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The Influence of Occupational Factors to Carpal Tunnel Syndrome on Administrative Workers in A Transportation Manufacturing Company

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Abstract. CTS is arranged in outer muscle problems. This infection is brought about by pressure of the middle nerve at the wrist. Occupational factors are work- related risk factors, such as working quickly, repetitive movements, work stress, work that uses a lot of wrists and vibrations. The motivation behind this study is to decide the impact of word related elements to CTS frequency on regulatory specialists. This study uses cross sectional design with 35 respondents as sample. To determine hand posture was carried out by observation and interpretation with RULA, measurement of repetitive motion use a stopwatch, and work stress use Stress Diagnosis Survey. Utilize the Phalen's Test and the Boston Carpal Tunnel Questionnaire to determine the incidence of CTS. The aftereffect of prescreening on managerial specialists uncovered that 40% laborers are positive for CTS. While the analysis uses binary logistic regression to determine the influence of occupational factors to CTS incident. Variables that influence CTS are repetitive motion of using mouse (p=0.005), repetitive motion of typing (p=0.027), and work stress (p=0.027). Therefore, it is necessary to give recommendations based on related variables (repetitive motion and work stress) in order to minimize the occurrence of CTS.

Keywords: Administrative Workers, BCTQ, Binary Logistic Regression, Carpal Tunnel Syndrome, Phalen's Test.

1 Introduction

The development of industry in Indonesia, include transportation sector, has grown rapidly according to technological advances and market demand for transportation facilities. One of them is a railroad manufacturing company. To produce quality products and in accordance with the requirements and specifications, it is necessary to prepare operational plans and reports for each production section. The scope of work is carried out by administrative personnel whose main job is data processing using computers.

Administrative work involves a combination of strength and repetitive motion of the wrist. The use of computers for more than 4 hours per day can result in wrist fatigue which is characterized by pain (Nafasa et al., 2019). Wrist pain is a symptom of CTS. In the general population, CTS affects 267 out of every 100,000 people annually. The incidence of CTS in the UK reaches 6-17% while in the United States it is 5% which is lower than in the UK (Ibrahim et al., 2012).

In Presidential Regulation No. 7 of 2019 about Occupational Diseases, Carpal Tunnel Syndrome is classified in musculoskeletal-disorders. Compression of the median nerve at the wrist causes CTS, a syndrome. The carpal passage contains the wrist bone, cross over carpal tendon, middle nerve, and computerized flexor ligament. Pain can be exacerbated by edema, tendon inflammation, hormonal changes, manual labor, and nerve compression. In more severe cases, median nerve muscle weakness can result in hand weakness(Padua et al., 2016). The most common symptom of CTS is tingling, numbness, weakness or pain felt in the fingers. Side effects that most frequently happen in the focal sensory system are the thumb, record, center, and half ring fingers.

The occurrence of Carpal Tunnel Syndrome is associated with work factors from the ergonomic aspect of awkward postures. Static positions and non-ergonomic postures on the shoulders, arms, and wrists for a long period of time can cause inflammation of the muscle tissue, nerves, or both. Repetitive motion is another factor that contributes to CTS.

In workplace, work pressure factor is related with the advancement of Business related Outer muscle Problems (WMSDs), including Carpal Passage Condition. In line with the research that show that there is a

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relationship between work stress and the occurrence of CTS. CTS has increased due to work stress with a hazard ratio of 1.86 (Harris-Adamson et al., 2016).

Based on the facts of these problems, the researchers are interested in raising the topic of research on the influence of occupational factors to Carpal Tunnel Syndrome on administrative workers in a transportation manufacturing company.

2 Method

This study used a cross-sectional design and is quantitative. It was performed on administration workers in a transportation manufacturing company. The number of populations is 41 workers include 35 males and 6 females. But the female workers were excluded because this study didn't involve gender as independent variable. So, this study was conducted on 35 respondents as sample.

The Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) was distributed as part of the pre-screening process to ensure that no worker experienced CTS symptoms. After that, Phalen's Test was used to categorize them as CTS or non-CTS. All members were educated in regards to the review subtleties and formal marked assent was gotten before any information were gathered.

