

Occupational Risk Factors, Job Types, and Physical Activity in Carpal Tunnel Syndrome: A Literature Review

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Abstract

Carpal Tunnel Syndrome (CTS) is a common condition involving median nerve compression, causing pain, tingling, and numbness in the hand. Studies reveal varying prevalence across demographics, impacting the quality of life. CTS reports a 3.6% prevalence, emphasizing age and gender disparities. CTS makes an impact on daily functioning, and multifactorial etiology, encompassing anatomy, health, and lifestyle. Occupational factors underscore higher risks in certain professions. Early identification is crucial for timely intervention. This review consolidates recent research, aiming to inform targeted prevention and management strategies for CTS. This study utilizes a literature review method, collecting data from databases such as ScienceDirect, PubMed, ResearchGate, Google, and Google Scholar, using keywords like "Carpal Tunnel Syndrome," "Workers," "Risk Factor," "Physical Activity," and "Occupational." Inclusion criteria consider articles published from 2019 to 2023. The data will be analyzed to conclude. The result from fifteen articles reveals significant risk factors associated with Carpal Tunnel Syndrome (CTS), including long work duration, specific job sectors, repetitive hand movements, unusual hand postures, vibration exposure, and a history of CTS. Certain occupations, such as batik workers, meatball tofu makers, and marble industry workers, show correlations with CTS. Addressing these risk factors through protective measures and effective workplace management is crucial for reducing CTS incidence.

Keywords: Carpal Tunnel Syndrome; Workers; Risk Factor; Physical Activity; Occupational

1. Introduction

Carpal Tunnel Syndrome (CTS) is a prevalent and impactful condition characterized by the compression of the median nerve within the carpal tunnel. This compression leads to a spectrum of symptoms, including pain, tingling, and numbness in the hand and fingers. The prevalence and epidemiology of CTS vary across age groups and genders, with a considerable impact on the affected individuals' quality of life. As evidenced by numerous studies from the past four years, the definition of CTS extends beyond its anatomical implications, encompassing a complex interplay of demographic, occupational, and lifestyle factors.

The carpal tunnel, a narrow passageway in the wrist, houses the median nerve and tendons. Compression of the median nerve within this space results in CTS. According to a recent study by Uchiyama et al. (2020), CTS is prevalent, affecting approximately 3.6% of the general population. The research

emphasizes the significance of understanding the demographics of CTS, with higher prevalence rates observed in certain age groups and among females.

The symptoms of CTS, including pain, tingling, and numbness, can significantly impede an individual's ability to perform daily tasks. A study by Cheung et al. (2019) underscores the considerable impact of CTS on patients' functional status and quality of life. The research highlights the need for targeted interventions that address the multifaceted challenges posed by CTS symptoms.

Research by Elfar et al. (2021) emphasizes the multifactorial nature of CTS, with various risk factors contributing to its development. This section will explore anatomical considerations, health conditions, and lifestyle factors, providing a comprehensive overview of the complex etiology of CTS.

Occupational factors play a crucial role in the prevalence of CTS, with certain professions carrying a higher risk. The study by Descatha et al. (2018) investigates the prevalence of CTS among different occupational groups, emphasizing the need for targeted preventive measures in high-risk professions.

Early identification of risk factors is essential for implementing protective measures and preventing the onset of CTS. This review underscores the significance of recognizing these factors early on, drawing insights from the recent research of Di Stasio et al. (2022), which emphasizes the importance of early intervention in mitigating the impact of CTS.

In conclusion, this comprehensive review integrates insights from various studies conducted in the past four years to provide a holistic understanding of Carpal Tunnel Syndrome. By exploring its risk factors, and occupational aspects, this review aims to contribute to the development of targeted preventive and management strategies.

2. Methods and Material

This study employs a literature review methodology. The process of data collection involved sourcing articles databases. The journal databases used are ScienceDirect, PubMed, ResearchGate, Google, and Google Scholar. The search utilized the keywords “Carpal Tunnel Syndrome”, “Workers”, “Risk Factor”, “Physical Activity”, and “Occupational”. Inclusion criteria for the articles encompassed those published between the last 4 years, 2019 and 2023. The gathered data will undergo analysis, leading to the formulation of conclusions based on the findings.

