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Physical Quality of Air and Sick Building Syndrome in Office Employees of "X" Company in Jakarta

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Abstract

Physical symptoms had led to the suggestion that a disease called Sick Building Syndrome (SBS) occured to the office of "X" Company in the city of Jakarta. This research that used a random sampling technique examined the physical air quality of the "X" Company, such as indoor temperature and humidity aspects, the SBS cases of 90 workers. Research results on the Company "X" office workers showed that, (1) 47.8% workers had cases of SBS; and, (2) a value of 0.714 was acquired from the result of bivariate analysis using Chi square statistics program with p value of 0.325 and RP of 95 percent. This signifies that there were no relations between indoor temperature and humidity with the SBS cases of the Company "X" workers in Jakarta City. Possibilities of other factors were found to trigger the SBS symptoms such as chemical and microbiological factors (from work tools and facilities), and psychosocial factor (from the workers themselves).

Abstrak

Kualitas Fisik Udara dengan Kejadian *Sick Building Syndrome* pada Karyawan Kantor Perusahaan "X" di Kota Jakarta. Adanya gejala-gejala sakit fisik, sehingga ada dugaan terjadi sakit yang disebut *Sick Building Syndrome* (SBS) pada para karyawan kantor Perusahaan "X" di Kota Jakarta. Penelitian ini membahas kualitas fisik udara pada kantor Perusahaan "X", yaitu aspek suhu udara dan kelembaban udara ruangan dengan kejadian *SBS* pada 90 karyawan kantor, dengan menggunakan teknik *random sampling*. Hasil studi terhadap karyawan kantor Perusahaan "X" menunjukkan, (1) sebanyak 47,8% karyawan mengalami kejadian *SBS*, (2) berdasarkan hasil analisis bivariat menggunakan program statistik *chi square*, nilai *p value* 0,325, dan *RP* 95 persen, didapat 0,714. Artinya, tidak adanya hubungan antara suhu udara dan kelembaban udara ruangan dengan kejadian *SBS* pada karyawan kantor Perusahaan "X" di Kota Jakarta. Terdapat beberapa kemungkinan faktor lain yang memicu terjadinya gejala-gejala *SBS* tersebut, seperti faktor kimia dan mikrobiologi (dari berbagai peralatan dan fasilitas kerja), dan faktor psikososial (dari pekerja sendiri).

Keywords: humidity, occupational disease, sick building syndrome, temperature

Introduction

City of Jakarta is a metropolitan city characterized by the many skyscrapers standing firm across nearly all its regions. The impact of those skyscapers' constructions is the city's reduction of Open Green Space (RTH), as well as the rise of motorized vehicles. Analysis of World Bank stated that Jakarta is the third worse Polluted city after Mexico City (Mexico) and Bangkok (Thailand).[1]

One of the effects of the narrow RTH areas and the many motorized vehicles are air pollution categorized into indoor and outdoor pollution, as well as the pollution produced by work environment. Indoor air pollution can occur in office buildings, and if a large proportion (20-50%) of buiding occupants complains about sickness caused by uncomfortable working environment or air, the buiding can be deemed as a "sick building".[2] The phenomenon whereby a building gets sick is called Sick Building Syndrome (SBS).

The term SBS was first introduced by experts from Scandinavia in the early 1980s. This term was then used widely, and there are now reports of this syndrome recorded from many countries in the regions of Europe, United States and even Singapore.[2] Sick Building Syndrome is a disease syndrome brought about by building conditions, and it is a collection of symptoms from a type of disease. Sick Building Syindrome is defined as symptoms based on the experiences of building occupants while they are in the building.[3] Complains for this syndrome are dry coughs; headache; eye, nose and throat irritations; dry and itchy skin; lethargy; and others.[2]