2.1 Data Collection

Direct observation, face-to-face interviews with questionnaires, and taking photographs of the actual work are all methods of data collection. BCTQ and SDS are included in the questionnaire that was distributed. The symptom severity scale (11 questions) and the functional status scale (eight questions) are the two parts of the BCTQ. Each question is scored on a five-point scale (range 1-5) showing the level of CTS seriousness. Complete score of side effects seriousness scale was sorted into asymptomatic (11), gentle (12-22), moderate (23-33), extreme (34-44) and exceptionally Serious (45-55). Asymptomatic (8), mild (9–16), moderate (17–24), severe (25–32), and very severe (33–40) were the functional status scale categories.

From that point onward, Phalen's Test was done by the organization center specialist. In Phalen's test, the member was approached to hold the wrists in constrained flexion by pushing the dorsal surfaces of two hands together for 60 seconds causing expanded strain in the carpal passage. When this position brought back one of the symptoms of wrist pain, tingling, or numbness, the test was deemed positive.

Stress Diagnosis Survey (SDS) based on Ministerial Regulation No. 5 of 2018 include 30 questions. The factors that cause work stress were grouped into 6 categories (role equivocal, role conflict, quantitative workload, qualitative workload, career development, responsibility towards others). And then the total score was divided into 3 categories, which are mild stress (≤ 9), medium stress (10-24), and severe stress (> 24).

The taken pictures of hand postures was assessed using RULA Table. The total score divided into two categories, which are normal if total score ≤ 4 and awkward if total score > 4. While direct observation used stopwatch to measure repetitive motion of using mouse which classify as ≤ 10 times per minute and > 10 times per minute. Then repetitive motion of typing categorized as ≤ 60 words per minute and > 60 words per minute.

2.2 Statistical Analysis

The distribution of respondent characteristics, which were the categorical variables, were summarized using descriptive statistics. The nominal and ordinal scale are examples of non-parametric variables. Therefore, binary logistic regression was used in the analysis to determine the relationship between CTS and occupational factors such as right hand posture, left hand posture, repetitive mouse and typing motion, and work stress. The SPSS adaptation 26.0 programming was utilized for all factual examinations. Then, at that point, p esteem ≤ 0.05 was thought of as measurably huge.

3 Results

Boston Carpal Tunnel Questionnaire (BCTQ) that has been collected is processed to determine the total score of each scale. Furthermore, the total score on each scale is calculated and categorized into 5 (five) groups. The following in Figure 1 shows the level of CTS complaints based on the BCTQ score.

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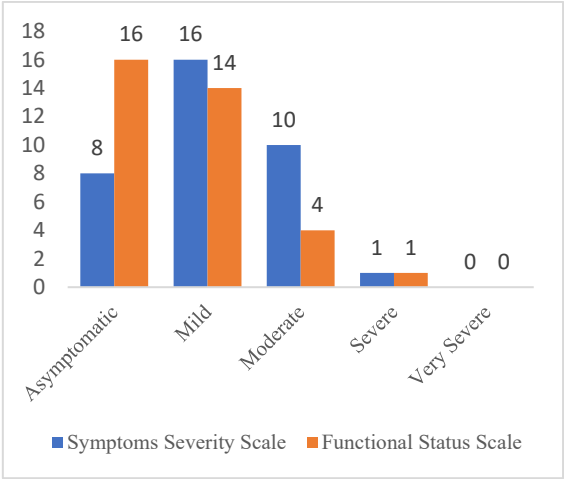

Figure 1. CTS Complaints Level of BCTQ.

Based on Figure 1, it is known that 77% respondents are symptomatic. On the severity scale, most workers feel mild complaints. While on the functional status scale, the most categories are asymptomatic. On both scales it is known that there are no workers who suffer very severe complaints.

The difference of frequency on two scales is due to different indicators in the BCTQ questionnaire question items. The symptom severity scale aims to determine the intensity of pain, tingling, and numbness felt by the respondent. While the score of the functional status scale is obtained from the difficulty level of the respondent when doing daily work. After that, Phalen's Test was carried out on 77% (27 respondents) who are symptomatic.

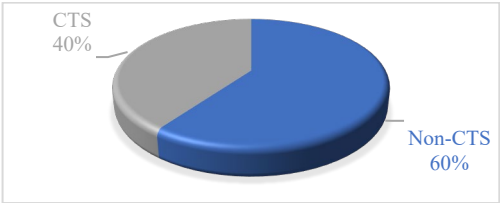

Figure 2. The Result of Phalen's Test.

