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Sick Building Syndrome Incidence by Age and Work Period: A Regression Analysis

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Article Info	ABSTRACT
	Many nonspecific symptoms of illness can occur as a result of exposure to specific harmful agents at certain workplaces, which is commonly referred to as Sick Building Syndrome (SBS). Several factors may contribute to the incidence of SBS, such as an individual's age and work period. This research aims to determine the impact of age and work period on the incidence of SBS among employees at Telkom Gorontalo's IT department. Cross-sectional observations were carried out in this research. Researchers conducted saturation sampling (total sampling) using all of Telkom Gorontalo's IT employees as a sample population. Following this, 35 IT employees were used as samples. According to the analysis results, among the 35 IT employees working for Telkom Gorontalo, 27 had SBS incidents. In addition, out of 35 IT employees, 28 were under 40, 27 had standard working hours (work for 8 hours), and 14 had worked at Telkom Gorontalo for less than three years. A logistic regression analysis revealed that age significantly contributed to SBS incidence among Telkom Gorontalo's IT employees (p-value = 0,001). Furthermore, the R-Square value was calculated using logistic regression, which is 46,45%.

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INTRODUCTION

The health problems that many people suffer from, especially those who are workers, are pretty standard. Sick Building Syndrome (SBS) is one of the health problems experienced by office workers. A generally accepted definition of "sick buildings" does not exist; however, "Sick buildings" are modern buildings with occupants who experience symptoms similar to those caused by formaldehyde exposure despite concentrations of formaldehyde being far below the threshold of reaction (1). Initially introduced by the World Health Organization (WHO) in 1983, SBS is described as a collection of nonspecific symptoms of illness resulting from exposure to harmful agents in specific workplaces (2,3).

Several common symptoms are associated with SBS incidence, including irritation of the eyes, nose, and throat; feeling of dry mucous membranes; red, itchy, and dry skin; headaches; and nausea and dizziness (1–3). In some cases, symptoms of SBS may worsen during a work shift and resolve rapidly after leaving the building at the end of the day. Generally, they improve during the weekend and disappear during the holidays (2). The symptoms of SBS usually manifest in one or more employees working in the same area, with employee/s experiencing two or more symptoms concurrently (4,5).

There are several causes of SBS. Previous research has shown that individual characteristics, such as age and working period, significantly impacted the incidence of SBS (6–8). Age is classified as under 40 or

40 and over (6,8,9). As for the work period, it is divided into two categories, namely the number of hours worked and the number of years worked. The classification of the number of hours worked distinguishes between the 8-hour workers and over-8-hour workers (7). Likewise, the number of years worked is categorized into those working under three years and three or above (6,8,9).

Researchers frequently use statistical analysis when conducting clinical studies to examine significant factors related to a disease or patient care (10). Regression analysis is a statistical technique that can determine factors contributing to SBS incidence. Often, this approach is employed to analyze health research data, mainly observational studies, emphasizing identifying relationships between multiple factors, disease outcomes, and prognostic factors (10,11). Model selection, selection of independent variables, coding the variables, determining how flexible the association between continuous variables and the outcome should be modeled, and reporting the model are all components of this analysis (11).

The Telkom Indonesia company is a state-owned enterprise (BUMN) that provides telecommunication services throughout Indonesia. One of its subsidiaries, Telkom Gorontalo, is responsible for several areas within the city. A direct observation by researchers in Telkom Gorontalo's IT (Information Technology) department determined that 15 out of 17 IT employees had symptoms of SBS, including headaches, dizziness, and respiratory problems. The results of a questionnaire distributed by the researchers during direct observation were used to obtain this information.

Therefore, it is imperative to conduct further research into the SBS incident at Telkom Gorontalo. This research will focus on understanding the potential influence of age and work period on the incidence of SBS among IT employees.

METHODOLOGY

The research was conducted using cross-sectional observations. Cross-sectional observations involve the simultaneous collection of data, and cross-sectional studies entail gathering relevant information at a specific point in time (12,13). Primary data is collected in this study using a validated and reliable questionnaire as a research instrument.