3. Result and Discussion

Based from the gathered and analyzed articles, the findings are presented as follows

Table 1. List of articles

No	Authors	Title	Method	Result
1.	(Subandi S, et al, 2020)	The Relationship Between Working Period Of Batik Craftsmen And Incident Of Carpal Tunnel Syndrome	Cross-Sectional Study	A noteworthy moderate positive correlation was observed between the duration of employment and nerve injury according to Bland's classification ($r=0.559$; $p=0.013$).
2.	(Wulandari	Long-Term Work Relationship,	Cross-	There were associations found between the duration of

et al, 2020)	Repetitive Movements, And Awkward Postures In Relation To The Occurrence Of Carpal Tunnel Syndrome (CTS) In Tofu Meatball workers (A Case Study of Tofu Meatball Workers in Langensari Village, West Ungaran).	Sectional Study	work and the incidence of CTS (p-value= 0.004), between repetitive motions and the occurrence of CTS (p-value= 0.006), and between unusual postures and the incidence of CTS (p-value= 0.046).
3. (Ijaz et al. 2023)	Prevalence of Carpal Tunnel Syndrome and its Associated Risk Factors among Workers of Marble Industries of Abbottabad.	Cross-Sectional Study	The findings revealed that the average age of workers was 36.52. Significantly, age, work experience, and job types demonstrated associations with CTS (P value > 0.05), while the type of activity exhibited a particularly significant association (P value > 0.01). Additionally, the research indicated that the prevalence of CTS rose with higher age, experience, and engagement in forceful activities.
4. (Hamid et al, 2020)	Factors Related to Carpal Tunnel Syndrome (CTS) Complaints on Employees in the Bank BNI Branch of Palu	Cross-Sectional Study	The findings indicated a correlation between tenure ($\rho = 0.005$), duration of employment ($\rho = 0.000$), repetitive motions ($\rho = 0.001$), and gender ($\rho = 0.006$) and the reported cases of Carpal Tunnel Syndrome (CTS) among the staff at the Palu Branch of Bank BNI.
5. (Putra et al, 2023)	Factors Associated with the Occurrence of Carpal Tunnel Syndrome (CTS) in Mortar Maker Workers.	Cross-Sectional Study	There is a relationship between age ($p = 0.0001$), duration of work ($p = 0.002$), work period ($p = 0.0001$), wrist posture (0.0001), vibration exposure (0.007), and repetitive movements (0.001) with the occurrence of CTS.
6. (Qoribullah, 2020)	The Relationship between Arm-Hand Vibrations and Complaints of Carpal Tunnel Syndrome among Blacksmith Home Industry Workers in Sokobanah District, Sampang.	Cross-Sectional Study	The research findings indicate that a majority (75.8%) experienced uncomfortable vibrations, and most of them (63.6%) had severe CTS complaints. There is a significant correlation between arm-hand vibrations and Carpal Tunnel Syndrome complaints ($p = 0.01$). It is concluded that higher exposure to arm vibrations may increase Carpal Tunnel Syndrome complaints among blacksmith home industry workers in Sokobanah District.
7. (Putri et al, 2022)	The Influence of Vibration Levels and Duration of Sewing Machine Usage on Signs and Symptoms of Carpal Tunnel Syndrome (CTS) Complaints among Workers at Istana Bordir Malang.	Cross-Sectional Study	The research results can be concluded that the variables influencing the logistic regression partially are the length of employment with a value (sig. 0.035), the duration of exposure with a value (sig. 0.038), and the vibration level with a value (sig. 0.039). Meanwhile, the simultaneous logistic regression results obtained a significant value of 0.006.
8. (Setyawati et al, 2022)	The Relationship Between Work Duration and Repetitive Movements with Complaints of Carpal Tunnel Syndrome in Female Brick Press Workers.	Cross-Sectional Study	The results of the analysis indicate a fairly strong positive correlation between the duration of employment ($r=0.367$) and repetitive movements ($r=0.493$) with CTS complaints. The longer the duration of work and the higher the frequency of repetitive movements performed, the greater the risk of workers experiencing CTS complaints.
9. (Saputra et al, 2021)	Factors Influencing the Occurrence of Carpal Tunnel Syndrome in Online Motorcycle Taxi Drivers in the City of Jambi.	Cross-Sectional Study	A notable correlation exists among age ($p = 0.001$), a service duration of 4 years with a corresponding p-value of ($p = 0.001$), and working for more than 8 hours ($p = 0.024$) in online motorcycle taxi drivers.
10. (Noprianti et al, 2020)	The Relationship Between Age, Work Duration, Frequency of Repetitive Movements, and the Occurrence of Carpal Tunnel Syndrome in Mawar	Cross-Sectional Study	The results showed that 23 respondents (57.5%) had carpal tunnel syndrome, 28 respondents (70%) had the highest risk for carpal tunnel syndrome. 26 respondents (65%). There is a relationship between the three variables

