ORIGINAL ARTICLE

SICK BUILDING SYNDROME AND ITS ASSOCIATED FACTORS AMONG OFFICE WORKERS IN FEDERAL HOUSE KOTA KINABALU

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ABSTRACT

Sick building syndrome is a term that has been described as a complex of non-specific symptoms caused by working in buildings with an adverse indoor environment. This study sought to determine the prevalence and factors associated with sick building syndrome among office workers in Federal House, Kota Kinabalu. A cross-sectional study was conducted from March to July 2010 among 361 office workers in Federal House, Kota Kinabalu. All workers who fulfilled the inclusion and exclusion criteria were included in the study. Respondents were interviewed using questionnaire which was translated to Bahasa Malaysia and validated to identity the socio-demography, work environment and symptoms of sick building syndrome. Indoor air assessment was done to determine the selected chemical and physical parameters. Data were entered and analysed by SPSS 12.0 using descriptive, univariate and multiple logistic regression analyses. The majority of the respondents were female (61.2%) and the staff involved were professional and management group (3.0%), support group I (82.3%) and support group II (14.7%). The mean age was 35.6 (9.22) years and median duration of working at the current workplace was 36 (76.0) months. The prevalence of sick building syndrome was 47.4% (95% CI: 42.2%, 52.5%). Logistic regression analysis showed that significant risk factors associated with sick building syndrome were female (OR: 2.12; 95% CI: 1.34, 3.35; *p*=0.001), history of allergic (OR: 2.51; 95% CI: 1.30, 4.19; *p*=0.001) and draught condition in work environment (OR: 2.71; 95% CI: 1.70, 4.32; *p*=0.001). Physical parameters were above the standard level but concentration of the chemical parameters was within the normal value. The prevalence of sick building syndrome was considered high. Those who had history of allergic, female and exposed to draught condition in work environment were at higher risk of sick building syndrome. Medical follow up should be carried out for the affected worker with regular indoor air monitoring in the workplace.

Keywords: *Sick building syndrome, office workers, indoor air assessment, prevalence*

INTRODUCTION

Environment at the workplace has been a concern nowadays. It is noted that good indoor air quality (IAQ) is required for a healthy work environment (DOSH, 2005). World Health Organization (WHO) defined healthy workplace as a place where everyone works together to achieve an agreed vision for the health and well-being of workers and the surrounding community. It provides all members of the workforce with physical, psychological, social and organizational conditions that protect and promote health and safety (WHO, 1983).

People also spend 80% to 90% of their time indoor (Jenkins *et al.,* 1992; Sattl*er et al*., 2003) and at least eight hours in office environment.

Indoor air pollution has an impact on our health such as asthma, cancer, effects on vision, hearing and cardiovascular systems (WHO, 2006). Other health problems which commonly associated with poor IAQ include allergic reactions, respiratory problems, eye irritation, sinusitis, bronchitis and pneumonia (DOSH, 2005).

Recently, sick building syndrome (SBS) emerged as a significant problem in the workplace, mostly in European countries, United States, Canada, Australia and Japan. Even though in Malaysia it is still not well-known, the awareness of this problem is increasing (Stephen *et al.,* 2008).

Sick building syndrome is a term that has been described as a complex of non-specific symptoms caused by working in buildings with an adverse indoor environment. Most studies of sick building syndrome had been conducted in workplaces such as office building. Increase of non-specific symptoms complaints can be attributed by the expectation of clean and comfortable in working environment (Ooi *et al.*, 1994; Max *et al*., 1995; Sanjeev *et al*., 2007).

Knowledge regards causes of sick building syndrome remains vague and like the syndrome itself, non-specific (Ake, 1998). It is also always been associated with poor indoor quality. However, many studies now agreed that possible causes of sick building syndrome are multifactorial. This includes physical work environment and psychosocial work environmental factor (Baker, 1989; Ooi *et al.*, 1994; Alan *et al.*, 1996a).

Sick building syndrome is considered as minor sickness. However, the impact of this condition can lead to reduced work productivity and increased absenteeism (Carrie *et al.,* 1997). It will be a mistake if this problem is continually ignored and not addressed properly.

