

Building characteristics and sick building syndrome among primary school students

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Abstract

Background: The sick building syndrome (SBS) describes situations in which building occupants experience acute negative physical and mental effects linked to the time spent in a contaminated area without any identified illness.

Objective: The study was carried out in order to assess the prevalence of SBS among primary school students in Qom, Iran, and the association between SBS symptoms and personal, psychosocial and environmental factors.

Method: A descriptive-analytical study was conducted on 24 primary schools in different regions of Qom, Iran, from 15 September 2014 to 27 February 2015. Four hundred and twenty students, comprising an equal number of randomly selected males and females, aged 7-13 years, participated in the study. A standardized questionnaire was completed by 397 (94.5 %) students. Data was then analysed using SPSS software.

Results: Twenty four percent of students, comprising 65.3% of female and 34.7% of male students, had SBS. The most frequent symptom of SBS was headache identified in 39 (10%) cases. A significant difference was observed between SBS symptoms and gender ($p = 0.001$). Whilst SBS had a significant direct correlation with the age of the school building ($p = 0.001$) there was a significant

inverse correlation with ventilation ($p = 0.002$) and the student satisfaction with the size and lighting of classrooms ($p = 0.02$).

Conclusions: Prevalence of SBS among students of primary schools in the city of Qom, Iran was 24%. Statistically significant associations were observed between SBS and gender, ventilation, age of school building and student satisfaction with the size and lighting of classrooms.

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(Keywords: Sick building syndrome, primary school students, building characteristics)

Introduction

World Health Organization (WHO) formally defined the concept of sick building syndrome (SBS) as a condition which increases the prevalence of a variety of non-specific symptoms associated with the indoor environments^{1,2}. SBS has general, mucosal and skin symptoms such as headache, fatigue, and irritation in the upper respiratory tract, throat, eyes, nose, hands and/or facial skin^{2,3}. Some risk factors associated with SBS have been identified, including personal, psychosocial and indoor environment factors⁴. SBS is a group of phenomena and not a syndrome as they are normally defined in medicine. These symptoms are related to the work environment, symptoms begin to appear when a person enters the building or shortly afterwards and disappear on exit. The appearance of two symptoms in one month are sufficient to diagnose SBS⁵.

Air pollution in school buildings can bring about significant problems such as adverse health effects, loss of perception and learning level in students. Evidence has shown that indoor air quality may affect students' health. Some studies have reported that wheezing and fever in children are significantly associated with exposure to indoor fungi⁶. On the other hand, the poor indoor air quality affects the presence and performance of students in the schools⁷. Moreover, prevalence of asthma and allergies in children can be increased by moisture and mold. A study in Sweden has demonstrated that the exposure of children to the indoor pollution in day-care centres will increase the incidence of respiratory infections and eczema⁸. Furthermore, a relationship has been proved to exist between SBS

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and damp or moldy buildings⁹. To the best of the authors' knowledge, no similar study about SBS has been yet performed in Qom, Iran.

Objective

The research was performed with the aim of assessing the prevalence of SBS among primary school students in Qom, Iran, and the association between SBS symptoms and personal, psychosocial and environmental factors.

Method

A descriptive-analytical study was conducted on 24 randomly selected primary schools in different areas of Qom from 15 September 2014 to 27 February 2015. Qom city is the capital city of Qom province and is located at 34° 44' 37" N, 55° 33' 27" E. The average elevation of city is 950 metres above sea level. Qom is a semi-arid city in the central part of Iran¹⁰⁻¹³. The annual average temperature and precipitation are 18.1°C and 161 mm, respectively.