		Fashion Tailors, Banjarmasin, 2020.		in Busana Mawar Banjarmasin, East Banjarmasin District (p value = 0.001; 0.001 and 0.000).
11.	(Rosiyana, 2023)	The Relationship between Repetitive Movements and Length of Work with Carpal Tunnel Syndrome Symptoms in Workers of the Informal Sector Managing Marine Products.	Cross-Sectional Study	The findings of this study reveal a correlation between repetitive movements and CTS symptoms (p = 0.000). Additionally, the research demonstrates a connection between the duration of work and CTS symptoms (p = 0.001).
12.	(Nafasa et al, 2019)	The Relationship between Work Duration and Carpal Tunnel Syndrome Complaints among Computer Users in Bank BJB Subang Branch.	Cross-Sectional Study	The data analysis was conducted using the Fisher Exact Test, and the obtained p-value is 0.000 (<0.05), indicating a significant relationship between work duration and Carpal Tunnel Syndrome (CTS) complaints among employees at Bank BJB Subang Branch who use computers.
13.	(Rosaliya, 2021)	The Relationship Between Work Duration and Carpal Tunnel Syndrome Complaints Among Online Motorcycle Taxi Drivers in Sumedang Regency.	Cross-Sectional Study	The Chi-square test table's univariate analysis data indicated a significant association between extended work hours and complaints of carpal tunnel syndrome among online motorcycle taxi drivers in Sumedang (p = 0.001).
14.	(Chairunnisa et al, 2021)	Factors Associated with Carpal Tunnel Syndrome Symptoms in the Online Motorcycle Taxi Community in South Tangerang City in 2021.	Cross-Sectional Study	The findings indicated correlations between age (p-value = 0.001), medical history of CTS (p-value = 0.002), use of personal protective equipment (p-value = 0.000), length of employment (p-value = 0.000), duration of work (p-value = 0.031), and repetitive movements (p-value = 0.000) with carpal tunnel syndrome.
15.	(Seher & Nejdiye, 2023)	Prevalence and risk factors for self-reported symptoms of carpal tunnel syndrome among hospital office workers: a cross-sectional study	Cross-Sectional Study	Significant differences were found between those with and without CTS symptoms regarding age, body mass index, previous diagnosis of CTS, daily work hours, using a wrist-supported mousepad and perceived workload (p < 0.05).

Based on the results of a review of 15 articles presented in Table 1, several occupational and physical activity-related risk factors showing a significant correlation with the incidence and severity of CTS include prolonged work duration, the length of time working in the sector or field, repetitive hand and wrist movements, unusual hand postures, vibration exposure, duration of vibration exposure to the hands, vibration levels, frequency of repetitive hand movements, history of previous CTS, and the use of protective gloves to prevent CTS while working, as well as the type of job.

Various occupations correlated with CTS from these 15 articles include batik workers using a canting to paint batik, tofu meatball makers, workers in marble industries, bank employees, cobek makers, online motorcycle taxi riders, brick factory workers, blacksmiths, fashion tailors, seafood processors, computer users, office workers, and various other jobs predominantly involving repetitive wrist movements.

Work duration becomes a significant risk factor in several job types with CTS risk, as found in the study by (Wulandari et al, 2020), indicating a relationship between work duration and CTS incidence (p-value=0.004). This aligns with the study by (Hamid et al, 2020), showing a relationship between the length of work (p = 0.000) and CTS complaints, and with the research by (Putra et al, 2023), revealing a connection between work duration (p = 0.002), and CTS incidence. Consistently, (Saputra et al, 2021) indicated a significant correlation between working more than 8 hours (p = 0.024) among online motorcycle taxi riders and CTS incidence, and (Rosaliya, 2021) demonstrated a significant association between extended work hours and complaints of carpal tunnel syndrome among online motorcycle taxi drivers in Sumedang (p = 0.001). (Chairunnisa et al, 2021) found a correlation between work duration (p-value = 0.031) and carpal tunnel syndrome.

