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THE EFFECT OF MACHINE VIBRATION ON COMPLAINTS OF CARPAL TUNNEL SYNDROME AMONG WORKERS IN WOOD PROCESSING

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ABSTRACT

Machine vibration can interfere with comfort at work, can accelerate the occurrence of fatigue and can cause health problems. Machine vibrations can reach the operator's arm through vibrations that are transmitted to the body locally through the hands. This research was conducted at CV Jati Mulia Timber Management, Pematangsiantar, North Sumatra, Indonesia. The research method used to obtain primary data is vibration measurement using a vibration meter and conducting interviews using a Symptom Severity Scale questionnaire. Data analysis was used to see the relationship between machine vibration and complaints of carpal tunnel syndrome in workers. The results of machine vibration measurements at the sawmill machine operator at CV Jati Mulia exceed the NAV with an average machine A of 9.66m/s^2, an average machine B of 8.72 m/s^{2,} and an average engine C of 11.18 m/s^2. The intensity of the vibration of the sawmill machine exceeds the Threshold Limit Value (NAV) with a long exposure of 8 hours per day. This research indicated that most workers experience carpal tunnel syndrome complaints due to exposure to machine vibrations that exceed the Threshold Limit (NAV).

Keywords: machine vibration, carpal tunnel syndrome, wood industry, worker.

INTRODUCTION

The sawing process is the most important process in the wood processing industry because at that stage the wood will be easier to process because it has been divided into various sorties (Ramage *et al*., 2017; Fajrie *et al*., 2021). Sawmill is a business unit that uses wood as raw materials, with the main tools, namely: saws, and propulsion machines, and is equipped with various tools or auxiliary machines. Sawmills and wood processing activities are carried out to improve the community's economy, both for sawmill owners, wood craft companies, and the surrounding community to get jobs (Kristakova *et al*., 2021; Abigail *et al*., 2020).

In general, vibration can interfere with comfort at work, can accelerate the occurrence of fatigue, and can cause health problems. Machine vibrations can reach the operator's arm through vibrations that are transmitted to the body locally through the hands, so this type of vibration is also known as segmental vibration. Arm vibration, also known as local vibration, is a vibration that propagates through the hand as a result of the use of vibrating equipment. Disturbances due to vibration felt by the operator's arm include circulation disorders, joint disorders, muscle disorders, and nerve disorders (Su *et al*., 2013; Chen *et al*., 2009).

Machine vibrations can be interpreted as vibrations caused by mechanical devices where some of these vibrations reach the body and can cause unwanted effects on our bodies (Duarte and de Brito Pereira, 2006). The magnitude of this vibration is determined by the intensity, frequency of vibration, and the duration of the vibration. The human body has a natural frequency where if this frequency resonates with the vibration frequency it will cause disturbances, including affecting work concentration, accelerating the arrival of fatigue, and disturbances in body parts such as eyes, nerves, muscles, etc (Rose, 2021).

Activities in the industry have a risk of danger that can cause accidents or occupational diseases (Muhdi *et al.,* 2021). One of which is the danger caused by the use of machines or mechanical devices in the form of mechanical vibrations. Vibrations generated by machines when exposed to humans or workers can cause adverse effects on the health of workers, including feelings of numbness in the fingers at work, bone, joint, and muscle disorders, neuropathy, and carpal tunnel syndrome (Bovenzi, 2006). Disorders of this nerve are related to work that has exposure to vibration in the long term repeatedly. The objective of this research was to analyze the effect of machine vibration and carpal tunnel syndrome complaints in sawmill workers.

MATERIALS AND METHOD

This research was conducted at CV Jati Mulia Timber Management, Pematangsiantar, North Sumatra Province. The materials, equipment, and tools used in this research are vibration meter, stationery, SPSS, and digital camera. The materials used are the Symptom Severity Scale Questionnaire and SPSS Software.

Sampling

This study uses a total sampling technique, namely the number of samples or respondents taken in this study based on the existing population. The total population of the operator's workforce is 15 people.

The sample is the object under study and is considered to represent the entire population (Shukla, 2020; Majid, 2018). The samples studied were all workers of the CV Jati Mulia Pematangsiantar Wood Management industry who used sawmill machines where the machines

were held directly by the workers' hands and produced vibrations where the number of workers was 15 workers.

Data Collection

Primary data is data obtained directly from workers in the operator section of CV Jati Mulia by using measuring instruments in the form of questionnaires and also data obtained from vibration measurements using a vibration meter. Secondary data, namely data obtained through documents or records from companies that are needed in this research, such as the conditions of the research location and the sawmill process.

