

## **Risk Factors for Carpal Tunnel Syndrome in Informal Sector Workers: *Literature Review***

**Hubaybah<sup>1</sup>, Muhammad Iqbal<sup>2</sup>, Budi Aswin<sup>3</sup>, Ismi Nurwaqiah Ibnu<sup>4</sup>, La Ode Reskiaddin<sup>5</sup>**

<sup>12345</sup> Public Health Study Program, Jambi University, Jambi

Correspondence : Muhammad Iqbal

Email : [mhdiqbal619@gmail.com](mailto:mhdiqbal619@gmail.com)

### **Abstract**

CTS is one of the diseases that occurs in many workers so it is often referred to as work-related Carpal Tunnel Syndrome. The high number of informal workers allows for high accidents in the workplace. The purpose of this study is to discuss the risk factors for the incidence of CTS in informal sector workers. This research is a descriptive research with the literature review method. The literature search strategy uses a prism flow chart, and inclusion and exclusion criteria. The databases used include: PubMed, Taylor and francis, and Google Scholar. From the 20 articles, 19 of them used the cross-sectional type of research, and 1 article used the case-control type of research. The types of informal work obtained from the 20 articles are: motorcycle taxi drivers, farmers, batik and bead craftsmen, blacksmiths, stone breakers, meatball sellers, coconut peelers, woodcarvers, tailors, angkot drivers, small-scale convection, hairstylists, and butchers. Overall, the journal articles obtained discuss related to the risk factors for the incidence of CTS in informal sector workers. Repetitive movements, length of service, length of work, hand posture (awkward), age, gender, and body mass index were found to influence the incidence of CTS in informal sector workers. Meanwhile, grasping work and a history of diabetes mellitus were not found to be related to the incidence of CTS in informal sector workers.

**Keywords:** Risk Factors, Carpal Tunnel Syndrome, Literature Review, Informal Sector Workers

### **INTRODUCTION**

*The National Health Survey (NHIS)* study estimated the prevalence of CTS in adults at 1.55% (2.6 million). CTS is more common in women than men between the ages of 25-64 years, and is most common in women over the age of 55 years, but is usually more common between the ages of 40-60 years. The proportion of CTS in the general population is estimated at 5% for women and 0.6% for men. The syndrome is unilateral in 42% of cases (29% right, 13% left) and bilateral in 58% of cases(1).

With a record 76,69 million people employed in the informal sector, Indonesia's informal sector is industrializing at a faster rate than the formal sector. As a result, there is a greater likelihood of workplace accidents, as well as an increased number of workplace risks. Workplace accidents can result in direct or indirect problems, such as damage to equipment and machinery used, damage to the environment, and stoppage of industrial processes(2).(2)

Informal sector workers themselves are identical to working without a *Standard Operating Procedure* (SOP). Work in the informal sector usually also does not provide insurance when a work accident occurs. As a result, if it does not receive attention, it can trigger an increase in accidents and occupational diseases given the high prevalence of CTS and the high number of informal workers in Indonesia. *Carpal tunnel* syndrome is one of the musculoskeletal problems

caused by many things such as: poor hand posture when working, working too long, continuous repetitive movements, age and length of service.

Informal sector work itself includes many activities with repetitive movements, excessive work, non-ergonomic hand postures, examples of work such as : motorcycle taxi drivers, rubber tappers, stone crushers, batik, carvers, blacksmiths, hairdressers, meat cutters and public transportation drivers. it is known that these jobs are triggers for CTS. Most of these jobs rely heavily on hand strength. Hand positions that are not ergonomic, repetitive motion movements continuously, this can cause stress on the wrist to the occurrence of *carpal tunnel syndrome*. the purpose of this study was to determine the factors related to CTS in workers in the informal sector.

## METHOD

The study strategy used is descriptive with a *literature review*. Literature review is a comprehensive overview of previous research on a particular issue. The overview informs the reader of what is known and what is not known about a topic, establishing the need for new investigations, which will be conducted by the research associated with the literature review(3).

The population of this study consisted of worldwide and national research publications identified in Basedata, PubMed, Taylor & Francis Online, and Google Scholar. related to the research title, namely the risk of carpal tunnel syndrome incidence in informal sector workers.