All employees of Telkom Gorontalo who work in IT were included as the research population. This research used saturated sampling (total sampling), and the entire population was utilized as a sample (14). Therefore, the number of samples used in this research is the same as that of the population (35 IT employees).

This research uses the incidence of SBS (Y) as a dependent variable. Meanwhile, the independent variables used are age (X_1) and work period, which are the number of hours worked (X_2) and the number of years worked (X_3). Data analysis techniques used in this research include univariate analysis (descriptive analysis), bivariate analysis (relationship analysis), and multivariate analysis (influence analysis). R software was used as a tool for the data analysis.

RESULTS

Univariate Analysis

The univariate analysis results depict a descriptive overview of SBS incidence among Telkom Gorontalo's IT employees. Table 1 presents a summary of the findings.

Table 1. Description of Telkom Gorontalo's IT Employees

Variables	Total	
	n	**%**
SBS Incidence (Y)		
Yes	27	77,1
No	8	22,9
Age (X_1)		
< 40 years old	28	80
≥ 40 years old	7	20
Number of hours worked (X_2)		
Normal (8 Hours)	27	77,1
Abnormal (> 8 hours)	8	22,9
Number of years worked (X_3)		
< 3 years	14	40
≥ 3 years	21	60

Based on Table 1, among the 35 IT employees at Telkom Gorontalo, a fifth are over 40, slightly more than 1/5 have worked for abnormal hours (longer than standard hours work), and three-fifths have been at the company for over three years. Further, as seen in Table 1, a large proportion of IT employees experienced SBS incidents while working at Telkom Gorontalo.

Bivariate Analysis

Bivariate analysis utilizes a correlation test using Fisher's Exact test. If a cell (for 2x2 dimensions) has an expected value less than five, this test is conducted; otherwise, the Pearson Chi-square test is used (15–18). Results are provided in Table 2 based on Fisher's exact test for two by two cells.

Table 2. Fisher's Exact Test 2x2

Variables	SBS Incidence		Expected Values		p-value
	Yes	No			
Age (X_1)					
< 40 years old	26	2	21,60	6,40	0,000
≥ 40 years old	1	6	5,40	1,60	
Number of hours worked (X_2)					
Normal (8 Hours)	21	6	20,83	6,17	0,999
Abnormal (> 8 hours)	6	2	6,17	1,83	
Number of years worked (X_3)					
< 3 years	8	6	10,8	3,2	0,039
≥ 3 years	19	2	16,2	4,8	

As shown in Table 2, variables X_1 and X_3 have rejected H_0 because their p-values (0,000 and 0,039, respectively) are less than α (0,05). Thus, age and number of years worked significantly correlate with the incidence of SBS (Y) in Telkom Gorontalo's IT employees. Meanwhile, the number of hours worked (X_2) failed to reject the H_0, as the p-value was greater than α; Consequently, it did not significantly correlate with SBS incidence.

Furthermore, Table 2 shows that 26 of the 28 IT employees under 40 experienced symptoms of SBS, while one person experienced those symptoms among the seven employees over 40. Additionally, Table 2 depicts that a little over half (8 out of 14) of IT employees who have worked for less than three years at Telkom Gorontalo have experienced SBS symptoms. Accordingly, the majority (19 out of 21) of employees who have worked for more than three years have also experienced SBS symptoms.

Multivariate Analysis

A logistic regression model is employed for multivariate analysis, in which the regression model is a predictive model that assesses the influence between the dependent variable (which is categorical data) and the independent variable (19). In the bivariate analysis, only variables X_1 and X_3 exhibit significant correlations with Y. A logistic regression analysis will, therefore, be conducted using age and length of work as independent variables. Presented in Table 3 is a logistic regression for multivariate analysis.