Based on results of the research conducted by the National Institute of Occupational Safety and Health (NIOSH) in 1977, 52% of respiratory diseases related to SBS were instigated by poor building ventilation and bad performance of Air Conditioner (AC) that were rarely cleaned. Results of Occupational Safety and Health Administration (OSHA) research on 446 buildings identified that air pollution in the buildings were due to lack of ventilation (52%), tools and materials in the building (7%), pollution outside the building (11%), microbes (5%), construction materials and office tools (3%), and causes unknown (12%).[4] Research results on 350 workers of 18 office in Jakarta over 6 months (July-December 2008) showed that health decline of indoor workers was caused by indoor air that was polluted by free radical (chemical material) originating from outside and inside the building. Moreover, 50% of people working in the office building had a tendency to acquire SBS.[4]

Temperature and humidity of a work room greatly affects the effectiveness of the work being conducted. Working in an excessively hot and humid environment can reduce the body's physical ability and cause overly quick fatigues. Meanwhile, working in an extremely cold environment can cause flexibility loss of motoric limbs initiated by stiffness in the body. These two conditions can reduce work productivity and even potentially lead to work-triggered accidents and diseases. Sick Building Syndrome is one of the occupational diseases occurring in luxury offices of tall buildings located in large cities.

The research aimed to identify the correlation between physical air quality and cases of SBS in the office employees of "X" Company in the city of Jakarta. Depiction of physical air quality can demonstrate the early overview of chemical and biological factors of pollution in an environment.

Methods

Primary data collection. The research population was office employees of "X" Company with 90 samples taken by using the random sampling technique of having the samples taken at random selection.

Table 1. Distribution of Respondents Frequency based on Measurement Location

Floor	Work Unit	Population		Respondents	
		n	%	n	%
3	Division I	80	30.8	28	31.1
4	Division IV	40	15.4	14	15.6
5	Division II	45	17.3	16	17.8
6	Marketing	30	11.5	10	11.1
7	Finance	30	11.5	10	11.1
9	HR & IT	35	13.5	12	13.3
	Total	260	100	90	100

Research variable. Air physical quality is comprised of indoor air temperature and humidity.

Measurement of physical air quality. Hygrometer was used to measure the physical air temperature and humidity in three points of a room. Measurements were conducted twice before (8 a.m. to 12 a.m.) and after break period (1 p.m. to 5 p.m.). Measurements were conducted while respondents were filling up questionnaires on SBS cases.

Analysis of illustrations in SBS cases. To find out the overview of SBS cases, respondents were given questionnaires which confirmed SBS cases if the respondent at least experienced one symptom of several health problems (eye, respiratory, indigestion, skin and neurotoxic problems). If at least 20% of employees experienced the symptoms when they were in the work room, the room was confirmed to have SBS.

Results and Discussion

The following are tables of research results and elaborations of the numbers acquired. Based on Table 2, the sex of respondents were 45 female respondents (50%) and 45 male respondents (50%). Age group with the most respondents was 20-30 years old amounting to 59 respondents (65.6%) and the longest tenure was 1-5 years amounting to 62 respondents (68.9%).

Based on Table 3, the first measurement showed that the lowest temperature happened in the sixth floor with 25.50 ^{o}C, and the highest temperature in the fourth floor of 28.65 ^{o}C. Result of the second measurement showed that the third floor had the lowest temperature of 25.65 ^{o}C while the highest temperature was in the fourth floor of 28.57.

Based on Table 4, result of the first measurement showed the lowest humidity happened in the ninth floor of 53.87% and the highest in the fourth floor of 61.97%.

Result of the second measurement showed that the ninth floor had the lowest humidity of 55.20% while the highest humidity was in the fourth floor of 62.05%.

Based on Table 5, as many as 43 workers (47.8%) experienced a case of SBS and 47 workers (52.2%) did not experience SBS case.

