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The Influence of Work Posture and Work Environment on Sick Building Syndrome in Port Service Company Employees

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ABSTRACT

Sick Building Syndrome is a combination of health problems that a human feels only when doing activities inside a building. This situation is due to various factors, such as ergonomic factors and a work environment that is not in accordance with applicable regulations. The office building of the Port Service Company has poor building conditions, such as a poor ventilation system, some work facilities that are not ergonomic, and the physical environment of lighting and work climate that is not up to standard. This study was conducted to determine the general description of the incidence of SBS in the office building of the Port Services Company and to determine the effect of work posture and work environment on SBS complaints. The statistical method used in this study is binary logistic regression test. The results of statistical testing showed that work posture (p-value=0.018) and lighting (p-value=0.027) had an effect on sick building syndrome.

Keywords: Sick Building Syndrome, Work Posture, ROSA, Lighting, Binary Logistic Regression

Introduction

The era of industrialization affects the development of office building infrastructure to meet the operational needs of employees. The infrastructure development is not proportional to the availability of land which is shrinking due to rapid population growth. Therefore, the construction of multi-storey buildings is considered the best alternative, because it does not require a large area of land. [8]. Most office buildings built in today's modern era use luxurious building designs with advanced supporting infrastructure. A luxurious building design and equipped with modern facilities at first glance is not a problem, but if you look closely at the completeness of the facilities available, there is no attention given to health and comfort for workers in the building.[4].

One of the building facilities that can have an impact on workers' health is the ventilation system. According to the EPA (Environmental Protection Agency of America), in buildings with inadequate ventilation systems, Legionella pathogenic bacteria can grow and

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cause various health problems for residents, such as sick building syndrome. [12]. Sick Building Syndrome (SBS) is a condition related to health and comfort problems of a person during activities in the building, where someone who experiences SBS will feel a set of health complaints, such as headaches, dry cough, sore throat, and so on that cannot be measured and assessed objectively [8]. The WHO indicates that in the United States and the Western Hemisphere, SBS health problems have occurred in as much as 20% of the population [6].

SBS can be caused by physical environmental factors, such as inappropriate lighting, temperature and humidity. Inadequate lighting and lack of indoor sunlight can cause fatigue and itchy eyes, which are the most common symptoms of SBS. [1]. Lighting is one of the important physical work environment factors to support the comfort and productivity of workers. Asri, Pulungan, and Fitri [3] in his research also stated that light intensity that is too high or too low in the building can cause SBS symptoms in the occupants. Inadequate light intensity will force workers to adjust their eyes to see, which can interfere with their comfort at work and their health.

Besides being caused by lighting, SBS can also be caused by temperature and humidity. In addition, based on research conducted by Ikmala, Ma'rufi, and Munawir [5], room temperature and humidity also have a positive influence on the occurrence of SBS in Telkom Jember employees. Based on the data from the last measurement of the work environment carried out in the office building of the Port Service Company, it shows that the measurement results of lighting and work climate have not met the required standards.

According to Murniati [8], buildings that do not pay attention to comfort factors such as humidity, temperature and airflow can contribute to the occurrence of SBS events in the building. High humidity can impact the growth of bacteria and viruses in buildings. This situation encourages the formation of particle clusters in the air which, when inhaled by humans, can cause respiratory infections. Substandard indoor temperatures are also significantly associated with an increased risk of SBS in workers. The increased incidence of SBS symptoms in workers due to substandard working conditions can reduce their ability to work, resulting in reduced efficiency and productivity.

The cause of SBS is not only related to the physical environment of a building, but can also be caused by ergonomic factors. The results of research by Harwani, Rahman and Sunu [4] show that there is a significant relationship between ergonomics and the incidence of SBS in the UMI rectorate. The results of the analysis showed that more respondents experienced SBS with poor ergonomic posture than respondents who experienced SBS with good ergonomic posture. Based on observations in the office building of the Port Service Company there are still non-ecological work tools such as chairs and backrests that cannot be adjusted in height, tables that cannot be adjusted in height, the use of computers where monitoring cannot be adjusted for user comfort. Some previous studies on SBS show that individual factors can also affect the incidence of SBS.