METHODS

A cross-sectional study was conducted from March 2010 to July 2010 among all office workers in Federal House, Kota Kinabalu, Sabah. The sampling frame was the list of office workers under respective departments occupying the Federal House building who fulfilled the study criteria. Sample size was calculated using the data from a study prevalence of sick building syndrome in Malaysia (Juliana *et al.*, 2009). The total sample size was 396 subjects.

In this study, Indoor Air Questionnaire, known as MM-40 questionnaire (Lahtinen *et al.,* 2004) was used. Walkthrough survey was done prior to indoor air sampling. Checklist for building inspection which was adapted from NIOSH Malaysia was used (NIOSH, 2006). The purpose of sampling air contaminants is for screening study to determine if indoor air is contaminated and to detect presence of contaminants.

The assessment was carried out according to the Code of Practice on Indoor Air Quality (DOSH, 2005). Air contaminants consist of carbon dioxide, carbon monoxide, formaldehyde, respirable particulates (PM10) and volatile organic compounds (VOCs). Physical conditions consist of ventilation, air temperature, air velocity and relative humidity. Equipment for indoor air sampling include Drager Accuro Pump Kit, Gas sampling tube, Anenometer Q-Trak™ 7565, MiniRAE 2000, DUSTTRACK® Model 8520. Data were entered and analysed using SPSS Version 12.0.1 (SPSS Inc, 2003).

RESULTS

A total of 396 workers were eligible and consented for the study after considering the inclusion and exclusion criteria. However, only 361 workers were included in the study after 35 workers dropped out from the study giving the response rate of 91.2%. Majority of the respondents are female comprised of 61.2%. The mean age of respondents was 35.6(9.22) years old with median duration of working at present work area was 36 months (76.0). Table 1 shows the characteristics of the respondents.

Table 1 Sociodemographic characteristics of respondents

Variable (n=361)	Frequency (%)	Mean (SD)	Median (IQR)
Age (year)		35.6 (9.22)	
Gender:			
Female	221 (61.2)		
Male	140 (38.8)		
Duration working at present work area (months)			36 (76.0) *
Smoking			
Yes	57 (15.8)		
No	304 (84.2)		
Job category			
Support group 2	53 (14.7)		
Support group 1	297 (82.3)		
Professional and management	11 (3.0)		

* Skewed to the right

Table 2 describes the characteristics of working environment while working at the present work area whether they experienced it often, sometimes or never.

Table 2 Characteristics of working environment of the respondents

Variable(n=361)	Frequency	%
Draught		
Yes, often	134	37.2
Yes, sometimes	20	5.5
No, never	207	57.3
Room temperature too high		
Yes, often	195	54.0
Yes, sometimes	108	29.9
No, never	58	16.1
Varying room temperature		
Yes, often	176	47.7
Yes, sometimes	147	40.7
No, never	42	11.6
Room temperature too low		
Yes, often	167	46.2
Yes, sometimes	36	10.0
No, never	158	43.8
Stuffy 'bad "air		
Yes, often	162	44.9
Yes, sometimes	60	16.6
No, never	139	38.5
Dry air		
Yes, often	157	43.5
Yes, sometimes	60	16.6
No, never	144	39.9
Unpleasant odour		
Yes, often	194	53.7
Yes, sometimes	80	22.2
No, never	87	24.1
Static electric causing shock		
Yes, often	111	30.7
Yes, sometimes	50	13.9
No, never	200	55.4

Continue to next page

Table 2 *continue*

Passive smoking		
Yes, often	121	33.5
Yes, sometimes	45	12.5
No, never	195	54.0
Noise		
Yes, often	225	62.3
Yes, sometimes	67	18.6
No, never	69	19.1
Light that is dim or causes glare and/or reflections	178	49.3
Yes, often	59	16.3
Yes, sometimes	124	34.4
No, never		
Dusty and dirty		
Yes, often	158	43.8
Yes, sometimes	112	31.0
No, never	91	25.2

Table 3 shows the characteristics of working condition of respondents. A higher proportion of the respondents described their working condition as seldom and never regards their work as interesting and stimulating and also seldom and never regards their work as too much. From these four work conditions, scores were given to determine the psychosocial work environment which categorized into three groups (few, moderate and plenty stress factors).

