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ASSOCIATION BETWEEN INDOOR AIR QUALITY AND SICK BUILDING SYNDROME AMONG WORKERS IN FOOD OUTLETS IN SELANGOR, MALAYSIA

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Abstract

Introduction: *Indoor air pollution, causing health issues like Sick Building Syndrome (SBS), is the third largest global contributor to disability-adjusted life years, emphasizing the urgent need for improved indoor air quality. This study aimed to determine the association between Indoor Air Quality (IAQ) and SBS among workers at food outlets in Selangor, Malaysia.* ***Methods:*** *A cross-sectional study was carried out among 107 workers in mall, new and old food outlet. A set of standardized and validated version questionnaires of the Industry Code of Practice on Indoor Air Quality (ICOP IAQ) 2010 was distributed to obtain respondents' sociodemographic information, symptoms present at the workplace, and psychosocial information.* ***Results and Discussion:*** *The study found significant differences in temperature (p = 0.004), air velocity (p = 0.037), ultrafine particles (p = 0.005), and carbon dioxide (CO_2) concentrations (p = 0.006) in malls, new and old food outlets. Workers in old food outlets had the highest prevalence of SBS (66.7%), compared to those in new outlets (60.5%) and mall outlets (64.7%). Environmental characteristics, such as increased dust and particulate matter during renovation (OR = 6.17, 95% CI = 1.34-28.34), repair (OR = 2.43, 95% CI = 1.03-5.76), along with temperature variations (OR = 7.21, 95% CI = 2.52-20.66) significantly influencing SBS.* ***Conclusion:*** *SBS prevalence in food outlets is not significantly linked to IAQ parameters, but exposure to UFP and $PM_{2.5}$ may contribute to its development. However, it is significantly associated with workplace renovations and repairs for interior design, as well as varying temperatures.*

INTRODUCTION

Epidemiological studies reveal that symptoms of the mucous membrane, central nervous system, and poor indoor Air Quality are common. The syndrome is currently considered obsolete, with a focus on specific symptoms and their underlying causes (1). Indoor air pollution has health effects that can appear immediately or years later. With people living in cities often spending more than 90% of their time indoors, the world is becoming an increasingly urbanized place (2). The development of additional indoor air contaminants, the isolation of the indoor environment from the natural outdoor environment in well-sealed office buildings, and the discovery of the so-called Sick Building Syndrome (SBS) have all contributed to increasing public concern. The fact that indoor air pollution is the third largest global contributor to disability-adjusted life years is more evidence of this expanding awareness, leading to health issues such as Sick Building Syndrome and emphasizing the need for improved indoor air quality (3-4).

SBS is characterized by a wide range of symptoms, such as inflammation of the mucous membranes (irritated eyes, rhinorrhea, nasal blockage, and sore throat), symptoms of asthma (wheezing, tightness in the chest), neurotoxic effects (headache, fatigue, and irritability), gastrointestinal disturbances, dry skin, and sensitiveness to scents (5–8). SBS can occur in a variety of environments, including office buildings, universities, and hospitals (9). It has been found that SBS is related to household cooking energy sources, cooking practices, and occupant incensing habits (10). This is usually a temporary problem, but some buildings have

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persistent problems. Problems frequently occur when a structure is used or maintained in a way that is contrary to its original layout or accepted operational guidelines. SBS, a health condition, is estimated to impact around 30% of workers in new and renovated buildings globally, leading to substantial productivity loss, increasing absenteeism and workforce turnover (11). Several well-known risks for SBS include personal variables and working conditions (psychosocial issues, stress at work, and allergy conditions) (12), as well as building-related factors (13). Although the causes of SBS seem to be multiple in this dynamic setting, most risk factors are connected to indoor air quality (14).

Research has found that exposure to airborne particulate matter (PM) generated during cooking, especially from certain techniques such as frying, can significantly increase the average number of ultrafine particles (UFP), with consequences for personal health (15). Research has been done on a number of indoor activities that cause pollution, and cooking is one of the most important sources of fine particle ($PM_{2.5}$; aerodynamic diameter < 2.5 µm) (16).

As the catering sector rapidly expands, individuals working in kitchens may face heightened exposure to particulate matter, potentially increasing their risk of exposure to ultrafine particles (17). Moreover, the majority of food outlets are located indoors, either in malls or in individual stores. A number of activities are performed in the outlets, including the preparation and cooking of food that could be related to the causes of SBS among food outlet workers.

Workers at food outlets spend most of their working hours indoors in air-conditioned buildings, and indoor air pollution (IAP) may adversely affect their health. Air-conditioned buildings with restricted air exchange can increase the presence of formaldehyde and other volatile organic compounds (VOCs), which may harm occupants' health and well-being (18). In addition, poor IAQ in food outlets potentially causes several symptoms of SBS among the workers in the mall. The occurrence of these several symptoms at once might affect the focus and quality of work.

This research study was designed to determine the association between IAQ and SBS among workers between the ages of 18 – 60 years old in food outlets in Selangor. This study is important for the management of the food outlet because the work environment sets a baseline for a worker's efficiency as the findings revealed that SBS negatively correlated with job performance (19). Thus, this study may help the management to tackle the issues of productivity among workers in the food outlet as higher workers productivity allows for more work to be done and ensures the smooth running of a business.

In addition, there is a lack of research done to study the association between IAQ and SBS among workers in food outlets in Malaysia. Most research on SBS symptoms has focused on the general population, particularly office employees as well as particular settings like colleges universities and dormitories but not in food outlet environments (20-21). As stated previously, most food outlet workers are exposed to different types of emissions from cooking activities. A study conducted in residential buildings in Korea reported that $PM_{2.5}$ concentrations exceeded 70 µg/m³ in 17 buildings during cooking. After cooking, the $PM_{2.5}$ concentration in 11 of these buildings remained above 70 µg/m³ (22). Therefore, this is crucial to investigate the IAQ in food outlets in order to produce a mitigation plan to improve the quality of air inside the outlets. As a result of the information gathered, good suggestions and insights can be provided to the management of the food outlet to enhance the quality of the air indoors and resolve SBS problems among employees.

METHODS

Study Location and Subject Selection

The purpose of this study is to ascertain the association between IAQ and SBS among workers in food outlets in Selangor, Malaysia.

