Journal of Health Informatics in Developing Countries
http://www.jhidc.org/
Vol. 14 No. 2, 2020

Submitted: June 29th, 2020 Accepted: Nov 18th, 2020

Effects of a closed office environment on the risk of Sick Building Syndrome in a medical city in Riyadh, Saudi Arabia: Findings from a cross-sectional study

Sara Mohammed Aloudah[1]

[1] *Public health senior specialist, family and community medicine department, King Saud University, Riyadh, Saudi Arabia.*

Abstract

Background: Sick Building Syndrome (SBS) is a state of discomfort and irritation in several body systems which affects employees in a closed office work environment. It has a 30% reported prevalence worldwide. This study aimed to determine the prevalence of Sick Building Syndrome and its associated symptoms. In addition, it also aimed to investigate the association between closed offices environment and the risk of Sick Building Syndrome as well as identifying its associated risk factors and its correlation to buildings in the Medical City in Riyadh, Saudi Arabia.

Methods: This cross-sectional study was conducted using a self-constructed questionnaire for data collection among office workers in four different buildings during the year 2018. Convenient random sampling was then used to select study subjects for the study.

Results: A total of 373 subjects participated in the study. SBS prevalence among office workers was found to be 20%. The study found that being female (OR 2.80; [95%CI: 1.61-4.84]), higher stress level (OR 2.885; [95%CI: 1.001-8.32]), allergies (OR 2.25; 95%CI: 1.32-3.85]), temperature fluctuations (OR 1.84; [95%CI 1.04-3.26]), noises (OR 1.83; [95%CI: 1.09-3.06]), and a cumulative exposure level to office conditions (OR 2.48; [95%CI: 1.47-4.16]) increased the likelihood of SBS. Four out of six SBS symptoms were reported in more than a quarter of the employees, while five symptoms were significantly associated with building types. Age and the number of years working in the same building or office were found to be protective factors (OR 0.64, OR 0.69, OR 0.75) respectively.

Conclusion: The high prevalence of SBS among office workers should attract attention to the existence of "sick buildings" in Saudi Arabia. Awareness and preventive measures should be adopted by the responsible entities of these "sick buildings" to reduce the health effects of SBS among office workers.

Keywords: Sick buildings; Sick building syndrome; Indoor air quality; Air quality; Closed buildings.

[1]Sara M. Aloudah; Department of Family and Community Medicine, College of Medicine, King Saud University, Riyadh 29391, Saudi Arabia; Email: Saloudah@ksu.edu.sa.

1. Introduction

Sick Building Syndrome (SBS) is defined as the situation wherein a building's occupants experience discomforts that have no evident specific causes [1]. The syndrome does not have any direct implications on the sources of the physiological responses or on how the symptoms are developed [1]. The World Health Organization (WHO) officially recognized this indefinite condition as Sick Building Syndrome in 1982 [2]. This work-related condition is a collective and generic term that describes a group of symptoms that are associated particularly with buildings [3]. According to the United States Environmental Protection Agency (US-EPA), the prevalence of SBS was undetermined until WHO reported that as many as 30% of new and remodeled buildings worldwide received several complaints associated with poor indoor air quality [2,6]. Among the British population, it was estimated that 8% of working-class people experience SBS [3]. Additionally, one study found that children and the elderly are more vulnerable and sensitive to SBS [7]. However, SBS is more often associated with adult office workers and rarely affects children [8].

SBS is characterized by excessive skin and mucous membrane irritations and other symptoms which are relevant to the patient's working conditions [2]. These symptoms are associated with the amount of time spent in the workplace and the services available in the building [7,9]. Notably, the occurrence of SBS may be localized or widespread throughout the building [6]. The most frequently occurring symptoms are headache and fatigue, which particularly occurs when relative humidity exceeds 80% and the temperature is high [7,12]. The symptoms are usually relieved within a few hours, except skin irritations, which tend to become alleviated after several days [4]. A person suffering from SBS will usually experience difficulty concentrating on certain tasks [2]. SBS is also associated with low productivity, absenteeism, more sick leaves, a high turnover of employees, and poor job satisfaction [3,7,12,13]. However, one study showed that SBS symptoms were reduced when the office's ventilation rate was increased [3].