Table 3. Logistic Regression Analysis

Coefficients	Estimate	OR	Z Value	p-value
Intercept	1,707	5,511	1,958	0,050
$X_{1(1)}$	-4,198	0,015	-3,028	0,002
$X_{3(1)}$	-1,686	5,399	-1,294	0,196

Table 3 indicates that the number of years worked (X_3) does not significantly influence the incidence of SBS (Y) among IT employees at Telkom Gorontalo, as the p-value is greater than α (0.196 > 0.05). As a result, logistic regression analysis must be repeated to retrieve estimates from the regression model without variable X_3. Table 4 summarizes the logistic regression analysis results, excluding variable X_3.

Table 4. Logistic Regression Analysis without Independent Variable X_3

Coefficients	Estimate	OR	Z Value	p-value
Intercept	2,565	13,00	3,495	0,000
$X_{1(1)}$	-4,357	0,013	-3,336	0,001
R-square	46,45%			

Table 4 reveals that the independent variable, X_1, and the dependent variable, Y, have a p-value (0,001) smaller than α. In conclusion, the incidence of SBS at Telkom Gorontalo is significantly influenced by the employees' age.

DISCUSSION

According to the logistic regression analysis results, age significantly contributed to the incidence of SBS among Telkom Gorontalo's IT employees, with a p-value of 0,001. Moreover, the results demonstrate that an IT employee over or equal to 40 ($X_{I(1)}$) who works at Telkom Gorontalo is at risk of experiencing an SBS incident 0,013 times more than an IT employee under 40.

The analysis results are consistent with prior research indicating that the prevalence of SBS is linked to age (4,6,7,9). Older adults are more susceptible to experiencing SBS symptoms due to a weakened immune system (5). However, (9) found that employees under 40 were at 4.6 times higher risk of experiencing an SBS incident due to prolonged indoor stays. Nonetheless, previous research also wrote that individuals in the productive age group are more likely to experience SBS symptoms than those in non-productive age groups, possibly due to their peak performance and engagement in strenuous work activities (7).

Moreover, Fisher's exact test and logistic regression analyses suggested that the work period (the number of hours and years worked) did not appear to have a bearing on SBS incidence. It is aligned with previous research that only age was associated with SBS incidence, while work period did not (4,9).

In addition, an R-square value of 46,45% was also yielded in the multivariate analysis. This value, also known as the coefficient of determination, is used to determine whether a regression model is suitable, with a value close to 100% indicating a high level of predictability (20). In this regard, the R-Square regression model in the result means that the age variable accounts for 46.45 percent of the variation in SBS incidence among Telkom Gorontalo's IT employees. The remaining variation is influenced by other variables not examined in this research.

Considering the matter further, it is worth noting that the condition of the Telkom Gorontalo building may represent another variable of interest. Previous research on SBS has indicated that building factors such as ventilation, temperature, and other related elements may be correlated with the incidence of SBS (4–8). Based on the observations gathered during the research data collection at PT Telkom Gorontalo, it was noted that the employee rooms within the IT department are equipped only with artificial ventilation, leading to suboptimal air circulation. Hence, this may potentially contribute to SBS symptoms among IT employees at Telkom Gorontalo, in addition to their age.

CONCLUSION

The analysis results conclude that 27 of 35 IT employees experienced SBS incidents while working at Telkom Gorontalo. Through a bivariate and multivariate analysis, it was found that age is the only factor significantly affecting SBS incidence among Telkom Gorontalo's IT employees, whereas work period, which is the number of hours worked and the number of years worked, did not impact the incidence of SBS. The R-squared value of 46.45 percent was also obtained by logistic regression.

RECOMMENDATION

Other independent variables, such as the condition of the buildings at Telkom Gorontalo, temperature, or others, can be added for further research.

To facilitate further learning and research, universities should include the latest literature and library sources in their educational programs.

Encouraging Telkom Gorontalo's IT employees to take breaks outside the building to breathe fresh air and relax their muscles; Breaks may reduce the risk of SBS symptoms among employees working in unfavorable work environments.

As for Telkom Gorontalo, it is hoped that it will be necessary to perform periodic measurements of the physical work environment, such as humidity and lighting, and to maintain the air conditioning system to prevent deterioration of indoor air quality and the development of SBS.

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