MAJALAH ILMIAH FISIOTERAPI INDONESIA

ORIGINAL ARTICLE

Volume 12, Number 3 (2024), Page 267-273
P-ISSN 2303-1921, E-ISSN 2722-0443

Duration of Work and Body Position on Carpal Tunnel Syndrome among BNI Employees in Denpasar City

Ida Ayu Diah Sancitawati[1], Ni Luh Putu Gita Karunia Saraswati[2], Indira Vidiari Juhanna[3], Indah Pramita[4]

[1]Bachelor of Physiotherapy and Professional Physiotherapy Program, Faculty of Medicine, Udayana University, Denpasar, Bali
[2,4]Department of Physiotherapy, Faculty of Medicine, Udayana University, Denpasar, Bali
[3]Department of Physiology, Faculty of Medicine, Udayana University, Denpasar, Bali
*Correspondence: dayudiahs02@gmail.com

Diajukan: 26 April 2024 | Diterima: 16 Mei 2024 | Diterbitkan: 25 September 2024
DOI: https://doi.org/10.24843/mifi.2024.v12.i03.p06

ABSTRACT

Introduction: Typing activities at work involving repetitive movements with static body posture, if not adequately addressed, can lead to Carpal Tunnel Syndrome (CTS). Data from the National Health Interview Study (NHIS) shows that the incidence rate of CTS in the general population is 2.6 million. Bank employees are one of the professions prone to CTS due to their computer typing activities. This study aims to determine the relationship between the duration of work and body position during typing and the occurrence of CTS among computer users at BNI in Denpasar City.
Methods: This study used a cross-sectional study design and purposive sampling technique for subject recruitment. The total sample size in this study was 86 BNI employees who use computers in Denpasar City. Data collection was conducted through interviews to determine the duration of work and specific examinations such as Phalen's and Tinel's tests, and researchers measured the body position of employees during typing using the Rapid Upper Limb Assessment (RULA).
Results: The chi-square test analysis yielded a p-value of 0.039, indicating a relationship between the duration of work and the occurrence of CTS, and a p-value of 0.002, indicating a relationship between body position during typing and CTS.
Conclusion: The study concludes that there is a relationship between the duration of work and body position during typing and the occurrence of CTS among computer users at BNI in Denpasar City. Providing ergonomic training and education by the institution, managing work time and modifying workstations, followed by light stretching by the subjects, can reduce the risk and severity of CTS occurrences.

Keywords: carpal tunnel syndrome, duration of work, body position during typing

INTRODUCTION

With the advancement of science and technology, computers have become essential in the workplace and mandatory for enhancing work effectiveness and efficiency. One of the activities involving computer usage at work is typing. Typing is an activity that engages the wrist function, performed with repetitive movements in a static body position and often prolonged over time. If not adequately addressed, this condition can lead to carpal tunnel syndrome.[1]

Carpal tunnel syndrome (CTS) is where the median nerve passing through the carpal tunnel is compressed—this compression of the median nerve results in motor and sensory disturbances in the fingers and hand. Sensory disturbances include paresthesia or tingling sensations and numbness in the thumb, index, middle, and part of the ring fingers. Motor disturbances manifest as decreased grip strength and loss of hand dexterity due to thenar muscle atrophy.[2] The diagnosis of CTS can be conducted through physical examination. A comprehensive physical examination should be performed on patients with particular attention to hand function, motor skills, sensory function, and autonomic function. Several specific tests are available to assist in confirming the diagnosis of CTS, including Phalen's Test and Tinel's Test.[3]

Data from the National Health Interview Study (NHIS) indicates that the incidence rate of CTS in the general population is 1.55%, equivalent to approximately 2.6 million individuals. In the United States, the prevalence of CTS reaches 5% of the total population, while in the United Kingdom, the prevalence ranges from 6% to 17%. A study conducted in Palembang, South Sumatra, regarding the prevalence of CTS among motorcycle taxi drivers, found that 76.6% of participants experienced CTS.[4] In Denpasar City, a study on the prevalence of CTS among 59 garment workers found that 79.2% experienced CTS, with different characteristics observed for each variable.[5]