In the United States, 24% of office workers suspected indoor air to be of poor quality and 20 % complained that their work performance was affected [6]. Workplace administration is responsible to promote, achieve and maintain a safe and healthy working environment [5]. Therefore, administrative participation should involve enhancing awareness of SBS and the reduction of any factors that can lead to this occupational syndrome [6]. Temperature, poor ventilation, high noise levels, poor lighting, and humidity are significant risk factors of SBS [5,7,11,15]. Illnesses that are relevant to the work environment and are building-related can be directly attributed to toxic agents present in the air [10,14,15]. The major sources of indoor pollutants include smoking, water and moisture, unvented indoor combustion, emissions from building materials and furnishings, household activities, heating, ventilation, air conditioning, dust or dirt, and microbiological growth [7,12,14].

According to studies, an average individual spends 80% of their time indoors either to keep away from the harsh conditions of the external environment or for human socio-economic activities [16]. Hodgson also reported

that people spend more than two-thirds of their day indoors [1]. In the Kingdom of Saudi Arabia, the desert climate encourages individuals to spend more time indoors, with its extreme temperatures, low amount of rainfall and the incidence of sandstorms. Riyadh, the capital of Saudi Arabia, often experiences dusty weather, which is evident from the quality of the indoor atmosphere. Buildings in Riyadh mostly have inadequate ventilation, resulting in dust and the humidity creating a conducive environment for the growth of contaminants. These biological contaminants can be found in household items and air conditioning systems [21]. It is also notable that the modernization of Saudi Arabia includes the construction of high-rise towers and large infrastructures that utilize year-round cooling systems, which are installed to be fully closed. Employees and household members predominantly stay indoors, which may predispose them to ubiquitous forms of sickness and discomfort caused by SBS. Thus, it is crucial to explore the burden of SBS in Saudi Arabia. This is why the overarching purpose of this study is to assess the factors which significantly increase the risk of acquiring this idiopathic syndrome among individuals working in selected buildings in Saudi Arabia. The study also aimed to investigate the association between closed office environments and the risk of Sick Building Syndrome, in addition to identifying its associated risk factors and its correlation with buildings in the Medical City in Riyadh, Saudi Arabia.

2. Subjects and Methods

2.1 Study design and setting

A cross-sectional study was conducted in four main buildings of KSUMC during the year 2018. A self-constructed questionnaire was used for data collection among office workers in four different buildings and convenient random sampling was used to select study subjects from office employees for the study. The study was conducted in the main four buildings of KSUMC: Building A (College of Medicine) and Building B (West Building), which both began operating in 1982; Building C (East Building), which began operating in 2016; and Building D (Administrative Building), which began operating in 2013. Building A is mainly occupied by students and faculty and contains classrooms, auditoriums, student labs, and some offices. Building B has patient wards, ER, X-ray, and a pharmacy department, while Building C has an operations rooms, a morgue, and patients' wards. Building D only has administrative offices with no patient-oriented activity.

2.2 Study Sample

The sample size required in order to have a representative sample to the population under study is 338. This was based on sample size calculation with a confidence interval of 95% and a 5% margin of error. Doctors, nurses, cleaners and maintenance workers were excluded from the study, as they usually do not spend their working day inside closed offices.

2.3 Data collection tool and process

This study utilized a self-made questionnaire, which determined the factors that could precipitate SBS in

the workplace as perceived by the respondents. Pilot testing was done among the employees of King Saud bin Abdulaziz University for Health Science – College of Public Health to validate the questionnaire. The first part of the questionnaire covered participants' characteristics, including both the demographic profile and employment background. The demographic data included age, gender, monthly income, educational level, and nationality. On the other hand, employment characteristics included the type of work that the participant does, working hours inside the office, job title, the building where they work, number of years working in the building, number of years working in the office, the presence of natural airflow, the approximate size of the office, the number of employees in the same office, and the perceived stress level. Part Two of the questionnaire consisted of questions associated with SBS, such as symptoms experienced by the respondents and their medical history, while the third part of the questionnaire determined the host-related factors linked to SBS. The items included discomfort experienced by the respondent while they were working in their offices in the last few months. Part Four determined occupational risks. This included 15 items which described the working conditions of the respondents, such as the indoor air quality; lighting; noise; the presence of photocopiers, cabinets, cleaning practices, and detergents; and the usage of in-house laundry. The questionnaire was constructed by using different items from related literature, covering sociodemographic status, work and office conditions, medical history, smoking status and a group of symptoms to describe SBS. Questionnaires were filled out by the interviewer herself to ensure accurate and prompt replies. A random selection of employees from the four buildings was asked to participate voluntarily and their consent was taken.