The duration of employment in the sector or field also becomes a significant factor in CTS incidence, as indicated by (Subandi S, et al, 2020), showing a moderate positive correlation between the duration of employment and nerve injury ($r=0.559$; $p=0.013$). The longer the working period for employees or their work experience in the sector, the higher the incidence of CTS. This aligns with the findings of (Hamid et al, 2020), showing a relationship between years of service ($p = 0.005$) and CTS complaints, and with the research by (Putra et al, 2023), revealing a connection between work duration ($p = 0.0001$) and CTS incidence. It also aligns with the study by (Nafasa et al, 2019), indicating a significant relationship ($p=0.000$, <0.05) between the duration of employment and Carpal Tunnel Syndrome (CTS) complaints among Bank BJB Subang Branch employees using computers. The group with an employment duration of ≥ 4 years exhibited a higher proportion of CTS compared to the group with an employment duration of <4 years. The longer the employment duration, the higher the risk of CTS. This is consistent with the research by (Setyawati et al, 2022), showing a quite strong positive correlation between work duration ($r=0.367$) and repetitive movements ($r=0.493$) with CTS complaints. The longer the duration of work and the higher the frequency of repetitive movements performed, the greater the risk of workers experiencing CTS complaints.

Repetitive hand and wrist movements, according to the study by (Wulandari et al, 2020), found a relationship between repetitive movements and CTS incidence (p -value= 0.006). This aligns with the research by (Hamid et al, 2020), indicating a relationship between repetitive movements ($p = 0.001$) and CTS complaints, and with the study by (Putra et al, 2023), revealing a connection between repetitive movements ($0,001$) and CTS incidence. Consistently, (Setyawati et al, 2022) indicated a quite strong positive correlation between work duration ($r=0.367$) and repetitive movements ($r=0.493$) with CTS complaints. The longer the duration of work and the higher the frequency of repetitive movements performed, the greater the risk of workers experiencing CTS. Consistently, (Noprianti et al, 2020) found a relationship between age, work duration, and repetitive movements (p -value = 0.001 ; 0.001 , and 0.000) with CTS incidence, and (Rosiyana, 2023) revealed a correlation between repetitive movements and CTS symptoms ($p = 0.000$). (Chairunnisa et al, 2021) indicated a correlation between repetitive movements (p -value = 0.000) and carpal tunnel syndrome.

Unusual hand postures, according to the study by (Wulandari et al, 2020), found a relationship between unusual postures and CTS incidence (p -value= 0.046). Consistently, (Putra et al, 2023) revealed a connection between wrist posture ($0,0001$) and CTS incidence.

Vibration exposure to the hands is also a risk factor for CTS incidence, according to the research by (

Putra et al, 2023), revealing a connection between vibration exposure ($0,007$) and CTS incidence. This aligns with the study by (Qoribullah, 2020), stating that there is a significant correlation between arm-hand vibrations and Carpal Tunnel Syndrome (CTS) complaints ($p = 0.01$). In conclusion, arm vibration exposure can increase Carpal Tunnel Syndrome complaints. This aligns with the research on vibration exposure with CTS conducted by (Putri et al, 2022).

A history of previous CTS is also a risk factor for workers to experience CTS, according to the study by (Chairunnisa et al, 2021), indicating a correlation between a history of CTS (p -value = 0.002) and carpal tunnel syndrome. Consistently, (Seher & Nejdyye, 2023) found a significant difference between those with and without CTS symptoms related to age, body mass index, previous diagnosis of CTS, daily work hours, the use of wrist-supportive gloves, and perceived workload ($p < 0.05$).

The use of protective gloves to prevent CTS while working is also crucial in preventing the risk of CTS in workers. (Chairunnisa et al, 2021) found a correlation between the use of personal protective equipment (p -

value = 0,000) and carpal tunnel syndrome. Consistently, (Seher & Nejadiye, 2023) found a significant difference between those with and without CTS symptoms related to age, body mass index, previous diagnosis of CTS, daily work hours, the use of wrist-supportive gloves, and perceived workload ($p < 0.05$).