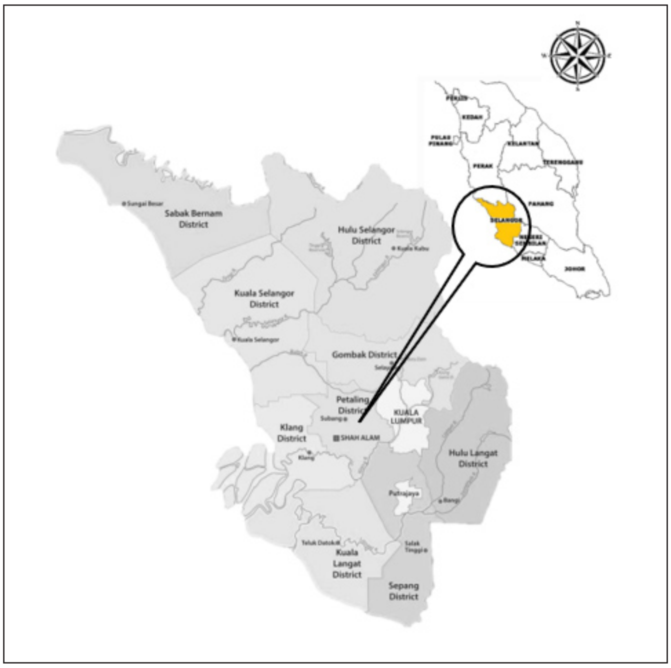

Figure 1. Food Outlets Location

Figure 1 shows the areas where 10 food outlets were chosen in Selangor, Malaysia. The levels of IAQ of these buildings were compared, and the buildings with higher SBS symptoms were determined. The mall outlets were the ones that are located in Putrajaya, Shah Alam, and Subang Jaya. Meanwhile, the new outlets were located in Bandar Baru Bangi, Petaling Jaya, Banting as well as Kajang and the old outlets were located at Kota Kemuning, Shah Alam, and Jenjarom. The selection of these studied areas is based on their characteristics for food outlets, which include mall outlets, new outlets, and old outlets. Food outlets in malls use centralized air conditioning, whereas new and old food outlets use non-centralized air conditioning (single-split type). Additionally, the cooking activities in these outlets contribute to indoor air quality variations, as different ventilation systems affect the dispersion of pollutants generated during cooking.

Sampling Unit

The study sample of this study consisted of workers (male and female) from selected food outlets in the Selangor area. The respondents were picked based on the inclusion and exclusion criteria that have been specified. The inclusion criteria are male and female workers who work full-time in the food outlets, ranging in age from 18 to 60 and have been employed in the food outlets for more than 1 month. The exclusion criteria are workers who had a history of respiratory illness such as asthma, workers who had respiratory problems before this research study began, workers who smoke and delivery workers who constantly travel outside the building. This survey does not include visitors to the food outlets.

Sampling Method

A list of the selected workers was obtained from the food outlet administration. The respondents were then selected using a purposive sampling method. The questionnaire was distributed to the workers who were willing to engage in the study as a respondent after receiving the Ethics Committee's consent for Research Involving Human Subjects (JKEUPM) and consent from the food outlets administration to conduct this study. The questionnaire was pre-tested out of the study area in a community that had similar characteristics before the data collection to assess the validity and reliability of the questions given. Cronbach's Alpha was determined to be 0.97.

Instrumentation

The questionnaire used in this research was based on a standardized and validated version of the Industry Code of Practice on Indoor Air Quality (ICOP IAQ 2010) questionnaire (23). The questionnaire's contents include socio-demographic information, symptoms present at the workplace, and psychosocial information. The questionnaire was provided in Malay Language to ensure that all respondents understand the questions and that completing them is easier.

If an SBS symptom appears at least once per week in the workplace, the workers will be classified as having SBS. These symptoms should be temporally linked to being in the building, resolve when the person is not in the building, and be found in several people in the building. The building tenants must also have reported problems for at least one to three days per week for the previous four weeks, with symptoms improving when she or he was away from work (24). The workers are encouraged to take note if any SBS symptoms appear. In severe cases, workers are advised to see a doctor.

Indoor Air Quality Instruments

Temperature (Temp), relative humidity (percent RH) and carbon dioxide (CO_2), were measured using the TSI Model 7575 Q-Trak Indoor Air Quality Monitor. In this study, CO_2 concentration was the indicator of ventilation for fresh air supply, diffuser supply air, return air, and outside air (25). TSI Model 8532 Dusttrak II Aerosol Monitor was used to detect particulate matter $PM_{2.5}$ and PM_{10}. In all food outlet, the TSI 8386 Velocicalc Plus (Velocicalc) had been utilized to evaluate air movement, air flow, velocity, volume, pressure difference, and ventilation rate. To detect the level of TVOC in the indoor air, the ppbRAE 3000 had been used. Lastly, P-Trak® Ultrafine Particle Counter 8525 had been used to detect ultrafine particles.

The quantity of sample sites was calculated based on ICOP IAQ, 2010 (Table 1). The instruments were placed at 1.2 to 1.5 meters above floor level at each sampling location, which corresponded to the human breathing zone. Ventilation vents, places with high human activities, and interior walls were avoided as measuring places. The measuring sites and the wall were separated by more than 0.5 m. The outdoor measurement points were situated around 30 meters from each store's entrance.

Table 1. Recommended Minimum Number of Sampling Points for Indoor Air Quality Assessment by ICOP

Total Floor Area (Served by MVAC system) (m^2)	Minimum Number of Sampling Points
< 3,000	1 per 500m^2
3,000 - < 5,000	8
5,000 - < 10,000	12
10,000 - < 15,000	15
15,000 - < 20,000	18
20,000 - < 30,000	21
≥ 30,000	1 per 1,200m^2

Real-time monitoring for IAQ was conducted in four time slots, each sampling point was monitored for 10 minutes using a direct reading instrument, once the readings had stabilized. Sampling was conducted

3 times at the same point. For the morning, data was taken between 10.00 am to 1.00 pm. In the afternoon, the data collection was between 1.00 pm to 4.00 pm. In the evening, the data collection was taken between 4.00 pm to 7.00 pm, while the night data was conducted between 7.00 pm to 10.00 pm.