2.4 Statistical Analysis

Descriptive, chi-square and logistic regression were used using SAS software version 9.4. Employees were considered to be SBS-positive if they reported three or more symptoms, which got better when they away from work and worsened during the working hours.

2.5 Ethical approval

Ethical approval was obtained from King Abdullah International Medical Research Center on July 12th, 2017 with reference number (RYD-17-419812-98285).

3. Results

3.1 Descriptive and cross-tabulations

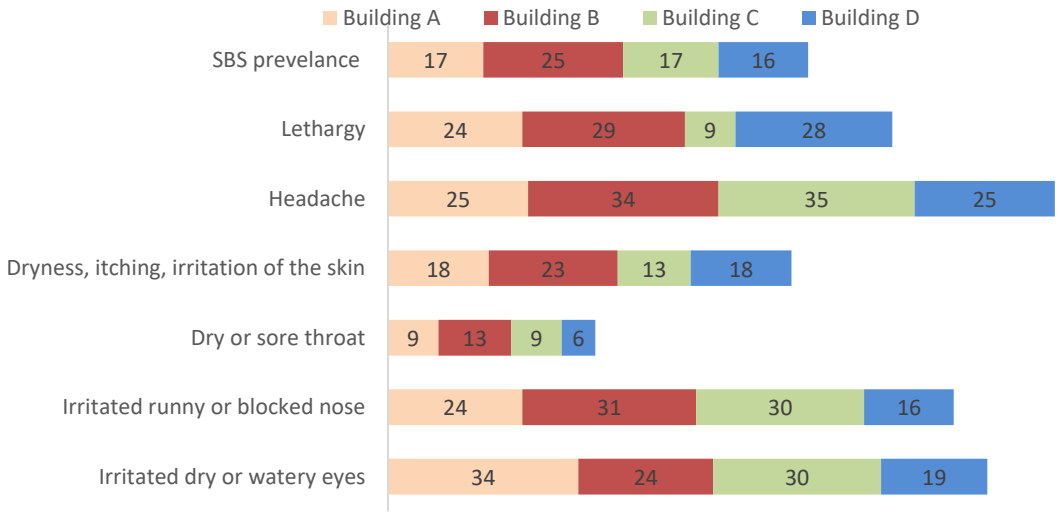
The study included 373 responses: 88 from building A, 133 from building B, 23 from building C and 129 from building D, with equal responses from both genders. The prevalence of SBS was 20%, with females showing higher levels of SBS when compared with males; 27% of females reported having symptoms of SBS, in contrast to only 12% of males (Table 1).

Table 1: sociodemographic and work characteristics of study participants

		SBS		
	(n)	%Yes	%No	P-value
Gender				
Female	187	27	73	0.0002
Male	186	12	88	
Age				
> 40	278	21	79	0.1689
≤ 40	95	15	85	
Monthly Income				
> 7,000	77	16	84	
7,000 – 14,999	238	21	79	0.3625
15,000 – 20,000	42	21	79	
< 20,000	16	6	94	
Educational Level				
High school	29	17	83	
College graduate	267	22	78	0.1041
Post-graduate	71	10	90	
Work type				
Health care	262	19	81	0.9372
Admin	111	20	80	
Building				
A	88	17	83	
B	133	25	75	0.3037
C	23	17	83	
D	129	16	84	
Nationality				
Saudi	262	21	79	0.1775
Non-Saudi	111	15	85	
Working hours				
> 5 hours	30	23	77	0.5881
≤ 5 hours	343	19	81	
Job title (grouped)				
Tech\Admin assistant	105	23	77	0.3167
Higher level jobs	268	18	82	
Number of years in the same building				
≤ 5	258	21	79	0.2028
> 5	115	16	84	
Number of years in the same office				
≤ 3	214	21.5	78.5	0.2772
> 3	159	17	83	
Natural air flow				
Yes	79	16	84	0.4318
No	294	20	80	
Office size				
Small	226	20	80	
Medium	87	17	83	0.7851
Large	60	22	78	
Number of employees in the same office				
None	42	17	83	
1-3 employees	186	20	80	0.8806
> 3 employees	145	20	80	

