Original Article

Sick Building Syndrome and Its Associating Factors at a Hospital in Kashan, Iran

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Abstract

Background and purpose: Sick building syndrome consists of a group symptoms, including fatigue, headache, nausea, nose irritation, dry skin and redness in which people in a building suffer from the symptoms. The purpose of this study was to assess the symptoms of SBS and its associated factors among staff at a hospital in Kashan, Iran.

Materials and Methods: The present study was conducted among all staff who volunteered to participate in the research. Totally, 41 subjects were surveyed for SBS symptoms. A MM040EA questionnaire was used to determine SBS among staff and indoor air quality. Chi-square and Fisher's exact tests in SPSS Software version 16 were applied to analyze the collected data.

Results: In general, the most prevalence symptoms of SBS were headache (85.4%), heaviness in the head (65.9%), low concentration, and dry skin (63.4%). The correlation was found to be not significant between SBS and age (P=0.46), gender (P=0.18), job (P=0.68), and working history (P=0.16). Also, the prevalence of SBS was significantly correlated with noise, low light, and unpleasant odor (P< 0.05).

Conclusion: Accordingly, the high prevalence of SBS among staff and its relationship with factors such as unpleasant odor, noise, low light and the effect of the syndrome on the efficiency and the quality of working life, the improvement of lighting distribution and the reduction of noise were proposed for the reduction of SBS.

Keywords: Sick building syndrome; Staff; Hospital; Kashan

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1. Introduction

Indoor air quality depends on factors including temperature, humidity, lighting, ventilation, volatile organic compounds (VOC_s) and particulate matter concentration (e.g. the probability of opening the windows) (1). Sick building syndrome (SBS) is an indoor air quality related disease, which stimulates the nerve system, skin, and respiratory system, and has symptoms including headaches, dizziness, nausea, coughing, sneezing, irritated mucous membranes of eyes, throat and inflammation and itching of skin, too (2). The syndrome is associated with indoor poor air quality and indoor air conditioning (3). The most common symptom is various in different studies; in some studies, the most common symptoms were headache, fatigue, and dry skin (4). While, in some other studies, weakness and fatigue are considered as the most common symptoms (5). According to the World Health Organization (WHO), the most common symptom of SBS is intellectual fatigue, but respiratory symptoms generally have the more frequency (6). The symptoms of SBS are related to the work environments, so that the symptoms appear immediately or shortly after entering the building and disappeared after exiting it. SBS causes the disease, weakness and fatigue in individuals with reduced efficiency and productivity and increased absenteeism (4). Previous assessments also showed an improvement in working environment, performance and staff protection in buildings by more than 40% (7). These symptoms can cause poor hospital indoor air quality (8). SBS can occur in work – places such as office buildings, universities, and hospitals (9). The inappropriate indoor air quality of hospitals may lead to outbreaks of infectious diseases or diseases associated with buildings such as headaches, fatigue, eye irritation and other symptoms between patients and hospital staff (6, 8, 10, 11). According to WHO, the prevalence of sick building syndrome is estimated up 30% in new buildings (6). Respirable particulate matters are one of the major pollutants in indoors and can penetrate deeply into the respiratory tract. These particles include particles less than 2.5 microns in diameter ($PM_{2.5}$) and particles less than 10 microns (PM_{10}). The present study aimed to assess signs and symptoms of sick building syndrome and its related factors at a hospital in Kashan city.

2. Materials and Methods

The cross-sectional study was carried out in Shahid Beheshti Hospital in Kashan. The hospital is located outside urban traffic and in the vicinity of Kashan University of Medical Sciences with an area of 40,000 square meters and 25 years old with the target wards including the operating room and ICU_2 wards situated on the first floor and in corners of the northeast and northwest, respectively, while the children ward is situated on the third floor and in the southwestern corner. Also, the operating room ward were equipped with air conditioner and central cooling-heating systems, and rooms of children ward were equipped with fan coil, while the corridor of ICU_2 ward was equipped with fan coil and standing gas cooler. In the present study, all staff of ICU_2, operating room, and children wards agreed to participate in the research. Accordingly, considering the respirable particles concentration as one of the most important factors in indoor air quality, and the importance of the respirable particles concentration in these wards, it was concluded that indoor particle concentrations

were higher than WHO and US-EPA standards, so the above-mentioned wards were selected for investigating SBS (12).