Statistical Analysis

IBM Statistical Package for Social Science (SPSS) Version 28 was used to record, categorize, and analyze all the results. First and foremost, a normality test was performed to ensure the data followed a normal distribution before proceeding with statistical analysis. The data were found to be non-normally distributed based on an insignificant p-value ($p > 0.05$) from the Shapiro-Wilk test. Thus, non-parametric tests were applied for the study variables. Descriptive statistics, including frequency, mean, median, and standard deviation, were used to assess the socio-demographic distribution of respondents. The Kruskal-Wallis test was applied to compare IAQ parameters such as relative humidity, temperature, air velocity, TVOC, PM_{10}, $PM_{2.5}$, and UFP across malls, new outlets, and old outlets. A chi-square test was then employed to compare the prevalence of SBS among workers in these food outlets and to examine the association between IAQ and SBS. Finally, logistic regression analysis was conducted to identify the key predictors influencing SBS among the workers, after controlling for confounding variables.

Ethical Consideration

The researcher began the study and data collection after receiving approval from JKEUPM (JKEUPM-2022-414). The questionnaire was distributed to all respondents, together with an explanation of the activities that will take place during the study project's execution. Since this study involved food outlet workers, the researcher must first get a consent form from the food outlet management. If the administration agrees to proceed with their workers' participation, they will be provided a written informed consent form to sign as an agreement. Only the researchers were able to access the data, which was strictly managed and protected.

RESULTS

Sociodemographic Information

A total of 107 respondents who answered the questionnaire in this study were made up of 34 workers from food outlets in the mall group, 43 workers from the new food outlets group, and 30 workers from the old food outlets group with completed information available of all data.

Table 2. Sociodemographic of Respondents

Variables	Mall	New	Old	n = 107	Z	p
	n = 34	n = 43	n = 30			
	Median (Range)	Median (Range)	Median (Range)			
Age (year)	22 (18-29)	20 (18-43)	22 (20-48)		4.441	0.109
	n (%)	**n (%)**	**n (%)**	**n (%)**	**x^2**	**p**
Gender						
Male	13 (38.2)	21 (48.8)	15 (50)	49 (45.8)	1.16	0.561
Female	21 (61.8)	22 (51.2)	15 (50)	58 (54.2)		
Race ℧						
Malay	34 (100)	41 (95.3)	29 (96.7)	104 (97.2)	3.46	0.484
Chinese	0 (0)	1 (2.3)	1 (3.3)	2 (1.9)		
Indian	0 (0)	1 (2.3)	0 (0)	1 (0.9)		
Smoking status ℧						
Yes	5 (14.7)	7 (16.3)	3 (10)	15 (14)	0.63	0.731
No	29 (85.3)	36 (83.7)	27 (90)	92 (86)		
Diagnosed Asthmatic ℧						
Yes	3 (8.8)	8 (18.6)	5 (16.7)	16 (15)	1.64	0.440
No	31 (91.2)	35 (81.4)	25 (83.3)	91 (85)		
Diagnosed Eczema ℧						
Yes	5 (14.7)	0 (0)	1 (3.3)	6 (5.6)	9.07	0.011*
No	29 (85.3)	43 (100)	29 (96.7)	101 (94.4)		
Furry Pet						
Yes	13 (38.2)	19 (44.2)	10 (33.3)	42 (39.3)	0.89	0.639
No	21 (61.8)	24 (55.8)	20 (66.7)	65 (60.7)		
Work position ℧						
Manager	5 (14.7)	5 (11.6)	3 (10)	13 (12.1)	1.81	0.771
Cashier	11 (32.4)	15 (34.9)	7 (23.3)	33 (30.8)		
Kitchen	34 (52.9)	43 (53.5)	30 (66.7)	61 (57)		
Working experience						
Less than 1 month	11 (32.4)	7 (16.3)	6 (20)	24 (22.4)	4.81	0.307
1-4 months	6 (17.6)	15 (34.9)	7 (23.3)	28 (26.2)		
More than 4 months	17 (50)	21 (48.8)	17 (56.7)	55 (51.4)		

**Significant at $p < 0.05$; n=107; ℧ by x^2test with Yates' correction for expected value <5*

Table 2 shows the summary of sociodemographic study population features. The total respondents involved in this study amounted to 107 food outlets who fulfilled the inclusion criteria. The nationality of all respondents was 100% Malaysian. The median age for workers in malls, new and old food outlets were 22 years, 20 years, and 22 years respectively.

The percentage of total female workers (54.2%) was higher compared to male workers (45.8%) in all three food outlets. Female workers in mall and new food outlets outperformed male workers, with a significant percentage of 61.8% and 51.2% respectively. While both female and male workers in old food outlets have the same percentage (50%). The majority of the respondents were Malay (97.2%), followed by Chinese (1.9%) and Indian (0.9%). The percentage of workers who have working experience of more than 4 months was 51.4%, followed by 1-4 months at 26.2%. Descriptive analysis and Chi-square were done to determine the relationship of the respondent with gender, race, smoking status, work position, and working experience.

Food Outlets' Environmental Characteristics

Primarily, the food served in these food outlets was fried chicken and burgers. Deep-frying, which often involves quick, high-heat cooking, was one of the primary cooking techniques employed in these restaurants. This method generates significant amounts of PM and VOCs. Natural gas used as the fuel source, releases additional pollutants such as CO, nitrogen dioxide (NO_2), and PM. The kitchen door was always kept closed. During cooking, all stoves in the kitchen were covered by a local exhaust ventilation system (LEV). LEV was installed to capture and remove contaminants. But the LEV system's efficacy depends on how well it is installed, maintained, and operated. If these things go wrong, the system could not be able to sufficiently remove airborne pollutants, which would result in poor indoor air quality. Although workers wore cotton uniforms, mouth cover and gloves to reduce exposure to grease and residues, these measures might not fully protect them from airborne pollutant. Additionally, renovation activities for interior design, along with service and repair work in the food outlet, contribute to increased dust and particulate matter. The development of SBS in such circumstances can be attributed to a variety of factors, including insufficient ventilation, elevated levels of pollutants from cooking, poor protective measures and the effects of renovation processes.

Comparison of Exposure to Indoor Air Parameter

Table 3 shows the median and interquartile range for each parameter of indoor air pollutants at the mall, new and old food outlets. Kruskal Wallis test was used to determine any significant difference between the three groups. It was reported that there were significant differences between the temperature, air velocity, UFP concentration, and CO_2 concentration (p = 0.004, p = 0.037, p = 0.005, p = 0.006) in malls, new and old food outlets at p<0.05. This study found that greater levels of temperature, UFP and CO_2 in mall food outlets using central air conditioning compared to newer and older food outlets equipped with single split unit air conditioning, which are not centrally located.