In this study, the sample consisted of 20 research articles, 16 of which were national research articles and 4 of which were foreign research articles that met the parameters for further review.

## RESULTS

Twenty journal articles that met the inclusion criteria, based on the topic of *literature review*, namely risk factors for *carpal tunnel syndrome* (CTS) in informal sector workers. Of the twenty journals nineteen of them used cross sectional research, one journal used case control research. Most of the research designs used are quantitative research designs. The types of informal work obtained from the 20 articles are: motorcycle taxi drivers, farmers, batik and bead craftsmen, blacksmiths, stone breakers, meatball sellers, coconut skin peelers, wood carvers, tailors, public transportation drivers, small-scale convection, hairdressers, and meat cutters. Overall, the journal articles obtained discuss the risk factors for *carpal tunnel syndrome* in informal sector workers. The following is a list of the results of research articles found by region:

**Table 1. Journal article search results by region/country**

No	Region/Country	Number of Articles
1	Indonesian	16
2	France	1
3	Botswana	1
4	Iran	1
5	Thailand	1
	Total	<b>20 Articles</b>

## **DISCUSSION**

The results of the researcher's literature study are presented in a chart based on the research conceptual framework, namely risk factors for carpal tunnel syndrome in the informal sector including work factors such as ; repetitive movements, length of service, length of work, grasping work, and hand posture (awkward) while personal factors such as ; age, gender, diabetes mellitus, and body mass index. In the discussion section, the researcher relates the results of the study based on the conceptual framework, and supporting theories that have been summarized in the literature review.

### **1. Repetitive Motion**

According to the findings of the literature review, 8 out of 20 studies examined the relationship between repetitive movements and the prevalence of carpal tunnel syndrome in workers in the informal sector. Eight studies stated that there was a correlation between repetitive movements and the incidence of *carpal tunnel syndrome* in informal sector workers.

Repetitive movements of the hand generally involve movements of the hand or wrist or fingers such as hand gripping or wrist flexion and extension, ulnar and radial deviation, and supination and pronation. Most of the studies found activities or jobs that trigger repetitive movements. Increased repetition of the same movements every day increases the risk for tendinitis. This damage can cause nerve compression and lead to CTS. Repetitive movements will increase the pressure on *carpal tunnel syndrome*.

The results of a study conducted in France that exposure to physical wrist stress is common as almost half of the farmers. Workers (49,3%) were exposed to at least one of the five physical wrist stressors studied. The main physical factors were high physical activity (25,1%), frequent awkward wrist postures (24,3%) and repetitive hand movements (21,4%), followed by hand-transmitted vibration (12,7%) and repetitive/strong grip (4,7%)(4).

In the research of Nanda Wulantika GAN et al (2021), sculpting and grinding sculptures, there are activities using equipment such as wooden hammers, grinders. If workers do not pay attention to the ergonomic posture of the hands when doing work, it can injure workers, cause pain, numbness, and tingling, and if it is not found, it can worsen the worker's condition. CTS is one of the disorders that can arise as a result of this work. Sculptors and stone tray makers use hammers and carving tools to perform repetitive reaching motions and apply direct pressure to the wrist. CTS is a possibility(5).

In Aprilia's research, NP. 2021 showed a p value <0,05. Because the p value <0,05, it can be interpreted that the more the frequency of repetitive movements performed in one duration of time, the complaints of CTS incidents suffered by workers will increase. Conversely, the lower the frequency of repetitive movements performed in one duration of time, the lower the complaints of CTS incidence suffered by workers (6). The results of a similar study by Setyoaji also showed a correlation between repetitive movements and the incidence of CTS(7).

Other in line results found that the results of statistical tests using the exact fisherman test at the 95% confidence level or = 0,05 resulted in sig (0,020) (0,05), indicating that there is a relationship between repetitive motion and complaints of carpal tunnel syndrome in stone crusher workers in North Moramo District, South Konawe Regency(8). Two more studies produced research findings in the same direction, namely by Wulandari, NN. et al. (2016)(9) and Wahyuni et al (2017)(10) found that there was a significant relationship between the frequency of repetitive movements and the incidence of CTS.