Table 2. Respondent Characteristics

Variable	Total	%
Sex:		
Female	45	50
Male	45	50
Total	90	100
Age:		
<20 years old	1	1.1
20–30 years old	59	65.5
31–40 years old	23	25.6
>40 years old	7	7.8
Total	90	100
Tenure:		
<1 years	17	18.9
1-5 years	62	68.9
>5 years	11	12.2
Total	90	100

Table 3. Average of Frequency Distribution in the First and Second Room Temperature Measurement

Floor	Room Temperature (°C)		Average	Category
	First Measurement	Second Measurement		
3	25.67	25.65	25.66	CS
4	28.65	28.57	28.62	NCS
5	25.90	26.00	25.95	CS
6	25.50	25.78	25.63	CS
7	25.65	25.90	25.77	CS
9	26.00	25.90	25.95	CS

Description: CS = Complying Standards
NCS = Not Complying Standards
Note: Data are average results of three measuring points.

Table 4. Average of Frequency Distribution in the First and Second Air Humidity Measurement

Floor	Room Air Humidity (%)		Average	Category
	First Measurement	Second Measurement		
3	56.25	56.60	56.42	CS
4	61.97	62.05	62.02	NCS
5	57.75	57.65	57.70	CS
6	56.80	56.87	56.83	CS
7	58.85	58.50	58.67	CS
9	53.87	55.20	54.53	CS

Description: CS = Complying Standards
NCS = Not Complying Standards
Note: Data are average results of three measuring points.

Based on Table 6, the most frequent employee complaints over the week were eye problems of sore eyes, watery eyes, red eyes, itchy eyes, and eye strain. The problems were experience repeatedly as many as twice or more in the last week for 72 employees (80%). The problem left when employees were not in the building. Meanwhile, the least SBS complaints were indigestion problems of abdominal pain (bloating and heartburn), difficulty in swallowing, diarrhea, loss of appetite, and nausea happening to 51 employees (56.7%).

Based on Table 7, out of the 43 respondents suffering from SBS, 5 respondents (11.6%) was in a room with temperature and humidity that did not comply with standards. Meanwhile, 38 respondents (88.4%) were in a room with temperature and humidity that complied with standards. Based on the Chi square test results, it was found that the P value was 0.325. If P value were higher than 0.05, it can be concluded that there were no correlations between room temperature and air humidity with SBS cases of office employees at "X" Company in the city of Jakarta.

Research results related to SBS cases. Complaints of SBS symptoms were seen on 43 respondents (47.8%), and the rest of 47 respondents did not experience such

Table 5. Distribution of Respondents Based on SBS Cases

Variable	Total	%
SBS Case	43	47,8
Not SBS Case	47	52,2
Total	90	100

Table 6. SBS Complaints of Employees over the Week

Type of Complaint	Category	Total	%
Eye	1. Yes	72	80
	2. No	18	20
Respiratory	1. Yes	66	73.3
	2. No	24	26.7
Indigestion	1. Yes	51	56.7
	2. No	39	43.3
Skin	1. Yes	57	63.3
	2. No	33	36.7
Neurotoxic	1. Yes	67	74.4
	2. No	23	25.6

Table 7. Frequency Distribution of Room Temperature and Air Humidity Related to SBS

Temperature & Humidity	SBS Case		Total	p value	RP	95%CI
	Y	N				
Not Complying Standards	5	9	14	0.325	0.714	0.342 - 1.494
Complying Standards	38	38	76			
Total	43	47	90			

Description: Y = Yes, N = No; CI = Confidence Interval

problems. The symptoms occurred over the week when employees were in the building. The complaints would be gone a few while after the employees left the building, or not be in the building at all. Sick Building Syndrome can be considered if it had occurred on at least 20-50% building occupants with problems of eye, indigestion, skin and neurotoxic.[2] Percentage of SBS cases was 47.8%, so it can be concluded that employees in the building experienced SBS.

Research results related to SBS symptoms. Symptoms experienced by employees when they were in the building were eye problems in 72 employees (80%), respiratory problems in 66 employees (73.3%), indigestion in 51 employees (56.7%), skin problems in 57 employees (63.3%) and neurotoxic problems in 67 employees (74.4%). Irritations in the eyes, nose and throat including mucous membrane like coughs happened due to general pollutants of CO, NO_2, and SO_2 gases produced by broken or less functioning heaters.