Table 3. Comparison of Indoor Air Pollutants Concentrations in Mall, New and Old Food Outlets

Variables	Mall n = 3	New n = 4	Old n = 3	Z	p
	Median (IQR)				
Temp (°C)	25 (3.03)	23.6 (3.68)	22.1 (4.18)	10.835	0.004*
RH (%)	60.9 (15.5)	61.85 (17.83)	68.6 (8.95)	3.287	0.193
Velocity (m/s)	0.085 (0.03)	0.11 (0.07)	0.185 (0.13)	6.588	0.037*
PM_{10} (µg/m³)	68 (35.5)	76.5 (64)	79 (80.25)	1.136	0.567
$PM_{2.5}$ (µg/m³)	49 (32.75)	74.5 (45.5)	66 (28.25)	3.378	0.185
UFP (pt/cc)	17197.5 (3670)	11649 (2355.8)	12313 (8320)	10.504	0.005*
TVOC (ppm)	0.485 (0.091)	0.46 (0.097)	0.468 (0.091)	0.693	0.707
CO_2 (ppm)	788.5 (321.75)	647 (236)	508 (192.5)	10.371	0.006*

**Significant at p < 0.05; n=107*

Prevalence of Sick Building Syndrome Among Food Outlet Workers.

Based on the findings shown in Table 4, there were no significant differences between the prevalence of SBS in malls, new and old food outlets. Although there is no significant difference among those three groups, old food outlets (66.7%) have a higher prevalence of SBS compared to workers of new food outlets (60.5%) and workers of mall food outlets (64.7%).

Table 4. Comparison of the Prevalence of Sick Building Syndrome (SBS) among Workers in Mall, New and Old Food Outlets

Variables	Prevalence of SBS n	Prevalence of SBS n (%)	x^2	p
Mall	34	22 (64.7)		
New	43	26 (60.5)	0.322	0.851
Old	30	20 (66.7)		

**Significant at p <0.05; n=107*

Association Between the Prevalence of Sick Building Syndrome with the Level of Indoor Air Quality

A chi-square test was performed to determine the relationship between indoor air quality with SBS symptoms among workers in food outlets as shown in Table 5. The indoor air parameters were categorized based on the mean value (temperature= 23.57 °C, relative humidity= 63.78%, air velocity= 0.127 m/s, PM_{10}= 74.5 µg/m³, $PM_{2.5}$= 63.16 µg/m³, UFP= 13719.83 pt/cc, TVOC= 0.471 ppm, and CO_2= 647.83 ppm). High exposure denotes the concentration that exceeds the mean value. Any concentration that was below the mean value was considered low exposure.

Table 5. Association between the Prevalence of Sick Building Syndrome with the level of Indoor Air Quality

Indoor Air Pollutants	Recent SBS Symptoms Yes (n=68) n (%)	Recent SBS Symptoms No (n=39) n (%)	x^2	p	OR	CI (95%)
Temperature (°C)						
High	43(69.4)	19(30.6)	2.14	0.143	1.81	0.82 – 4.02
Low	25(55.6)	20(44.4)				
Relative Humidity (%)						
High	41(66.10	21(33.9)	0.42	0.516	1.30	0.59 – 2.88
Low	27(60)	18(40)				

Indoor Air Pollutants	Recent SBS Symptoms Yes (n=68) n (%)	Recent SBS Symptoms No (n=39) n (%)	x^2	p	OR	CI (95%)
Air Velocity (m/s)						
High	28(62.2)	17(37.8)	0.06	0.808	0.91	0.41 – 2.01
Low	40(64.5)	22(35.5)				
PM_{10} (µg/m³)						
High	31(63.3)	18(36.7)	0.003*	0.955	0.98	0.44 – 2.15
Low	37(63.8)	21(36.2)				
$PM_{2.5}$ (µg/m³)						
High	35(63.6)	20(36.4)	0.00*	0.985	1.01	0.46 – 2.22
Low	33(63.5)	19(36.5)				
UFP (pt/cc)						
High	27(55.1)	22(44.9)	2.79	0.095	0.51	0.23– 1.13
Low	41(70.7)	17(29.3)				
TVOC (ppm)						
High	35(58.3)	25(41.7)	1.61	0.205	0.59	0.27 – 1.33
Low	33(70.2)	14(29.8)				
CO_2 (ppm)						
High	35(61.4)	22(38.6)	0.24	0.622	0.82	0.37 – 1.81
Low	33(66)	17(34)				

**OR significant at 95% CI > 1; n = 107*

Table 6. Association between Prevalence of Sick Building Syndrome with the Level of Indoor Air Parameter in Old Food Outlet

Indoor Air Pollutants	Recent SBS Symptoms Yes (n = 20)	Recent SBS Symptoms No (n = 0)	x^2	p	OR	CI (95%)
Temperature (°C)						
High	12(85.7)	2(14.3)	4.53	0.033*	6.00	1.00 – 35.90
Low	8(50)	8(50)				
Relative Humidity (%)						
High	18(66.7)	9(33.3)	0.00	1.000	1.00	0.08 – 12.56
Low	2(66.7)	1(33.3)				
Air Velocity (m/s)						
High	10(55.6)	8(44.4)	2.65	0.104	0.25	0.04 – 1.48
Low	10(83.3)	2(16.7)				
PM_{10} (µg/m³)						
High	8(57.1)	6(42.9)	1.08	0.300	0.44	0.09 – 2.09
Low	12(75)	4(25)				
$PM_{2.5}$ (µg/m³)						
High	10(58.8)	7(41.2)	1.11	0.292	0.43	0.09 – 2.15
Low	10(76.9)	3(23.1)				
UFP (pt/cc)						
High	3(33.3)	6(66.7)	6.28	0.012*	0.12	0.02 – 0.69
Low	17(81.0)	4(19.0)				
TVOC (ppm)						
High	11(64.7)	6(35.3)	0.07	0.794	0.82	0.17 – 3.81
Low	9(69.2)	4(30.8)				
CO_2 (ppm)						
High	5(50)	5(50)	1.88	0.171	0.33	0.07 – 1.65
Low	15(75)	5(25)				

**OR significant at 95% CI > 1; N of old food outlet workers= 30; ʊ by x^2test with Yates' Correction for expected value <5*