Table 3 Characteristics of working condition of respondents

Variable(n=361)	Frequency	%
Work as interesting and stimulating		
Yes, often	11	3.1
Yes, sometimes	26	7.2
No, seldom	164	45.4
No, never	160	44.3
Too much work to do		
Yes, often	4	1.1
Yes, sometimes	17	4.7
No, seldom	207	57.3
No, never	133	36.9
Any opportunity to influence working conditions	61	16.9
Yes, often	94	26.0
Yes, sometimes	175	48.5
No, seldom	31	8.6
No, never		
Fellow-workers help problems in work		
Yes, often	4	1.1
Yes, sometimes	21	5.8
No, seldom	132	36.6
No, never	204	56.5
Psychosocial work environment		
Few stress factors	129	35.7
Moderate stress factors	139	38.5
Plenty stress factors	93	25.8

Table 4 shows allergic diseases among respondents which was determined for the last one year. Respondents was distinguished as having history of allergic they reported one of the three allergic diseases. Most of the respondents reported history of allergic comprised of 71.7%.

Table 4 Past diseases of respondents

Variables(n=361)	Frequency	%
Asthmatic problems		
Yes	49	13.6
No	312	86.4
Hay fever		
Yes	281	77.8
No	80	22.2
Eczema		
Yes	44	87.8
No	317	12.2
History of allergic		
Yes	259	71.7
No	102	28.3

Descriptive statistics on symptoms experienced by respondents which often occurred, sometimes or never for every week for the past three months are presented in Table 5. A higher proportion of respondents were experienced symptoms which often occurred every week with percentages more than 60%.

Table 5 Symptoms experienced by respondents

Variable(n=361)	Frequency	%
General symptoms:		
Fatigue		
Yes, often	202	55.9
Yes, sometimes	141	39.1
No, never	18	5.0
Feeling heavy-headed		
Yes, often	221	61.2
Yes, sometimes	96	26.6
No, never	44	12.2
Headache		
Yes, often	252	69.8
Yes, sometimes	84	23.3
No, never	25	6.9
Nausea/dizziness		
Yes, often	211	58.4
Yes, sometimes	27	7.5
No, never	123	34.1
Difficulties in concentrating		
Yes, often	243	67.3
Yes, sometimes	42	11.6
No, never	76	21.1
Mucous membrane symptoms:		
Itching, burning or irritation of the eyes	156	43.2
Yes, often	92	25.5
Yes, sometimes	113	31.3
No, never		
Irritated, stuffy or runny nose		
Yes, often	194	53.7
Yes, sometimes	59	16.4
No, never	108	29.9
Hoarse, dry throat		
Yes, often	218	60.4
Yes, sometimes	44	12.2
No, never	99	27.4
Cough		
Yes, often	242	67.0
Yes, sometimes	39	10.8
No, never	80	22.2
Dermal symptoms:		
Dry or flushed facial skin		
Yes, often	137	38.0
Yes, sometimes	24	6.6
No, never	200	55.4

Continue to next page

Table 5 *continue*

Scaling/itching scalp or ears		
Yes, often	111	30.7
Yes, sometimes	40	11.1
No, never	210	58.2
Hands dry, itching, red skin		
Yes, often	80	22.2
Yes, sometimes	31	8.6
No, never	250	69.2

Table 6 shows the descriptive statistics of those respondents who experienced symptoms for the past three months which occurred every week and they believed it was due their work environment. Difficulty in concentrating is the highest symptoms that they reported which comprised of 70.8%.

