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"Sick Building Syndrome" (SBS) in Iran: SBS affects on Office Workers

Nazanin Moazzen Ferdos [1] **Touraj Ashrafian** [1] **Masoud Haghlesan**[2]

1 Young Researchers Club of Tabriz- Islamic Azad University Tabriz branch, E-mail: t.ashrafian@gmail.com, moazzen_arch@yahoo.com

2 Architecture Department, Islamic Azad University, Ilkhchi Branch, Iran, E-mail:mhaghlesan@yahoo.com

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Name of the Presenter: **Nazanin Moazzen Ferdos**

Abstract

The term "Sick Building Syndrome" (SBS) is used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified. In 1984, world health organization (WHO) indicated that up to 30% of new and remodeled buildings worldwide may be linked to symptoms of SBS. SBS has variety of causes but HVAC system has the most influence on SBS, furthermore, air contaminants, mold and lighting system can cause SBS symptoms among office workers. Symptoms associated with acute discomfort, e.g., headache; eye, nose, or throat irritation; dry and itchy skin, which are known as SBS symptoms are well reported amongst people who work in offices in Iran.

Unfortunately, in Iran, there is less attention to SBS; however, there are worldwide attentions to this matter. This paper will focus on Iran's office buildings which affected by SBS and debate about SBS and its prevailing symptoms among office workers in Iran and will recommend some methods to prevent this matter in selected case study office buildings.

Key words: Sick Building Syndrome, Office Workers, Iran, HVAC, Prevailing Symptoms

1. Introduction

People spend most of their time indoor, estimations indicate that human spend more than 90 percent of their life inside buildings, hence, issues related to indoor spaces are very important factors in human well-being and comfort. On the other hand, by considering 8 hour work time for office workers, it will be concluded that they spend about 33 percent of their time in office. One of recent issues about buildings is "Sick Building Syndrome" (SBS).

In 1988, the Environmental Protection Agency was plagued by a multitude of claims in its new office building. For several years, more than 100 of the 5,500 employees in the EPA

headquarters had complained of new symptoms since moving into the new building, including hoarseness, dizziness, headaches, rashes, nausea, fatigue, blurred vision, chills, sneezing, fever, irritability, memory loss and burning sensations in the throat, eyes, ears, and chest. Further investigation revealed that more than 1,000, or nearly one-fifth, of the occupants of the building had serious health complaints by November of 1989.

The SBS appears to be a modern one. Yet, this is not one of the new fads that crop up from time to time and then disappear again, never to be mentioned again. Indeed, it is a modern problem, caused by the improvements in building standards. Air that has been used and breathed and not replaced caused to raise concentration of CO2. Slowly, the level of days off for sickness rose and the quality of work sank in these newer or refurbished buildings, leading to something referred to as SBS, since it appeared to affect everybody in one building.

Investigations of unhealthy office environments associated with widespread reports of headache, fatigue, and mucous membrane complaints did not usually identify single air contaminants at levels which could account for the symptoms.

In sick buildings, the predominant explanation invoked for SBS complaints is inadequate fresh air intake in mechanically ventilated buildings. The presence of mechanical ventilation and air changes per hour are less important than the type of air conditioning, with the moisture common to humidification and chilling systems being associated with high complaint rates. Work organization, job category, and gender are associated with the perception of work-related symptoms independent of class of ventilation. Occupant activities and the building furnishing parameters are associated with indoor air quality complaint rates. (Kreiss K. 1997)

In general, SBS is used for Building where occupants experience a range of symptoms which cause discomfort and a sense of being unwell rather than specific illnesses and they increase when in building, go home, and gets better. It is typical in modern buildings with mechanical ventilation. In related buildings, occupants suffer from common symptoms of discomfort, for instance a variety of people in the building have same problems for no obvious reason experienced more often than usual and increase in severity with time in building, then disappear away from building and reappear when go back in.

2. What Is Sick Building Syndrome?

In the 1970s, health care providers were faced with increasing numbers of people having headaches and allergic-like reactions to unspecified stimuli. Some of the reactions included lethargy, fatigue, headache, dizziness, nausea, irritation of mucous membranes, eye and nasopharyngeal irritation, and sensitivity to odors. In 1984, world health organization's (WHO) report introduce SBS for public. After this time, SBS become an important issue in building design and control process.