This study was conducted among all staff who volunteered to participate in the research. Totally, 41 subjects were surveyed for SBS symptoms. To determine sick building syndrome and indoor air quality, a valid translated MM040EA questionnaire was used (4). In the present study, the reliability was confirmed by Cronbach's alpha test (α =0.76). To identify symptoms of patients, the answers were divided into three options including; yes often, yes sometimes, and no never. Individual symptoms comprises feeling of heaviness in the head, headache, nausea, dizziness, difficulty in concentration, the stimulation of respiratory mucosa irritation and itch, watery nose, sneezing, dry throat cough, itchy or watery eyes, scaling and itching of the scalp, ear, skin redness and dryness which are all produced in the working environment (4).

The gained data from the questionnaire were analyzed through chi-square and Fisher exact tests in SPSS Software, version 16. Also, Cochran's and Mantel-Haenszel test were used due to the imbalance of the studied wards.

3. Results

In the current study, from among 41 participants as the staff of Shahid Beheshti Hospital working in different hospital wards of operating room, children, and ICU_2, 19 (90.5%) were females and two (9.5%) were males working in the operating room ward. It should be said that in the children ward, 11 subjects (100%) were females, while in the ICU_2 ward, eight volunteers (88.9%) were females and just one case (11.1%) was male. The participants' average ages were also 33.35 ±5.91, 30.00±7.03, and 30.78±3.67 years in the operating room, children ward, and ICU_2 ward, respectively. Based on the data from the questionnaire, the average work experience of staff were 10.05±6.18, 10.60 ± 6.35, and 6.50 ±3.25 years in the operating room, children ward, and ICU_2 ward, respectively. Among the staff who filled out the questionnaires, there were 23 nurses (56.1%), eight operating room technicians (19.51%), six anesthesiology experts (14.63%), and three service workers (7.32%). The findings of the current study showed that there was a significant association between the studied wards and SBS (P=0.009). The most prevalence symptoms of SBS among the studied subjects were also found to be headache (90.5%), heaviness in the head (81%), and dry skin (76.2%) in the operating room ward. In the children ward, on the other hand, the symptoms of SBS including headache and difficulty in concentration (72.7%), Fatigue (63.6%), dry skin (63.6%), and itching of the scalp (63.6%) were more prevalent than other symptoms. Also, headache (88.9%) and heaviness in the head (44.4%) were the most common signs of SBS in the ICU_2 ward, as shown in Table 1.

Table 1. Frequency distribution of SBS symptoms in the staff

Wards	Operating Room		Children		ICU_2	
SBS syndromes	N	%	N	%	N	%
Fatigue	7	33.3	7	63.6	3	33.3
Heavy headed	17	81	6	54.5	4	44.4
Headache	19	90.5	8	72.7	8	88.9
Nausea	15	71.4	5	45.5	2	22.2
Low concentration	15	71.4	8	72.7	3	33.3
Burning eyes	13	61.9	3	27.3	2	22.2
Nose irritation	15	71.4	5	45.5	3	33.3
Dry throat	15	71.4	4	36.4	0	0
Cough	12	57.1	4	36.4	3	33.3
Skin redness	10	47.6	5	45.5	3	33.3
Itching scalp and ears	9	42.9	7	63.6	2	22.2
Dry skin	16	76.2	7	63.6	3	33.3

In general, the most prevalent symptoms of SBS were headache (85.4%), heaviness in the head (65.9%), low concentration, and dry skin (63.4%). In the present study, it was also documented that 85 percent of the subjects had frequently been seen with SBS symptoms, while 68.42 percent of them were diagnosed with SBS symptoms, and sometimes sensed unpleasant odor during the week at the workplace (Table 2). Also, there was a significant correlation between noise and SBS symptoms (P=0.04). From among the subjects with SBS symptoms, 86.96 percent had often sensed high noise at workplace, while 62.5 percent of them experienced high noise sometimes during the week, as shown in Table 3.

