without adequate countermeasures.

Two subjects who were diagnosed as having nSHS symptoms according to the nSHS diagnostic criteria answered, "both the residence and the office" as specific places, and one subject answered, "the residence, school, and the office." This indicates that a patient may have several specific places that may cause symptoms.

In the comparison between the patient group and the healthy group, the frequency of the SHS sufferers according to the MM040 questionnaire in the patient group (70.8 %) was expectedly significantly higher than that among the healthy group (17.2 %). The major symptoms were coughing, fatigue, and feeling heavy headed, for which there were no significant differences. This suggests the difficulty to diagnose SHS from only the symptoms.

In the comparison of the symptom scores between the patient group and the healthy group, the patient group scores were equally distributed from 1 to 13; however, approximately 10% of the subjects had 4 points or more in the healthy group. The difference in the scores between the groups might be a factor to indicate the necessity of seeking medical care. It is noteworthy that the symptom scores according to the MM040 varied widely.

As limitations of this study, for the analyses, although the frequencies of symptoms were calculated by the answers, "Yes, often," and "Yes, sometimes," in the MM040 questionnaire, we counted the subjects who answered either, "Yes, often," or "Yes, sometimes," as among those who have symptoms. This was due to the limited

number of subjects. The analysis based on the frequencies, “Yes, often,” “Yes, sometimes,” and “No, never,” will result in different findings. Further studies are warranted with larger populations. We did not clearly ask when the symptoms occurred, which should be included in future studies. Because the chief complaints in the diagnostic criteria of nSHS were not categorized, the subjects answered freely. Therefore, our only suggestion is that the chief complaints should be added to those 13 in the MM040.

Moreover, because this study was a cross-sectional study, a follow-up study is warranted to determine whether or not subjects who were regarded as having nSHS either according to the MM040 or the nSHS diagnostic criteria should seek further medical treatment.

The male to female ratio was 1:2.5 in the healthy group and 1:2.0 in the patient group. The mean age in the two groups was similar. We compared the distribution of the symptom scores between the groups. For that comparison, the differences between the male to female ratio and the subjects’ ages may not significantly affect the results. However, it should be noted that there is a discrepancy between the male to female ratios between the current study and previous studies. In previous studies^{6,7)} regarding subjects diagnosed as having SHS, there were more females (1:4).

It should be noted that smoking is an opportunity of exposure to chemicals in daily life for healthy people and definitely a significant exacerbating factor; therefore, the relation between SHS and smoking should also be examined in future studies.

Conclusions

In the patient group, the MM040 is useful as a supplemental diagnostic tool. However, it is inappropriate to diagnose SHS only according to

the MM040 because some subjects who met the nSHS diagnostic criteria could not be diagnosed as having SHS only according to the MM040. Among the healthy group, the number of subjects regarded as having SHS symptoms according to the MM040 was significantly related to that of those who met the nSHS diagnostic criteria, however it should be noted that the symptom scores according to the MM040 were relatively low. The MM040 questionnaire was partially helpful to diagnose SHS in the patient group and detected SHS subjects in the healthy population.

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抄録

シックハウス症候群には広範な原因が含まれるが、特に化学物質によるもの、いわゆる狭義のシックハウス症候群の診断には問診が用いられており、何らかの標準的な質問紙票が望まれる。そこで、シックビルディング症候群と狭義のシックハウス症候群は共通点が多く存在することから、Andersson のシックビル質問紙票 MM040を用いて狭義のシックハウス症候群を診断することができるか、シックハウス症候群疑いの患者66人と一般集団227人を対象にして検証した。

患者群では症状が場所と関連する狭義のシックハウス症候群診断該当者39人中31人において MM040 質問紙票の症状項目の少なくとも1つが場所と関連していた。ただし、一般集団においても MM040 による症状が場所と関連する者が約17.2%いたことには留意すべきである。このことから MM040 質問紙票はシックハウス症候群の補助診断や潜在化したシックハウス症候群症状の評価として有効である可能性がある。
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《キーワード》シックハウス症候群、MM040、シックビルディング症候群、診断