Regarding symptoms, it was found that four out of the six symptoms being studied were reported in more than a quarter of the employees. These symptoms were headache (29%), lethargy (26%), irritated dry or watery eyes (25%) and irritated runny or blocked nose (24%). The study participants were asked to determine the frequency of each symptom during the past month. Overall, the highest reported symptoms were tiredness and sneezing/coughing (47% and 44% respectively). Similarly, the highest reported symptom occurring on a daily basis was sneezing and coughing (32%), followed by tiredness (25%). However, on a weekly basis, the most common symptom was irritability (34%), followed by concentration difficulties and tiredness (27% for both). In addition, figures 1 and 2 show the prevalence of SBS Symptoms among participants in different buildings and relevant SBS symptoms.

Figure 1: Prevalence of SBS Symptoms among Participants in Different Buildings



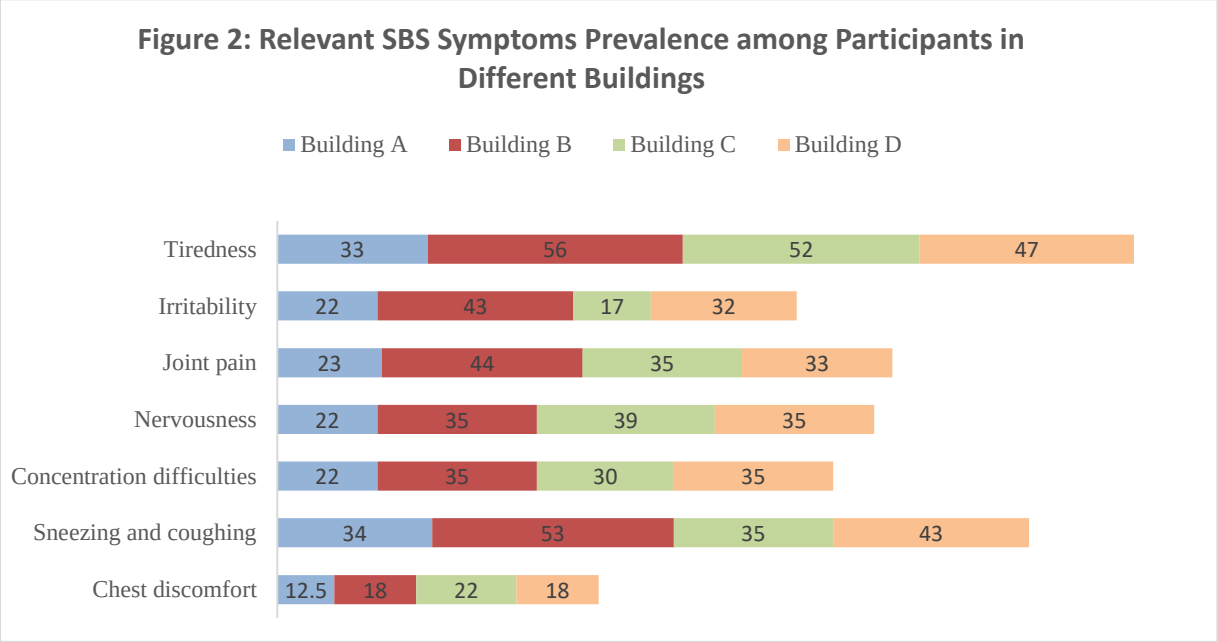


Table 2 demonstrates the cross-tabulation of all symptoms with the different types of buildings. The study found that having an irritated runny or blocked nose, sneezing and coughing, joint pain, irritability, and tiredness were all significantly associated with building type. The highest reported symptoms were in Building B, in contrast to building A which had the lowest reported percentages of all symptoms, except for irritating runny or blocked nose, which was lower in building D, and irritability, which was lower in building C.