Table 6 Weekly and work-related symptoms by respondents

Variable(n=361)	Frequency	%
Fatigue Yes, occurred every week and work-related	121	59.9
Feeling heavy-headed Yes, occurred every week and work-related	145	65.6
Headache Yes, occurred every week and work-related	163	64.7
Nausea/dizziness Yes, occurred every week and work-related	113	53.6
Difficulties in concentrating Yes, occurred every week and work-related	172	70.8
Itching, burning or irritation of the eyes Yes, occurred every week and work-related	121	43.2
Irritated, stuffy or runny nose Yes, occurred every week and work-related	126	53.7
Hoarse, dry throat Yes, occurred every week and work-related	99	45.4
Cough Yes, occurred every week and work-related	135	55.8
Dry or flushed facial skin Yes, occurred every week and work-related	79	57.7
Scaling/itching scalp or ears Yes, occurred every week and work-related	45	40.5
Hands dry, itching, red skin Yes, occurred every week and work-related	38	47.5

Combination of at least one symptom from each group of general, mucosal and skin symptoms (Berndt *et al.*, 1995), symptom is work-related and experienced every week (WHO, 1995) were calculated to fulfil the definition of sick building syndrome. Table 7 shows the prevalence of sick building syndrome according to gender.

Table 7 Gender-specific prevalence of sick building syndrome among office workers in Federal House, Kota Kinabalu

Gender	n	Symptoms of SBS	
		Frequency (%)	95% CI
Male	140	48 (34.3)	26.3, 42.2
Female	221	123 (55.7)	49.1, 62.3
TOTAL	**361**	**171 (47.4)**	**42.2, 52.5**

Descriptive statistics of selected indoor air parameters in the Federal House Kota Kinabalu are presented in Table 8.

Table 8 Selected indoor air parameters in the Federal House Kota Kinabalu

Parameters	DOSH standard In 8-TWA	Min	Max	Mean (SD)
Temperature (˚C), n=210	20-26	19.9	30.2	26.6 (2.36)
Relative Humidity (%), n=210	40-60	62.6	80.3	71.7 (4.53)
Air Velocity, n=210	25 – 55fpm	7.0	780.0	24(72.0)*
CO ppm, n=210	10	0.1	0.8	0.3(0.12)
CO_2 ppm, n=210	C1000	250.5	810.6	406.8(102.98)
Particulate matter mg/m^3, n=210	0.15	0.0	0.1	0.02(0.019)
TVOC ppm, n=210	3	0	0.6	0.3(0.11)
Formaldehyde ppm, n=21	0.1	0	0	0

[a] Median (IQR)

The concentration level of each indoor air parameters was taken within four hours apart during the working hours for three alternate days in a week. A total of 210 sampling points for each indoor parameter were taken except for formaldehyde where 21 sampling points were taken. Table 8 shows the maximum, minimum and mean concentration of the indoor air parameters. Day one indicates measurement was done on Mondays. Day two indicates measurement was done on Wednesdays. While day three indicates measurement was done on Fridays. It is shown in Table 1 to 7.

All associated factors for sick building syndrome had been analysed using chi-square test, independent t-test and simple logistic regression. Respondents with sick building syndrome were more in female, non-smoking, have history of allergic, lower job category and high job stress to non-sick building syndrome. There were no differences in terms of age between the groups. Work environmental factors that associated with sick building syndrome were draught, static electricity causing shock and passive smoking. Results are presented in Table 9 and Table 10.

Table 9 Association of sociodemographic characteristics and sick building syndrome

Variables	Non-Sick building syndrome (n=190)		Sick building syndrome (n=171)		*p*-value
	n (%)	mean (SD)	n (%)	mean (SD)	
Age		35.3 (9.27)		35.8 (9.20)	0.634 [a]
Gender					
Male	92(48.4)		48(28.1)		
Female.	98(51.6)		123(71.9)		<0.001 [b]
Smoking					
No	150(78.9)		154(90.1)		
Yes	40(21.1)		17(9.9)		0.004 [b]
History of allergic					
No	68(35.8)		34(19.9)		
Yes	122(64.2)		137(80.1)		0.001 [b]
Job category					
Low	140(73.7)		141(82.5)		
High	50(26.3)		30(17.5)		0.045 [b]
Psychosocial work environment					
Low job stress	63(33.2)		66(38.6)		
High job stress	127(66.8)		105(61.4)		0.282 [b]

SD: standard deviation; Mean diff: mean difference; *p* value <0.05 as significant; a = t-statistics (independent t-test); b = Chi-square test