Through exploration over several years, these reactions were linked to common symptoms of people in specific buildings and a lack of symptoms when these people were not in the buildings. This spectrum of specific and non-specific complaints, when tied to a particular building, became known as SBS. It is important to note that sick building syndrome is not the same as “Building Related Illness” (BRI) which refers to a specific airborne building contaminant. These terms are used to define illnesses related to modern buildings, mainly offices, in which people spend many working hours. (Table 1) One well-known example of building related illness is Legionnaires’ disease. Indeed, Sick Building Syndrome (SBS) is an imprecise term used to describe those buildings in which there is a prevalence of a range of

symptoms causing discomfort and a sense of being unwell rather than a distinct illness. Clinically-diagnosed illnesses which can readily be attributed to a particular cause, such as humidifier fever, Legionnaires ' disease, or exposure to a toxic agent in the workplace environment , in the case of enough and appropriate ventilation, are not usually regarded as SBS. Sick building syndrome is often more prevalent among asthmatics among whom there is a large percentage of allergies to common indoor allergens. Indoor air pollution also disproportionately affects some populations, such as African Americans living in inner city homes that are not modernized. For these populations, there is a three times greater risk of asthma mortality than Caucasians, which may be compounded by a variety of sources including rat and cockroach infestations, sanitary conditions, access to healthcare and education, as well as indoor air pollution.

Indicators of SBS	Indicators of BRI
Building occupants complain of symptoms associated with acute discomfort	Building occupants complain of some long-lasting symptoms
Most of the complaints report relief soon after leaving the building	Complaints may require prolonged recovery times after leaving the building
The cause of the symptoms is unknown	The symptoms can be clinically defined and have clearly identifiable causes

Table 1. Differences between indicators of SBS and BRI (Okhovat H. and others, 2010)

3. SBS Symptoms

Common list of symptoms summarised by the World Health Organisation are as follow:

- Eye, nose and throat irritation.
- Sensitisation of the mucus membrane and skin.
- Dry or itchy skin or skin rash.
- Mental fatigue.
- Headaches, high frequency of airway infections and coughs.
- Hoarseness and wheezing.
- Nausea and dizziness.
- Lethargy, irritability or poor concentration.
- Stuffy or runny nose.

These symptoms can be divided into four categories:

1. Dryness of skin, eye, nose and throat.
2. Allergic symptoms, watery eyes, runny nose.
3. Asthmatic symptoms such as chest tightness
4. General feelings such as lethargy and headaches.

	CO2	C0	O3	Formaldehyde	NO_X	VOC	Dust	Microorganisms	ETS	SO2
Eye irritation		•	•	•	•	•	•	•	•	
Nose irritation			•	•	•	•	•	•	•	•
Throat irritation			•	•	•	•	•	•	•	•
Respiratory complaints			•	•	•	•	•	•	•	•
Headache	•	•	•	•	•	•			•	

Vertigo	•		•	•	•							•											
Fatigue	•		•	•	•					•		•		•									
Confusion			•	•						•		•		•									
Nausea			•		•							•									•		
Skin rash					•							•		•									
Altered smell/taste					•																		

Table 2. Physiological effects of common indoor air pollutants. (Ross C.P. and others, 1997)