According to the assumptions of researchers, almost all jobs in the world use hands, meaning that when working it cannot be separated from using the muscle strength of the hands. The higher the frequency of working with hands, the greater the likelihood of repetitive movements so that the hands experience stress and overexertion in a more serious level the worker can experience *carpal tunnel syndrome*. This means that there is indeed a relationship between repetitive movements and the incidence of CTS in informal workers supported by the 8 studies above which also state that there is a relationship between the two. Therefore, excessive repetitive movements at work must be minimized in order to remain productive and can achieve maximum results. workers who do something with repetitive movements that involve the movement of hands, wrists, or fingers will be at risk of developing *carpal tunnel syndrome*. two other studies stated there was no relationship.

## **2. Years Of Service**

Based on the results of the literature study, 5 out of 20 articles examining the correlation of a worker's working period with the incidence of *carpal tunnel syndrome*. five articles state that there is a relationship between working period and the incidence of *carpal tunnel syndrome* in informal sector workers.

Another study by Setyawan, H (2017) also found that the results of bivariate analysis showed no significant relationship between work period and carpal tunnel syndrome ( $p$  value = 0,312)(11).

According to research by Nurdasari, A. (2021), workers with a work period of < 4 years have more potential to experience CTS events (12).

Reinforced by other research by Irmayani et al (2021) shows that there is a relationship between tenure and the incidence of CTS in public transportation drivers in Lubuk Pakam ( $p$  = 0,034)(13).

The results of the Chi-Square test between the duration of work and the incidence of CTS resulted in  $p = 0,009$  (0,05), indicating that there was a meaningful relationship between the period of work and the incidence of CTS in the previous study. This is in line with research on repair workers who have worked for more than 7 years and are at risk of CTS(9).

However, in one study by Rohmah S (2016) based on bivariate analysis of the relationship between work period and CTS, 5 workers (35,7%) with a work period of less than 1 year experienced CTS and as many as 10 workers (38,5%) with a work period of more than 1 year experienced CTS. The results of bivariate analysis showed a  $p$  value > 0.1 (Sig. = 1,125) which means that there is no significant relationship between work period and CTS. While based on the calculation of risk estimate (OR) obtained  $\exp(B) = 1,125$  (0,363 – 3,490), meaning that workers who work more than one year have a risk of 1,125 times to experience CTS compared to workers who work less than 1 year (14).

Basically, the working period is the overall time of workers in the workplace from entry to a certain time. This means that it can be said that workers with a long working period or more than 5-10 years have relatively long struggled with their work and have automatically met and carried out activities that can trigger CTS. The longer working period is at risk of causing *Carpal Tunnel Syndrome*, this happens because the longer the working period there will be repetitive movements of the hand continuously for a long period of time so that it can cause stress on the tissue around the carpal tunnel. Supported by 5 articles that state there is a relationship between tenure and CTS. However, 1 article states that there is a relationship between tenure and CTS if the worker has worked for > 1 year. This means that workers with or who have worked for a longer period of time are more likely to develop CTS.

### **3. Length Of Working**

Based on the results of the literature study, 5 out of 20 studies discussed the correlation between the length of work of a worker and the incidence of *carpal tunnel syndrome*. Four studies stated that there was a relationship between the amount of time spent at work in relation to the occurrence of carpal tunnel syndrome in informal sector workers. While one other study states that there is no relationship between the period of work and the incidence of *carpal tunnel syndrome* in informal sector workers.

The study by Nurdasari, A. (2021) variable length of work which also has a significant relationship with a p-value = 0,000. In addition, the results of multivariate analysis using multiple logistic regression tests show that length of work affects the potential incidence of CTS because the probability value is 0,000 (12).

Research by Sekarsari, D. obtained sig (0,032) <  $\alpha$  (0,05) As a result, in North Moramo District, South Konawe Regency, a correlation was obtained between the amount of time spent doing work related to Carpal Tunnel Syndrome (8).

These two studies are also in line with research by Irmayani, et al. (2021)(13) and Aprilia NP, et al. (2021)(6) which show that there is a relationship between length of work and the incidence of *carpal tunnel syndrome*.

However, inconsistent results were obtained in the research of Wahyuni, et al (2017) Based on the results of data analysis on the variable duration of work per day with *Carpal Tunnel Syndrome* (CTS), it shows that (p value 0, 429;  $\alpha$ : 0,05) which means that there is no relationship between work duration and CTS in bead craftsmen in Pampang Village, Samarinda City (10).