CV Jati Mulia has three bandsaws and the three bandsaws used by machine operators at CV Jati Mulia are owned by CV Jati Mulia itself. Saw machine (bandsaw) A was purchased in 2018 along with the establishment of CV. JatiMulia. 6 months later the owner bought a bandsaw machine B. And in 2020 the owner bought a bandsaw C. Even though the bandsaw A, B, and C have the same function and specifications. However, the three bandsaws have a different service life, the condition of the bandsaw A is more widely used than the bandsaw B and the bandsaw C.

In each bandsaw, there are five bandsaw operators, 1 person works as a pusher of the log towards the bandsaw, 1 person adjusts the size of the log to be sawed, and 1 person works to hold the end of the log so that the sawn results are flat. , 1 person works as a carrier of sawn products that are of appropriate size to the board collection point and another person works as a tip remover or unused bark to the wood collection point provided to be used as firewood.

The research method used to obtain primary data is vibration measurement using a vibration meter and conducting interviews using a Symptom Severity Scale questionnaire.

a) Measuring and describing machine vibration on workers. Vibration Meter, which is a tool to measure vibration. In this study, the instrument used is the LUTRON VB-8200 Vibration Meter. The measurement technique is as follows:

a) First check the battery by pressing the power button. When a double dot appears on the display, it means that the battery needs to be replaced.

b) Pressing power for about 10 seconds. Choose the appropriate measurement scale and the tool is ready for measurement.

c) Attaching the vibration sensor or magnetic base to the machine part to be measured in an upright position. The mechanical vibration value is shown on the display. After that, the tool can be removed from the object. Reads and records numbers on the display.

d) Press the power button again for the next measurement. In order to get a good and precise data measurement, take the average value (median) of the vibration values generated by the machine.

b) Measure and describe complaints of carpal tunnel syndrome. Measurement of subjective complaints of carpal tunnel syndrome using the Symptom Severity Scale questionnaire. Symptom severity scale (SSS) is a questionnaire sheet to measure carpal tunnel syndrome complaints containing 11 questions regarding labor complaints during the last 1 week filled in based on the severity of symptoms and the level of labor complaints, based on the source of the Boston Carpal Tunnel Syndrome Questionnaire. Each answer can be scored from one (mildest) to five (most severe). The overall symptom severity score or SSS was calculated as the average score for the eleven questions.

Identification of Research Variables

The variables of this study consisted of independent variables and dependent variables.

a) Independent variable. The independent variable in this study is the variable that causes the occurrence or change of the dependent variable. The independent variables in this study were exposure to sawmill vibration, age, years of service, and use of PPE.

b) Defendant variable. The dependent variable in this study is the variable that is affected or the result, because of the independent variable. The dependent variable in this study was complaints of carpal tunnel syndrome.

Data Analysis

Data analysis was used to see the relationship between machine vibration and complaints of carpal tunnel syndrome in workers. The data that has been collected is then analyzed univariately and bivariately. Statistical analysis is carried out by statistical test of the Contingency Coefficient using the SPSS computer program. Multiple linear regression aims to determine the effect between two or more independent variables and the dependent variable. Multiple linear regression calculations were performed using SPSS. Multiple linear regression formula:

$Y = a + b1X1 + b2X2 + b3X3 + b4X4$
Y = the respondent's CTS complaints.
X1 = sawmill machine vibration.
X2 = the age of the respondent.
X3 = the respondent's tenure.
X4 = the use of PPE.

The coefficient of determination (R2) is an indicator used to describe how much variation is described in the regression method. The coefficient of determination (R2) from the results of multiple regression shows how

much the dependent variable (CTS complaints) is influenced by the independent variables (engine vibration, age, service life and PPE). The coefficient of determination varies from 0 to 1, by increasing the coefficient of determination or close to one, it can be said that the independent variable has a large influence on the dependent variable. This means that the model used to explain the effect of the independent variables studied on the dependent variable is more certain. Conversely, if the coefficient of determination is close to 0 then the influence of the independent variable on the dependent variable is small, meaning that the model used to explain the influence of the independent variable on the dependent variable does not fit or does not explain its effect.