Table 2: Prevalence of various symptoms in each of the four buildings

Buildings					
Symptom	A	B	C	D	p-value
	Percentage with symptoms				
SBS symptoms					
Irritated dry or watery eyes	34	24	30	19	0.0923
Irritated runny or blocked nose	24	31	30	16	0.0285
Dry or sore throat	9	13	9	6	0.3388
Dryness, itching, irritation of the skin	18	23	13	18	0.6296
Headache	25	34	35	25	0.2988
Lethargy	24	29	9	28	0.2133
Other symptoms					
Chest discomfort	12.50	18	22	18	0.6147
Sneezing and coughing	34	53	35	43	0.0286
Concentration difficulties	22	35	30	35	0.1332
Nervousness	22	35	39	35	0.1202
Joint pain	23	44	35	33	0.0168
Irritability	22	43	17	32	0.0033
Tiredness	33	56	52	47	0.0090

Furthermore, the frequency of Sick Building Syndrome symptoms in males and females were analyzed, controlling for stress level. Among those who reported a stressful work environment, there was a significant difference in SBS prevalence between males and females (p-value 0.0001); 30% of females reported having SBS compared to only 12% of males. Concerning medical history and smoking status, employees diagnosed with allergies had a significant association with SBS; the prevalence of SBS among employees with allergies was double that among those with no allergy (30% and 16%, respectively). On the other hand, there was no significant difference in SBS prevalence with regard to smoking status or exposure to smoking from others.

Table 3 shows office conditions and the level of exposure to office conditions in relation to SBS. The study then investigated the effects of a number of office conditions that may have a relationship with the risk of SBS. Furthermore, to determine the level of cumulative exposure to these factors, a composite variable was created to account for the exposure to these factors together (temperature fluctuations, lighting up candles, floor type, having a printer inside the office, office cleaning frequency, office lighting, and access to a quiet atmosphere). A high level of exposure was assigned when more than three conditions were present in the employee's office, and was considered low when three or fewer conditions were there. Temperature fluctuations inside the office during the day, noise around the office and high exposure levels were significantly associated with SBS, whereas other office conditions were not associated with the syndrome (Table 3).

Table 3: Office conditions and level of exposure to office conditions in relation to SBS

	SBS		
Office condition	**Yes**	**No**	**P-value**
	%	**%**	
Temperature fluctuation during the day	23	14	**0.0344**
Light up Candles inside the office	25	18	0.1053
Light up Bokhoor inside the office	21	19	0.6259
Floor type (carpeting)	13	21	0.131
Printer inside the office	20	17	0.7037
Cabinet inside the office	21	11	0.07
How often Office cleaned	23	18	0.26
Detergent smell after cleaning the office	20	19	0.68
Using in-house laundry	17.5	20	0.727
Suitable lighting	21	19	0.71
Quiet surrounding	26	16	**0.021**
Level of exposures to office conditions*			**0.0005**
High	29	71	
Low	14	86	

3.2 Findings of regression analysis

Table 4 shows the results of logistic regression analyses of the association between the risk of SBS and several risk factors. Being an older employee, working in the same building for more than 5 years and working in

the same office for more than 3 years, reduces the odds of SBS (albeit not significantly) by 40%, 30%, and 25%, respectively. Regarding gender, female employees were three times more likely to experience SBS when compared to males (OR 2.80, [95%CI: 1.61-4.84]). A high level of exposure to office conditions (positive exposure to more than three inside the office) was associated with a significant risk of SBS (OR 2.48; [95%CI: 1.47-4.16]) compared to those with low exposure. Additionally, a stressful work environment has three times the risk of SBS, compared to a more relaxing work environment, while allergies increase the odds of SBS twofold. Job titles were grouped into two: higher-level jobs, which included managers, supervisors and specialists, and low-level jobs, which included technicians, admins and admin assistants. Although not significant, being a technician, admin or admin assistant was associated with a 46% higher risk of SBS. Furthermore, the analysis of part of the office conditions showed that employees with noise and high-volume sounds around their offices had an 83% higher chance of SBS than employees with quiet surrounding (OR 1.83; [95%CI: 1.09-3.06]). The presence of a paper cabinet inside the office was associated with an almost significant increased risk of SBS (OR 2.23, CI 0.92-5.43, p-value 0.076). Moreover, temperature fluctuations during the working day increased the odds of SBS by 84% (OR 1.84, CI 1.04-3.26).