As we know, the longer the hand is used to carry out activities continuously for a long time a day (>8 hours), it will trigger inflammation of the tissue around the wrist nerve so that it can cause *carpal tunnel syndrome*. This is also supported by the 4 studies above which state that there is a relationship between length of work and the incidence of CTS. Here it can be concluded that the length of work is indeed related to the incidence of CTS, especially those who work continuously without any breaks and work more than 8 hours. Those with more than 8 hours of work are more at risk of developing CTS. thus why 1 study states it is not in line.

### **4. Grasping Work**

Research by Sekarsari, D. et al. (2017) For long periods of time, workers who break stones bang tools repeatedly while holding them firmly, and their joint posture is poor/exaggerated. Over long periods of time, workers also perform many flexion and extension movements. When performed frequently and over a long period of time in a high-intensity manner, it can create several disorders, especially in the hand i.e. CTS(8).

According to the researcher, grasping work is included in the risk category but in some jobs such as chili pickers, and meatball sellers are not at risk, this is because some of these workers do not do work by grasping tools and do grasping work with a fairly high intensity compared to some workers such as chiseling / grinding, blacksmiths, tailors, batik and meat cutters.

### **5. Hand Posture (Awkward)**

Based on the results of a literature study, seven out of twenty studies examined the correlation of workers' hand posture (awkward) to the incidence of CTS. The seven studies all state that there is a relationship between ama work and the incidence of *carpal tunnel syndrome* in informal sector workers. Awkward or non-ergonomic hand postures can cause direct pressure on the median nerve so that if done continuously and continuously it can

cause *carpal tunnel syndrome*. This means that awkward hand postures affect the incidence of *carpal tunnel syndrome*.

Research in Botswana shows that there is a correlation between awkward posture and the incidence of CTS (OR 2,52, 95% CI: 1,03-6,19)(15). Another study in Indonesia by Farhan, FS. Dkk (2018) based on chi square analysis, there is a significant relationship between wrist posture and CTS complaints ( $p < 0,05$ )(16). This research is in line with the research of Aprilia, NP. Dkk (2021) there is a significant relationship that is quite strong and in the same direction between work posture and the incidence of CTS in manual coconut skin peeling workers (6).

Three other studies conducted in Indonesia also stated the same thing. Based on the test results between work posture variables and *Carpal Tunnel Syndrome* (CTS), the significance value is obtained ( $p$  value 0, 002;  $\alpha$ : 0,05) which means that there is a relationship between work posture and CTS in bead craftsmen in Pampang village, Samarinda City (10). Then research by Setyoaji, et al there is a correlation between hand posture and the incidence of CTS pa batik tulis "Seruling Etan" ( $p$  Value = 0,001) (7).

Research by Sekarsari D, et al (2017) entitled The Relationship Between Length of Work, Repetitive Movement And Awkward Postures On Hands With Carpal Tunnel Syndrome (Cts) Complaints In Stone Breaker Workers In North Moramo District, South Konawe Regency in 2016 showed the results of statistical tests using the exact fisher test at a confidence level of 95% or  $\alpha = 0,05$  obtained PValue  $< \alpha$  so that there is a relationship between awkward postures on the hands with complaints of Carpal Tunnel Syndrome (8). This is also reinforced by the research of Wulandari, E et al. (2020) which states that the  $p$ -value of  $0,046 < (0.05)$  which means it shows that there is a significant relationship between awkward postures and the incidence of CTS in meatball tofu workers in Langensari Village, West Ungaran (17).

Awkward or non-ergonomic hand postures can cause direct pressure on the nerves in the wrist so that if done continuously and continuously it can cause carpal tunnel syndrome. The seven studies above that discuss awkward hand postures with the incidence of CTS and all state that there is a significant relationship as well. This means that awkward hand postures affect the incidence of *carpal tunnel syndrome*.

## 6. Vibration

Of the 20 studies, only 2 studies were found that discussed the relationship between vibration and the incidence of CTS, namely in the research of Qoribullah, F (2020) and Nanda Wulantika, GAN. et al (2021). The two studies state that vibration has something to do with the incidence of *carpal tunnel syndrome*.