The researcher then conducted a preliminary study by distributing SBS complaint questionnaires to 40 respondents at the Port Service Company and found that 67.5% of respondents suffered from SBS. Based on initial observations and preliminary studies that have been carried out by researchers, this study is to determine the effect of work posture and work environment on SBS complaints in employees at the Port Service Company using the Binary Logistic Regression Test.

Research Methods

Data collection in this study was carried out on 91 respondents in the office building of the Port Service Company. The number of respondents was obtained from sample calculations using simple random sampling techniques with the Slovin equation from a total population of 117 respondents.

For the dependent variable, sick building syndrome, researchers used a questionnaire containing 13 questions regarding health complaints related to the work environment that may be experienced by respondents during the last 1 month since the questionnaire was

Jurnal Teknologi 16 (1) pp 95-104 © 2024

distributed and 3 additional questions to classify whether respondents suffered from SBS or not. The health complaint question points in the questionnaire refer to the Indoor Climate Questionnaire developed by Andersson and Stridth . The questionnaire used in this study had previously been tested for validity and reliability by the researcher, where the results of the test were that all question items were valid and reliable.

Respondents are classified as experiencing SBS if they feel complaints with a percentage of >30% of the total respondents and gradually disappear when leaving the office building / workplace, and are classified as not experiencing SBS if they do not feel complaints / feel complaints with a percentage of <30% of the total respondents and do not disappear when leaving the office building / workplace.[9].

Furthermore, for the first independent variable, namely work posture, researchers used Rapid Office Strain Assessment (ROSA) to assess work posture variables. The ROSA assessment sheet is divided into 3 sections, namely section A of the chair, which includes chair height, seat depth, armrests, backrests, section B monitors and telephones, and section C mouse and keyboard. In each of these sections, a score will be given which will then be entered into the ROSA assessment matrix until the final score is obtained.

The assessment of work posture variables was carried out three times for each respondent, namely the first assessment conducted at around 09.00 WIB, the second assessment conducted at around 11.00 WIB, and the third assessment conducted at around 16.00 WIB. Respondents are classified as having a non-hazardous work posture if they have a ROSA final score <5, and will be classified as having a hazardous work posture if they have a ROSA final score ≥5. [11]

In the second variable, namely lighting, data is obtained from measuring the lighting work environment using a Lux Meter measurement tool. Lighting measurement points were determined using local measurements at the computer workstation, so that 4 measurement points were obtained at each respondent's workstation. Measurements were taken 3 times at each measurement point.

If the measurement results at the respondent's workstation are ≥ 300 Lux, then the lighting at the respondent's workstation is classified as meeting the standard. However, if the measurement result at the respondent's workstation is < 300 Lux, then the lighting at the respondent's workstation is classified as not meeting the standard.[7].

The last variable is the work climate, where data on the work climate is obtained from measuring the work environment of work climate factors using the WBGT (Wet Bulb Globe Temperature) measurement tool. The point of measurement of the working climate, which is at each worker with a height of about 0.6 m when sitting. Measurements are taken every 5 minutes for 6 times at each measurement point.

The workload obtained from all office workers is categorized as light workload, it can be seen that the required NAB value is 31.0 ^{0}C with a working time setting every hour is 75%-100%. If the results of measuring the working climate in the respondent's work environment are ≤ 31.0 ^{0}C, then the working climate in the respondent's work environment is classified as meeting the standard. However, if the results of measuring the working climate in the respondent's work environment are> 31.0 ^{0}C, then the working climate in the respondent's work environment is classified as not meeting the standard. [7].

The method used in this research is binary logistic regression, where the method is used to find the effect of the independent variable on the dependent variable. The stages in testing the effect of using binary logistic regression are simultaneous test, individual test, and model fit test. The simultaneous test is used to determine the effect of all independent variables on the dependent variable. The hypotheses for this simultaneous test are:
H0 : Work posture, lighting, and work climate have no significant influence on SBS complaints.

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H1 : Work posture, lighting, and work climate have a significant influence on SBS complaints.
The simultaneous test is said to have no effect (H0 accepted) if the p-value obtained is> 0.05, and it is said to have an effect (H0 rejected) if the p-value obtained is ≤ 0.05.