Table 7. Association between Prevalence of Sick Building Syndrome with Current Food Outlets Environmental Characteristic

Variables	Recent SBS Symptoms Yes (n=68)	Recent SBS Symptoms No (n=39)	x^2	p	OR	CI (95%)
Renovation in the workplace						
Yes	17	2	6.70	0.010*	6.17	1.34-28.34
No	51	37				
Repair or services process						
Yes	31	10	4.17	0.041*	2.43	1.03-5.76
No	37	29				
Varying temperature						
Yes	35	5	15.82	0.001*	7.21	2.52-20.66
No	33	34				

**OR significant at 95% CI > 1(n = 107)*

Results from this study showed no significant difference in SBS between buildings with high-level indoor air quality and those with low-level indoor air quality. Although there was a significant difference in the level of indoor air quality among the three groups (mall, new and old) as shown in Table 5, in Table 6 it was found that low level of UFP in old food outlets showed a significant association with the prevalence of SBS (OR = 0.1, 95% CI = 0.02 - 0.69).

The SBS in all food outlets has no significant association with the IAQ parameters. However, Table 7 shows the prevalence of SBS has been found to be closely related to the current food outlets' environmental characteristics for the past three months which were the renovation in the workplace, repair or services process and varying temperatures in the workplace with (OR= 6.2, 95% CI = 1.34-28.34), (OR= 2.4, 95% CI = 1.03-5.76) and (OR= 7.2, 95% CI = 2.52-20.66) respectively.

Predictors of Sick Building Syndrome Among Food Outlet Workers After Considering All Confounders

Table 8 shows the significant predictor that has influenced the SBS among food outlet workers after considering all confounders. Logistic regression was used to identify the main predictor that could influence the SBS of food outlet workers that participated in this study after all confounders of this study had been controlled. The risk of getting SBS increased among workers in food outlets that have renovation and varying temperatures in the workplace (B = 2.307, p = 0.020, AOR= 7.7, 95% CI = 1.39-42.35) and (B = 2.052, p = 0.000, AOR= 7.7878, 95% CI = 2.43-24.94). The results show that 34% (Nagelkerke R^2 = 0.34) of SBS was influenced by renovation and varying temperatures in the workplace.

Table 8. Predictors of Sick Building Syndrome among Study Respondents After Considering All Confounders

Variable	B	S. E	p	AOR	CI (95%)
Constant	-0.949	3.261	0.771	0.39	-
Temperature	-0.120	0.104	0.245	0.89	0.72-1.09
Relative Humidity	-0.017	0.029	0.562	0.98	0.93-1.04
$PM_{2.5}$	0.000	0.005	0.935	1.00	0.99-1.01
UFP	0.000	0.000	0.215	1.00	1.00-1.00
Renovation in the workplace	2.042	0.886	0.021*	7.66	1.39-42.35
Repair or services process	0.000	0.595	0.999	0.99	0.28-2.63
Varying temperature.	2.009	0.607	0.001*	7.46	2.43-24.94

**Significant at $p<0.05$; n=107; B= Regression Coefficient; S. E= Standard Error; AOR=Adjusted Odds Ratio; Nagelkerke R^2=0.34; Overall percentage= 70.1%*

DISCUSSION

Comparison of Indoor Air Quality

Ten food outlets were selected for this research. 3 outlets represent food outlets in the mall, 4 outlets represent new food outlets, and another 3 outlets represent old food outlets. Food outlets in malls refer to food outlets that use centralised air conditioning while new and old food outlets use non-centralised air conditioning (single-split type). According to Zainal et al., old buildings were defined as those that were more than 10 years old, while new buildings were those that were less than 10 years old (26).

It was reported that there were significant differences between the temperature, air velocity, UFP concentration, and CO_2 concentration in malls, new and old food outlets at $p<0.05$. Specifically, the temperature, UFP, and CO_2 levels in the mall were measured at 25°C, 17,197.5 pt/cc, and 788.5 ppm, respectively. In contrast, the levels in new and old outlets were 23.6°C and 22.1°C, 11,649 pt/cc and 12,313 pt/cc, and 647 ppm and 508 ppm, respectively. This may be attributed to the centralised need for more complex maintenance needs, particularly those related to ductwork and system calibration, while single-split units are simpler but require frequent attention to placement and air flow. Even though CO_2 is not a hazardous gas, it is the primary indicator for determining the effectiveness of the air ventilation system provided (19,22). Inadequate ventilation can increase indoor pollutant levels since it doesn't provide enough outdoor air into a building to dilute emissions from indoor sources nor does it remove indoor air pollutants. Pollutant concentrations can also be increased by high temperatures and humidity levels (27). After heating the oil for 30 seconds, heat dispersed considerably. During the cooking procedure, there was an approximate 10.0°C increase in the ambient temperature surrounding the cook. Furthermore, the kitchen frequently experiences substantial CO_2 accumulation throughout the cooking process (28). This increase in atmospheric CO_2 levels can trigger respiration issues and cause various forms of systemic confusion (29). Since Covid19-derived restrictions have been implemented, the significance of indoor CO_2 concentrations and their related health risks has grown increasingly important. Due to people spending more time indoors for comfort and activities studied the health risks, ventilation, thermal comfort, and CO_2 exposure in low-income kitchens at home across 12 global cities, and found that CO_2 concentrations varied significantly depending on the number of occupants (30). Therefore, higher levels of CO_2 in mall food outlets may be due to high occupancy compared to the new and old food outlets as they were located in individual outlet outside the mall.

The concentrations of $PM_{2.5}$ and PM_{10} were higher in new and older food outlets that use a single split unit of ventilation system compared to mall food outlets with central air conditioning, despite the fact that there was no significant difference in $PM_{2.5}$ and PM_{10} levels between the various types of food outlets. Previous studies have found that the thermal environment in Chinese residential kitchens is highly uniform but excessively hot in summer. Cooking two dishes can raise the air temperature by 5.3°C and create a 3.2°C vertical change in air temperature, conditions that exceed national standard limits for TVOCs and $PM_{2.5}$ (31).