The types of informal work of the two studies are both related to equipment and vehicles that are identical to cause vibrations, for example the vibration of grinding machines on construction workers and motorized vehicles on motorcycle taxi drivers. Activities using these equipment and vehicles mostly cause vibrations in the hands. vibrations with a high frequency can cause excessive contractions as well. The result is muscle pain in the arms and hands and the risk of developing carpal tunnel syndrome. vibration does affect *carpal tunnel syndrome* but depends on the type of informal work. If the informal work environment is surrounded by machines and the use of machines, then he is more at risk of developing *carpal tunnel syndrome*.

## 7. Age

Based on the results of the literature study, nine out of twenty studies examined the relationship of the age variable of a worker to the incidence of *carpal tunnel syndrome*. Six studies stated that there was a relationship between length of work and the incidence of

*carpal tunnel syndrome* in informal sector workers. three other studies stated that there was no correlation between the age variable and the incidence of CTS.

Age is a person's length of life calculated from birth to the present. Based on the results of a study by Rohmah, Siti (2016) obtained (p value 0, 020;  $\alpha$ : 0,05) which means there is a relationship between age and CTS in bead craftsmen in Pampang village, Samarinda City (10). This research is reinforced by other research by Nurdasri, A and Arum Ariasih, AA (2021) mentioned in individual factors, namely the age variable has an OR value = 1,6 which indicates that respondents aged  $\geq 32$  years are 1,6 times more likely to experience CTS events (12). Other research by Farhan, FS. (2018) also states that there is a relationship between age and CTS complaints (16).

Another unidirectional research finding revealed a relationship between age and the occurrence of CTS in batik artisans writing "flute Etan." The age of craftsmen was found to be a factor for 43,3 percent of craftsmen aged 41-60 years, and craftsmen aged 41-60 years had a higher incidence of CTS than craftsmen aged 41-60 years (43,3 percent)(7). Setyawan H (2017) also stated in his research article that age is the most influential factor in increasing the incidence of carpal tunnel syndrome 24 times (p value = 0.057, Exp = 24,965)(11).

However, there are 3 studies that state that there is no significant relationship between age and CTS  $P > 0.1$  (Sig. = 0,141). Meanwhile, based on the derived risk estimate (OR) exp (B) = 2,771 (0,879 – 8,734), workers over 35 years old have a 2,771 times greater chance of experiencing CTS than those under 35 years old(14).

Another study found that a Chi-Square statistical test for the association of age with CTS events yielded a p value = 0,152 ( $>0,05$ ), indicating that there was no significant association between age and CTS events(9). There is no significant relationship between age and CTS erick P, et al (2020) research in Botswana entitled Risk Factors for Self-Reported Carpal Tunnel Syndrome in Hairdressers in Gaborone, Botswana(15).

Based on the review of previous studies, it is known that with increasing age, there are changes in muscle strength and calcification of joints that occur during the aging process and the absence of physical balance and physical capacity compared to younger workers. This is why the 6 studies above state that there is a relationship between age and the incidence of CTS, because it is directly related to muscle strength when working. Three studies stated that it was not related, possibly because age is not directly related to the incidence of CTS but there are other contributing factors such as; history of disease, work with high intensity of movement, especially in the hands.

## **8. Gender**

Based on the results of the literature study, 4 studies out of 20 studies examined the relationship of the variable gender of a worker to the incidence of *carpal tunnel syndrome*. all of these studies state that there is a relationship between gender and the occurrence of CTS. Individual factors such as gender, increasing age, length of employment and alcohol consumption are predictors of CTS symptoms. Women are 10 times more likely to report the occurrence of CTS when compared to their male counterparts (OR 9,99, 95% CI: 3,64-27,44)(15).

Research Rohmah, Siti (2016) P 0.1 (Sig. = 0.094) derived from the results of multiple logistic regression tests, indicating that there is a significant relationship between gender and CTS. Meanwhile, based on the risk estimate (OR) derived exp (B) = 3.500 (1.005 - 12.188), female workers have a 3,5 times greater risk of developing CTS than male workers(14). The study is in line with the study of Haris Setyawan (2017), entitled Risk

Factors for *Carpal Tunnel Syndrome* in Food Packing Workers in Karanganyar. The findings revealed that CTS complaints were substantially associated with age and gender(11).

