



Carpal Tunnel Syndrome Complaints in Female Packing Workers

Rizka Faliria Nandini, Mona Lestari[✉], Novrikasari, Desheila Andarini, Anita Camelia, Poppy Fujianti

Study Program of Public Health Sciences, Faculty of Public Health, Sriwijaya University, Indonesia

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Abstract

The estimated prevalence of Carpal Tunnel Syndrome (CTS) in the general population is 1-5%. CTS can be experienced by workers who use hand strength at work. PT. X is one company that still uses manual labor in the process of packing soap and vermicelli. The purpose of this study was to determine the correlation between repetitive movements, wrist posture, age, history of illness, Body Mass Index (BMI), and years of service on CTS complaints. The research method used a cross-sectional study with a sample of 65 workers. Univariate, bivariate, and multivariate data analyses were using the chi-square and binary logistic regression test. Analysis of CTS complaints using a questionnaire and Phalen's test. The results showed that as many as 40 workers (61.5%) experienced complaints of CTS. The results of statistical tests showed that the variable BMI was the most influential factor for the complaints of CTS ($p = 0.031$). In addition, workers who experience CTS complaints can also be influenced by repetitive movement ($p = 0.024$), age ($p = 0.022$), and years of service ($p = 0.024$). To prevent the severity and relieve complaints of CTS, packing workers can do stretching, massage, independent acupressure massage, and maintain a healthy lifestyle.

Introduction

Demands for meeting the economic needs are increasing. It makes the production activity for goods or services increase. In the production process, human labor is still often used, especially in the packaging and transportation process. However, in human labor usage, there are limitations in both physical and non-physical abilities. Having an impact on the emergence of disorders called musculoskeletal disorders (MSDs). Sulaiman study concluded that MSDs are some of the most common health problems in the workplace around the world that can cause disability, reduced human performance, and reduced quality of life (Sulaiman, P, Ibrahim, & Nuhu, 2015). MSDs are a group of health problems in the function of muscles, tendons, and nerves. One example of an MSDs disorder is Carpal Tunnel Syndrome (CTS). CTS is a peripheral compression induced neuropathy, also known

as a set of symptoms caused by compression or injury to the median nerve in the wrist, and often occurs in working-age adults (A Rhode & Rhode, 2016; Cazares-Manríquez et al., 2020; Duncan, Bhate, & Mustaly, 2017; Newington, Harris, & Walker-Bone, 2015). Complaints or symptoms that often arise are pain, numbness, and tingling in the hands (Inji, Goddard, Khan, & Smitham, 2012).

The estimated prevalence of CTS in the general population ranges from 1 - 5% of the general population with an annual incidence of 72 per 100,000, while the CTS prevalence among workers is 1.7% to 21% of the population (Dale et al., 2013; Gyanchandani & Chaudhry, 2020; Jenkins, Watts, Duckworth, & McEachan, 2011). From 2007 to 2014, as many as 139,336 cases of workers in California were reported to have suffered from CTS (6.3 cases per 10,000 full-time workers) with a high risk, especially in the clothing industry, food, and beverage

[✉] Correspondence Address:

Study Program of Public Health Sciences, Faculty of Public Health, Sriwijaya University, Indonesia

Email : mona_lestari@unsri.ac.id

packaging, as well as administrative work in offices where workers do repetitive movements or maintaining an unergonomic work posture (Jackson, et al., 2018).

Based on the data mentioned in previous paragraphs, it can be concluded that there is a positive correlation between jobs involving repetitive hand movements and the incidence of CTS. However, the prevalence of occupational diseases, especially CTS in work problems in Indonesia, is not yet known. It is because there are still very few, even no occupational diseases, reported either to companies, health facilities, or the government. The prevalence of CTS cases in Indonesia can be seen in several previously mentioned study data. According to a previous study, most of the respondents diagnosed with CTS were women (80,4%) and people aged 40-60 years old (67,4%) (Emril, Zakaria, & Amrya, 2019). However, other research states that CTS for men and women is not significantly different, especially if the work is the same (A Çirakli & Ekinici, 2018). That is until a follow-up study was conducted to determine the differences in male and female risk factors for CTS by measuring the cross-sectional area of the carpal tunnel. As a result, the average cross-sectional area of the female carpal tunnel is smaller than that of men ($p < 0.05$). Therefore, in theory, this could be a significant factor (Sassi & Giddins, 2016).