Bivariate analysis. Bivariate analysis is an analysis used on two related or correlated variables, namely between the independent variable and the dependent variable using the Chi-Square test by comparing the value of 0.05 with a 95% confidence level with positive and negative correlation coefficient values. The basis of decision-making used is based on probability. If probability < 0.05 then H0 is rejected H1 is accepted. This means that the two variables have a significant relationship. However, if the probability > 0.05 then H0 is accepted and H1 is rejected. This means that there is no significant relationship between these variables. H0 is a hypothesis that states that there is no relationship between two variables. H1 is a hypothesis that states that there is a relationship between two variables.

RESULTS AND DISCUSSIONS

General Condition of the Research Site

CV Jati Mulia which is located at Jalan Usman Saragih, Tanjung Pinggir Ruko Complex, Pematangsiantar has been established since 2018, with activities carried out at CV Jati Mulia are sawmills, namely by processing logs into boards, broti wood, and long wood. CV Jati Mulia processes wood supplied from Community Plantation Forests and ordered online. The raw materials used are Pinus merkusii and some mixed forests such as Eucalyptus spp., meranti, macadame, and others. The activity that occurs at the time of sawing is that workers must use a machine that causes vibrations, namely a sawmill machine. The machine causes high vibrations and is directly exposed to the hands of workers.

The production process at Jati Mulia operates for 8 hours a day for 6 days a week with 1 hour rest time. The total number of workers as machine operators in Wood Processing is 15 workers. There are no control measures against vibration on the part of the owner of CV Jati Mulia so far, but control is carried out by each worker who is exposed to vibration, for example by using cloth as a base to reduce the intensity of the vibration generated by the machine and directly exposed to the worker's hands.

Wood Processing

Most of the wood processing factories, including CV Jati Mulia, do not directly use logs but instead convert the wood into saw wood such as boards through certain methods according to the desired purpose. These wooden boards will be processed into different sizes and quantities according to consumer demand. Sawing is an important process in wood processing at CV Jati Mulia.

The standard process in sawmills is the sequence of activities for converting logs into sawn timber in general. There are differences between one sawmill industry and another, in the order in which the logs are converted into sawn wood sortiment. The sequence of activities in the sawmill industry in general begins with the process of splitting logs into smaller raw materials. In general, the conversion of logs into sawn timber consists of the first split (breakdown sawing), followed by resection (secondary breakdown sawing), then side cutting (edging), and trimming the ends (trimming).

In the sawing process at CV Jati Mulia, the initial stage is the first split (breakdown sawing). This process is intended to reduce or direct the product both in terms of size and quality and at the same time direct the yield (Figure-1).

Figure-1. First cleavage process (breakdown sawing).

Re-splitting is done to re-split the wood that has been processed in the first cleavage stage into smaller raw materials. In this process, wood with the final thickness is obtained (Figure-2).

Figure-2. Re-cleavage (secondary breakdown sawing).

Side cutting (edging) or also known as edge straightening is done for wood that has no straight edges. In addition to straightening the edges, this process also aims to remove edge defects so as to increase the quality of sawn wood. And this process is also the final stage in the sawing process at CV Jati Mulia. The results obtained from edging, sawn wood have width and thickness that meet the requirements or according to the needs and purposes of wood use (Figure-3).

Figure-3. Side cutting (edging).

Characteristics of Respondents

A. Gender

Based on the results of observations made at the time of the study, it is known that the gender of the 15 respondents studied was male.

B. Age

The list of the frequency distribution of respondents based on age in the sawmill machine operator section can be seen in Table-1.

Table-1. Frequency distribution of respondents' age.

No	Age (years)	Frequency	Percentage (%)
1	< 40	9	60
2	> 40	6	40
Total		15	100

Based on Table-1, it is known that the sample used in this study is a workforce with an age limit of 30-60 years. From the results of the study, the age of most respondents aged <40 years amounted to 9 people (60%). This is because the number of young workers is more, while the rest are respondents with a range of >40 years totaling 6 people (40%). The older the respondent, the higher the level of Carpal Tunnel Syndrome. According to Hobby *et al* (2015), the symptoms of Carpal Tunnel Syndrome experienced at the age of > 20 years are mostly caused by occupational factors. Workers who work with repetitive biomechanical stresses on the hands or wrists every day are more likely to develop symptoms of carpal tunnel syndrome early.

Basically, the older a person gets, the more they can cause Carpal Tunnel Syndrome (CTS) symptoms. According to Blumenthal *et al*. (2006), increasing age can increase the risk of symptoms of Carpal Tunnel Syndrome (CTS), where the age of occurrence of this disease ranges from 29 to 62 years. With increasing age, it can be ascertained that exposure to work tools that use hand assistance will be longer due to daily use at work and the ability of the elasticity of bones, muscles, and veins to decrease as a damper from vibrations propagated to the body.