Theoretically, usages of printer, scanner, facsimile and photocopy machines produce ozone gas. Volatile Organic Compounds (VOCs) which normally occur in many substances such as perfumes and carpets can also produce pollutants. Biological pollutants such as bacteria, fungus and virus can spawn in stagnant water accumulated in pipes, water reservoirs of air conditioning or wherever water is gathered such as ceilings, carpets and insulations which all produce pollutants for human.

Indigestion such as nausea is caused by many factors including noise over long periods of time and inadequate ventilation which deprived a person of enough oxygen to breathe normally. VOCs are also found in office supplies that can be detected by the odor coming out of the tools. Irritation symptoms on skin such as itchiness or red spots can be caused by dusts around the employee working in an office room.

Dusts in the office room may originate from accumulated dusts in the carpet and air conditioner filter. Some surfaces of opened items can also be filled with dusts, for example, shelves, cabinets and office tables. Neurotoxic problems (such as headache) may be caused by work environment factors such as noise and VOCs, for example, the usages of electronic machines like computers and photocopies. Work stress can be caused by certain types of work done by office employees, and all the factors can trigger SBS.[4]

Research results related to field observations. Environmental conditions of the research location that are expected to be the source of pollutants are electronic tools such as computer, printer, facsimile and photocopy machines. The type of air conditioning used was central cooling, and lighting source came from fluorescent tabular lamps. Other possible sources of pollutants were dusts on cabinet shelves and the fact that employees are not used to opening the windows. These indeed can be the range of SBS symptom causes in the work environment.

Moreover, based on the research conducted by Burge et al.,[5] air quality, ventilation, lighting and usage of chemicals in a building are the potential causes of SBS. The research conducted by Apter et al.,[6] stated that building condition is worsened by ill-maintenance of air conditioning machine. Furthermore, based on the research of Environmental Protection Agency (EPA),[7] inadequate ventilation will result in poor air aeration so that the air pollution occurring in the room is caused by exposure of elements in the building such as carpets, photocopy machines and disinfectants that can produce VOCs.

Correlation between room temperature and SBS cases. Room temperature greatly influences work comfort since the human body produces heat that is used for basal and muscular metabolism However, from the entire energy produced by the body, only 20% is utilized, and the rest is emitted to the environment.[8] Generally, the temperatures of office rooms in "X" Company in the city of Jakarta was rather varied between 25.50 ^{o}C to 28.65 ^{o}C, with an average of 26.26 ^{o}C. Usually, humans are able to work comfortably in the temperature ranging from 20 ^{o}C to 26 ^{o}C.[4]

Based on the Minister of Health Decree of the Republic of Indonesia on Office and Industrial Work Environment Health Requirements, the normal temperature is between 18–28 ^{o}C.[9] The average room temperature of "X" Company office building was already up to standards. However, there is a floor with work room temperatures exceeding the threshold, which went up to 28.62 ^{o}C on the fourth floor. It was concluded that the room temperature in that particular floor did not comply with the standards. In regards to the six floors of the research object, it can be concluded that room temperatures of the building fulfilled the standards.

Exceedingly cold work room temperatures can cause disruptions in the work of employees; one of it is concentration loss since the employees are trying to reduce the sense of chill.[8] On the other hand, hot room temperatures may lead to dehydration, muscle spasms, blood flow changes, and harm bodily tissue network.[10] The research from London Hazards Center stated that rooms with non-standard temperature and air humidity are triggering factors of SBS.[11]

From the research results, as many as 43 respondents experienced a case of SBS. Subjects working in a room that did not fulfill standards amounted to 5

employees (11.6%) while 38 employees (88.4%) were in temperatures that reach up to standards. Based on calculation results of bivariate analysis, it turned out that Chi-Square test requirements were fulfilled since values of less than 5 were not expected.[12] Bivariate analysis results using Chi-Square test to test the correlation between room temperature and SBS cases. The results were a significancy value of 0.325 which means that P value > 0.05. It was concluded that there are no correlations between room temperature and cases of SBS. Based on Confidence Interval (CI), the value of 0.342–1.494 was acquired. This also showed that there are no correlations between room temperature and SBS occurrences.

