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THE EFFECT OF VIBRATION LEVEL, WORKLOAD AND LONG EXPOSURE TO THE USE OF SEWING MACHINES ON SIGNS OF COMPLAINTS OF CARPAL TUNNEL SYNDROME (CTS) IN WORKERS AT THE ISTANA BORDIR, MALANG

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ABSTRACT

Activities that cause vibrations in the machine using the help of hands for a long time are often associated with Carpal Tunnel Syndrome (CTS). Carpal Tunnel Syndrome (CTS) is an occupational disease caused by entrapment of the median nerve through the carpal. Symptom experienced by workers in Istana Bordir are pain and tingling in the hands when working too long. The purpose of this study was to determine the effect of vibration levels, workload and duration of exposure to the use of sewing machines on signs of Carpal Tunnel Syndrome (CTS) symptom in workers in Istana Bordir Malang. This study used an observational analytic research design with a cross sectional design. The research sample amounted to 15 people who were taken based using total sampling technique. The instrument used is a vibration meter, palpation to count the pulse and a questionnaire. Analysis of research results using ordinal logistic regression test. The results of the study can be concluded that the variables that influence the results of the partial logistic regression are working period with a value (sig. 0.035), length of exposure with a value (sig. 0.038), vibration level with a value (sig. 0.039), and workload value is (sig. 0,007). While the results of the logistic regression simultaneously obtained a significant result of 0.006. So it can be concluded that there is an effect of vibration level and duration of exposure to the use of sewing machines on signs of Carpal Tunnel Syndrome (CTS) symptom in workers in Istana Bordir Malang.

KEYWORDS: Vibration Level, Exposure Time, Carpal Tunnel Syndrome (CTS)

1 INTRODUCTION

Occupational Health and Safety (OHS) is a public health area that focuses on both formal and informal employees. Worker protection includes Occupational Health and Safety (OHS). Occupational Health and Safety (OHS) aims to reduce workplace accidents

(Elphiana , 2017). In 2018, the International Labor Organization (ILO) reported that 2.78 million employees died as a consequence of workplace accidents and occupational illnesses. While occupational illnesses killed about 2.4 million people, labor accidents killed over 380,000. Nonfatal occupational accidents outnumber fatal ones every year. An estimated 374 million employees are engaged in non-fatal accidents each year (ILO , 2018). The lack of occupational health and safety (OHS) protection in Indonesia's informal sector is especially concerning. Workers see workplace safety and health problems as a given. This is due to employees' lack of knowledge about OHS (Ramdan , 2012). Many tasks are now performed by mechanical devices, ranging from basic machines to machines based on advanced and complicated technologies. Mechanical equipment is to blame for vibrations. The periodic back and forth movement of the equilibrium point is known as vibration. Workers who are continually exposed to vibrations will develop health problems in vibration-prone parts of their bodies (Mastha, 2015). The length of time a person is directly exposed to machine vibration while working in one working day is referred to as the duration of vibration exposure. Each employee is usually only allowed to work 8 hours every day. The longer a person is exposed to mechanical vibrations, the greater the risk of injury to employees (Ahmad , 2018). Carpal Tunnel Syndrome is typically associated with tasks that cause vibrations in the machine while employing the hands for a prolonged length of time. Carpal Tunnel Syndrome is a work-related ailment caused by nerve damage caused by entrapment of the median nerve, which travels through the carpal tunnel. Workers who are subjected to vibrations regularly are in danger of getting this neurological condition (Cindyastira, 2014). Carpal Tunnel Syndrome patients typically report discomfort, tingling, and numbness. The index, middle, and ring fingers are the most prone to this. The nerves in the wrist will be repressed if the motion is repeated repeatedly with a high enough vibration (Qoribullah, 2020). The Regulation of the Minister of Health of the Republic of Indonesia Number 70 of 2016 on Standards and Requirements for Health in the Industrial Work Environment governs the threshold value for vibration in the hands and arms. The legislation establishes a hand and arm vibration threshold value (NAV) of 5 meters per second for 8 hours of labor each day. According to the Center for Health Statistics in the United States, there are more than 2 million instances of carpal tunnel Syndrome, a form of illness caused by median nerve damage that is common in the country (Musarrofah, 2017). Because there have been few reports, the prevalence of Carpal Tunnel Syndrome Indonesia is uncertain. In studies on employees at high risk of a wrist injury, a 15% prevalence was found (Kemenkes RI, 2016). Tailors are one profession that may be subjected to vibration. The Needlework Palace is one of Malang's most popular embroidery facilities, both among residents and tourists. This embroidery shop was founded in 1986. This firm is fast growing year after year. According to a preliminary study, employees at the Istana Bordir work 8 hours every day. The embroidery machine at the Istana Bordir is in bad condition since it has been in use since 2000, and equipment maintenance is done when the equipment is in poor condition. Workers complain about discomfort and tingling in their hands while working for a lengthy amount of time, according to the results of eight worker interviews. Based on this, the researchers