Table 10 Relationship of work environment factors and sick building syndrome

Variable	Non-Sick building syndrome (n=190) n (%)	Sick building syndrome (n=171) n (%)	χ^2 (df)[a]	p-value
Draught				
Non-work environmentally related	138(72.6)	89(52.0)	16.339(1)	<0.001 [b]
Work environmentally related	52(27.4)	82(48.0)		
Room temperature too high				
Non-work environmentally related	88(46.3)	78(45.6)	0.018(1)	0.894 [b]
Work environmentally related	102(53.7)	93(54.4)		
Varying room temperature				
Non-work environmentally related	102(53.7)	87(50.9)	0.284(1)	0.594 [b]
Work environmentally related	88(46.3)	84(49.1)		
Room temperature too low				
Non-work environmentally related	110(57.9)	84(49.1)	2.786(1)	0.095 [b]
Work environmentally related	80(42.1)	87(50.9)		

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Table 10 *continue*

Stuffy 'bad air'				
Non-work environmentally related	112(58.9)	87(50.9)	2.369(1)	0.124 [b]
Work environmentally related	78(41.1)	84(49.1)		
Dry air				
Non-work environmentally related	105(55.3)	99(57.9)	0.254(1)	0.615 [b]
Work environmentally related	85(44.7)	72(42.1)		
Unpleasant odour				
Non-work environmentally related	88(46.3)	79(46.2)	0.001(1)	0.982 [b]
Work environmentally related	102(53.7)	92(53.8)		
Static electricity, often causing shocks				
Non-work environmentally related	144(75.8)	106(62.0)	8.051(1)	0.005 [b]
Work environmentally related	46(24.2)	65(38.0)		
Passive smoking				
Non-work environmentally related	139(73.2)	101(59.1)	8.022(1)	0.005 [b]
Work environmentally related	51(26.8)	70(40.9)		
Noise				
Non-work environmentally related	75(39.5)	61(35.7)	0.554(1)	0.457 [b]
Work environmentally related	115(60.5)	110(64.3)		
Light that is dim or causes glare and/or reflections				
Non-work environmentally related	105(55.3)	78(45.6)	3.352(1)	0.067 [b]
Work environmentally related	85(44.7)	93(54.4)		
Dust and dirty				
Non-work environmentally related	98(51.6)	105(61.4)	3.530(1)	0.060 [b]
Work environmentally related	92(48.4)	66(38.6)		

[b] Chi-square test zero cell has expected count less than five

By using simple logistic regression analysis, variables such as gender, smoking status, history of allergic and job category was significantly associated with sick building syndrome as shown in Table 11.

Table 11 Relationship of demographic and personal factors with sick building syndrome

Variable	Crude *OR*[a]	95% CI[b]	Wald [c]	*df*[d]	*p* value[d]
Age (year)	1.01	0.98,1.03	0.23		0.633
Gender					
Male	1	-	-		
Female	2.41	1.55,3.73	15.40	1	0.001
Smoking					
No	1	-	-		
Yes	0.41	0.23,0.76	8.02	1	0.005
History of allergic					
No	1	-	-		
Yes	2.25	1.39,3.62	10.98	1	0.005
Job category					
Low	1	-	-		
High	0.60	0.36,0.99	3.97	1	0.046
Psychosocial work environment					
Low job stress	1	-	-		
High job stress	0.78	0.51,1.22	1.16	1	0.282

[a] OR = Odds Ratio, [b] CI = Confidence Interval, [c] Wald = value of Wald statistic , [d] *df* = degree of freedom, [e] *p*-value = *p*-value of Wald test (Simple logistic regression)

Table 12 presents the univariable analysis of work environmental factors with sick building syndrome among respondents.