In general, CTS is caused by two factors: external and internal. Internal factors include Body Mass Index (BMI), age, and gender. Meanwhile, external factors include employment length, work duration, and body posture during work.[6] The ideal duration of work or work duration per day typically ranges from four to eight hours. The longer the duration of work, the longer the pressure on the median nerve, which can lead to CTS and reduce an individual's effectiveness and productivity at work.[7]

Work posture is one of the contributing factors to body positioning during work. Body parts that often experience errors in the working process include the hands, particularly during typing activities.[8] If someone types for a prolonged period with a non-ergonomic posture, it can lead to CTS. The correct typing position involves keeping the wrists straight, maintaining the elbows at a 90° angle, and ensuring the body is in a neutral and relaxed position.[9]

The duration of work and body position while typing are among the causes of CTS because typing using fingers at 60 words per minute translates to a pressure applied to the fingers equivalent to or exceeding 25 tons per day. The incidence of CTS related to typing activities is increasing among computer users, given the current rise in computer usage in various industries and fields. Approximately 260,000 CTS surgeries are performed each year, with 27% of cases attributed to occupational factors.[10]

BNI employees perform tasks such as data entry and typing simultaneously. Bank employees are susceptible to CTS, particularly those in administration and customer service departments. According to observations made by the researchers before conducting this study, BNI employees are vulnerable to CTS due to their computer-based work and prolonged typing activities. A survey of the incidence of CTS in Bitung City among bank employees found a prevalence of 13 individuals out of 47 respondents, or 28%,[11]

Based on this background, the researchers aim to understand whether there is a relationship between body posture while typing and duration of work with the occurrence of CTS. The researchers have observed that many studies related to CTS only examine one independent variable and are limited to sample characteristics such as age, gender, and duration of work. The researchers have chosen to enrich the literature on CTS by considering work posture among employees. Additionally, no existing research investigates the relationship between body posture while typing and duration of work with the occurrence of CTS among BNI employees in Denpasar City. This study aims to demonstrate how longer work durations and non-ergonomic body postures while typing will positively correlate with increased CTS occurrences among BNI employees who use computers in Denpasar City.

METHODS

This study employed a cross-sectional design conducted in BNI branches in Denpasar from June to October 2023. Sampling was performed seven times in several BNI branches in Denpasar City that agreed to participate in the study. Since the workstations, organizational structures, and work procedures are relatively similar across BNI branches in Denpasar, the characteristics of the subjects from the branch offices where the research was conducted can represent BNI employees in Denpasar City.

A purposive sampling technique was used to select subjects based on specific characteristics that met the inclusion and exclusion criteria. The inclusion criteria included BNI employees in Denpasar who engaged in computer typing activities, worked in administration and customer service departments, were aged 23-50 years, were of both genders and were willing to provide informed consent. Exclusion criteria involved subjects with a history of rheumatoid arthritis, trauma/fracture, diabetes mellitus, and pregnant employees. The sample size for this study was 86 individuals, determined using a cross-sectional formula. The independent variables in this study were body posture while typing and duration of work, while the occurrence of CTS was the dependent variable.

The duration of work for BNI employees in Denpasar in this study was determined by interviewing workers about their daily work hours. Daily work duration refers to the time an individual works in a day. Standard work duration is 4-8 hours daily, while non-standard work duration is > 8.

The Rapid Upper Limb Assessment (RULA) measured body posture while typing in this study. RULA is suitable when the job requires workers to maintain a static position in a specific place, such as when typing. RULA measurements were conducted by observing the work posture of employees, documenting their work posture using a mobile phone camera, and then measuring it using the Kinovea application to project angles. There are two major groups in the RULA assessment: Group A includes the evaluation of upper limb angles (arms and hands), and Group B includes neck, trunk, and lower limb angles. There are three score tables in this assessment sheet: Table A is used to determine the score results of the Group A assessment, and Table B is used for the Group B assessment score results. The final RULA score is obtained with Table C to assess the combined scores of both groups (A and B). The interpretation of RULA measurement results is as follows: scores of 1-2 indicate no risk and no need for posture improvement, scores of 3-4 indicate low risk and posture changes may be necessary, scores of 5-6 indicate moderate risk and posture changes are required as soon as possible, and a score of 7 means high risk and immediate posture changes are needed.