Gender can be considered a risk factor for carpal tunnel syndrome. Women experience *carpal tunnel syndrome* twice as often as men, and women's muscle strength is on average only about 60% of men's muscle strength, especially in the arms, back and legs, a person's gender can affect the onset of CTS complaints. From the weak muscle strength of women compared to men, it allows women to get tired faster and also allows them to be more at risk of developing *carpal tunnel syndrome*. The weaker a person's strength, the worse the posture in doing work. This means that everything is interconnected so that gender can be said to be related to the incidence of CTS in informal sector workers.

## **9. Diabetes Melitus**

Based on the results of the literature study, 3 out of 20 studies examined the relationship of a worker's history of diabetes mellitus to the incidence of carpal tunnel syndrome. The 3 studies stated that there was no correlation between the history of diabetes mellitus and the incidence of CTS.

Research by Setyoaji, D. et al (2017) found that diabetes mellitus has no relationship with the occurrence of CTS among batik craftsmen who write "seruuling Etan." Univariate analysis found that 16.7% of artisans had diabetes, while cross table analysis revealed that artisans with CTS were 63.3% more likely to have diabetes(7).

This is in line with research by Debora, MN, et al (2018) entitled Overview of Factors Associated with the Incidence of Carpal Tunnel Syndrome in Housewives in Guju Baru Village, Only three people were found among those who had a history of DM and also suffered from CTS with a sample of 100 people (18). Another study also mentioned that no correlation was found with obesity and diabetes mellitus, regardless of the model(4).

Diabetes mellitus can be said to be an indirect cause of carpal tunnel syndrome, because diabetes mellitus is divided into 2, namely wet DM and dry DM. The risk is wet DM, because usually wet DM causes weight gain so that due to weight gain there is swelling which can compress the nerves, especially in the wrist area so that wet DM can indirectly increase the risk of developing *carpal tunnel syndrome*.

## **10. Body Mass Index**

Based on the results of the literature study, 4 studies out of 20 studies examined the relationship of a worker's BMI to the incidence of carpal tunnel syndrome. two studies stated that there was a relationship between BMI and the incidence of CTS. The other two studies stated that there was no correlation between BMI and the incidence of CTS.

CTS occurs due to compression of the median nerve under the transverse carpal ligament associated with increased body weight and BMI. A low BMI is a good health condition for the protection of the median nerve function. Workers with a BMI of at least  $\geq 25$  are more likely to develop CTS than those with a lean body weight.

Study in France by Requalaure, Y et.al (2019) there is a significant influence between IMT and the incidence of CTS,  $P < 0.05$  (4). This is reinforced by research by Farhan, SS and Kamrasyid, AA (2018) with the title Factors Affecting the Onset of Carpal Tunnel Syndrome in Ojek Riders Based on the results of bivariate analysis, it is known that IMT correlates with CTS complaints (16).

According to bivariate analysis, the relationship between IMT and CTS has a p value  $> 0.1$  (Sig. = 0.241), indicating that there is no significant correlation between the two (14). Another incongruent result Chi-Square test between IMT and CTS incidence resulted in a p



value = 0,442 (>0,05); OR = 0,417; 95 percent CI 0,084 – 2,071, indicating that there was no significant association between the two (9).

Two studies stated that BMI has an association with the incidence of CTS BMI is divided into two low and high. This means that people with a high body mass index (Obesity) as a potential risk factor for musculoskeletal problems, especially Carpal Tunnel Syndrome. two other studies disagree because it depends again on a person's BMI level. It is those with a BMI greater than  $\geq 25$  who are at risk of CTS. Obesity can cause swelling and thickening, especially in the thumb of the wrist, then the nerves in the thumb and wrist become pinched and cause *carpal tunnel syndrome*.

## **CONCLUSIONS AND SUGGESTIONS**

Based on a *literature review* of twenty research journals, it can be concluded that repetitive motion, tenure, length of service, hand posture (awkward), age, gender, and body mass index have all been associated with the development of *carpal tunnel syndrome* in informal sector workers and found to be correlated. While grasping work and a history of diabetes mellitus were not found to be associated with the incidence of *carpal tunnel syndrome* in informal sector workers.

Workers should perform repetitive movements interspersed with other movements, conduct health checks (examination of CTS symptoms) if workers have worked for more than 5 years, hand posture should be improved when working.

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