Prevalence Ratio (PR) value showed a result of 0.714. RP value < 1 means that employees were in room temperatures that complied with standards, and they were 0.465 times protected from SBS, compared to employees that did not work in rooms with standard temperature.

Based on the analysis of SBS cases, SBS status is acquired when the room temperature is found to not be up to standards. SBS cases were experienced by 5 employees in the building floors that did not comply with standards. Based on the measurements conducted on the six floors, only the fourth floor was the room temperatures that did not comply with standards. This caused the bivariate analysis to not show any indications of correlation between room temperature and SBS cases. Based on observations, air conditioning system in the fourth floor at the time of research was broken. The windows were also closed so the rooms were poorly ventilated.

Correlation between air humidity and SBS cases. The research generally found that the air humidity in the office rooms of "X" Company in the city of Jakarta was rather varied between 53.87-62.05% with an average of 57.69%. Based on the standards, normal air humidity should be in the range of 40-60%. The average result of air humidity in the office building was already up to standards.

However, there happened to be a building floor with work room humidity of 62.02% in the fourth floor which exceeded the threshold. It was concluded that the air humidity of the floor was not up to standards, and it can be concluded that the building air humidity could be categorized as complying with standards.

When the air humidity is low (lower than 20%), the temperature is dry and sweat evaporates easier. This causes the mucous membrane, skin, esophagus and nose to be dry causing itchy skin, headache and dry eyes.[11] It was stated in Burge's research that physical air quality that does not comply with standards is a highly potential cause of SBS.[6]

Based on the gathered data, from the 43 respondents, 5 employees experiencing SBS cases worked in non-standard air humidity (11.6%) and 38 employees (88.4%) were in standard humidity. Based on the conducted bivariate analysis, Chi-Square test requirements were fulfilled since values of less than 5 were not expected.[12] The result of bivariate analysis utilized Chi-Square to test the correlation between air humidity and SBS cases. The result showed a significancy value of 0.325 that means P value > 0.05. Therefore, SBS cases and air humidity did not have any correlations. Based on the CI value, 0.342–1.494 was acquired. This went to show that there are no correlations between room humidity and SBS cases.

RP value was 0.714, and when RP < 1, it means that employees were in room temperatures that complied with standards, and they were 0.465 times protected from SBS, compared to employees that did not work in rooms with standard air humidity. Based on the analysis, SBS was found if the air humidity of a room was not in the standard range. SBS cases experienced by employees working in building floors with air humidity that did not fulfill standards happened to 5 people.

Based on the value of room humidity in the six floors of the research object, only the fourth floor had air humidity that did not reach up to standards. This caused bivariate analysis to show that there are no correlations between room temperature and SBS cases. Based on the observation, several spots in the fourth floor did not receive sunlight so there are places with inadequate lighting. This can cause high humidity in the rooms.

Conclusions

It is concluded that there are no correlations between room temperature and air humidity with SBS cases experienced by the office employees of "X" company in the city of Jakarta. The office room temperature and air humidity of the company was already up to standards. However, as many as 43 respondents (47.8%) experienced SBS symptoms with triggers that may come from other factors such as chemical and microbiological factors (from work tools and facilities) and psychosocial factor (from the workers themselves).

Air quality examination should be done periodically in the rooms for chemical and biological physical quality aspects that are conducted in accordance with parameters and standards. Examinations should be done on chemical and microbiological factors (from work

tools and facilities) and psychosocial factor (from the workers themselves).

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