The examinations used to diagnose CTS were the Phalen's and Tinel's tests. The Phalen's Test involves maximal wrist flexion movements. If numbness or paresthesia occurs in the fingers within 60 seconds, this test can help diagnose CTS. This test has a 40-80% sensitivity and specificity > 81%. The Tinel's Test involves percussion of the carpal tunnel with the wrist slightly dorsiflexed. This test supports the diagnosis when paresthesia is felt in the median nerve distribution area. This test has a specificity of 70-90% and a 25-75% sensitivity.

This study conducted univariate and bivariate data analysis. Univariate analysis aimed to provide an overview of the percentage of work duration, body posture while typing, CTS, gender, and age of BNI employees in Denpasar. Bivariate analysis aimed to determine the relationship between work duration and body posture while typing with the occurrence of CTS using the Chi-Square test.

The researchers are fully aware of confounding variables related to CTS in the study, and to minimize bias, they controlled variables that could affect the occurrence of CTS and conducted measurements using standard procedures accordingly. The standard procedures performed by Physiotherapists in diagnosing CTS ensure the quality of the findings. In measuring RULA, the researchers ensured that photos of employees' postures were taken at a similar distance and position. This effort is made to reduce bias in the findings of this study as much as possible. This study was approved by the Research Ethics Commission of the Faculty of Medicine, Udayana University, with ethical clearance number 845/UN14.2.2.VII.14/LT/2023.

RESULTS

This study used a cross-sectional method on BNI employees who use computers in Denpasar City. The research began with obtaining permission and screening the target population based on inclusion, exclusion criteria, and dropouts to obtain research subjects. This was followed by data collection of research variables, data analysis, and reporting of results, as outlined in Figure 1.

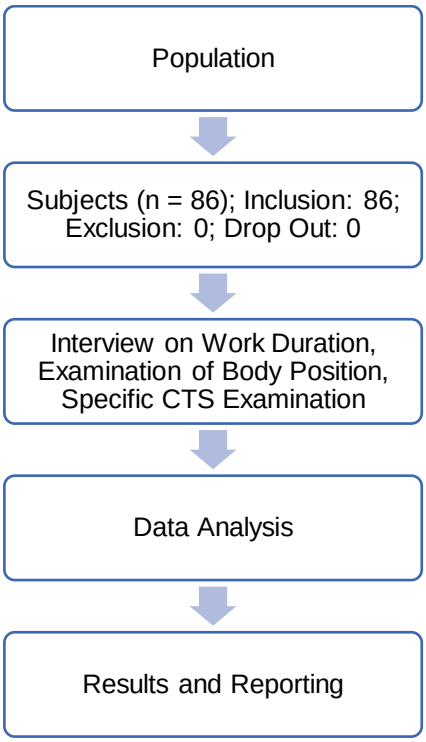

Figure 1. Research Flowchart

Here is an overview of the sample characteristics extracted from the research findings, as presented in Table 1.

Table 1. Sample Characteristics

Variable	Count	Percentage (%)
Age		
17-25	12	14.0
26-35	44	51.2
36-45	19	22.1
46-55	11	12.8
Gender		
Male	40	46.5
Female	46	53.5
Work Duration		
Standard	28	32.6
Non-standard	58	67.4
Body Position		
While Typing	31	36.0
Low Risk	33	38.4
Moderate Risk	22	25.6
High Risk		
Carpal Tunnel Syndrome	30	34.9
Yes	56	65.1

Based on the table above, the research subjects are between 23 and 50 years old, with the dominant age group being 26 and 35 years old, totalling 44 individuals (51.2%). Most subjects are female, comprising 46 individuals (53.5%). According to the interview results, most employees work non-standard hours, totalling 58 individuals (67.4%). Using the RULA method to measure employees' body positions while typing, it was found that 33 individuals (38.4%) had a moderate risk posture. The research results indicate that 30 individuals (34.9%) are affected by CTS, while 56 individuals (65.1%) are unaffected by CTS.