Table 4: Logistic regression analyses of the risk of SBS with different risk factors

	OR (95%CI)	**P-value**
Age		
> 40	1.0	
≤ 40	0.642 (0.340-1.212)	0.1713
Gender		
Male	1.0	
Female	2.80 (1.61-4.84)	**0.0002**
Level of exposures to office conditions		
Low	1.0	
High	2.475 (1.47-4.16)	**0.0006**
Stress level		
Relaxing	1.0	
Stressful	2.885 (1.001-8.315)	**0.0497**
Job title		
Higher level	1.0	
Tech.\Admin	1.46 (0.87-2.44)	0.148
Years in the same building		
≤ 5	1.0	0.208
> 5	0.685 (0.38-1.23)	
Years in the same office		
≤ 3	1.0	0.2781
> 3	0.75 (0.44-1.265)	
Diagnosed with Allergy		
No	1.0	**0.0031**
Yes	2.25 (1.315-3.849)	
Quiet surrounding		
Yes	1.0	**0.022**
No	1.83 (1.09-3.06)	

Cabinet inside the office No Yes	 1.0 2.23 (0.92-5.43)	0.0764
Temperature fluctuate inside the office during the day No Yes	 1.0 1.84 (1.04-3.26)	**0.0362**

4. Discussion

In this research, there were 373 responses from office employees, with an equal response from both genders. The majority of respondents were from buildings B and D. The prevalence of SBS among office workers was found to be 20%. Being female, a stressful work environment, noise, temperature fluctuation, high exposure level and a group of symptoms with building type were significantly associated with SBS. SBS prevalence varies within the literature; one study reported the prevalence of SBS to be 7% among office workers [7], whilst others reported a prevalence of 30% [9]. Within the Saudi population, the prevalence of SBS was 20%, as participants were considered SBS-positive if they reported three or more symptoms which are alleviated when the employees are away from their work environment. The aforementioned variation between this sample and the wider population can be attributed to differences in the prevalence of symptoms and risk factors.

With respect to the symptoms, headache was the highest reported symptom among the study population (29%). This is consistent with the study findings of Hodgson M. that reported headache to be the most common symptom in almost all indoor environmental studies [1]. Additionally, the other highly reported symptoms of SBS among this sample were lethargy, irritated dry or watery eyes, and an irritated runny or blocked nose. These findings are also consistent with study findings by Jung CC et al. and Straus DC et al., wherein they stated that the most common symptom in their samples was eye irritation [9,14]. Furthermore, Lukcso D. et al. and Straus DC et al. stated that the most common symptoms of SBS were upper respiratory tract symptoms [13,14].

Regarding the association between symptoms and building type, the study found that irritating runny or blocked nose, sneezing and coughing, joint pain, irritability, and fatigue were all significantly associated with building type. The highest reported symptoms were in building B, in contrast to building A, which had the lowest reported percentages of all symptoms, except for having an irritated runny or blocked nose, which was lower in building D, and irritability, which was lower in building C. The differences between buildings can be attributed to the age of the buildings, maintenance, cleaning techniques and the kinds of activities carried out in each building. Both buildings A and B began operating in 1982. Building A is dedicated to teaching, with classrooms, an auditorium, student labs and offices. This building has the lowest density of activities among the four buildings, which might explain why it has the lowest percentage in reported symptoms. Building B has the ER department, patients' wards, laundry, labs, X-rays and central pharmacy. This could explain the high percentages of complaints in this building—high-density activities with many patients circulating. In 2016, building C began operating, with

operation rooms, a morgue, and several clinics. Building D began operating in 2013 and contains only administrative offices with no patients. In contrast to this study's findings, a Danish study reported reduced SBS symptoms with older age buildings, and increased symptoms reporting with newer buildings [19].

More than double the prevalence of SBS was reported among females (27%) when compared to males (12%). This finding is consistent with the results of Brasche S. et al. and Jung CC et al. [9,18]. This finding could be attributed to women being more comfortable reporting impairments than men [23]. Moreover, stress has been positively linked to Sick Building Syndrome symptoms as reported in several studies [1,6,9,13]. In this study, women reported having a stressful work environment more than men, which may be the reason why SBS is higher amongst women. Additionally, this study's results are also compatible with those of Abdel Hamed et al., where there was no significant association between SBS and age, smoking history or working hours [7]. KSUMC has no smoking policy inside its premises, which might explain why smoking was not significant despite it being reported to be a risk factor for SBS [4,7]. In line with allergies being a risk factor to SBS [6,18], employees diagnosed with an allergy had significantly higher odds of SBS than healthy employees (twice as high). Allergy and SBS symptoms have some similarities, including what triggers both, e.g. dust or strong odors that trigger an allergic reaction to a certain substance present in the work environment.