Prevalence of Sick Building Syndrome Among Food Outlet Workers

Table 4 shows that there was no significant difference among the prevalence of SBS in malls, new and old food outlets. Even though there is no significant difference between those three groups, workers at old food outlets have a higher prevalence of SBS when compared to those at new food outlets and workers at mall food outlets. This study was aligned with another research which found that compared to new buildings, old buildings had a significantly higher prevalence of SBS where 29.1% was recorded by the new building, compared to 80% by the older one. When comparing the old and new buildings, the old building had a noticeably greater prevalence of SBS ($\chi2$=31.44, $p<0.001$). Due to the use of new furniture, freshly painted walls, wood goods, and vaporized chemicals, older buildings typically contain high amounts of indoor air pollutants (32). In this study, the main cooking method included deep-frying which generally operates under rapid high-heat conditions. A study confirmed that commercial cooking releases excessive levels of indoor PM; an open-kitchen restaurant grilling meats or frying with oil likely emits serious levels of indoor PM. This study also found that the particle pollution levels in the dining room of an open-kitchen restaurant are high enough to pose short- and long-term health risks for staff and frequent customers (33). A study found that carbon dioxide, the temperature of the air, respirable dust, ultrafine particles, and formaldehyde were linked to general symptoms of SBS (26). Even though formaldehyde is typically present in both indoor and outdoor air at low levels ranging from 0.01 to 0.05 ppm, elevated concentrations can significantly increase the risk of upper airway symptoms associated with SBS (34).

Association Between Prevalence of Sick Building Syndrome with The Level of Indoor Air Quality

Results from this study showed no significant difference in SBS prevalence between buildings with high-level indoor air quality and those with low-level indoor air quality. However, the temperature, relative humidity and $PM_{2.5}$ showed an insignificant with OR more than 1 increased risk in developing SBS which indicates that temperature higher than 23.57 °C, relative humidity higher than 63.78% and concentration of $PM_{2.5}$ higher than 63.16 μg/m^3 were a risk factor for the prevalence of sick building syndrome. This is supported by research in new and old buildings at a public university and stated that there was a significant association between SBS prevalence with TVOC (OR=4.55, 95% CI=1.12-18.48); UFP (OR=4.63, 95% CI=1.25-17.21); PM_{10} (OR=4.80, 95% CI=1.33-17.29); $PM_{2.5}$ (OR=5.06, 95% CI=1.36-18.89), temperature (OR=4.02, 95% CI=1.02-15.85), and job insecurity (OR=4.08, 95% CI=1.03-16.23) (32).

Having thermal discomfort at work can seriously impact an employee's motivation and productivity. An increase in temperature above the thermal comfort range can cause headaches, fatigue, and mucosal irritation (35). Research on office workers has found that the highest prevalence of Sick Building Syndrome (SBS) was nasal symptoms, affecting 25.3% of individuals. The study suggests that to reduce the risk of SBS, it is important to maintain optimal air temperature levels in air-conditioned offices below 23 °C, with relative humidity between 60% and 70% (36).

Predictors of Sick Building Syndrome Among Food Outlet Workers After Considering All Confounders

After determining the association, Logistic Regression was employed to identify the primary determinant associated with SBS prevalence and indoor air quality. After adjusting for confounders, the relationship between reported SBS symptoms and indoor air quality showed no clear association. Even though there is no relationship found between the reported SBS symptoms with the IAQ, prolonged exposure to UFP and $PM_{2.5}$ may contribute to SBS development among the workers. Multiple pathways allow UFPs to enter the human body and be absorbed rapidly and easily by cells, tissues, and organs. In contrast to bigger particles, ultrafine particles that enter the tiny airways and alveoli stay in the lungs for a longer period of time (37). Furthermore, the particles can induce oxidative stress, inflammation, and apoptosis in the body (38).

Table 8 indicated that other elements that had a major impact on the SBS among workers in food outlets are food outlets that were having renovation. Renovation activities, such as interior painting, have been linked to lower respiratory problem. The research shows a strong association between recent interior painting, chemical exposure, intense labor demands, longer hours at work, and migraines. Notably, the study found that exposure to fresh paint carried a high estimated relative risk for lower respiratory symptoms (adjusted OR = 20.6; 95% CI = 2.96–143) (39). Awang et al. in their study of in a public university building, found that humidity levels in the old structure were minimal. They observed that sneezing and painful or dry throat are examples of upper respiratory symptoms, as well as general symptoms including headaches, weariness, unusual tiredness, or sleepiness, were the most frequent SBS symptoms among responders. This indicates that working in a workplace with low humidity may increase the likelihood of employees experiencing both general and upper respiratory problems (40).

Most workers buildings in centralized MVAC systems complained about not being able to control the inside air temperature, which was sometimes extremely low (26). Study among college students found that those exposed to high relative humidity were 1.8 times more likely to develop SBS symptoms (OR=1.77; 95% CI=1.54-5.79). Additionally, students exposed to high temperatures were 2.6 times as likely to experience SBS symptoms (OR=2.56; 95% CI=2.66-9.87) (11).

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AUTHORS' CONTRIBUTION

NIIS: Investigation, Sampling, Visualization, Writing and Editing. JJ: Conceptualization, Methodology; Investigation; Supervision: Critically Reviewing. JJ & NFS: Study design, Result Interpretation and Discussion. JJ & FH: Writing, Revising and Editing. JJ & ART: Revising and Editing. All authors have read and agreed to the published version of the manuscript.

CONCLUSION

In conclusion, this study found that there were significant differences between the temperature, air velocity, UFP concentration and CO_2 concentration in malls, new and old food outlets. This study reveals a higher level of temperature, UFP and CO_2 in mall food outlets that use central air conditioning compared to new and old food outlets that use non-central air conditioning such as singlet split units. Headaches, fatigue, throat dryness, feeling like having flu, irritative cough and sore throat were the most common symptoms of SBS among food outlet workers.

The prevalence of SBS in all food outlets has no significant association with the IAQ parameters. However, exposure to UFP and $PM_{2.5}$ may contribute to SBS development. The prevalence of SBS was found to be significantly associated with the current food outlets' environmental characteristics for the past three months which were the renovation in the workplace, repair or services process, and varying temperatures in the workplace.

In order to maintain the ideal air temperature, workers can control their thermal comfort by adding or removing layers of clothes as needed. The food outlets' kitchens, which produce strong odors and high levels of UFP and $PM_{2.5}$, should exhaust air to the outside rather than circulate it within the food outlets. The mall management should regularly maintain local exhaust ventilation systems for optimal performance and air quality. Coordinate the ventilation and air conditioning systems to work efficiently by adjusting AC settings to support the exhaust systems. Upgrade to high-efficiency filters and variable-speed fans in both ventilation and air conditioning systems for efficient temperature control.