intended to see whether there was an "Effect of Vibration Level, Workload, and Length of Exposure to Sewing Machine Use on Signs of Carpal Tunnel Syndrome(CTS) Symptom in Workers at the Istana Bordir Malang.

2 MATERIALS AND METHODS

The study approach used is an observational analysis using a cross-sectional design to learn more about the influence of sewing machine vibration exposure on employees with Carpal Tunnel Syndrome at the Istana Bordir in Malang. The participants in this research were all sewing machine operators at the Malang Istana Bordir. The sample consists of 15 sewers. The sampling approach was total sampling. The data analysis approach used is univariate analysis to see the description of the frequency distribution and the percentage of each independent variable and the dependent variable. Crosstab analysis is used in bivariate analysis to identify the influence of the independent variable on the dependent variable (cross-tabulation). While logistic regression was used in the multivariate analysis.

3 RESULTS

Respondent Characteristics

Respondent characteristics such as age, years of service, length of exposure, vibration level, exercise habits, and indicators of Carpal Tunnel Syndrome (CTS) symptom.

Table 1. Frequency Distribution of Respondents Age

Age (Year)	Frequency	(%)
Teenager (12-25 year)	0	00.0 %
Mature (26-45 year)	8	53,3 %
Elderly (46-65 year)	7	46,7 %
Total	15	100 %

According to the age distribution table of respondents above, there are 8 people in the 26- 45 year age category, with a proportion of 53.3 percent. The percentage of responders in the age group 46-65 years was 46.7 percent.

Table 2. Frequency Distribution of Respondents Working Period

Years of service	Frequency	(%)
≤ 4 years	3	20.0 %
> 4 years	12	80,0 %
Total	15	100 %

According to the above frequency distribution table of respondents' tenure, the number of respondents who worked less than 4 years was 3, with a proportion of 20.0 percent. The number of respondents who worked more than 4 years was as high as 12, with an 80.0 percent response rate.

Table 3. Frequency Distribution of Respondents Time of Exposure

Time of Exposure	Frequency	(%)
< 8 hours	5	33,3 %
≥ 8 hours	10	66,7 %
Total	15	100 %

According to the frequency distribution table of respondents' exposure time shown above, 5 people were exposed to vibration for less than 8 hours, for a proportion of 33.3 percent. The number of responders who were subjected to vibration for more than 8 hours was 10 people, with a proportion of 66.7 percent.

Table 4. Frequency Distribution of Respondents Vibration Level

Vibration Level meter/second^2	Frequency	(%)
5 meter/second^2	4	26,7 %
≥ 5 meter/second^2	11	73,3 %
Total	15	100 %

According to the frequency distribution table of the respondent's vibration level shown above, 4 people were exposed to the 5 m/s^2 vibration level, for a percentage of 26.7 percent. The number of respondents who were exposed to vibration intensities more than 5 m/s^2 was 11,with a 73.3 percent response rate.

Table 5. Frequency Distribution of Respondents Workload

Workload	Frequency	(%)
Heavy	3	20,0 %
Currently	5	33,3 %
Light	7	46,7 %
Total	15	100 %

According to table 5, there are 3 people (20 percent) of respondents who have heavy workloads, 5 people with currently workloads and 7 people (46.7 percent) who have light workloads.