Variable	Crude *OR*[a]	95% CI[b]	Wald[c]	*df*[d]	*p* value[e]
Draught					
Non-work environmentally related	1	-	-		
Work environmentally related	2.45	1.58,3.79	16.0	1	0.001
Room temperature too high					
Non-work environmentally related	1	-	-		
Work environmentally related	1.03	0.68,1.56	0.02	1	0.894
Varying room temperature					
Non-work environmentally related	1	-	-		
Work environmentally related	1.12	0.74,1.69	0.28	1	0.594
Room temperature too low					
Non-work environmentally related	1	-	-		
Work environmentally related	1.42	0.94,2.16	2.78	1	0.096
Stuffy 'bad air'					
Non-work environmentally related	1	-	-		
Work environmentally related	1.39	0.91,2.10	2.36	1	0.124
Dry air					
Non-work environmentally related	1	-	-		
Work environmentally related	0.89	0.59,1.36	0.25	1	0.615
Unpleasant odour					
Non-work environmentally related	1	-	-		
Work environmentally related	1.01	0.66,1.52	0.01	1	0.982

Continue to next page

Table 12 *continue*

Static electricity, often causing shocks					
Non-work environmentally related	1	-	-		
Work environmentally related	1.92	1.22,3.02	7.94	1	0.005
Passive smoking					
Non-work environmentally related	1	-	-		
Work environmentally related	1.89	1.21,2.94	7.93	1	0.005
Noise					
Non-work environmentally related	1	-	-		
Work environmentally related	1.18	0.77,1.80	0.55	1	0.457
Light that is dim or causes glare and/or reflections					
Non-work environmentally related	1	-	-		
Work environmentally related	1.47	0.97,2.23	3.34	1	0.068
Dust and dirty					
Non-work environmentally related	1	-	-		
Work environmentally related	0.67	0.44,1.02	3.51	1	0.061

[a] OR = Odds Ratio, [b] CI = Confidence Interval, [c]Wald = Value of Wald statistic , [d]*df* = degree of freedom, [e]*p* value = *p*-value of Wald test (Simple logistic regression)

Those who exposed to draught (p=0.001), static electricity often causing shocks (p=0.005) and passive smoking (p=0.005) which are work environmentally related shows statistically significant with sick building syndrome.

In multivariable analysis, multiple logistic regression analysis was used to identify the independent associated factors for sick building syndrome. The independent variables that were statistically significant as predictors towards the occurrence of sick building syndrome were female in gender, had history of allergic and exposed to draught working with $p<0.05$.

Hosmer and Lemeshow test for fitness of model was not significant with p-value 0.945, showing that the model was fit. Model fitness was also supported by Classification Table and Receiver Operating Characteristics (ROC) curve (Appendix I). The sensitivity of the model was 70.4% and the specificity was 58.9%. The overall percentage (63.4%) shows fairly acceptable. Area under the curve was 0.686 shows fairly acceptable discrimination. Cut off points of 1 for Cook's influence statistics and 4 for Leverage value were used to determine influential outliers. There was no outlier given

by Cook's test and Leverage value. No multicollinearity problem noted. Based on the above findings, the preliminary model was accepted for final model (Table 13).

Table 13 Associated factors for sick building syndrome by multiple logistic regressions

Variable	Beta	SE	Adjusted OR[a]	95% CI[b]	*df*[c]	*p* value
Gender						
Male			1			
Female	0.75	0.23	2.12	1.34,3.35	1	0.001
History of allergic						
No			1			
Yes	0.92	0.26	2.51	1.50,4.19	1	0.001
Draught						
Non-work environmentally related			1			
Work environmentally related	0.99	0.24	2.71	1.70,4.32	1	0.001

[a] OR = Odds Ratio, [b] CI = Confidence Interval, [c] *df* = degree of freedom
Constant = -0.859
Hosmer and Lemeshow Test P-Value = 0.945
Receiver Operating Characteristics (ROC) curve = 0.686
No outlier by Cook's test and Leverage value

The final model (Table 13) shows the following interpretation:
Female workers are two times more likely to have sick building syndrome (adjusted OR:2.12; 95% CI: 1.34,3.35; *p*=0.001)

Those workers who have history of allergic are about two times more likely of having sick building syndrome compared to those who have not (adjusted OR2.51; 95% CI: 1.30,4.19; *p*=0.001)

Those workers who exposed to draught at working environment are about two times more likely of having sick building syndrome compared to those who are not exposed. (adjusted OR:2.71; 95% CI: 1.70,4.32; *p*=0.001)