C. Working period

The list of frequency distribution of respondents based on years of service in the sawmill machine operator section can be seen in Table-2.

Table-2. Frequency distribution of respondents working period.

No	Working period (years)	Frequency	Percentage (%)
1	< 13	8	53.3
2	> 13	7	46.7
Total		15	100

In Table-2 it can be seen that the sawmill machine operator workers at CV Jati Mulia Pematangsiantar were mostly in the working category <13 years, namely 8 workers (53.3%), compared to the > 13-year category with 7 workers (46.7%). The working period is related to the symptoms of Carpal Tunnel Syndrome where the sawmill machine operator complains of Carpal Tunnel Syndrome, because the longer the working period, the greater the exposure to machine vibration received by the workforce. This will increase the complaints of Carpal Tunnel Syndrome in the workforce. If the working period is long, it can be ascertained that the workers will be exposed to work tools with the existing vibration intensity and will cause health problems in the form of a feeling of discomfort in the hands at work.

Sari *et al*. (2020) workers who have a working period of > 4 years have a greater risk of experiencing CTS compared to workers whose tenure is 1-4 years. This happens because the longer the working period, there will be repetitive movements or repetitive vibrations on the arm (finger) continuously for a long time so that it can cause stress on the tissues around the hand.

The working period is associated with symptoms of carpal tunnel syndrome whereas sawmill machine operators with medium and long periods of work experience symptoms of carpal tunnel syndrome. The longer a person's working period, the more repetitive motion of the wrist will occur continuously for a long period of time it can cause tissue damage around the carpal tunnel (Setyowati *et al.,* 2015).

D. Use of personal protective equipment (PPE)

Based on the results of observations made at the time of the study, it is known that there are no respondents who use Personal Protective Equipment (PPE) such as gloves, when working using machines that cause vibrations and are directly exposed to the respondent's hands. With the presence of personal protective equipment, it is hoped that accidents and occupational diseases can be minimized. Personal protective equipment that is suitable for vibration propagated through hand work tools is gloves with foam and providing damping or damping rather than tools that are in direct contact with the worker's hands, thus vibrations that propagate to the hands can be reduced to below the specified threshold

value, namely 4 m/s^2 for exposure time of 4 hours and less than 8 hours per day.

Machine vibration in the sawmill machine operator section

Measurement of machine vibration at the sawmill machine operator is carried out by attaching a tool (vibration meter) to the sawmill machine that causes vibrations and is directly exposed to the hands of workers. The distribution of engine vibration measurement results at CV Jati Mulia can be seen in Table-3.

Table-3. Distribution of machine vibration measurement results.

No	Machine	Vibration Frequency(m/s^2)
1	Machine A	9.66
2	Machine B	8.72
3	Machine C	11.18

Based on Table-3, it can be seen that the results of machine vibration measurements at the sawmill machine operator at CV Jati Mulia exceed the NAV with an average machine A of 9.66m/s^2, an average machine B of 8.72 m/s^2 and an average engine C of 11.18 m/s^2. And the intensity of the vibration of the sawmill machine exceeds the Threshold Limit Value (NAV) with a long exposure of 8 hours per day, as stated in the Minister of Manpower Regulation No. Per.13/MEN/X/2011 states that the NAV of vibration of work tools that are in direct or indirect contact with the hands of the workforce is set at 4 m/s^2, for the number of exposures per working day which is 4 hours and less than 8 hours.

If the daily exposure is affected by the worker, it will cause the worker to feel uncomfortable due to complaints or health problems caused by the vibration of the work tool. A disease that usually appears in workers with high vibration exposure is CTS where the equipment used is exposed to workers for a long time. The equipment used in the company will vibrate and the vibration will be transmitted to the arm, the vibration produced by the work tool in a short time has no effect or has an effect on the hand, but in a long period of time it will cause health problems in the hands of workers.

Complaints of carpal tunnel syndrome in the machine operator section

The distribution of the results of measuring CTS complaints on 15 respondents who were studied using the Symptom Severity Scale questionnaire can be seen in Table-4.

Table-4. Distribution of carpal tunnel syndrome complaints measurement results.