The sample comprised 420 students, aged 7-13 years, who were selected using Cochran's sample size formula. Qom city is divided into 4 regions as determined by the Qom education office. Six schools were selected from each region, among which the questionnaires were distributed. School selection was based on 2 criteria, i.e. age of school building and gender of students. The selected schools were divided into 3 groups: <20, 20 and >20 years. Approval for conducting the study in the designated schools was provided by Qom department of education. Protocol of this study was approved by ethical committee of Qom University of Medical Sciences

A standard questionnaire was obtained from a similar study¹⁴. Questionnaires in Persian, the students' native language, were given to 420 students to be completed at home with the help of their parents. Three hundred and ninety seven (94.5%) students completed the questionnaires. Students were randomly selected based on the proportion of public and private schools to avoid socioeconomic bias. Questionnaire had 4 sections, namely personal information (age, gender and student satisfaction with size and lighting of classroom), school characteristics (age, types of heating, ventilation and number of floors), overall health status of students (nervous, digestive, skin, smell, eye, respiratory, cold, sinusitis, lung, asthma, allergies, migraine) and SBS symptoms (general, mucosal, skin). For each SBS symptom, 4 alternatives were delineated as "Yes, daily", "Yes, 2-3 times a week", "Yes, less than that", which were assigned the value of 1 and "No, never" having the value of 0. Students who had a disease associated with SBS were excluded from study. Data were analysed using Chi-square test by SPSS software (ver.20.0) at significance level of 0.05.

Results

Mean age of students was 9.2 ± 1.8 years (range 7-13 years). There were 51.4% females and 48.6% males. Mean age of school buildings was calculated to be 18.7 years with a standard deviation of 10.08). 40.5% of school buildings were over 20 years old. Since the variables had some missing data, in addition to actual percentage, valid percentage were calculated by SPSS software (Table 1).

Table 1: Personal information of students (n=397) and school characteristics

Variable	Number (%)	Valid percentage
<i>Gender</i>		
Male	193 (48.6)	48.6
Female	204 (51.4)	51.4
<i>*Student satisfaction with size and lighting of classrooms</i>		
Yes	44 (11.1)	11.7
No	348 (87.6)	88.3
<i>**Age of school building</i>		
20	20 (05.6)	08.5
>20 years	147 (37.0)	40.5
<20 years	188 (47.3)	51.0
<i>Heating type of schools</i>		
Heater	161 (40.6)	40.6
Radiator	236 (59.4)	59.4
<i>***Ventilation</i>		
Poor	45 (10.7)	11.3
Medium	163 (38.8)	41.1
Good	157 (37.4)	39.5
Very good	32 (07.6)	08.1
<i>****Student location</i>		
Ground floor	206 (49.0)	58.5
First floor	59 (14.0)	16.8
Second floor	87 (20.7)	24.7

*Missing data= 5, **Missing data= 42, ***Missing data= 23, ****Missing data= 68

Table 2 shows the prevalence of symptoms and students with SBS. The afflicted students are those who had a minimum of two symptoms in one month, these symptoms vanishing on exit from school buildings. The results showed that 24.2% of students (65.3% females, 34.7% males) were affected by SBS. The headache had the maximum prevalence of all symptoms (10% or 39 cases). After headache, confusion (9.5%), fatigue (7.4%) and nausea (6.1%) were the common symptoms. It was also found that general symptoms were more common in students. But, skin symptoms were found to have the least

frequency. Only 3 cases of male students suffered from symptoms related to this group.

According to the results, 63.3%, 17.8%, 18.9% of students who suffered from SBS were attending the classrooms on the ground, first and second floors, respectively. Whilst SBS had a significant direct correlation with the age of the school building ($p=0.001$) there was a significant inverse correlation with ventilation ($p=0.002$) and the student satisfaction with the size and lighting of classrooms ($p=0.02$).