In the current study, the symptoms of SBS were associated with environmental factors such as very high temperature (P=0.02), various temperature (P=0.002), stuffy bad air (P=0.00), dry air (P=0.008), unpleasant odor (P=0.004), noise (P=0.03), low light (P=0.01), and dust (P=0.00). But the relationships between the symptoms of SBS and very low temperature (P=0.16), and contact with static electricity were documented to be not statistically significant (P=0.12).

Table 2. Frequency distribution of SBS prevalence by feeling unpleasant odor in the workplace

SBS feeling unpleasant odor	Yes (%)	No (%)	Sum (%)
Yes often	17(85)	3(15)	20(100)
Yes sometimes	13(68.42)	6(31.58)	19(100)
No never	2(100)	0	2(100)
Total	32(78.05)	9(21.95)	41(100)

Regarding the respirable particles concentration in the studied wards, the mean $PM_{2.5}$ and PM_{10} concentrations were determined to be 55.25 and 212.36 µg m^{-3}, 57.61 and 203.64 µg m^{-3}, and 54.32 and 210.96 µg m^{-3} in the operating room, children wards, and ICU_2 wards, respectively.

Table 3. Frequency distribution of SBS prevalence by noise

SBS Noise	Yes (%)	No (%)	Sum (%)
Yes often	20(86.96)	3(13.04)	23(100)
Yes sometimes	10(62.5)	6(37.5)	16(100)
No never	2(100)	0	2 (100)
Total	32(78.05)	9(21.95)	41(100)

4. Discussion

The present study showed that headache was a common sign of SBS symptoms among the staff in all studied wards in the target hospital. In the current study, the prevalence of SBS syndrome had no association with age and employment history (P>0.05), which was consistent with some other studies that have concluded that these two factors had no effect on SBS (13). In the present study, the relationship between the prevalence of SBS and gender was not statistically significant (P>0.05), and this finding was in line with some other similar studies (4, 14-16). In the current research, the most common general symptoms of SBS were headache, heaviness in the head, difficulty in concentration and dry skin among the subjects in the studied wards. As observed in various other studies, the frequency of symptoms was different. For example, in one conducted study, the most prevalent symptoms of SBS among nurses were lack of concentration, headache, dry skin, redness, and eye irritation (14). While, another study, which was investigating SBS in the hospitals of Portugal, the prevalent factors were revealed to be environmental factors including unpleasant odor, smoking, and noise (15). Hence, different buildings and various SBS causes can create diversity in SBS frequency in different studies. One other finding of this study was the absence of significant association between working conditions such as interesting work, high workload, influencing on work conditions, and helping fellow-workers with the prevalence of SBS (P>0.05), which was also in line with the results of a similar study (14). However, no significant relationship was found between job and SBS (P>0.05). In the present study, the indoor means of $PM_{2.5}$ and PM_{10} concentrations were documented to be higher than the daily standards recommended by WHO and US-EPA (17, 18). It could then be concluded that poor indoor air quality was the main factor of high prevalence of SBS among the hospital staff. This result was approved through finding significant association between PM concentrations and the symptoms of SBS. At the same time, the present study revealed the existence of a significant relationship between SBS and environmental factors, such as noise and unpleasant odor, which again shows consistent result with the findings of a similar study (14). Unpleasant odor including bad smell of toilets, sewage waste, medicines, and cooking odors were among the factors affecting SBS prevalence in the studied wards of Shahid Beheshti Hospital. Because of the effect of low light, noise, and unpleasant odor on symptoms of SBS among the hospital staff, installation of an effective ventilation system, improvement of lighting distribution, and reduction of noise in the wards were found to be necessary for reducing the symptoms of SBS in individuals. The current study was conducted to determine the SBS and related factors in the studied hospital. The syndrome was investigated in the operating room, children wards, and ICU wards due to the most significant respirable particles as one of the effective factors in SBS. In addition to respirable particles, other factors, such as gaseous pollutants NO_2, CO, volatile organic compounds (VOC_s), and formaldehyde, are the hospital indoor air pollutants that can be effective on SBS. Therefore, it is suggested that the role of these factors to be considered in forthcoming investigations. Finally, it should also be noted that since the current study was a cross-sectional research, some confounding factors could have affected the results of the study.

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Conflicts of interest

The authors have no conflict of interest.

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