Furthermore, the individual test is used to determine the effect of each independent variable on the dependent variable. The hypotheses for this simultaneous test are:
$H_0$1: there is no significant influence between work posture and SBS complaints.
$H_1$1: there is a significant influence between work posture with SBS complaints
$H_0$2: there is no significant influence between lighting with SBS complaints
$H_1$2: there is a significant influence between lighting and complaints of SBS
$H_0$3: there is no significant influence between work climate and SBS complaints
$H_1$3: there is a significant influence between work climate and SBS complaints
In individual tests, it is said to have no effect (H0 is accepted) if the p-value obtained is> 0.05, and it is said to have an effect (H0 is rejected) if the p-value obtained is ≤ 0.05.

Meanwhile, the model fit test is used to determine whether a hypothesis is appropriate or not. The hypotheses for the model fit test are:
H_0 : The model is appropriate (there is no significant difference between the observations and the possible predictions of the model).
H_1 : The model does not fit (there is a significant difference between the observations and the possible predictions of the model).
In the model fit test, it is said that the hypothesis is not suitable (H0 is accepted) if the p-value obtained is <0.05, and it is said that the hypothesis is suitable (H0 is rejected) if the p-value obtained is ≥ 0.05.

Results and Discussion
Based on Table 1 shows that 56% of employees or 51 respondents in the office building of the Port Services Company experienced SBS complaints. From this study it is also known that the majority of employees at the Port Services Company have dangerous work postures, namely 84% of respondents or as many as 76 employees. In addition, it can also be seen that most of the employee work stations in the Port Service Company are not in accordance with the standard or worth < 30 Lux, which is 61% of respondents or as many as 55 employee work stations. Meanwhile, the work climate of employees who meet the standards is more than those who do not meet the standards, namely 96% of respondents or as many as 87 employees.

Table 1. Univariate Analysis of Research Variables

No.	Variable	n=91	%
1	SBS Symptom		
	SBS	51	56
	No SBS	40	44
2	Work Posture		
	Harmless	15	16
	Harmful	76	84
3	Lighting		
	Complies with Standard	36	39
	Does Not Comply with Standard	55	61
4	Work Climate		
	Complies with Standard	87	96
	Does Not Comply with Standard	4	4

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Based on Table 2, it can be seen that the most common health complaints suffered by employees of the Port Service Company are dry and hoarse throat, difficulty concentrating, and aches and pains in the back. While the least health complaint felt by employees of the Port Service Company is nausea.

Table 2. Distribution of Respondents' Health Complaints

No.	Health Complaints	SBS	No SBS	Percentage
1	Fatigue	35	6	45%
2	Head feels heavy	27	13	44%
3	Headache	28	14	46%
4	Nausea	20	9	32%
5.	Difficulty concentrating	36	12	53%
6.	Itchy, irritated eyes	21	12	36%
7	Runny or runny nose	26	15	45%
8	Dry and hoarse throat	33	17	55%
9	Cough	23	12	38%
10	Dry and flushed facial skin	28	11	43%
11	Dry and itchy hand skin	33	5	42%
12	Hand aches and pains	20	11	34%
13	Back aches and pains	33	11	48%

Based on Table 3, it can be seen that the p-value in the simultaneous test that has been carried out between the independent variables, namely work posture, lighting, and work climate on the dependent variable, namely SBS complaints, is 0.003 where the value is <0.005, so it can be concluded that work posture, lighting, and work climate simultaneously affect SBS complaints.

Table 3. Simultaneous Test Results

Independent Variable (X)	Dependent Variable (Y)	p-value	α	Hypothesis	Decision
Work posture, lighting, work climate	SBS Complaints	0,003	0,05	H_0 rejected	Influential

Furthermore, individual tests of each independent variable on the dependent variable were conducted. Based on Table 4, it can be seen that the variables that affect SBS complaints that occur in employees at the Port Service Company are work posture and lighting. The individual test of the work posture variable on SBS complaints results in a p-value of 0.018, where the value is less than 0.05, so it can be concluded that work posture has a significant effect on SBS complaints. Furthermore, the individual test of the lighting variable on SBS complaints results in a p-value of 0.027, where the value is less than 0.05, so it can be concluded that lighting also has a significant effect on SBS complaints. While the individual test of the work climate variable on SBS complaints results in a p-value of 0.999, where the value is more than 0.05, so it can be concluded that the work climate does not have a significant effect on SBS complaints.