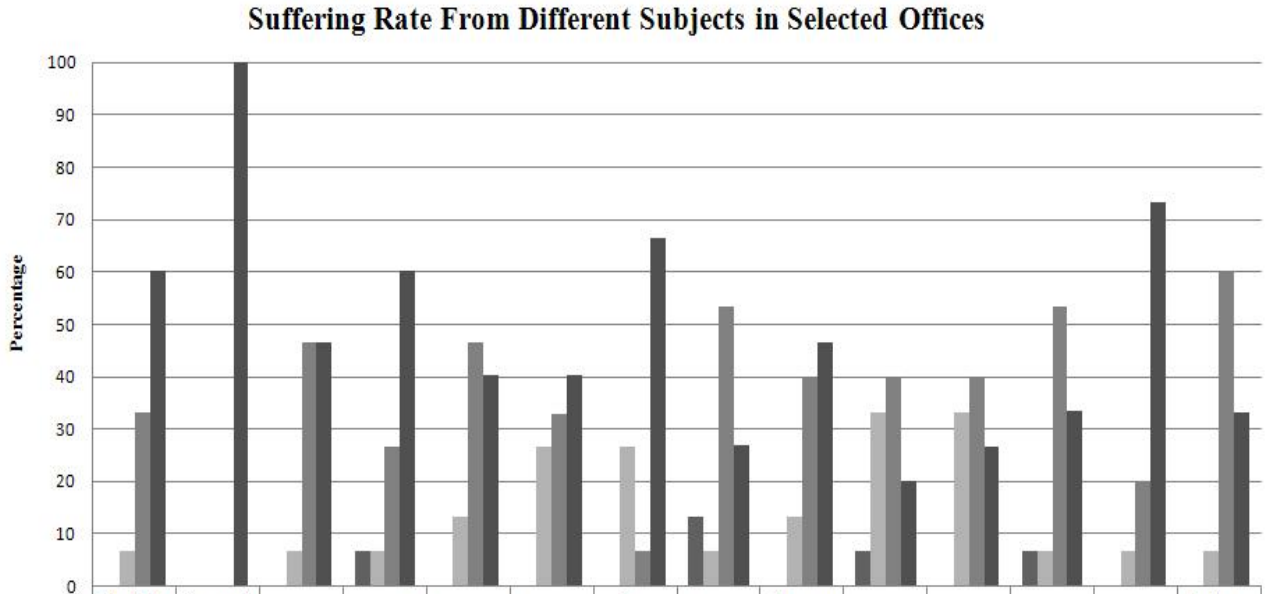
4. SBS Identification

There are two components to identifying a sick building. The first is that the reactions or types of reactions are shared by several or many of the people who also inhabit the building. The second is that the reactions are triggered when in the building and are not triggered when not in the building. Some individuals, however, may have greater sensitivities to some stimuli than do other people. For these individuals, something or things in the building may be triggering a reaction, but the building may not be "sick". This is often the case when a certain office or part of a building is rehabbed or reconfigured and decorated. That particular area of the building may create reactions in individuals, but the building itself is not problematic.

5. SBS in Iran

In most of developing counties like Iran, term of SBS is not a common term and is strange one which most of people and designer are not familiar with. Oppose to these countries, in developed countries like Japan, this term is a well-known term for most of designers and people. By way of illustration, building Sanitation Management Standards strictly regulate the ventilation capacity of air conditioning systems installed in Japan's buildings. In Iran, only some investigation about hospitals and SBS in related buildings have been done up to now.

We have chosen three different offices in Tabriz, a big city in north-west of Iran, and have done an investigation about possibility of existing SBS and SBS symptoms in those buildings. 15 persons who spend most of their time indoor in related offices have been participated in this investigation and following result indicates the outcomes of our investigation about participant's experiences in their work places: (Table 3)