DISCUSSION

Most of respondents were within middle age group with mean (SD) age for the respondents was 35.6 (9.22) years old. This is similar with the study done by Juliana *et al*. (2009) where mean of age is 36 years old in old building and 31 years old in new buildings. However, there was no mean difference of age between those who had sick building syndrome and those who hadn't. Study done by Ooi *et al*. (1998) noted that younger age group (16-25) years old were significantly associated with sick building syndrome. Duration of working in the current workplace was range from 6 months to 33 years and it was skewed to the right. One of the inclusion criteria in this study is working at least 6 months in the current workplace or station. Usually worker takes between 3 to 6 months to adapt to their new working environment (Rotton, 1996). It was skewed to the right because of high turnover rate. Federal House, Kota Kinabalu is the headquarters for the three federal agencies that is Health Department, Federal Financial Department and Education Department. Those working in headquarters are usually had been promoted and senior in their job title. However, they tend not to stay longer in the current workplace since once they were confirmed for their seniority; they applied for transfer to their previous workstation or transferred to the districts.

Findings in this study documented a high prevalence of sick building syndrome among office workers which is 47.4% (95% CI.42.2, 52.5). Levy (1990) suggested that building is "sick" if the frequency of symptoms of sick building syndrome among occupants in certain building is more than 20%. To qualify for acceptable indoor air quality, a threshold of 20% and less of occupant's complaint express dissatisfaction (ASHRAE, 2003).

A study done by Ooi *et al*. (1998) in Singapore noted that prevalence of sick building syndrome is 19.6%. In the study, criteria to define sick building syndrome is two or more symptoms. This may explain why the prevalence is lower. The study also discussed that changing the criteria to at least one symptom, there was a demonstrable shift proportion of affected workers. However, no figure was given. Local study done by Juliana *et al*. (2009) reported prevalence among office workers in old buildings is 68.8% while in new buildings is 36.1%. In this study, Federal House, Kota Kinabalu is considered an old building since it aged 35 years. However, even in building that is considered new, the prevalence of sick building syndrome is about 30% (WHO, 1983). Prevalence of SBS can be as high as 70%. Alan *et al*. (1996b) noted that 76% in air-conditioned buildings with acceptable indoor air quality report at least one work-related SBS symptoms.

Some of the researchers determine the prevalence of sick building syndrome based on gender (male and female). In this study, the prevalence of SBS among female is 55.7% while male is 34.3%. This prevalence is higher compared with study done by Berndt *et al*. (1995) where prevalence of SBS among female is 12% while in male is 4% and study done by Marmot *et al*. (2006) prevalence of SBS among female is 19% while male is 14%.

From this study, the most frequent complaint by the respondents (n=361) is difficulty in concentrating comprised of 70.8%. While the least complaint is scaling/itching of scalp or ears comprised of 40.5%. These symptoms were occurred every week and work-related. Sanjeev

et al. (2007) noted that the main symptoms in sick building syndrome were headache (51%), lethargy (50%) and dryness of the mucous (33%). While, study done by Marmot *et al*. (2006), the most frequent symptoms noted were headache, 50.9% and the least is wheeziness, 8.4%. According to James *et al*. (1996), the typical SBS complaints include lethargy (56%), headache (45%), stuffy nose (43%), dry throat (40%), dry eyes (30%), itchy/watery eyes (22%), runny nose (22%), flu-like symptoms (15%), breathing difficulties (8%) and chest tightness (8%). This shows variety of symptoms of sick building syndrome. Most of these symptoms are inclusive of the core symptoms that been originally listed by WHO (1983). Linda (1999) noted that symptoms commonly occur with SBS is different from each other depend on different microenvironments or host factors.

Due to the differences of SBS definition used by different authors lead to difficulty in comparison pertaining to prevalence. According to Carrie *et al*. (1997), there is still no universally accepted clinical definition of SBS. However, WHO (1983) definition should be used as the standard definition. This may need to improvise according to the current situation. The threshold set by ASHRAE (2003), Standard 62-89 which is 20% and less of occupant's complaint express dissatisfaction as the level to indicate problem of sick building syndrome.