REFERENCES

1. Wolkoff P, Azuma K, Carrer P. Health, Work Performance, and Risk Of Infection in Office-Like Environments: The Role of Indoor Temperature, Air Humidity, and Ventilation. *Int J Hyg Environ Health*. 2021;233(1):1-18. https://doi.org/10.1016/j.ijheh.2021.113709
2. Vardoulakis S, Kinney P. Grand Challenges in Sustainable Cities and Health. *Frontiers in Sustainable Cities*. 2019;1(7):1-5. https://doi.org/10.3389/frsc.2019.00007
3. Chang KH, Hsu PY, Lin CJ, Lin CL, Juo SHH, Liang CL. Traffic-related Air Pollutants Increase The Risk For Age-Related Macular Degeneration. *J Investig Med*. 2019;67(7):1076–1081. https://doi.org/10.1136/jim-2019-001007
4. Hong T, Kim J, Lee M. Integrated Task Performance Score for The Building Occupants Based on The CO2 Concentration and Indoor Climate Factors Changes. *Appl Energy*. 2018;228(1):1707–1713. https://doi.org/10.1016/j.apenergy.2018.07.063
5. Rahayu EP, Maharani R, Jepisah D, Suhara AI. Analysis of Symptoms of Sick Building Syndrome for Nurses in Hospital Inpatient Rooms. *J Penelit Pendidik IPA*. 2023;9(2):770–774. https://doi.org/10.29303/jppipa.v9i2.3028
6. Smajlović SK, Kukec A, Dovjak M. Association Between Sick Building Syndrome and Indoor Environmental Quality in Slovenian Hospitals: A Cross-Sectional Study. *Int J Environ Res Public Health*. 2019;16(17):1-18. https://doi.org/10.3390/ijerph16173224
7. Ezani E, Brimblecombe P, Asha'ari ZH, Fazil AA, Ismail SNS, Ramly ZTA, et al. Indoor and Outdoor Exposure to $PM_{2.5}$ during Covid19 Lockdown in Suburban Malaysia. *Aerosol Air Qual Res*. 2021;21(3):1-12. http://dx.doi.org/10.4209/aaqr.2020.07.0476
8. Mata TM, Oliveira GM, Monteiro H, Silva GV, Caetano NS, Martins AA. Indoor Air Quality Improvement Using Nature-Based Solutions: Design Proposals to Greener Cities. *Int J Environ Res Public Health*. 2021;18(16):1-20. https://doi.org/10.3390/ijerph18168472
9. Akova İ, Kiliç E, Sümer H, Keklikçi T. Prevalence of Sick Building Syndrome in Hospital Staff and Its Relationship with Indoor Environmental Quality. *Int J Environ Health Res*. 2022;32(6):1204–1219. https://doi.org/10.1080/09603123.2020.1862067
10. Yussuf SM, Dahir G, Salad AM, Hayir TMM, Hassan SA, Gele A. Sick Building Syndrome and Its Associated Factors Among Adult People Living in Hodan District Moqadishu Somalia. *Frontiers in Built Environment*. 2023;9(1):1-8 https://doi.org/10.3389/fbuil.2023.1218659
11. Dhungana P, Chalise M. Prevalence of Sick Building Syndrome Symptoms and Its Associated Factors Among Bank Employees in Pokhara Metropolitan, Nepal. *Indoor Air*. 2020;30(2):244–250. https://doi.org/10.1111/ina.12635
12. Arikan I, Tekin ÖF, Erbas O. Relationship Between Sick Building Syndrome and Indoor Air Quality Among Hospital Staff. *Med Lav*. 2018;109(6):435–443. https://doi.org/10.23749/mdl.v110i6.7628
13. Tsantaki E, Smyrnakis E, Constantinidis TC, Benos A. Indoor Air Quality and Sick Building Syndrome in A University Setting: A Case Study in Greece. *Int J Environ Health Res*. 2022;32(3):595–615. https://doi.org/10.1080/09603123.2020.1789567
14. Azuma K, Ikeda K, Kagi N, Yanagi U, Osawa H.

Physicochemical Risk Factors for Building-Related Symptoms in Air-Conditioned Office Buildings: Ambient Particles and Combined Exposure to Indoor Air Pollutants. *Sci Total Environ*. 2018;616(1):1649–1655. https://doi.org/10.1016/j.scitotenv.2017.10.147