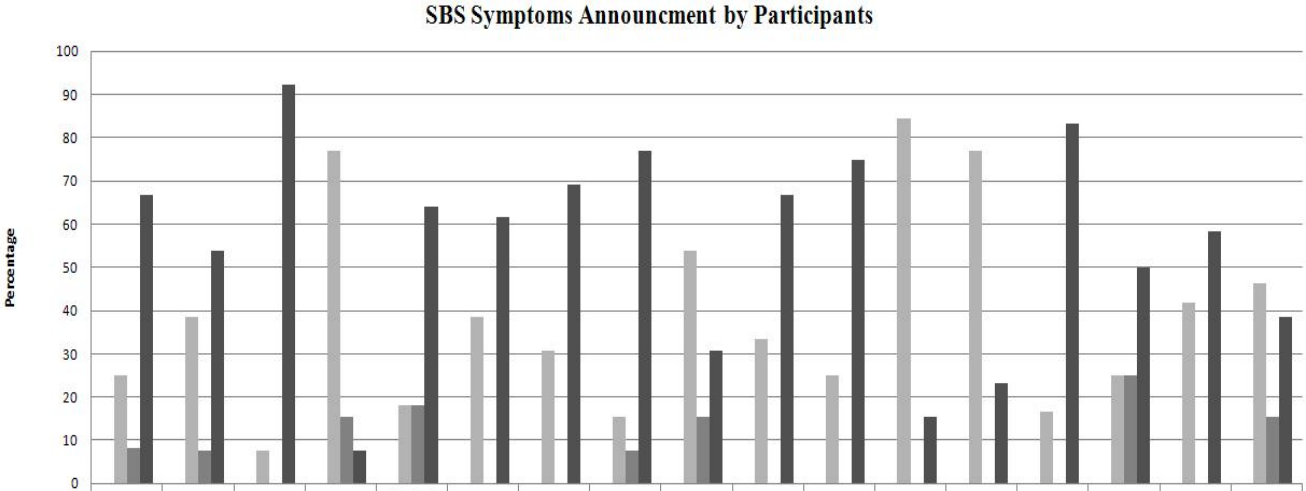


	Too little air	Too much air	Too dry	Too moist	Too hot	Too cold	Too bright	Too dim	Glare on surfaces	Too noisy	Too quiet	Smooky	Stuffy	Unpleasant odour
Always	0	0	0	6.6	0	0	0	13.2	0	6.6	0	6.6	0	0
often	6.6	0	6.6	6.6	13.3	26.7	26.7	6.6	13.3	33.3	33.3	6.6	6.6	6.6
Sometimes	33.3	0	46.7	26.7	46.7	33	6.6	53.3	40	40	40	53.4	20	60.1
Never	60.1	100	46.7	60.1	40.2	40.3	66.4	26.9	46.7	20.1	26.7	33.4	73.4	33.3

Table 3. The percentage of suffering from each defined subject in selected offices in Tabriz.

According to above results, the most critical subject which almost 80 percent of our participants have suffered from, at least sometimes, is noise and then, being too dim have suffered approximately 73 percent of them at least sometimes. Unpleasant odor and being smoky were ranked in the third place with about 67 percent of our participant vote. Approximately 60 percent of participants had difficulty with temperature in their workplaces. Glare on surfaces and being too dry caused that more than half of participants experienced a difficulty in their workplaces. Thus, it can be concluded that those offices owners should spend more attention to design appropriate acoustic, light and ventilation of related buildings, however, temperature, light direction according to furniture and humidity should been considered in those offices.

Also, the following results indicate our participants' experiences about SBS symptoms: (Table 4)



	Dry or sore throat	Skin dryness	Skin rashes	Eye irritation	Contact lens problem	Runny nose	Difficulty in breathing	Flu-like symptoms	Headache	Dizziness	Nausea	Drowsiness	Lethargy	Chest pain	Backache	Stuffy nose	Stress
Always	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Often	25	38.5	7.7	76.9	18	38.4	30.8	15.4	53.8	33.3	25	84.6	76.9	16.7	25	41.7	46.2
Sometimes	8.3	7.7	0	15.4	18	0	0	7.7	15.4	0	0	0	0	0	25	0	15.4
Never	66.7	53.8	92.3	7.7	64	61.6	69.2	76.9	30.8	66.7	75	15.4	23.1	83.3	50	58.3	38.4

Table 4. The percentage of SBS symptoms announcement by participants.

Table 4 shows that more than 90 percent of participants had at least sometimes experience of eye irritation in their workplaces. Other prevailing symptoms of SBS in related building are drowsiness, lethargy, headache, stress and backache with about 85, 77, 70, 62 and 50 percent of complaint by participants respectively. Also skin dryness, stuffy nose, runny nose, contact lens problem, dry or sore throat and dizziness have ranked in place between 7 and 12 by participants. At the end of ranking, nausea, flu-like symptoms, chest pain and skin rashes are placed respectively.