The prevalence of CTS including in Batik workers in several studies is 43.96% among female subjects aged 36-50 years old, has a working period of more than five years, and standard body mass index (Setyaningrum et al., 2019), and 68,8% among females aged 36-45 years old, with work period of more than ten years, and having a high-risk work attitude (Khomairoh & Widajati, 2020). Bahrudin also argues that CTS is influenced by mechanical and vascular factors such as BMI, gender, age, and history of illness (Bahrudin, 2011). The occurrence of CTS is characterized by the appearance of sensations such as tingling and numbness, as well as increased weakness in the muscles (Wolny, Linek, & Saulicz, 2019). In addition, years of work are also a risk factor as workers engage in increasingly frequent repetitive movements that can cause

compression of the carpal tunnel network.

Work in goods packing is one of the occupations having the CTS potential, especially those that still use human labor to perform statical repetitive movements. The same study was carried out on workers in the sauce and soy sauce industry in Karanganyar. They installed bottle caps using a press machine with hand power. It was stated that workers often complained of pain, fatigue, and numbness in the arms (Setyawan, 2017).

PT. X is one of the companies that still use humans in the packaging of soap and vermicelli. Work positions are mainly standing and bending down with monotonous wrist movements that include outreaching, grasping, and transporting goods. Based on preliminary observations, these movements make workers often feel pain and tingling in their wrists. Therefore, further research is needed to determine the correlation between repetitive movements and wrist posture as well as individual characteristics such as age, BMI, medical history, and length of service with complaints of CTS.

Method

This study is an observational analytic study with a cross-sectional study design to determine the correlation between the independent variable (risk factor) and the dependent variable (impact) by measuring and assessing it at one time. The total sample was 65 workers in soap and vermicelli packing activity at PT.X. All are female. Univariate, bivariate, and multivariate data analysis used the chi-square and binary logistic regression statistical test. CTS complaints in workers were analyzed using a modified Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) questionnaire and conducting a Phalen test to determine the occurrence of complaints carried out for 60 seconds by flexing both palms at an angle of 90° with the help of a physiotherapist. In addition, a RULA assessment observation sheet was used to measure wrist posture, stopwatch, and job scoring tables was used to measure repetitive movement, as well as a Mechanical Stadiometer to measure the worker's height and weight.

Result and Discussion

This research was conducted at PT. X in the packing section involving repetitive movements of the wrist. Based on the univariate results, there were 40 out of 65 packing workers who experienced CTS complaints (61.5%), 41 workers doing repetitive movements of ≥ 30 actions in one minute (63.1%). 37 whose wrist posture was in a high-risk level based on the assessment using the RULA method (56.9%), 48 are aged ≥ 30 years old (73.8%), 16 had an abnormal body mass index (24.6%), 20 had a history of illness (30.8%), and 41 had a work period of ≥ 4 years (63.1%) (Table 1).

The bivariate analysis found that the repetitive movement variable (p-value = 0.024), age (p-value = 0.022), BMI (p-value = 0.031), and years of service (p-value = 0.024) were statistically related to CTS complaints. Whereas wrist posture (p-value = 0.373), and history of illness (p-value = 0.510) were not statistically associated with complaints of CTS (Table 2).

Table 1. Univariate Analysis

| Variables | n = 65 | % |
|---|--------|------|
| CTS complaint | | |
| Yes | 40 | 61.5 |
| Not | 25 | 38.5 |
| Repetitive Movement | | |
| Yes (≥ 30 actions in 1 minute) | 41 | 63.1 |
| No (< 30 actions in 1 minute) | 24 | 36.9 |
| Wrist Posture | | |
| High Risk | 37 | 56.9 |
| Moderate Risk | 28 | 43.1 |
| Age | | |
| ≥ 30 Years | 48 | 73.8 |
| < 30 Years | 17 | 26.2 |
| BMI | | |
| Abnormal (> 25 or < 18 kg / m ²) | 16 | 24.6 |
| Normal (18.5 - 25 kg / m ²) | 49 | 75.4 |
| History of Illness | | |
| Has History of Illness | 20 | 30.8 |
| No History of Illness | 45 | 69.2 |
| Years of service | | |
| ≥ 4 years | 41 | 63.1 |
| < 4 Years | 24 | 36.9 |