15. Tang R, Pfrang C. Indoor Particulate Matter (PM) from Cooking in UK Students' Studio Flats and Associated Intervention Strategies: Evaluation of Cooking Methods, PM Concentrations and Personal Exposures Using Low-Cost Sensors. *Environ Sci Atmos*. 2023;3(3):537–551. https://doi.org/10.1039/d2ea00171c
16. Admasie A, Kumie A, Worku A, Tsehayu W. Household Fine Particulate Matter ($PM_{2.5}$) Concentrations From Cooking Fuels: The Case in An Urban Setting, Wolaita Sodo, Ethiopia. *Air Qual Atmos Heal*. 2019;12(6):755–763. https://doi.org/10.1007/s11869-019-00700-0
17. Gao X, Zhang M, Zou H, Zhou Z, Yuan W, Quan C, et al. Characteristics and Risk Assessment of Occupational Exposure to Ultrafine Particles Generated From Cooking in The Chinese Restaurant. *Sci Rep*. 2021;11(1):1-11. https://doi.org/10.1038/s41598-021-95038-y
18. Lee K, Park SI, Park JS. Flushing Newly Built Residential Buildings with Outdoor Air For Reducing Formaldehyde and VOCs Concentrations. *J Asian Archit Build Eng*. 2024;23(5):1646-1657. https://doi.org/10.1080/13467581.2023.2270025
19. Khalid S, Tariq S, Younas F. Sick Building Syndrome and Job Performance in Women Factory Workers. *J Postgrad Med Inst*. 2021;34(1):22–28. https://jpmi.org.pk/index.php/jpmi/article/view/2541
20. Thach TQ, Mahirah D, Dunleavy G, Nazeha N, Zhang Y, Tan CEH, et al. Prevalence of Sick Building Syndrome and Its Association with Perceived Indoor Environmental Quality in An Asian Multi-Ethnic Working Population. *Build Environ*. 2019;166(1):1-8. https://doi.org/10.1016/j.buildenv.2019.106420
21. Rahim NNA, Jalaludin J, Junaidi ES, Sumantri A. Association Between Air Microbiological Exposure With Sick Building Syndrome (SBS) among College Dormitory Students in Public University. *Malaysian J Med Heal Sci*. 2023;753(6):36–46. https://doi.org/10.1016/j.scitotenv.2020.141904
22. Kang K, Kim H, Kim DD, Lee YG, Kim T. Characteristics of Cooking-Generated PM_{10} and $PM_{2.5}$ in Residential Buildings with Different Cooking and Ventilation Types. *Sci Total Environ*. 2019;668(1):56–66. https://doi.org/10.1016/j.scitotenv.2019.02.316
23. Department of Occupational Ssafety and Health Malaysia. Industry Code of Practice on Indoor Air Quality. Kuala Lumpur: Department of Occupational Ssafety and Health Malaysia; 2010. https://www.dosh.gov.my/index.php/legislation/codes-of-practice/chemical-management/594-02-industry-code-of-practice-on-indoor-air-quality-2010/fileMalaysia
24. Ooi PL, Goh KT, Phoon MH, Foo SC, Yap HM. Epidemiology of Sick Building Syndrome And Its Associated Risk Factors in Singapore. *Occup Environ Med*. 1998;55(3):188-193. https://doi.org/10.1136/oem.55.3.188
25. Park S, Song D. CO_2 Concentration as An Indicator of Indoor Ventilation Performance to Control Airborne Transmission of SARS-CoV-2. *J Infect Public Health*. 2023;16(7):1037–1044. https://doi.org/10.1016/j.jiph.2023.05.011
26. Zainal ZA, Hashim Z, Jalaludin J, Lee LF, Hashim JH. Sick Building Syndrome among Office Workers in Relation to Office Environment and Indoor Air Pollutant at an Academic Institution, Malaysia. *Malaysian J Med Heal Sci*. 2019;15(3):126–134. http://psasir.upm.edu.my/id/eprint/75581
27. United States Environmental Protection Agency. Introduction to Indoor Air Quality. Washington: Environmental Protection Agency; 2021 https://www.epa.gov/indoor-air-quality-iaq/introduction-indoor-air-quality
28. Chen X, Gao Y, Yang L, Liu Y, Qin M, Xia J, et al. An Experimental Study on Temperature, Relative Humidity, and Concentrations of CO and CO_2 during Different Cooking Procedures. *Processes*. 2023;11(9):1-14. https://doi.org/10.3390/pr11092648
29. Jacobson TA, Kler JS, Hernke MT, Braun RK, Meyer KC, Funk WE. Direct Human Health Risks of Increased Atmospheric Carbon Dioxide. *Nat Sustain*. 2019;2(8):691–701. https://doi.org/10.1038/s41893-019-0323-1
30. Kumar P, Hama S, Abbass RA, Nogueira T, Brand VS, Wu HW, et al. CO_2 Exposure, Ventilation, Thermal Comfort and Health Risks in Low-Income Home Kitchens of Twelve Global Cities. *J Build Eng*. 2022;61(1):1-26. https://doi.org/10.1016/j.jobe.2022.105254
31. Liu S, Cao Q, Zhao X, Lu Z, Deng Z, Dong J, et al. Improving Indoor Air Quality and Thermal Comfort in Residential Kitchens with A New Ventilation System. *Build Environ*. 2020;180(1):1-15. https://doi.org/10.1016/j.buildenv.2020.107016
32. Zubir N, Jalaludin J, Rasdi I. Indoor Air Quality and Psychosocial Factors Related to Sick Building Syndrome among Office Workers in New and Old Buildings of a Public University in Klang Valley, Malaysia. *Malaysian J Med Heal Sci*. 2022;18(13):1–9. http://psasir.upm.edu.my/id/eprint/101876
33. Chang HS, Capuozzo B, Okumus B, Cho M. Why Cleaning The Invisible in Restaurants is Important During Covid19: A Case Study Of Indoor Air Quality of An Open-Kitchen Restaurant. *Int J Hosp Manag*. 2021;94(1):1-12. https://doi.org/10.1016/j.ijhm.2020.102854
34. Ramaiya A, Villalobos P, Chipeta E, Lopez JV, Maddaleno M, Zuo X, et al. How Do Adolescents Navigate Covid19 Information, and Why Does It Matter? *J Glob Health*. 2021;11(1):1-9. https://doi.org/10.7189%2Fjogh.11.03110
35. Nag PK. Sick Building Syndrome and Other Building-Related Illnesses. Singapore:

Springer Singapore; 2019;53–103. https://doi.org/10.1007/978-981-13-2577-9_3

36. Surawattanasakul V, Sirikul W, Sapbamrer R, Wangsan K, Panumasvivat J, Assavanopakun P, et al. Respiratory Symptoms and Skin Sick Building Syndrome among Office Workers at University Hospital, Chiang Mai, Thailand: Associations with Indoor Air Quality, AIRMED Project. *Int J Environ Res Public Health*. 2022;19(17):1-17. https://doi.org/10.3390/ijerph191710850
37. Schraufnagel DE. The Health Effects of Ultrafine Particles. *Exp Mol Med*. 2020;52(3):311–317. https://doi.org/10.1038/s12276-020-0403-3
38. Zhang J, Chen Z, Shan D, Wu Y, Zhao Y, Li C, et al. Adverse Effects of Exposure to Fine Particles and Ultrafine Particles in The Environment on Different Organs of Organisms. *J Environ Sci*. 2024;135(1):449–473. https://doi.org/10.1016/j.jes.2022.08.013
39. Lu CY, Tsai MC, Muo CH, Kuo YH, Sung FC, Wu CC. Personal, Psychosocial and Environmental Factors Related to Sick Building Syndrome in Official Employees of Taiwan. *Int J Environ Res Public Health*. 2018;15(1):1-9. https://www.mdpi.com/1660-4601/15/1/7
40. Awang MF, Md Zaini R, Abdul NA, Mat Tahir MR, Baharuddin A, Husin SNH, et al. Assessing Indoor Air Quality and Sick Building Syndrome in Public University Buildings: A Cross-Sectional Study of Office Worker Health and Well-Being. *J Kejuruter.* 2023;SI6(1):271–278. https://doi.org/10.17576/jkukm-2023-si6(1)-23