According to table 5 which indicates some of our participant's idea about the frequency time of each symptom in afternoon and morning, skin rashes, contact lens problem, difficulty in breathing, headache, dizziness, nausea, chest pain, backache, stuffy nose, eye irritation, stress, drowsiness, lethargy and skin dryness are more common in the afternoon when flu-like symptoms and runny nose are more common in the morning and dry or sore throat has equal possibility to happen in the morning and afternoon: (Table 5)

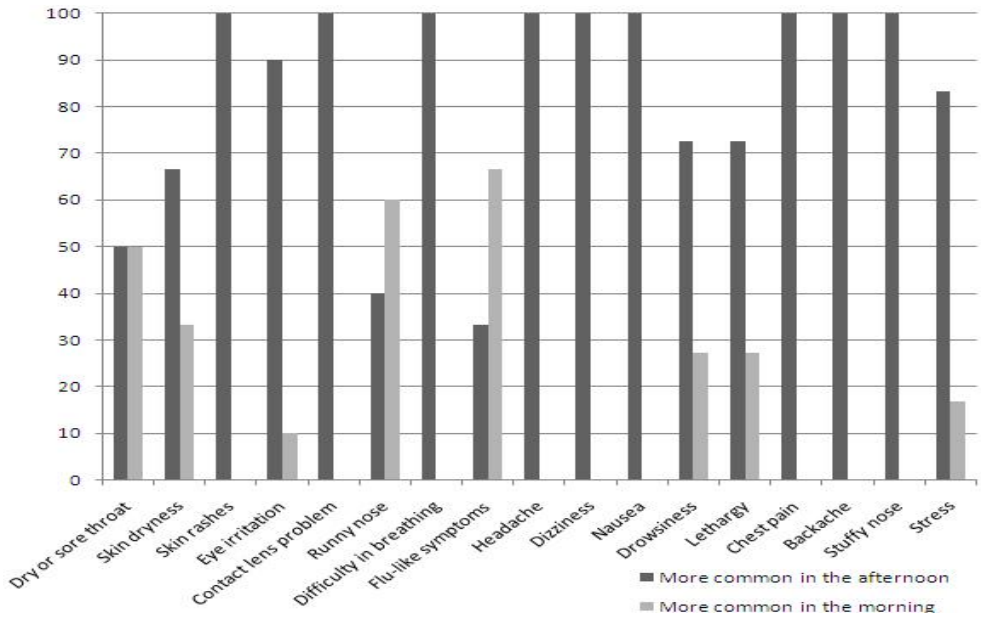
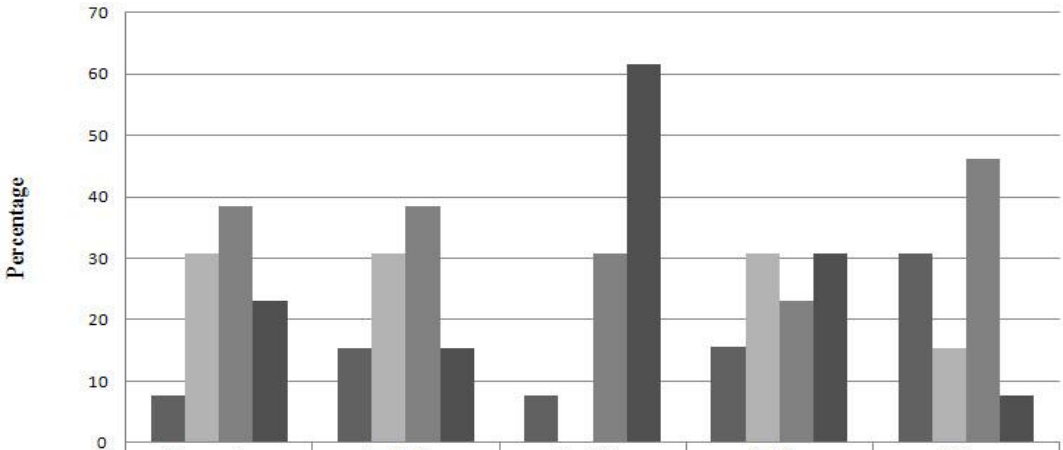


Table 5. Some participant's idea about the frequency time of each symptom.