No	Complaints of Carpal Tunnel Syndrome	Frequency	Percentage (%)
1	No complaints	1	6.7
2	Light	10	66.7
3	Moderate	2	13.3
4	Heavy	2	13.3
5	Very heavy	0	0
Total		**15**	100

Based on Table-4, it can be seen that 2 respondents experienced severe Carpal Tunnel Syndrome complaints (13.3%), 2 respondents experienced moderate Carpal Tunnel Syndrome complaints (13.3%), and 10 respondents experienced mild Carpal Tunnel Syndrome complaints. people (66.7%) and 1 person (6.7%). Based on the questionnaire, it can be seen that most workers experience carpal tunnel syndrome complaints due to exposure to machine vibrations that exceed the Threshold Limit (NAV).

CTS can occur due to an inflammatory process in the tissues around the median nerve in the carpal tunnel. This inflammation causes the tissue around the nerve to become median. This pressure on the median nerve will further cause the speed of conduction (conduction) in its nerve fibers to be inhibited, causing various symptoms in the hands and wrists.

Symptoms usually begin gradually, the initial symptoms come and go with more symptoms such as tingling loss of touch, or numb hands, but over time these symptoms may be constant (Lubis, 2017). However, the symptom of waking up at night is characteristic of CTS. And symptoms often worsen at night and can wake the patient from sleep. Thus, it can be said that the work characteristics of the sawmill machine operator can trigger CTS because when using the tool the operator performs repetitive hand movements with static hand strength and position.

Multiple linear regression analysis

Multiple linear regression analysis was used to determine the effect between two or more independent variables and the dependent variable. The calculation of the multiple linear regression model was carried out using the SPSS program. The results of the analysis can be seen in Table-5.

Table-5. Multiple linear regression test results.

Variable	Coefficient	t-count	Sign.	Conclusion
Constant	1.789	0.657	0.526	
Machine vibration (X1)	0.769	2.352	0.037	Significant different
Age (X2)	0.041	2.769	0.020	Significant different
Working period (X3)	0.035	2.293	0.041	Significant different
PPE (X4)	0.227	2.430	0.032	Significant different

The results of multiple linear regression analysis in Table-8 can be obtained from the coefficients for the independent variable Machine Vibration (X1) = 0.769, Age (X2) = 0.041, Service Period (X3) = 0.035 and APD (X4) = 0.227 with a constant of 1.789. So that the multiple linear regression equation models obtained is as follows: Y = 1.789 + 0.769 X1 + 0.041 X2 + 0.035 X3 + 0.227 X4.

The constant value of 1.789 indicates that the engine vibration variable, age, working period and PPE if the value is) then the CTS complaints of workers are permanent or constant. The regression coefficient of machine vibration (X1) is 0.769, which means that machine vibration has a positive effect on worker CTS complaints, and for every 1-time increase in machine vibration, CTS complaints will increase by 1.789 assuming the other variables are constant. The age regression coefficient (X2) is 0.041, meaning that the age of the worker has a positive effect on workers' CTS complaints, and for every 1-time increase in age, CTS complaints will increase by 0.041 assuming the other variables are constant. The regression coefficient for the working period (X3) is 0.035, meaning that the tenure has a positive effect on workers' CTS complaints, and for every 1-time increase in service time, CTS complaints will increase by 1.789 assuming the other variables are constant. The regression coefficient for the use of PPE (X4) is 0.227, meaning that the use of PPE has a positive effect on workers' CTS complaints, and for every 1-time increase in PPE use, CTS complaints will increase by 1.789 assuming the other variables are constant.

The coefficient of determination (R^2) is an indicator used to describe how much variation is described in the regression method. The coefficient of determination (R^2) from the multiple regression results shows how much the dependent variable (CTS complaints) is influenced by the independent variables (machine vibration, age, service life, and PPE). The coefficient of determination (R^2) is 0.754. This shows that 75.4% of CTS complaints are influenced by engine vibration variables, age, working period, and PPE. While 24.6% is influenced by other variables that are not included in this research model. Based on decision-making on the coefficient of determination test, if the value of R^2 is close to one, it can be said that the independent variable can explain the relationship to the dependent variable. So from the results obtained, it can be concluded that the model used to explain the effect of the independent variables (machine vibration, age, service life, and PPE) studied on the dependent variable (CTS complaints) is more certain.

The Relationship of machine vibration with complaints of Carpal Tunnel Syndrome

To find out the relationship between engine vibration and CTS complaints on operator workers at CV Jati Mulia, it was analyzed by bivariate test. The relationship test of engine vibration with complaints of carpal tunnel syndrome can be seen in table 10.