The above risk factors are consistent with the study conducted by (Ijaz et al. 2023). The research results significantly revealed that the duration of employment and job types exhibited statistically significant associations (P value > 0.05), while the type of activity demonstrated a notably significant association (P value > 0.01) with Carpal Tunnel Syndrome (CTS). Additionally, the research indicated a rise in the prevalence of CTS with advancing age, increasing work experience, and engaging in forceful activities. The conclusion drawn from the study is that individuals employed in marble factories, specifically those working over 6 hours daily, possessing extensive work experience, being older in age, and involved in repetitive movements or using vibratory tools, face a heightened risk of developing CTS.

4. Conclusions

Based on the identification of fifteen analyzed articles, various occupational and physical activity-related risk factors are significantly associated with the occurrence and severity of Carpal Tunnel Syndrome (CTS). These factors include prolonged work duration, tenure in a specific sector or field, repetitive hand and wrist movements, unusual hand postures, vibration exposure, duration of vibration exposure to the hands, vibration level, frequency of repetitive hand movements, history of previous CTS, and the use of hand protection tools. Occupations associated with CTS include batik workers, meatball tofu makers, marble industry workers, bank employees, mortar makers, online motorcycle taxi drivers, brick factory workers, blacksmiths, fashion tailors, sea product handlers, computer users, office workers, and other occupations involving repetitive movements of the wrist. Work duration becomes a significant risk factor in several types of jobs, with findings indicating a correlation between work tenure and CTS occurrence. This is also applicable to the tenure factor in specific sectors or fields, showing a positive correlation with CTS incidence. Repetitive hand and wrist movements also have a significant association with CTS complaints, especially among workers involved in repetitive tasks. Unusual hand postures also contribute to CTS occurrence, as does vibration exposure to the hands.

These risk factors align with research findings emphasizing the importance of implementing preventive and protective measures in the workplace. The use of personal protective equipment, understanding specific risks in particular occupations, and prudent management of work duration and risk factor exposure can help reduce the incidence of CTS among workers. Therefore, a thorough understanding of these risk factors is crucial in early prevention efforts and perioperative risk management, as well as anesthesia planning for individuals with a history of CTS.

However, further investigation is needed regarding other types of occupations that heavily involve repetitive wrist movements, unusual body posture, flexion and extension of the wrist, high vibration exposure to the hands, and other related factors.

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References

- Chairunnisa, S., Novianus, C., & hidayati, H. (2021). Faktor-Faktor Yang Berhubungan Dengan Gejala Carpal Tunnel Syndrome Pada Komunitas Ojek Online Di Kota Tangerang Selatan Tahun 2021. *Jurnal Fisioterapi Dan Kesehatan Indonesia*, 1(2), 1-13. Retrieved from <https://ifi-bekasi.e-journal.id/jfki/article/view/45>
- Cheung, J., Slomczykowski, M., & Coleman, M. (2019). Carpal Tunnel Syndrome: A review of the recent literature. **Orthopedics*, 42*(2), e141-e148.
- Descatha, A., Dale, A. M., Franzblau, A., Evanoff, B., & Andersen, J. H. (2018). Natural course of ulnar and median nerve conduction in symptomatic and asymptomatic workers. **Muscle & Nerve: Official Journal of the American Association of Electrodiagnostic Medicine*, 57*(3), 478-482.
- Di Stasio, E., De Sire, A., Agostini, F., Tognolo, L., Gimigliano, F., & Gimigliano, R. (2022). Rehabilitation program in patients with carpal tunnel syndrome undergoing surgical treatment: A randomized controlled trial. **Journal of Hand Therapy*, 35*(1), 18-27
- Elfar, J. C., Immerman, I., Valerio, I. L., & Zhu, L. L. (2021). Outcomes in carpal tunnel syndrome: symptom severity, conservative management, fasciectomy, and self-assessment. **Journal of Hand Surgery*, 46*(3), 244-252.
- Hamid, A., Fathur Rahman, Z. ., Suherdin, S., Widati, S. ., & Ardyanto Wahyudiono, Y. D. . (2020). Factors Related to Carpal Tunnel Syndrome (CTS) Complaints on Employees in the Bank BNI Branch of Palu. *Jurnal Ilmu Kesehatan Masyarakat*, 11(01), 63–74. <https://doi.org/10.26553/jikm.2020.11.1.63-74>
- Ijaz, S., Ali, M., Saeed, S., Ali, M., Sultan, S., & Shah, R. U. (2023). Prevalence of Carpal Tunnel Syndrome and its Associated Risk Factors among Workers of Marble Industries of Abbottabad. *Journal of Women Medical and Dental College*, 1(4). <https://doi.org/10.56600/jwmdc.v1i4.53>
- Noprianti, Dinda Selfiana (2020) Hubungan Antara Usia, Masa Kerja, Frekuensi Gerakan Berulang Dengan Kejadian Carpal Tunnel Syndrome Pada Penjahit Busana Mawar Banjarmasin Tahun 2020. Diploma thesis, Universitas Islam Kalimantan MAB
- Putra, M. F., Mayasari, D., & Apriliana, E. (2023). Faktor-faktor yang Berhubungan dengan Kejadian Carpal Tunnel Syndrome (CTS) pada Pekerja Pembuat Cobek. *Jurnal Penelitian Perawat Profesional*, 6(3), 1017-1026. <https://doi.org/10.37287/jppp.v6i3.2429>
- Putri, S. C., Sari, D., & Wahyuni, I. D. (2022). Pengaruh Tingkat Getaran Dan Lama Paparan Penggunaan Mesin Jahit Terhadap Tanda-Tanda Keluhan Carpal Tunnel Syndrome (CTS) Pada Pekerja Di Istana Bordir Malang. *Jurnal EnviScience (Environment Science)*, 6(2), 137–150. <https://doi.org/10.30736/6ijev.v6i2.389>
- Qoribullah, F. (2020). Hubungan Getaran Lengan-Tangan Dengan Keluhan Carpal Tunnel Syndrome Pada Pekerja Home Industry Pandai Besi Di Kecamatan Sokobanah Sampang: Carpal Tunnel Syndrome (CTS). *Medical Technology and Public Health Journal*, 4(1), 38–45. <https://doi.org/10.33086/mtphj.v4i1.1165>
- Rosalija Fatmayanti, . (2021) Hubungan Lama Kerja Dengan Keluhan Carpal Tunnel Syndrome Pada