Source : Primary Data, 2020

Table 2. Bivariate Analysis

| Variables | CTS Complaint | | | | p-value | PR (95% CI) |
|----------------------------|---------------|------|----|------|---------|---------------------------|
| | Yes | | No | | | |
| | N | % | N | % | | |
| Repetitive Movement | | | | | | |
| Yes | 30 | 73.2 | 11 | 26.8 | 0.024 | 3,818 (1,315 - 11,084) |
| Not | 10 | 41.7 | 14 | 58.3 | | |
| Wrist Posture | | | | | | |
| High Risk | 25 | 67.6 | 12 | 32.4 | 0.373 | 1,806 (0,565 - 4,970) |
| Moderate Risk | 15 | 53.6 | 13 | 46.4 | | |
| Age | | | | | | |
| ≥ 30 Years | 34 | 70.8 | 14 | 29.2 | 0.022 | 4,452 (1,377 - 14,394) |
| < 30 Years | 6 | 35.3 | 11 | 64.7 | | |
| BMI | | | | | | |
| Abnormal | 14 | 87.5 | 2 | 12.5 | 0.031 | 6,192 (1,270 - 30,192) |
| Normal | 26 | 53.1 | 23 | 46.9 | | |
| History of Illness | | | | | | |
| Has History of Illness | 14 | 70.0 | 6 | 30.0 | 0.510 | 1,705 (0,554 - 5,250) |
| No History of Illness | 26 | 57.8 | 19 | 42.2 | | |
| Years of service | | | | | | |
| ≥ 4 years | 30 | 73.2 | 11 | 26.8 | 0.024 | 3,828 (1,315 - 11,084) |
| < 4 Years | 10 | 41.7 | 14 | 58.3 | | |

The results of the multivariate analysis showed that the BMI variable was the most influential factor to CTS complaints among female packing workers at PT.X (p-value = 0.031). The final modeling results showed that

workers with an abnormal BMI (> 25 or < 18 kg/m²) have a 6.9 times higher risk of experiencing CTS complaints compared to workers with normal BMI (18,5-25 kg/m²) after being controlled by the repetitive movement variable,

age, and years of services. In addition to the BMI variable, the multivariate test results also showed that years of service were associated with CTS complaints (p-value = 0.048). With

a 95% degree of confidence, workers with ≥4 years of service have 3.4 times higher risk than workers with < 4 years of service to experience CTS complaints.

Table 3. Final Modeling in Multivariate Analysis

| Variables | B | p-value | OR | 95% CI |
|---------------------|--------|---------|-------|--------------|
| Repetitive Movement | 1.030 | 0.104 | 2.802 | 0.809-9.704 |
| Age | 1.083 | 0.118 | 2.953 | 0.760-11.466 |
| BMI | 1.929 | 0.031* | 6.881 | 1.193-39.697 |
| Years of services | 1.224 | 0.048* | 3.401 | 1.013-11.419 |
| Constant | -2.050 | 7.022 | | |

*: Significant

The multivariate test results can be made into a model to determine the probability of workers experiencing CTS complaints. The results of the Hosmer and Lemeshow Test showed the number 0.740 (p-value>0.05). It means that the model below is per the actual

situation. A worker with an abnormal BMI has ≥4 years of service, performs ≥30 actions of repetitive movements in 1 minute, and is ≥30 years old has a 96% chance of experiencing CTS complaints.

$$CTS = \frac{1}{1 + e^{-(-2.050 + 1.929 BMI(Abnormal) + 1.224 Years of Service(≥4 years) + 1.030 Repetitive Movement(Yes) + 1.083 Age(≥30 years))}} \tag{1}$$

The results showed that as many as 40 workers (61.5%) complained of tingling and pain in the wrists after conducting the Phalen test and interview for symptoms using the BCTQ questionnaire. Complaints are experienced while working and finishing work due to the repetitive movements' frequency for a long time with flexion and extension movements during packing activities. This result is per the study by Musolin which stated that 42% of workers who work in the production section experience CTS characterized by decreased nerve conductivity and the onset of symptoms (Musolin, Ramsey, Wassell, Hard, & Mueller, 2014). Symptoms and signs of CTS are caused by compression (pressure) on the median nerve in the carpal tunnel (Gyanchandani & Chaudhry, 2020). Symptoms of CTS include paraesthesia (tingling), numbness, and pain in the hands which are also caused by temporary ischemia of the compressed median nerve (Zamborsky, Kokavec, Simko, & Bohac, 2017). Workers can do stretching for the muscles in the wrists, hands, and arms areas to prevent

and relieve symptoms of CTS. A study by Shem stated that a self-myofascial stretching of the carpal ligament could be a relatively modest treatment option for people with CTS (Shem, Wong, & Dirlikov, 2020).