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Table 4. Individual Test Results

Independent Variable (X)	Dependent Variable (Y)	p-value	α	Hypothesis	Decision
Work Posture	SBS Complaints	0,018	0,05	H_0 rejected	Influenced
Lighting		0,027	0,05	H_0 rejected	Influenced
Work Climate		0,999	0,05	H_0 accepted	Not Influenced

In the last test, namely the model fit test, it can be seen based on Table 4 that the resulting p-value is 0.933, where these results are more than 0.05 so it can be concluded that the hypothesis used is appropriate.

Table 5. Model Fit Test Results

Chi-square	df	Sig.
0,434	3	0,933

The results of the test of the effect of work posture variables on SBS complaints in research conducted at the Port Service Company are in line with research conducted by Harwani, Rahman, and Sunu. [4], where the results of the study showed that there was a significant relationship between work position and SBS complaints.

Harwani, Rahman, and Sunu [4] also mentioned that one of the factors that can affect the occurrence of SBS is ergonomic factors, where ergonomic factors are in the form of work procedures, such as work positions and sitting positions, as well as work tools, such as chairs used by workers.

Research conducted by Rizqiyah & Putri [10] also mentioned that ergonomics-related problems are an important risk factor in the incidence of SBS. Ergonomics is related to designing work, work processes, and equipment that are suitable for workers with the aim of avoiding the need for workers to adjust to their work. Ergonomics must be designed in such a way as to prevent the occurrence of SBS.

Based on the assessment of work postures that have been carried out on employees at the Port Service Company using Rapid Office Strain Assessment (ROSA), the results show that the majority of employees still have work postures that are considered dangerous. Some aspects that cause many employees to have work postures that are considered dangerous can be divided into three, namely errors in work positions, errors in the use of work facilities, and work duration.

Poor working positions based on the assessment that has been carried out include the position of the feet when sitting that does not form a 90^0 angle, a sitting position that is too forward or too backward, so that there is no distance between the knees and the end of the chair, a sitting position that leans forward or does not lean on the back of the chair.

In addition to being caused by incorrect working positions, work postures are considered dangerous due to errors in the use of existing work facilities such as chair seat arrangements that are too long forward or too narrow, the location of the monitor that is too low or not parallel to the eyes, mouse grip bending, and wrist bending when using the mouse and keyboard, as well as the height of the chair, chair seat, armrests, backrest, and table surface that cannot be adjusted to suit the needs and comfort of its users.

The work posture is also considered increasingly dangerous because workers are in

Jurnal Teknologi 16 (1) pp 95-104 © 2024

this position for a long duration of time, which is more than 4 hours every day. This causes the work posture variable to significantly affect the occurrence of SBS in employees at the Port Service Company. Based on research conducted by Harwani, Rahman, and Sunu [4], respondents who experienced SBS with poor work positions were more than respondents who experienced SBS with good work positions.

The results of the test of the effect of lighting variables on SBS complaints in research conducted at the Port Service Company are in line with research conducted by Quoc, Huong, and Duc. (2020), where the results of the study showed that lighting is one of the risk factors that affect the occurrence of SBS. Research conducted by Quoc, Huong, and Duc (2020) also mentioned that the intensity of indoor lighting affects the comfort of eye performance, which can cause SBS complaints in the form of eye complaints, such as red eyes and eye irritation.

The results of the influence test of the lighting variable on SBS complaints at the Port Service Company are different from the research conducted by Ikmala, Ma'ruf, and Munawir. [5], where the results of the study showed that there was no significant effect of lighting on SBS complaints. The study also showed that the results of lighting measurements in the office building used as the research location had a low category at all measurement points. According to Grandjean's theory used in his research, it is stated that computer work should have a lighting intensity of around 300-400 Lux.