Another obstacle faced in determining the prevalence of SBS is diagnosing sick building syndrome. WHO did not provide standardized method on how to diagnose sick building syndrome. Many authors agreed that self-administered questionnaire is a reliable method. Gary (1996) did an empirical comparison of questionnaire design revealed that in order to have greater comparability of SBS research in the future, a standard questionnaire should be develop as a proper calibration of instruments. In this study, the MM questionnaire which had been translated into Malay version was used. Good internal consistency was noted with overall Cronbach's alpha is 0.87. Lahtinen *et al*. (2008) give a remark that this MM questionnaire is useful as a screening method in diagnosis of indoor air problem but not sick building syndrome per se. Thomas (2008) also recommends this MM questionnaire as it has section for psychosocial factors.

In this study, there is no definitive diagnosis for the condition such as immunological and biochemical tests. Carrie *et al*. (1997) suggested that patient with building-related complaints should be assessed by clinician. Appropriate investigation such as chest radiography, spirometry or peak flow recordings should be undertaken if clinical presentation suggests one of the well-defined building-related illnesses such as asthma or hypersensitivity pneumonitis (Kjell, 2008). Usually in sick building syndrome, there is lack of pathophysiological abnormalities.

An indoor air quality evaluation of a building is crucial to the management of SBS. It is noted that indoor air quality is a useful indicator for sick building syndrome (Sanjeev, 2007). In this study, a few parameters were included which is the indoor air contaminants and physical condition. For air contaminants, all the parameters were in a normal range as recommended by Code of Practice on Indoor Air Quality (DOSH, 2005).

In this study, carbon dioxide concentration is within the normal range as recommended by Code of Practice on Indoor air quality (DOSH, 2005). ASHRAE (2003) has recognized the importance of carbon dioxide as a surrogate indicator of the effectiveness of overall ventilation and air exchange rates. ASHRAE (2003) adopted a maximum level of carbon dioxide of 1000ppm which is also a ceiling limit of carbon dioxide in Malaysia (DOSH, 2005). The ventilation rate is normal since the room level of carbon dioxide is below 1000 ppm. Carbon monoxide level is within the DOSH (2005) standards limit. The mean value is lower compared with mean value in study by Ooi *et al*. (1998) and Edimansyah *et al*. (2009). VOCs level is within the normal level. The mean value is lower compared to study done by Ooi *et al*. (1998). Study by Juliana *et al*. (2009) noted that VOCs showed significant association with the sick building prevalence. No trace of formaldehyde detected in this study. The normal value is less than 0.1 ppm over 8 TWA airborne concentrations (DOSH, 2005).

The level of PM10 is normal with mean value is lower compared with mean value in study by Ooi *et al*. (1998). This show that amount of outdoor air brought into the building is enough with good building's air supply system.

The mean value of temperature is slightly higher (26.6°C) compared with normal range (20-26°C) and the relative humidity is also higher (71.7%) compared with normal range (40-60%) recommended by Guidelines on safety and health in the office (DOSH, 1996). More than 60% of the respondents perceived stuffy bad air and dry air.

This study is the first evaluation study of associated factors for sick building syndrome among office workers in East Malaysia specifically Sabah.

In this study, after controlling the potential confounders such as age, job category, smoking

and passive smoking exposure in work environment, the only significant risk factors associated with sick building syndrome were female (adjusted odds ratio (OR)=2.12; 95% CI: 1.34,3.35; *p*=0.001), history of allergic (adjusted odds ratio (OR) =2.51, 95% C.I.:1.50, 4.19; *p* value= 0.001) and draught condition in work environment (adjusted odds ratio (OR) =2.71, 95% C.I.:1.70, 4.32; *p* value= 0.001)

CONCLUSION

A high percentage of office workers in Federal House Kota Kinabalu have sick building syndrome. Multivariable analysis showed that workers who have history of allergic, female and exposed to draught condition in work environment are significantly associated with sick building syndrome. Assessments of the indoor air quality in terms of chemical parameters are within normal range but physical parameters were higher than the guidelines.

Our study confirmed the occurrence of sick building syndrome. Office workers who have history of allergic, female and exposed to draught condition in work environment are risk factors for developing sick building syndrome.

COMPETING INTERESTS

There is no conflict of interest.

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