Regarding office conditions and SBS, it was found that lighting candles and incense inside the office was not significantly associated with SBS in this sample. However, Hodgson M. and Lukcso D. et al. reported that odors were an important risk factor that may trigger some symptoms of SBS [1, 13]. On the other hand, noises around employees' offices were statistically significant with SBS (OR= 1.83), which was also reported to be a risk factor for SBS in several studies [7, 11, 19, 21]. Natural ventilation was defined as there being a window allowing natural air to circulate inside the office, but the results showed no correlation with SBS, which contradicts the existing literature [2,3,7]. Moreover, carpet flooring inside the office had been considered to be a risk factor for SBS [1,19], but the study's results showed no correlation between floor type and SBS.

Although job titles are identified as a risk factor for SBS [3,5], they were not statistically significant in the results. However, being a technician, admin or admin assistant increases the risk of SBS by 46%. This might be because technicians, admins, and admin assistants handle more papers, and use printer, photocopiers and paper cabinet more often. However, it could also be attributed to psychosocial factors, i.e. dissatisfaction and quantity of work [19]. Nevertheless, working in the same building for more than five years and working in same office for more than three years can reduce the odds of getting SBS by 30% and 25%, respectively. This could be a result of humans' natural adaptation to surrounding environments. It was reported in the literature that the duration of work was associated with SBS [3].

4.1 Strengths and limitations

To the researchers' knowledge, this is one of very few studies tackling the issue of SBS in Saudi Arabia.

The sample was representative, and thus the results can be generalized to the entire Saudi population. However, one of the potential limitations of this study might be recall bias; all data were self-reported and there were no physical measurements for irritants inside the offices. Future studies should include medical records, particulate matter measurements, and leaves of absence to avoid recall bias. Longer time frames are preferred in order to follow employees and monitor changes in office conditions, ensuring more accurate results regarding SBS risk factors. Susceptibility to environmental contaminants, risk perception and levels of hazard exposure differ amongst employees. Therefore, further measurements are recommended to avoid these disparities.

5. Conclusion

Sick Building Syndrome is a relatively new health condition that has no specific cause or defined risk factors and affects occupants of closed buildings. The main characteristic of SBS is that its symptoms start to fade once the occupant leaves the sick building. Given the impact of SBS on employees' performance and the scarcity of research tackling this issue in Saudi Arabia, this study of great importance. There is no simple solution to prevent Sick Building Syndrome. Preventive measures should include collaborations between several disciplines and efforts, such as higher-level authorities, engineers and maintenance personnel. Buildings should be built with universal standards, and maintenance and construction should be avoided during the working days. Additionally, offices should have natural air ventilation by allowing windows to be open, and noise should be controlled by separating offices from patient-oriented areas. It is vital to eliminate any identified irritants present in employees' offices. Building occupants should be aware of SBS to take preventive measures themselves, such as use in-house plants.

6. Declarations

6.1 Abbreviations

SBS	Sick Building Syndrome
BRI	Building Related Illness
OR	Odds Ratio
CI	Confidence Interval

6.2 Conflict of Interest Statement

The authors declare that they have no competing interests.

6.3 Funding Disclosure

Not applicable.

6.4 Ethical approval and consent to participate

Ethical approval was obtained from King Abdullah International Medical Research Center on July 12th, 2017 with the reference number RYD-17-419812-98285. During the data collection, it was emphasized that participation was voluntary and that participants had the right to ask any questions and to decline participation at any time.

6.5 Consent for publication

Written informed consent for publication was obtained from all study participants.

6.6 Availability of data and materials

All data generated or analyzed during this current study is available from the corresponding author on reasonable request.

6.7 Authors' contributions

The manuscript was prepared using the thesis work of SMA. This study was conceptualized by SMA. SMA conducted the study and prepared the first draft of the manuscript. SMA was involved in reviewing the relevant literature available on the topic. The dissertation was supervised by MAZ, HJ, and AAS who provided feedback during hypothesis formulation and development of the research question. All of them also provided rigorous feedback on data analysis and critically reviewed the manuscript. All authors have reviewed and approved the final version of the manuscript.

6.8 Acknowledgments

The authors acknowledge the support of all administrators for the conduct of this study. Authors would like to extend their gratitude to all the study participants, for their contribution to this research. Special thanks are extended to the other faculty of the College of Public Health, who taught the author during her study of her masters' degree and helped her formulate her current knowledge.

7. References

[1] Hodgson M. Indoor Environmental Exposures and Symptoms. Environmental Health Perspectives. 2002; 110 (4): 663-667.