From Figure 2, the final result shows 40% (14 respondents) are classifed as CTS while the other 60% (21 respondents) are non-CTS.

3.1 Distribution of Respondent Characteristics

After the primary data from all variables are completed, then it can be summarized to be distribution of respondent characteristics as shown in Table 1.

A majority of the 35 administrative workers in the CTS incident was non-CTS (60%) with normal hand posture 63% respondents. A majority of administrative workers who did repetitive of mouse use ≤10 times/minute about 57%. While repetitive motion of typing ≤60 times/minute 51% in majority and mild work stress is also 51% in majority. However, none of the respondents feel severe work stress.

Table 1. Univariate Analysis

Respondent's Characteristics	Frequency (n)	Percentage (%)
CTS Complaints		
Non-CTS	21	60
CTS	14	40
Right Hand Posture		
Normal	22	63
Awkward	13	37
Left Hand Posture		
Normal	22	63
Awkward	13	37

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Repetitive Motion of Using Mouse		
≤10 times/minute	20	57
>10 times/minute	15	43
Repetitive Motion of Typing		
≤60 words/minute	18	51
>60 words/minute	17	49
Work Stress		
Low	18	51
Medium	17	49
High	0	0

Because there is no respondent who feel severe work stress based on SDS questionnaire, so to do further analysis this category should be removed. Then continued to do binary logistic regression test as its steps below.

3.2 Binary Logistic Regression Test

In this review, parallel strategic relapse was utilized to dissect the impact of word related factors on carpal passage disorder occurrence. It has three stages. The first stage is concurrent test was used to determine whether there was at least one variable influence CTS.

Table 2. Simultaneous Test

Predictor Variables	Respon Variable	α	p – value
Right Hand Posture, Left Hand Posture, Repetitive Motion of Using Mouse, Repetitive Motion of Typing, Work Stress	CTS Incident	0.05	0.000

Based on Table 2, p value 0.00 ≤ 0.05. So that the results of this simultaneous test show that there is an influence between right hand posture, left hand posture, repetitive motion of using mouse, repetitive motion of typing, and work stress to CTS incident.

Table 3. Individual Test

Predictor Variables	OR	p-value
Right Hand Posture	0.667 (0.165 - 2.688)	0.569
Left Hand Posture	1.108 (0.272 - 4.509)	0.886
Repetitive Motion of Using Mouse	0.125 (0.027 - 0.580)	0.008
Repetitive Motion of Typing	0.200 (0.046 - 0.872)	0.032
Work Stress	0.200 (0.046 - 0.872)	0.032

From Table 3, it shows 3 independent variables influence CTS incident. There are repetitive motion of using mouse, repetitive motion of typing, and work stress. While right hand posture and left-hand posture didn't affect CTS incident.

The table also shows the OR of independent variables for the outcome CTS incident. Factors significantly related to CTS were repetitive motion of using mouse ≤ 10 times/minute compared with > 10 times/minute (OR = 0.125, 95% CI = 0.027 - 0.580), repetitive motion of typing ≤ 60 words/minute compared with > 60 words/minute (OR = 0.200, 95% CI = 0.046 - 0.872), mild work stress compared with moderate work stress (OR = 0.200, 95% CI = 0.046 - 0.872).

The binary logistic regression model that has been obtained is analyzed to assess a model according to the data and has explained the data. The suitability of the model is obtained through the output of the Hosmer and Lemeshow Test values.

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Table 4. Model Fit Test

Hosmer and Lemeshow Test		
Chi-square	df	p-value
2.107	6	0.910

From Table 4, the p-esteem is 0.910 which is with $\alpha \geq 0.05$. Therefore, the model fit test's findings are appropriate. This made sense of that there was no massive contrast between the noticed outcomes and the conceivable expectation brings about the framed model.

4 Discussions

After performed statistical tests using binary logistic regression test on occupational factors (hand posture, repetitive motion, and work stress) on CTS complaints as the dependent variable. Furthermore, a discussion is carried out related to the results of the hypotheses that have been obtained.