Table 2. Analysis of Work Duration and CTS

Work Duration	CTS		
	Yes	No	Total

Standard	5	23	28
Non-standard	25	33	58
Total	30	58	86

Based on the table above, it was found that 28 employees (32.6%) work standard hours, with five individuals (16.7%) affected by CTS. Among the 58 employees (67.4%) working non-standard hours, 25 individuals (83.3%) were found to have CTS.

Table 3. Chi-Square Test Results Regarding the Relationship Between Work Duration and the Incidence of CTS

The Relationship Between Work Duration and the Incidence of CTS	
P-Value	0.039

The p-value indicated in Table 3 of 0.039 (p < 0.05) indicates a significant relationship between work duration and the incidence of CTS among computer users at BNI in Denpasar City.

Table 4. Analysis of Body Position While Typing and CTS

Body Position While Typing	CTS		
	Yes	No	Total
Low Risk	5	26	31
Moderate Risk	11	22	33
High Risk	14	8	22
Total	30	56	86

Based on Table 4 above, it was found that employees with low-risk work postures amounted to 31 individuals (36.0%), among whom five individuals (16.7%) were affected by CTS. Among the 33 employees (38.4%) with a moderate-risk work posture, 11 individuals (36.7%) were found to have CTS. Additionally, 14 individuals (46.7%) had CTS out of 22 employees (25.6%) with a high-risk work posture.

Table 5. Chi-Square Test Results Regarding the Relationship Between Body Position While Typing and the Incidence of CTS

The Relationship Between Body Position While Typing and the Incidence of CTS	
P-Value	0.002

The p-value indicated in Table 5 of 0.002 (p < 0.05) indicates a significant relationship between body position while typing and the incidence of CTS among computer users at BNI in Denpasar City.

DISCUSSION

This study was conducted from June to October 2023 at BNI branches in Denpasar City and involved 86 research subjects. A purposive sampling technique was used for subject selection. The research subjects were BNI employees in Denpasar City working in the administrative department aged 24-50 years and in the customer service department aged 23-35 years.

The incidence of CTS in this study was higher among employees aged 36-45 years (46.7%). This finding is consistent with a previous study conducted in 2023 on production workers in the Tapung District by February, which found that respondents over 30 years were 164 times more likely to develop CTS compared to respondents under 30 years.[12] Increasing age can impact the tissues inside the body, leading to a decline in function due to degenerative processes. This is also suspected to occur in the muscles and ligaments found in the wrist, resulting in decreased flexibility. This reduced flexibility can cause the median nerve to become trapped in the carpal tunnel, triggering the occurrence of CTS.[8]

In this study, CTS was higher among female employees, with 24 individuals (80.0%), compared to male employees, with six individuals (20.0%). This is consistent with Putri's research on computer operator employees at Abdul Manap Hospital, which found that female employees experienced CTS more frequently than males. The narrower carpal tunnel in females creates a tighter space for nerves and tendons to pass through, thereby increasing the risk of CTS for women compared to men.[6] In addition to working outside the home, female employees often have responsibilities for household chores such as washing dishes, cooking, and cleaning the house, which can lead to the emergence of musculoskeletal disorders due to various physical stressors.

CTS can be attributed to improper work duration and body position while working. This study found CTS in 25 individuals (83.3%) among employees working non-standard hours and five individuals (16.7%) among those working standard hours. Working more than 8 hours daily should be avoided as much as possible. Overtime exceeding 25% of the regular working hours can negatively impact the workforce. The longer someone works, the longer the median nerve will be compressed, leading to the development of CTS.[7]

The body positions of BNI employees while typing, measured using RULA, revealed poor work posture leading to CTS. This study found a higher incidence of CTS among employees with a high-risk body position while typing, with 14 individuals (46.7%). Additionally, 11 individuals (36.7%) with a moderate-risk posture experienced CTS, followed by five individuals (16.7%) with a low-risk posture. Static and non-ergonomic work positions of the wrist, arm, and shoulder can lead to inflammation of tissues, muscles, and nerves. This inflammation compresses the median nerve, leading to the development of CTS.[13]

Relationship Between Work Duration and the Incidence of CTS Among Computer Users at BNI in Denpasar City

The analysis regarding work duration's impact on the occurrence of CTS, as depicted in Table 3, shows a p-value of 0.039 ($p < 0.05$), confirming the hypothesis that longer work durations correlate positively with increased CTS incidence among computer-using employees at BNI in Denpasar City. CTS among BNI employees in Denpasar City may be due to most employees working non-standard or more than 8 hours daily. When BNI employees engage in typing activities on computers beyond the standard work duration, prolonged pressure on the median nerve can lead to the development of CTS, resulting in decreased effectiveness and productivity at work.