[2] World Health Organization. Indoor air pollutants; exposure and health effects. Cpenhagen. WHO Regiopnal Office for Europe, 1983 (EURI Reports and Studeies No. 78). Available at: http://apps.who.int/iris/bitstream/10665/107300/1/euro_series_78.pdf

[3] Jansz J. Theories and Knowledge About Sick Building Syndrome, in Sick Building Syndrome: in Public Buildings and Workplaces. 2011. Available at: file:///C:/Users/John/Downloads/9783642179181-c1%20(2).pdf

[4] Burge, PS. Sick Building Syndrome. Occup Environ Med. 2004; 61: 185-190. doi: 10.1136/0em.2003.008813.

[5] Passarelli G. Sick building Syndrome: An overview to raise awareness. Journal of Building Appraisal. 2009; 5 (1): 55-66.

[6] United States Environmental Protection Agency or EPA. Sick Building Syndrome. Indoor Air Facts No. 5. 1991. Available at: https://www.epa.gov/sites/production/files/2014-08/documents/sick_building_factsheet.pdf

[7] Abdel-Hamid MA, Hakim S, Elokda E, Mostafa N. Prevalence and risk factors of sick building syndrome amog office workers. J Egypt Public Health Assoc. 2013; 88(2):109-14.

[8] Seltzer J, Fedoruk M. Health Effects of Mold in Children. Pediatr Clin N Am. 2007; 309-333. doi 10.1016/j.pcl.2007.02.001.

[9] Jung CC, Liang HH, Lee CC, Hsu NY, Su HJ. Allostatic load model associated with indoor environmental quality and sick building syndrome among office workers. PLoS One, 2014; 9(4): 95791.

[10] Maroni M., Seifert B., Lindvall T. Indoor air qaulity. A comprehensive reference book. Amsterdam, Elsevier. 1995.

[11] Niven RM, Fletcher AM, Pickering CAC, Faragher EB, Potter IN, Booth WB, Jones TJ, Potter PDR. Building sickness syndrome in healthy and unhealthy buildings: an epidemiological and environmental assessment with cluster analysis. 2000; 57: 627–634.

[12] Abdul-Wahab SA. Sick Building Sydrome in Public Buildings and Workplaces. Muscat, Oman. Springer; 2011.

[13] Lukcso D, Guidotti TL, Franklin D, Burt A. Indoor environmentala and air qaulity characteristics, building-related health symptoms, and worker productivity in federeal buidng complex. Arch of Envi & Occu Health. 1-17 doi 10.1080/ 19338244.2014.965246.

[14] Straus DC, Cooley J, Wong W. Studies on the role of fungi in Sick Building Syndrome. Arch Environ Health. 2003; 58(8): 475-78.

[15] Franchi M, Carrer P, Kotzias D, Rameckers EMA, Sepannen O, von Bronswijk JEMH, Viegi G, Glider JA, Valovirta E. Working towards healthy air in dwellings in Europe. 2006; 61: 864–868.

[16] Environmental Analytics L.L.C. Sick building syndrome. Arizona: Environmental Analytics L.L.C. 2009. Available at: http://www.environmentalanalytics.net/iaq.php/

[17] Wittczak T, Walusiak J, Palczynski C. Sick building sundrome- a new problem of occupationa medicine. Med Pr. 2001;52: 369-373.

[18] Brasche S, Bullinger M, Morfeld M. Why do women suffer from sick building syndrome more than men? Subjective higher sensitivty versus objective causes. Indoor Air. 2001;11: 217-222.

[19] Skov P, Valbjorn. The sick building syndrome in the office environment; the Danish town hall. Environ Int. 1987; 13: 339-349.

[20] The Environmental Illness Resource or EIR. Sick building syndrome. 2007. Available at: http://www.ei-resource.org/illnessinformation/related-conditions/sick-building-syndrome-(sbs).

[21] Bahobail MA. Sick Building Syndromes and Their Effects on Homes within Riyadh City. J King Saud Univ. 2013; 25 (2): 69-78.

[22] Oliver C, Shackleton B. the indoor air we breath; a public health problem of the 90's. indoor air quality. 1998;113:398-409.

[23] Rodin J, Ickovics J. Women's health: Review and research agenda as we approach the 21st century. American Psychologist. 1990;45(9):1018-1034.