Table 6. Frequency Distribution of Respondents CTS Symptom

CTS Symptom	Frequency	(%)
No symptom	3	20,0 %
Minor symptom	5	33,3 %
Moderate symptom	7	46,7 %
Total	15	100 %

According to the frequency distribution table for Carpal Tunnel Syndrome (CTS)respondents table 6 above, the number of respondents with no symptom was 3, with a proportion of 20.0 percent. The number of responders with minor symptom was 5, with a ratio of 33.3 percent. The percentage of respondents with moderate symptom was 46.7 percent, with7 people responding.

The Impact of Age on Carpal Tunnel Syndrome (CTS) Symptom

Table 7. Logistic Regression Test the Impact of Age on CTS Symptom

Usia	*Carpal Tunnel Syndrome*(CTS)				Sig.
	No Symptom	Minor Symptom	Moderate Symptom	Total	
Adult (26-45 y.o)	1	3	4	8	0,565
Eldery (46-65 y.o)	2	2	3	7	
Total	3	5	7	15	

According to table 7, 1 respondent had no symptom of Carpal Tunnel Syndrome (CTS), 3 respondents had minor symptom CTS, and 4 respondents had moderate symptom of CTS out of15 respondents in the age group 26-45 years. In the age group 46-65 years, 2 respondents reported no symptom of CTS, 2 had minor symptom of CTS, and 3 had moderate symptom of CTS. In the logistic regression test, a significant P-value greater than 0.05 suggests that age has no effect on indications of CTS symptom.

The Impact of Working Period on Carpal Tunnel Syndrome(CTS) Symptom

Table 8. Logistic Regression Test the Impact of Working Period on CTS Symptom

Working Period	*Carpal Tunnel Syndrome*(CTS)				Sig.
	No Symptom	Minor Symptom	Moderate Symptom	Total	
≤4 years	3	0	0	3	0,035
> 4 years	0	5	7	12	
Total	3	5	7	15	

According to table 8, 3 of the 15 respondents in the group of working period 4 years had no symptom of CTS. In the group of working period more than 4 years, 5 respondents had mild CTS and 7 respondents had moderate CTS. The logistic regression test resulted in a significant value of 0.035 for the effect of working period on indications of CTS symptom. In the logistic regression test, a significant value of P-value 0.05 is used in decision making, indicating that there is an effect of tenure on signs of CTS symptom.

The Impact of Exposure Time on Carpal Tunnel Syndrome(CTS) Symptom.

Table 9. Logistic Regression Test the Impact of Exposure Time on CTS Symptom

Exposure Time	*Carpal Tunnel Syndrome*(CTS)				Sig.
	No Symptom	Minor Symptom	Moderate Symptom	Total	
< 8 hours	3	2	0	5	0,038
≥ 8 hours	0	3	7	10	
Total	3	5	7	15	

According to table 9, 3 respondents in the category of exposure duration 8 hoursand more had no symptom of CTS, and 2 respondents had minor symptom of CTS. 3respondents had mild CTS and 7 respondents had moderate CTS in the group of exposure duration 8 hours. The logistic regression test assessing the effect of long exposure on CTS symptom yielded a significant value of 0.038. A significant factor is used P- value 0.05 in decision making in the logistic regression test, indicating that the length of exposure has an effect on the symptom of CTS.

The Impact of Vibration Levels on Carpal Tunnel Syndrome (CTS) Symptom

Table 10. Logistic Regression Test the Impact of Vibration Levels on CTS Symptom

Vibration Levels ($meter/second^2$)	*Carpal Tunnel Syndrome*(CTS)				Sig.
	No Symptom	Minor Symptom	Moderate Symptom	Total	
5 $meter/second^2$	3	1	0	4	0,039
≥ 5 $meter/second^2$	0	4	7	11	
Total	3	5	7	15	

According to table 10, 3 respondents had no symptom of CTS and one had mild CTS of the 15 respondents in the vibration level category according to the TVL 5 meter/second2. In the category of vibration level that does not match the TVL 5 meter/second2, 4 respondents have mild CTS and 7 respondents have moderate CTS. The logistic regression test resulted in a significant value of 0.039 for the effect of vibration level on indications of CTS symptom. In the logistic regression test, a significant P-value of 0.05 suggests that there is an effect of vibration level on indications of CTS symptom.