Repetitive movements are movements in work activities carried out repeatedly, as many as 73.2% of the packing workers at PT. X doing repetitive movements has complaints of CTS. Determination of repetitive motion assessment of the wrist is carried out based on the riskiest limb used in packing activity which is the right hand. The results of this study indicate that there is a statistical correlation between repetitive movements and complaints of CTS in packing workers (p-value = 0.024). While the multivariate results show that repetitive movements are one of the confounding variables. The repetitive movements carried out by the female packing workers include outreaching, packaging, and transporting goods to the collection point. From the results of observations and calculations using a stopwatch, it was found that the total frequency

of repetitive motion actions performed by packing workers was 25 to 47 times per minute, with an average above ten times. Working hours start from 8 am to 4 pm so that workers perform repetitive movements for 7 hours per day and 42 hours per week.

This study is in line with the Newington which concluded that there was a positive correlation between CTS and work that involved the highly repetitive movement of the hands (Newington et al., 2015). In theory, rapid repetitive movements involving the wrist joint performed every day at work more than 30 times a minute can cause tendinitis (inflammation of the tendons) that results in compression of the nerves, affecting the blood supply to the hands and wrists (Mallapiang & Wahyudi, 2014). Repetitive movements over a long period can also cause stress to the network around the carpal tunnel which causes the carpal tunnel to become narrow (Setyowati, Dwijayanti, & Sultan, 2015)

Wrist posture is a vital element in work activities. The posture can affect the concentration and productivity of workers. As many as 67.6% of packing workers have a high-risk level and experience complaints of CTS. The results of this study indicate that there is no statistical correlation between wrist posture and complaints of CTS (p -value = 0.373). Based on the observations, the absence of this correlation is due to the unergonomic wrist posture carried out by the packing workers was not maintained for a long time because they still have to perform various other movements causing the wrist position to change repeatedly. The non-ergonomic posture that is done is when the wrist is in a position of flexion and extension during the activity of packing soap and vermicelli.

Though the statistical tests did not show any correlation, study data showed that most of workers who experienced CTS complaints and wrist posture were at high risk (67.9%). These results indicate that wrist posture can be a risk factor for CTS complaints in workers if this factor is not controlled. A study by You found that prolonged non-neutral wrist postures created two times increased risk for CTS compared to non-neutral wrist posture in a short period (You, Smith, & Rempel, 2014).

Extension of the wrist causes pressure on the dorsal retinaculum extensor. It increases space in the volar carpal ligament on the volar side, which then pushes the volar carpal ligament out of the carpal bone. The dislocated volar carpal ligament causes additional pressure in the carpal tunnel. When the wrist is in a flexed posture, the flexor of the retinaculum compresses the flexor of the tendons beyond its radius. This pressure results in additional pressure on the fluid and will affect the movement of the flexor tendons. This movement causes internal friction (shift), which can affect the median nerve (Duncan et al., 2017).

Age is a number that describes the length of a person's life from birth to the research was conducted. Based on the results, workers aged ≥ 30 years experienced more CTS complaints, namely as many as 34 people (70.8%). The results of this study indicate a statistical correlation between age and complaints of CTS (p -value = 0.022). While the multivariate analysis showed that age is one of the confounding variables. It is in line with Zyluk's research that there is a correlation between age and CTS with the highest number of patients was in the age range of 40 - 65 years (Zyluk & Puchalski, 2013).

Bray's theory states that age is one of the risks closely related to CTS because of the reduction in the synovial fluid causing swelling of the joints as a person gets older (Bray, 1985). A person aged ≥ 30 years will also experience degeneration, including tissue damage, formation of scar tissue, and a reduction in the fluid, which causes the stability of bones and muscles to decrease (Ashworth, 2010). In addition, the potential for increased risk of CTS is also associated with axon loss, development of nerve conduction, and blood vessel abnormalities because the older a person is, the more disease complaints are felt, especially those who work in places that require excessive energy (Komurcu, Kilic, & Anlar, 2014)