Table-6. Relationship of engine vibration with complaints of carpal tunnel syndrome.

CTS Complaints	Engine Vibration		Total	Sig. P
	<4 m/s^2	>4 m/s^2		
Very heavy	0	0	0	0.002
Heavy	0	2	2	
Moderate	0	2	2	
Light	0	10	10	
No Complaints	0	1	1	
Total	0	15	15	

Table-6 shows that of the 15 workers who work with vibration intensity > 4 m/s^2, 2 workers experience severe CTS complaints, 2 workers experience moderate CTS complaints, and 10 workers experience mild CTS complaints. and 1 worker who did not experience CTS complaints. The results of statistical tests with the chi-square test obtained a value of p = 0.002 where p 0.05 which indicates there is a significant relationship between vibration intensity and symptoms of carpal tunnel syndrome. The sign of positive correlation indicates that the two variables have a unidirectional pattern of relationship. This can be interpreted that the higher the intensity of vibration, the higher the symptoms of carpal tunnel syndrome, but on the contrary, the lower the level of vibration intensity, the lower the symptoms of carpal tunnel syndrome.

Based on the results of machine vibration measurements at CV Jati Mulia, it is known that the intensity of machine vibration exceeds the NAV for a long exposure of 8 hours per day so the intensity of machine vibration in the workplace exceeds the allowed NAV for a long exposure of 8 hours per day, this is not in accordance with Permenker No. Per.13/MEN/X/2011 states that the NAV of vibration of work tools that are in direct or indirect contact with the hands of the workforce is set at 4 m/s^2, for the length of exposure per working day which is 4 hours and less than 8 hours, so that the workforce

exposed to the vibration of the machine has the possibility of experiencing CTS complaints.

Based on interviews with operator workers at CV Jati Mulia Pematangsiantar, many complained of wrist pain while working due to exposure to the mechanical vibration of the sawmill machine. This is supported by research by Pangestuti, *et al* (2014) which states that the intensity of vibration experienced by lawn mower operators with vibrations exceeding the Threshold Value who do not wear gloves has an 87.2% risk of Carpal Tunnel Syndrome (CTS) symptoms. In addition to the intensity of the engine vibration above the NAB, also because there is no damper or damping installed on the machine that is in direct contact with workers which can inhibit the occurrence of carpal tunnel syndrome because the presence of a damper or damping the intensity of the vibration transmitted will be reduced and is expected to be at the set threshold is 4 m/s^2.

For this reason, it is better to reduce the occurrence of CTS guidelines or preventive tactics by changing work patterns by repeated use of hands, i.e. activity time and rest time synchronized, and apply pattern work based on priority so as to avoid usage activities excessive hands so that pain can be minimized.

Lubis (2017) states that awareness of the importance of using PPE such as gloves is due to workers' ignorance of the dangers posed by vibration, especially on the workers' arms. A low level of awareness about the use of personal protective equipment, namely gloves, can also have an effect on exacerbating exposure to vibrations in the workers' arms, where the vibrations directly propagate to the workers' arms without any reduction in vibration from the work tools. Workers generally do work, the position of the body or body parts is often monotonous so in the palm area, there is an emphasis on the median nerve, and this will cause CTS.

Efforts can be made by companies to reduce symptoms of CTS, namely by providing appropriate bearings or PPE to reduce vibration directly with workers and also providing education to workers about the importance of using personal protective equipment when working, especially for workers who continue to work with heavy machine vibrations related The importance of using PPE, especially gloves.

To prevent the occurrence of Carpal Tunnel Syndrome (CTS) symptoms in ergonomics is to control body posture, prevent repetitive movements, perform rotations and vibrations. One way to be considered vibration is with the use of gloves. The use of gloves must be adjusted to the size of the hand and protect the hands.

CONCLUSIONS

Machine vibration measurements at the sawmill machine operator at CV Jati Mulia exceed the NAV with an average machine A of 9.66m/s^2, an average machine B of 8.72 m/s^2 and an average engine C of 11.18 m/s^2. And the intensity of the vibration of the sawmill machine exceeds the Threshold Limit Value (NAV) with a long exposure of 8 hours per day. There is a significant relationship between machine vibration and complaints of carpal tunnel syndrome in sawmill machine operators. Tthe higher the engine vibration threshold value, the greater the possibility of carpal tunnel syndrome complaints. Efforts to control and prevent carpal tunnel syndrome complaints related to machine vibration, for example by providing foam gloves and providing vibration dampers to the machine.

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