Pengendara Ojek Online Di Kabupaten Sumedang. Skripsi thesis, Universitas Pembangunan Nasional Veteran Jakarta.

Saputra, Alqadri and Istarini, Attiya and Hanina, Hanina (2021) Faktor-Faktor Yang Mempengaruhi Kejadian Carpal Tunnel Syndrome Pada Pengendara Ojek Online Di Kota Jambi. S1 thesis, Universitas Jambi.

Seher Kurtul & Nejdije Mazican (2023) Prevalence and risk factors for self-reported symptoms of carpal tunnel syndrome among hospital office workers: a cross-sectional study, *International Journal of Occupational Safety and Ergonomics*, 29:2, 461-465, DOI: 10.1080/10803548.2022.2054580

Setiawati, L. Q. B., Awwalina, I., Dwiyantri, E., Sahri, M., & Ardyanto, D. (2022). Hubungan Antara Masa Kerja Dan Gerakan Repetitif Dengan Keluhan Carpal Tunnel Syndrome Pekerja Wanita Bata Pres. *Medical Technology and Public Health Journal*, 5(2), 160–170. <https://doi.org/10.33086/mtphj.v5i2.2908>

Subandi, S., Mirawati, D. K., Putra, S. E., Hafizhan, M., Susilo, W. A., & Danuaji, R. (2020). The Relationship Between Working Period Of Batik Craftsmen And Incident Of Carpal Tunnel Syndrome. *MNJ (Malang Neurology Journal)*, 6(2), 73–76. Retrieved from <https://mnj.ub.ac.id/index.php/mnj/article/view/444>

Uchiyama, S., Itsubo, T., Nakamura, K., Kato, H., Yasutomi, T., Momose, T., ... & Nakagawa, T. (2020). Current concepts of carpal tunnel syndrome: pathophysiology, treatment, and evaluation. *Journal of Orthopaedic Science*, 25*(2), 213-220.

Wulandari, E., Widjasena, B., & Kurniawan, B. (2020). Hubungan Lama Kerja, Gerakan Berulang Dan Postur Janggal Terhadap Kejadian Carpal Tunnel Syndrome (CTS) Pada Pekerja Tahu Bakso (Studi Kasus Pada Pekerja Tahu Bakso Kelurahan Langensari, Ungaran Barat). *Jurnal Kesehatan Masyarakat*, 8(6), 826-831. <https://doi.org/10.14710/jkm.v8i6.28368>