Table 2: The prevalence of SBS symptoms in Qom primary schools

Symptom	Female Number (%)	Male Number (%)	Total Number (%)
<i>General symptom</i>			
Headache	15 (07.5)	24 (12.6)	39 (10.0)
Fatigue	13 (06.5)	16 (08.4)	29 (07.4)
Confusion	20 (10.0)	17 (08.9)	37 (09.5)
Lack of focus	07 (03.5)	09 (04.7)	16 (04.1)
Memory loss	12 (06.0)	04 (02.1)	16 (04.1)
Nausea	16 (08.0)	08 (04.2)	24 (06.1)
Vomiting	06 (03.0)	04 (02.1)	10 (02.6)
<i>Mucosal symptom</i>			
Nasal (obstruction, itching and running)	08 (04.0)	05 (03.5)	13 (03.4)
Shortness of breath (dyspnoea)	03 (01.5)	05 (03.5)	08 (02.0)
Dry cough	03 (01.5)	03 (01.6)	06 (01.5)
Wheeze	03 (01.5)	03 (01.6)	06 (01.5)
Hyperosmia	02 (01.0)	02 (01.0)	04 (01.0)
Hyposmia	02 (01.0)	01 (0.5)	03 (0.8)
False sense of smelling (phantosmia)	02 (01.0)	02 (01.0)	04 (01.0)
Eye (redness, burning and darkness)	07 (03.5)	02 (01.0)	09 (02.4)
Throat (itching and burning)	01 (0.5)	02 (01.0)	03 (0.8)
<i>Skin symptom</i>			
Skin dryness	0 (0)	01 (0.5)	01 (0.3)
Eczema	0 (0)	01 (0.5)	01 (0.3)
Skin rash	0 (0)	01 (0.5)	01 (0.3)
Students afflicted with SBS	66 (65.3)	35 (34.7)	101 (24.2)

Discussion

Personal, psychosocial and indoor environmental factors have been defined as the risk factors of SBS. Primary school students as a susceptible group spend a long time in the classrooms as the indoor environment, which can make them vulnerable to SBS. To verify this hypothesis, the study set out to examine the prevalence of SBS among Qom primary school students and analysed the association between SBS symptoms and personal information of students and characteristics of schools.

According to the results in Table 2, headache was the most common symptom of SBS. In one study, headache was also reported as the most frequent symptom¹⁵. The results of several studies were in contrast to those of the current research. For example in one study by Amin *et al.* (2015), rhinitis was reported as the most common symptom¹⁶. In the current study, skin symptoms were known as the

least frequent symptoms. This result was in tandem with that of other research conducted for example in China¹⁷ and USA¹⁸.

Of a total of 24% of students having SBS, 65.3% were females. Some studies showed that there is a close relationship between gender and SBS. It has been confirmed that SBS is more common in females than in males^{19,20}. Until now, there is no confirmed evidence to explain the factor or factors which can account for the high prevalence of SBS in female students. It is reported that in the UK the prevalence of SBS is higher among women, because they often work in poor conditions²¹. There is a comprehensive theory attributing this difference to the educational level, working conditions, job characteristics and other psychosocial factors influencing SBS prevalence^{22,23}.

Based on data analysis, 63.3% of students who had SBS were attending the classrooms on the ground floor. According to the results of several studies, it can be concluded that there is a significant relationship between the floor of the building and the incidence of SBS symptoms. This can be due to moisture and excessive growth of mold and fungi on the floor of the building. Wang et al. (2015) have reported that airborne fungi levels grow rapidly in the children's rooms on the ground floor²⁴. In the current study, significant differences were observed between ventilation, age of school building and SBS symptoms. Ventilation and the age of school building are factors that have a significant impact on the increase of SBS-related symptoms. It has been reported that the ventilation rate lower than 10 l/s will increase SBS symptoms²⁵. In addition, a relationship has been observed between increasing ventilation rates in the schools and a reduction in the prevalence of SBS symptoms²⁶. It should be noted that researchers have surveyed the effect of the type of structure and materials used in the building on the prevalence of SBS symptoms. Besides, the use of new materials in Russian houses has increased asthma, allergies and wheezing in students aged 8 to 12 years²⁷.

The increase in SBS symptoms can cause problems with the education of students in schools. Since the population in the current study was selected from primary schools, productivity loss and unacceptable performance in students was anticipated to occur with SBS development. It is, therefore, suggested that similar studies with broader populations and more influential factors be carried out in Qom to further evaluate the prevalence of SBS in other indoor environments.

Conclusions

- In this study, 24% of students had SBS symptoms.
- Among the personal factors affecting the incidence of SBS, gender had a significant role.
- The variables of ventilation and school building age (belonging to indoor environment factors) and student's satisfaction with the size and lighting of the classroom (of psychosocial factors) were associated with SBS.

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