4.1 Analysis of Hand Posture to CTS

The results of measurements of right-hand posture and left-hand posture show that workers mostly worked with normal posture, which is 63%. In Table 3 for individual test shows p-value of right-hand posture variable is 0.569 and left-hand posture is 0.886. Both p-values are > 0.05, which means that the variables of right-hand posture and left-hand posture have no effect on CTS incident.

The consequences of this study are in accordance with research led on enrollment organization official at Dr. Soetomo Provincial Public Medical clinic, stated that there was no effect between hand posture and CTS (Rahardjo et al., 2020). In addition, the results of research on violinists also found that there was no effect between hand posture and CTS because violinists were comfortable with their position when playing the violin (Farahdhiya, Jayanti and Ekawati, 2020).

This variable is not a factor that influence CTS incident. This is because the workplace for administrative workers has an ergonomic layout. In light of Table 1, it shows that 63% of respondents work with typical hand stances. In addition, hand posture will change if the worker feels tired and within 8 hours does not work in a stagnant hand position.

However, this is different from the research that showed an influence between awkward posture and complaints of CTS in hairstylists (Erick et al., 2021). The movement of bending and straightening the arm and wrist, the position when the hand rotates, and the weight of a load being lifted can affect the value in determining the level of risk of work posture, where the higher the risk level, the greater the chance for Carpal Tunnel Syndrome to occur.

4.2 Analysis of Repetitive Motion to CTS

In collecting data for repetitive motions using the mouse, it is known that more workers perform movements ≤ 10 times per minute. As for repetitive motion of typing 51% from workers who type ≤ 60 words per minute. By using a confidence level of 95% ($\alpha = 0.05$) so that the independent variable that has a p-value or significance of ≤ 0.05 is considered to have a significant effect. In Table 3 shows the p-value of the repetitive motion of using mouse is 0.008 and repetitive motion of typing is 0.032. Which means that the variable repetitive motion of using the mouse or typing has an influence on CTS incident.

Although from the results of data collection more workers do not perform repetitive motion > 10 times/minute and > 60 words/minute, but this is also in line with Figure 1 which shows that the results of CTS incidents are indeed fewer. Repetitive motion that are done repeatedly cause inflammation of the tendon that lies along the carpal tunnel along with the median nerve. This can add to pressure of the middle nerve and lead to grumblings of wrist torment.

The consequences of this study are in accordance with research led by different scientists that there is a relationship and impact between tedious developments and CTS (Triana, Agustini and Bustamam, 2020). In addition, research among working population also found that there was a significant effect of repetitive movements on CTS complaints among workers (Romana et al., 2022). However, this is different from the research on online gamers which showed that repetitive motion had no effect on CTS incident (Pramandani and Wirawan, 2021).

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4.3 Analysis of Work Stress to CTS

The results of the SDS questionnaire indicated that no employees had experienced significant work stress. As numerous as 51% of laborers feel moderate work pressure and the rest are gentle. It very well may be seen that the p-worth of the work pressure variable for the calculated relapse test is 0.032.This shows that from the two factual experimental outcomes, the pvalue ≤ 0.05 implies that the work pressure variable impact to CTS.This influence is because administrative workers in the company get high job demands and continue to work according to job descriptions even though they feel stressed. Work stress can increase muscle tension which triggers muscle stiffness and musculoskeletal loads including tendons in it. The body's hydromineral balance is altered as a result, and sodium retention in fluids rises, triggering local nerve compression by edema in adjacent tissues at the onset of CTS.

The results showed in line with those of other studies that used the logistic regression test to show how CTS was affected by work stress(Rigouin et al., 2014). In addition, when explained the relationship between work stress and CTS by using a causal diagram with each variable, as well as proving the hazard ratio value of 1.86 (Harris-Adamson et al., 2016). However, a prospective surveillance study in a large working population stated that work stress did not affect CTS complaints (Petit et al., 2015).

5 Conclusions

This study found 40% respondents of administrative workers were classified as CTS. After carried out statistical analysis using binary logistic regression, showed that there were 3 variables that had an effect on CTS complaints. There are repetitive motion of using mouse, repetitive motion of typing, and work stress. While hand posture didn't affect CTS incident because the company had been accommodated ergonomic layout for administrative workers, proven by the collected data that showed 63% workers were working with normal posture.

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