BMI is a condition that shows a person's nutritional status, obtained by calculating calculating the ratio between body weight and height. The Ministry of Health of the Republic of Indonesia classifies the BMI range into 3, namely underweight (<18 kg/m²), standard (18.5-25 kg/m²), and overweight (>25 kg/m²), while in this study the BMI range was

divided into 2 i.e. abnormal BMI is in the range >25 or <18 kg/m² and normal BMI is in the range of 18.5-25 kg/m². Based on the results through measurement of height and weight calculated using the formula, 14 packing workers who had an abnormal BMI (87.5%) had complaints of CTS. The results of this study indicate a statistical correlation between BMI and complaints of CTS (p-value = 0.031). The multivariate results showed that BMI is the influential factor for CTS complaints among female packing workers at PT.X. Study by Shiri stated that overweight and obesity can increase the risk of CTS by 1.5 and 2 times higher (Shiri, et al, 2015).

The American Obesity Association states that 70% of all CTS sufferers are overweight. Excess body weight (abnormal BMI) was reported as a risk factor for CTS (Shiri et al., 2015). The over-weight condition can lead to an increase in fluid accumulation in the carpal tunnel network. BMI has also reported as a risk factor for CTS because of a causal relationship between CTS and BMI due to increased fat tissue in the carpal tunnel or increased hydrostatic pressure across the carpal tunnel in obese individuals (Ghali, Murugasu, Day, & Nicholls, 2012; Shakir Eman A, 2017). A motor and sensory study on 38 obese CTS patients also stated that obesity could cause severity in the carpal tunnel network (Mansoor et al., 2017). Therefore, weight loss can be a therapy for CTS sufferers as well as a preventive measure by maintaining health.

History of illness is a person's experience with certain diseases. 14 packing workers had a history of illness and had complaints of CTS (70.0%). The results of this study indicate that there is no statistical correlation between illness history and complaints of CTS (p-value = 1.705). It means that a person who has a history of illness that causes CTS (diabetes mellitus, rheumatoid arthritis, wrist trauma, and fractures) does not always suffer from CTS. However, it is different from other studies which state that a history of illness can cause complaints of CTS such as rheumatoid arthritis, which causes tingling sensations in the morning, diabetes mellitus which can cause focal demyelination accompanied by axonal damage due to compression in the carpal

tunnel, fractures or dislocations due to synovial inflammation and fibrosis in tenosynovitis, fractures of the carpal bones, and thermal injuries to the hands or forearm (Solmaz et al., 2017).

Years of service is the total working time a person has in a workplace from when they first start working until currently. Packing workers who have years of service of ≥ 4 years and experience CTS are 30 people (73.2%). The results of this study indicate a statistical correlation between years of service and complaints of CTS (p-value = 0.024). After the multivariate analysis, it was found that years of service was one of the factors that influenced CTS complaints (p-value = 0.048) after being controlled with repetitive movement variables, age, and BMI. This study is in line with the research of Riccò in female workers in visual display units where there is a correlation between years of service and an increased risk of CTS (p-value = 0.019) (Riccò, Cattani, & Signorelli, 2016). Khoimaroh and Widajati's study also states that years of service is associated with CTS complaints because of repeated and excessive hand and finger movements through the years (Khomairoh & Widajati, 2020).

A person who works in a workplace exposed to repetitive movements within ≥ 4 years has a higher proportion of CTS because the increasing number of working years will increase the amount of time to do repetitive activities (Burt et al., 2013; Setyowati et al., 2015). CTS is a musculoskeletal disorder that does not have an immediate impact but takes time and is caused by continuous exposure to risk factors for a long time. Repetitive hand movements cause a two times higher risk of developing CTS. Because the longer the working period, the more frequent repetitive movements will occur, causing compression of the tissue around the carpal tunnel. The injuries can occur in months or years, depending on the severity or severity of the trauma.

Conclusion

Packing workers at PT. X experiencing CTS complaints was 61.5%. The results of the bivariate analysis showed that repetitive movements, age, BMI, and years of service

were associated with CTS complaints, while the results of the multivariate analysis showed that BMI was the most influential factor for CTS complaints (p-value = 0.031). To prevent the severity and relieve complaints of CTS, workers are expected to carry out a series of stretching movements on the wrist for 5 minutes every 3-4 times a day, do a massage or small massage on the wrist by opening the narrowed carpal tunnel, perform “acupressure” massage by pressing around 2-3 fingers under the palms of the hands for 30 seconds, as well as providing dissemination about the cultivation of a healthy lifestyle to the workers so that they always maintain an ideal weight.

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