Research conducted by Putra in 2021 on employees at PT.X aligns with this study, finding that most respondents working > 8 hours per day experienced CTS (79.7%), concluding that there is a relationship between work duration and CTS. The longer someone works, the higher the pressure on the median nerve increases the risk of CTS. Increased work duration also indicates repetitive tasks performed by the hands.[14]

Another study conducted by Sariana on online motorcycle taxi drivers in East Jakarta found that most respondents affected by CTS worked > 8 hours/day (59.8%) and identified a relationship between work duration and the occurrence of CTS. Prolonged working hours can decrease work quality, productivity, fatigue, and health issues. Working more than 8 hours a day indicates repetitive tasks on the hands for a more extended period, which can lead to the occurrence of CTS.[15]

Working > 8 hours per day carries a risk of developing CTS because longer work durations tend to increase pressure on the median nerve, leading to an increased incidence of CTS. The effects of repetitive motions also depend on the duration of work, where the longer someone works, the longer they are exposed to factors contributing to CTS.[5]

Relationship Between Body Position While Typing and the Incidence of CTS Among Computer Users at BNI in Denpasar City

The analysis regarding the relationship between body position while typing and the occurrence of CTS, as shown in Table 5, indicates a p-value of 0.002 ($p < 0.05$), confirming the hypothesis that non-ergonomic body positions while typing correlate positively with an increased incidence of CTS among computer-using employees at BNI in Denpasar City.

BNI employees in Denpasar City who develop CTS do so because they work with non-ergonomic wrist postures, such as performing wrist flexion or extension movements exceeding 15°.

This study aligns with research by Gede on administrative staff at RS Bangli, which found a correlation between work posture and CTS. Working in improper postures causes the body's muscles to work less efficiently, requiring more incredible energy to complete tasks. If prolonged, static and uncomfortable work postures, especially in the hands, can lead to inflammation and swelling. Someone can develop CTS due to pressure on the median nerve, resulting in reduced space in the carpal tunnel when the wrist is in an extreme position.[16]

The research conducted by Aripin on employees at the Islamic University of Bandung strengthens the findings of this study, concluding that there is a relationship between computer typing posture and CTS. Working with improper body posture can increase the energy needed to perform tasks. If these risk factors persist for a long duration, the body's capacity will decrease, leading to discomfort in the limbs and serving as the initial trigger for CTS.[1]

The onset of CTS can be attributed to one factor, namely hand position. When working with a keyboard positioned higher than the wrist, BNI employees in Denpasar City result in the wrist hanging while typing. Additionally, a lower keyboard position causes pressure on the wrist while typing. Research conducted by Saerang on the incidence of CTS among bank employees in Bitung City concluded that hand position is a significant contributing factor to CTS.[11] In this study, it was found that more employees developed CTS due to a lower keyboard position, resulting in increased pressure on the wrist while typing.

Through this research, it is known that inadequate or uneven workstations and workloads can influence the occurrence of CTS. Maintaining body positions during long working hours leads to decreased blood supply, accumulation of lactic acid, and inflammation. In the wrist, the impact of continuous workload without adequate rest leads to the compression of the median nerve inside the carpal tunnel, resulting in decreased nerve function and health, ultimately affecting employee performance and productivity in the workplace.[1]

Employees can experience health disorders due to prolonged exposure to non-ergonomic work arrangements, which can lead to CTS due to inflammation of joint and nerve tissues as well as swelling that compresses the median nerve.[13] In this study, it was found that employees affected by CTS were those working in high-risk postures (n=14; 46.7%). Actions taken include the need for further analysis and improvement or changes in current work postures, particularly at the wrist, to reduce the risk of CTS occurrence and mitigate the progression of CTS in employees already diagnosed with it.