Based on the measurement of lighting intensity that has been carried out using a Lux Meter at each respondent's workstation, the results show that the majority of the Port Service Company employees' workstations have lighting intensity that does not meet the standard. This can be caused because some employee workspaces have dark floor and wall paint colors that affect the value of the lighting intensity in the room. If the lighting intensity in a workspace has a value below 300 Lux, workers will be more forced to see, so it will be more risky to feel SBS complaints, especially eye complaints, such as eye irritation. This causes lighting to be associated with the occurrence of SBS in employees at the Port Service Company.

The results of the test of the effect of work climate variables on SBS complaints in research conducted in Port Service Companies are in line with research conducted by Mawarni, et al. [8], where the results of the study showed that there was no significant effect of temperature on SBS complaints. However, research conducted by Mawarni, et al. [8] explained that the continuous use of air conditioning can have a negative impact on workers, such as disorders of the respiratory system and digestive system, as well as irritation of the skin.

In addition, the results of the test of the effect of the work climate on SBS complaints in the Port Service Company are also in line with research conducted by Wibisono, et al.[13], where the results of the study showed that there was no relationship between temperature and humidity with SBS complaints. The absence of a relationship between temperature and humidity with the occurrence of SBS complaints is due to the results of measurements that have been taken do not show a comparison of values that are far from the threshold value, so that the worker's body does not need to adapt too much to its work environment.

However, the results of the test of the effect of work climate variables on SBS complaints at the Port Service Company are different from the results of research conducted by Ikmala, Ma'rufi, and Munawir. [5], which showed that room temperature and humidity had a significant effect on the occurrence of SBS complaints. In addition, research conducted by Murniati, et al. [8], also mentioned that workplaces that pay less attention to their work environment, such as temperature, humidity, airflow, and lighting can cause discomfort in workers which in turn can cause SBS complaints in workers.

Air temperatures that are too low in a room can cause employees to experience SBS complaints in the form of impaired concentration, while temperatures that are too high can cause dust particles to stay in the air

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for a long time and are continuously inhaled by employees which results in these employees experiencing SBS complaints in the form of health complaints in respiratory function. Likewise, a room that has high humidity will cause microorganisms to multiply easily so that it will cause SBS complaints in the form of skin irritation.

Based on the results of work climate measurements that have been carried out using WBGT (Wet Bulb Globe Temperature), it shows that the majority of the employee work environment in the office building of the Port Services Company has met the standard, which is less than 30^0C. However, there are still four employee work environments that do not meet the standards. This is because at the time of measuring the working climate, the air conditioner in the employee's workspace was not working and the windows were opened so that hot air from outside the building could enter the room. This condition causes the work climate to have no effect on the occurrence of SBS in employees of the Port Service Company.

Conclusions

The conclusions that can be obtained from this research include, among others, the work posture variable has a significant effect on SBS complaints with a p-value of 0.018, the lighting variable has a significant effect on SBS complaints with a p-value of 0.027, the work climate variable has no significant effect on SBS complaints with a p-value of 0.999. The advice given based on the results of the research that has been done is that the company can make improvements to the variables that affect the incidence of SBS. For work posture variables, the company can provide socialization related to office ergonomics and replace work facilities that are still not ergonomic. In addition, for lighting variables, the company can replace the type of lamp and increase the number of lamps so that the lighting intensity can be in accordance with the standard. It is also possible to change the color of the walls and floors to bright colors, so that the lighting intensity in the room can increase.

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Author Contributions

Conceptualization, Juwitaning Sekar Kinanti and Dewi Kurniasih; methodology, Dewi Kurniasih; software, Juwitaning Sekar Kinanti; validation, Juwitaning Sekar Kinanti, Dewi Kurniasih, and Farizi Rachman; formal analysis, Juwitaning Sekar Kinanti. ; investigation, Juwitaning Sekar Kinanti; resourcing, Juwitaning Sekar Kinanti; writing-preparation of initial draft, Juwitaning Sekar Kinanti; writing-review and editing, Juwitaning Sekar Kinanti; visualization, Juwitaning Sekar Kinanti; supervision, Dewi Kurniasih and Aulia Nadia Rachmat; project administration, Juwitaning Sekar Kinanti. All authors have read and approved the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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