The Impact of Workload on Symptom Carpal Tunnel Syndrome (CTS)

Table 11. Logistic Regression Test the Impact of Workload on CTS Symptom

Workload	*Carpal Tunnel Syndrome* (CTS)				Sig.
	No Symptom	Minor Symptom	Moderate Symptom	Total	
Heavy	0	0	3	3	0,007
Currently	1	2	2	5	
Light	2	2	3	7	
Total	3	4	8	15	

According to table 11, 3 of the 15 respondents in the workload category reported no symptom of CTS. Meanwhile, the most common moderate complaint was 8 respondents for CTS symptom, with a significant value of 0.007. In the logistic regression test, a significant P- value of 0.05 suggests that there is an effect of workload on CTS symptom.

Partial Test

By looking at the significant value 0.05, the partial test was utilized to determine the partial effect between the independent variable and the dependent variable.

Table 12. Parameter Estimates

		Sig.
Threshold	Symptom of *Carpal Tunnel Syndrome* (CTS)	,005
Location	Age	,565
	Working period	,015
	Length exposure	,028
	Vibration level	,039
	Workload	,007

According to table 12, the independent factors with a significant value of 0.05 include working period, length of exposure, vibration level, and workload. This demonstrates that these variables have a considerable impact on the symptom of CTS. While the age variable has no significant effect on CTS symptom because the significant value is greater than 0.05,

The model fit test (Goodness of Fit)

The model fit test (Goodness of Fit) was performed to determine whether or not the derived ordinal regression model could be used. The results of the model fit test using the Deviance test are shown. The tested hypotheses are H0: the model is appropriate and H1: the model is not appropriate. According to the table, the test condition is to reject H0 if the significant value is less than 0.05. The significant number is 0.905, according to the Deviance test value in the table. Because the significant value is greater than 0.05, the decision is made to accept H0. The conclusion is that the resulting logistic model is appropriate for use, and the model is considered to be fit with the data.

Table 13. Goodness-of-Fit

	Sig.
Pearson	,825
Deviance	,905

Simultaneous Test

Table 14. Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	27,729			
Final	11,456	16,273	5	,006

Table 14 displays the p-value 0.05 results. If the table sig. result is 0.006, the decision to reject H0 and accept H1 implies that there is a significant influence.

Coefficient of Model Determination

The Nagelkerke R-Square value indicates the value of the logistic regression model's coefficient of determination.

Table 14. Pseudo R-Square

Model	Dependent Variables	Value
Nagelkerke	1. Workload 2. Length exposure 3. Vibration level 4. Workload	,846

According to table 14, the Nagelkerke coefficient of determination is 84.6 percent. This suggests that the independent variable has an 84.6 percent influence on the dependent variable, while the remaining 15.4 percent is influenced by variables not included in this study.

4 CONCLUSION

According to the characteristics of respondents, the highest age category is the age of 26- 45 years for as many as 8 people, the highest working period category is 4 years for as many as 12 people, the highest light workload category is 7 people, the highest vibration level category is vibration level 5ms2 for as many as 11 people, and the highest duration of exposure is 8 hours for as many as 10 people.

Signs of CTS in tailor workers at the Istana Bordir, namely numbness and pain in the palms and wrists when working for an extended period of time. According to the findings of a multivariate analysis using logistic regression, there is a relationship between the intensity of vibration, workload, and length of exposure to indicators of Carpal Tunnel Syndrome (CTS) symptom in Istana Bordir workers. In the logistic regression test, a significant value of P-value

0.05 is used in decision making, indicating that there is an influence between the intensity of vibration, workload, and duration of exposure to indicators of Carpal Tunnel Syndrome (CTS) symptom.

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