This study found that the higher the risk of work posture, the higher the incidence of CTS among BNI employees. BNI employees are advised to perform light stretching for about five minutes before using the computer and while typing. Exercising during computer work can reduce CTS complaints. Additionally, the researchers emphasized the importance of workplace safety in the office environment.

Various efforts have been made to improve workplace safety in the office environment based on previous research, including improvements to the work environment and work systems. These efforts are aimed at both increasing work productivity and reducing musculoskeletal complaints. Joint efforts in ergonomic changes include using tools and work facilities that can personally adjust to the employee's body. Critical criteria commonly applied in ergonomic changes, especially in office settings, include using adjustable desks, ergonomic monitor stands, and office chairs with adjustable height and cushions for the back and neck. Although the importance of providing ergonomic work tools is recognized, direct implementation by relevant parties can currently be a significant financial burden. Instead, other alternatives need to be considered to ensure employee well-being without instantly burdening production costs.[17]

Providing education and further understanding of ergonomics in the workplace can significantly reduce musculoskeletal complaints among office workers. Relevant agencies can consider this to facilitate pocket guides and regular ergonomic training for BNI employees, especially in Denpasar City. Researchers suggest emphasizing points such as adjusting chair height so that employees' feet are not dangling and excessive pressure is not placed on the popliteal area, raising the monitor to eye level by providing a thick base to reduce neck strain, and providing information on improving posture to prevent excessive strain on the spinal tissues.[18]

This study still has several limitations because the subjects were only BNI employees in Denpasar City, which may affect the generalizability of the findings if conducted on BNI employees elsewhere or BNI as a whole. Other researchers may generalize these findings after considering characteristics such as the age range of the employees studied, duration of work, workstation, and work activities (typing) that are similar to those in this study. This study did not examine other factors contributing to CTS, such as tenure and BMI. This needs to be considered and controlled by other researchers as it represents potential bias and can influence research outcomes. Despite the validity and reliability of specific examinations for CTS, researchers believe other researchers can recommend electrodiagnostic and radiological examinations as the gold standard for CTS diagnosis. Additionally, more complex analytical methods such as multivariate analysis and higher forms of studies such as case-control studies, cohort studies, or RCTs can be considered by other researchers to explain the relationship between variables affecting CTS more intensely and to test the effectiveness of ergonomic interventions on CTS incidence.

CONCLUSION

Based on the research findings, it can be concluded that there is a significant relationship between the duration of work and typing posture with the occurrence of CTS among computer users at Bank Negara Indonesia (BNI) in Denpasar City. For future research, it is recommended that researchers conduct a more in-depth study on the factors causing CTS. Researchers may consider using higher study designs than this cross-sectional study and performing more complex analyses to improve the quality of evidence and provide better clarity on the relationship between variables. Researchers also suggest that ergonomic interventions be highlighted by institutions and individuals, given the high risk associated with typing posture. Providing ergonomic training and education by institutions, as well as managing work schedules and modifying workstations, followed by light stretching by individuals, can reduce the risk of CTS occurrence and prevent it from worsening.