As reported by our participant, noise, ventilation temperature and light have most influence on their work performance respectively. and humidity is less important factor which can affect on their performance. In general, our participant had the following idea about the influence of environmental factors on their performance and work: (Table 6)



	Temperature	Ventilation	Humidity	Lighting	Noise
Always	7.7	15.4	7.7	15.5	30.8
Often	30.7	30.7	0	30.7	15.4
Sometimes	38.5	38.5	30.8	23.1	46.1
Never	23.1	15.4	61.5	30.7	7.7

Table 6. Participants' idea about the influence of environmental factors on their performance.

By considering to above results, it can be concluded that there is less attention to SBS and its symptoms in Iran owing to the fact that the rate of complain is more than expectation and there are lots of factors which have been suffering workers in their work environment. Indeed,

those workplaces are a few examples of offices in Iran which are involve in SBS. By improving workplace environment, workers' performance will be improved considerably.

6. Recommendation

According to Health and Safety Executive (HSE) of UK we recommend following items to prevent SBS in Iran's office buildings:

- Most forced ventilation systems work with a large proportion of extracted air being recycled after conditioning; i.e. filtered, heated or cooled or humidified as necessary. A proportion of fresh/make-up air is always required. The quantity of fresh air required is a function of building occupancy and the level of tobacco-smoking. Fresh air supply rates of 8 liters per second per person would be sufficient for respiratory and odor-dilution needs. Supply rates ranging from 12 liters per second per person for some smoking, to 32 liters per second per person for areas of heavy smoking, are necessary to maintain acceptable atmospheres. Where high fresh air supply rates are required but the existing ventilation system is incapable, without excessive modification, of supplying the higher rates, then provision of a separate dedicated smoking area/rest-room with an integral extract ventilation system may be a reasonable solution.
- The source of fresh air supply should be sited such that it is not contaminated by external sources such as road traffic, industrial processes and other ventilation system discharges.
- Lack of perceptible air movement within the workplace can promote a feeling of stuffiness, whereas excessive air movement will produce complaints of draughts. Air velocities should normally be approximately 0.1 to 0.15 meters per second and up to 0.25 meters per second during the summer.
- Very low relative humidity, less than 20%, may sometimes cause skin or eye problems in some individuals. It is unlikely that low relative humidity itself is a cause of SBS, but indirect effects may have a bearing on factors such as static electricity build-up, off gassing, and the presence of airborne dusts and fibers. High relative humidity, in excess of 70%, is uncomfortable, and health may be threatened through the development of surface condensation and mould growth. Levels of relative humidity in the range of 40 to 70% are recommended for the workplace environment. At higher temperatures, the relative humidity should be at the lower end of this range.
- Simple air-temperature measurements are unsuitable for the assessment of thermal comfort. Personal thermal comfort depends on air-temperature, radiant heat, humidity, air velocity, clothing, activity rates and personal preferences.
- The thermal environment of a workplace where the activity is light and mainly sedentary should conform to the following criteria, tending towards the lower limits:

(1) An operative temperature of 20 to 24°C during winter and 23°C to 26°C during summer.

(2) The vertical air temperature difference between head and ankle levels should be less than 3°C. The mean air velocity should be less than 0.15 m/s in winter and 0.25 m/s in summer.

The Fuel and Electricity (Heating) (Control) (Amendment) Order 1980 prohibits the use of fuel and electricity for the heating of premises above 19°C. This does not necessarily conflict with the recommended operative temperature. There will be other

heat inputs to the building environment such as occupants, office lighting and machinery and also solar gain.

- Most people prefer to work in natural daylight, and should be able to do so whenever possible. Other aspects of lighting which can have a bearing on SBS are inadequate lighting levels, glare, very uniform artificial lighting, dull decor and tinted glass windows. These features should be avoided where practicable. (HSE, 2004)
- Poor acoustics cause the great dissatisfaction, however, an interesting finding by Jensen K. L. and other illustrates that occupants in totally open offices are significantly more satisfied with noise level and speech privacy level than occupants in cubicles, although cubicles are usually assumed to reduce the noise level experienced by their occupants. A possible explanation might be that private conversations are possible in open offices when a visual check reveals that there is nobody within earshot. Another might be that expectations for any form of privacy are lower in the visually open workplace, and that people adapt their listening and speaking habits accordingly. (Jensen K. L. and others, 2005)

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