REFERENCES

1. Aripin TN, Rasjad AS, Nurimaba N, Djojosugito MA, Irasanti SN. Hubungan Durasi Mengetik Komputer dan Posisi Mengetik Komputer dengan Gejala Carpal Tunnel Syndrome (CTS) pada Karyawan Universitas Islam Bandung. Jurnal Integrasi Kesehatan & Sains. 2019;1(2):97–101.
2. Salim D. Penegakan diagnosis dan penatalaksanaan Carpal Tunnel Syndrome. J Kedokt Meditek. 2017;23(6):67–70.
3. Rozzi F. Keluhan Carpal Tunnel Syndrome (CTS) Pada Operator Mesin Traktor Tangan. Repository.Unej.Ac.Id. 2017. 1–122 p.
4. Vinanda T. Faktor-Faktor Yang Mempengaruhi Kejadian Carpal Tunnel Syndrome (CTS) Pada Pegawai Bank BTN Di Kota Palembang Tahun 2021. Skripsi. 2021;
5. Paramita, Tini K, Budiarsa IGNK, Samatra DPGP. Prevalensi dan Karakteristik Carpal Tunnel Syndrome pada Pekerja Garmen di Kota Denpasar. Jurnal Medika Udayana. 2021;10(2):6–11.
6. Putri WM, Iskandar MM, Maharani C. Gambaran Faktor Risiko Pada Pegawai Operator Komputer Yang Memiliki Gejala Carpal Tunnel Syndrome Di Rsud Abdul Manap Tahun 2020. Medical Dedication (medic) : Jurnal Pengabdian kepada Masyarakat FKIK UNJA. 2021;4(1):206–17.
7. Anggraeni DR, Anggraini MT, Romadhoni. Faktor-Faktor yang Berpengaruh dengan Kejadian CTS Pada Pekerja Bulu Mata Bagian Cantel di Desa Rakit. J Chem Inf Model. 2019;53(9):1689–99.
8. Sari RK, Wardani RS, Prasetio DB. Faktor Risiko Kejadian Carpal Tunnel Syndrome (CTS) Pada Pekerja Bulu Mata Bagian Cantel. Jurnal Mahasiswa Kesehatan Masyarakat. 2018;7–18.
9. Yassierli, Wijayanto T, Hardiningtyas D, Dianita O, Muslim K, Kusmasari W. Panduan Ergonomi “Working From Home.” Perhimpunan Ergonomi Indonesia. 2020;1–19.
10. Berbudi A, Ariyanti F, Sariana E. Hubungan Posisi Pergelangan Tangan Saat Mengetik Terhadap Risiko Terjadinya Carpal Tunnel Syndrome. Jurnal Fisioterapi dan Kesehatan Indonesia. 2022;2(1):1–151.
11. Saerang D, Kembuan M, Karema W. Insiden Carpal Tunnel Syndrome Berdasarkan Anamnesis Pada Karyawan Bank Di Kota Bitung Sulawesi Utara. e-CliniC. 2015;3(1).
12. Febriani W, Hastuty M. Faktor-Faktor yang Berhubungan dengan Kejadian Carpal Tunnel Syndrome (CTS) Pada Pekerja Bagian Produksi di PT Sewangi Sawit Sejahtera Kecamatan Tapung Tahun 2023. 2023;1(3):423–34.
13. Muthoharoh, Basri K S, Nuraeni T. Faktor yang Berhubungan dengan Kejadian Carpal Tunnel Syndrome (CTS) pada Karyawan SPBE Di Indramayu. Afiasi : Jurnal Kesehatan Masyarakat. 2018;3(2):37–44.
14. Putra DK, Setyawan A, Zainal AU. Faktor Yang Berhubungan Dengan Gejala Carpal Tunnel Synrome (CTS) Pada Pekerja Komputer Bagian Editing Di Pt . X Tahun 2021. Environmental Occupational Heath and Safety Journal. 2021;2(1):11–8.
15. Sariana E, Bowo Laksono AB. Hubungan Karakteristik, Riwayat Penyakit, dan Obesitas dengan Keluhan Carpal Tunnel Syndrom (CTS) Pada Komunitas Ojek Online Wilayah Kecamatan Ciracas Jakarta Timur Tahun 2022. Jurnal Untuk Masyarakat Sehat (JUKMAS). 2023;7(2):139–48.

16. Gede I, Pertama W, Rahim AF, Suparsa IM. Hubungan Postur Kerja Terhadap Keluhan Carpal Tunnel Syndrome Pada Pegawai Administrasi Di Rsud Bangli. Advanced In Social Humanities Research. 2023;1(1):17–26.
17. Marfuah HH, Kunci K, Kerja S, Muskuloskeletal K. Perbaikan Sistem Kerja Yang Ergonomis Untuk Mengurangi Kelelahan Dan Keluhan Muskuloketal Dengan Pendekatan Ergonomi Partisipatori. Dinamika Teknik. 2018;11(1):1–8.
18. Majid M, Jalali M, Golmohammadi R, Faradmal J, Zakeri HR, Nasiri I. Ergonomic Risk Factors and Musculoskeletal Disorders in Bank Staff: an Interventional Follow-up Study in Iran. Journal of The Egyptian Public Health Association. 2021;