Incidence of Occupational Carpal Tunnel Syndrome and Its Association with the Square Wrist Sign in Workers Evaluated by a Disability Qualification Board

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Abstract

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Introduction: Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy among the working population, associated with ergonomic factors and individual characteristics such as wrist anthropometry. Objective: To determine the incidence of work-related CTS and its relationship to the square wrist sign. Methodology: A cross-sectional, observational, descriptive-analytical study of 80 workers evaluated by the Atlántico Disability Assessment Board in 2023. Statistical tests (ANOVA, chi-square, and odds ratio) were applied. Results: A significant association was found between a wrist index ≥0.7 and CTS ($p<0.05$). Workers with a square wrist were up to 38 times more likely to receive a diagnosis. Conclusions: The square wrist sign constitutes a relevant risk factor for work-related CTS and should be included in epidemiological surveillance programs.

INTRODUCTION

One of the most common compressive neuropathies worldwide is carpal tunnel syndrome (CTS), characterized by compression of the median nerve as it passes through the carpal tunnel. Clinically, this condition presents with symptoms such as pain, paresthesia, muscle weakness, and functional limitation of the hand. Its impact is not limited to the clinical domain but also has significant implications for workers' quality of life. CTS is a major cause of disability and absenteeism in the workplace. For this reason, its study has gained particular importance in the field of occupational health. Understanding its associated factors is key to effective prevention. In this sense, a comprehensive approach to the phenomenon is required. (Bicha et al., 2024)

From an etiological perspective, CTS is considered a multifactorial disorder in which biomechanical, organizational, and anatomical factors converge. It is well established that risk factors include work activities involving repetitive movements, prolonged use of hand tools, and awkward postures. Additionally, organizational conditions such as long working hours and high work intensity can contribute to the development of this condition. However, not all individuals exposed to these factors develop the syndrome. This suggests the existence of additional variables that modulate individual susceptibility. Among these, anatomical factors have increasingly attracted attention. Their study helps deepen the understanding of CTS. (Harris-Adamson et al., 2022)

In recent years, research has incorporated the analysis of anthropometric variables as potential predisposing factors for CTS. Among these, the relationship between wrist dimensions, known as the square wrist sign, is particularly noteworthy. (Singh et al., 2025). This indicator is based on the proportion between wrist width and thickness, suggesting that certain anatomical configurations may predispose individuals to median nerve compression. Several studies have reported a possible association between this sign and the presence of the syndrome. However, findings have not always been conclusive. This highlights the need for further investigation. Especially in specific occupational populations. (Çupi et al., 2023)

Despite advances in the international literature, evidence in Colombia regarding the relationship between the square wrist sign and the occupational origin of CTS remains limited. This knowledge gap restricts the inclusion of this variable in assessment, diagnosis, and prevention processes in occupational health. It also hinders evidence-based decision-making in disability evaluation boards. Local studies that allow for understanding the specific characteristics of this phenomenon in the Colombian context are lacking. This is particularly relevant given the country's unique labor conditions. Therefore, there is a need to generate context-specific knowledge. One that responds to these realities. (Shoukat et al., 2026)

In the field of occupational health, Koca & Nazlıgül (2026) stated that early detection of risk factors is a fundamental strategy for preventing work-related diseases. In this context, the use of anthropometric variables may provide additional tools for identifying vulnerable populations. Incorporating the square wrist sign into clinical evaluations could improve the accuracy of identifying cases with a higher likelihood of developing CTS. However, its value depends on the strength of the scientific evidence supporting its association with the syndrome. Therefore, it is essential to continue advancing research that validates its relevance. Particularly in real-world occupational settings. This would strengthen prevention strategies. (Yesuf et al., 2023)

Furthermore, it is important to consider that recognizing the occupational origin of CTS has legal, economic, and social implications. Classifying this condition as an occupational disease determines access to benefits and rights for affected workers. In this process, disability evaluation boards play a central role. However, decision-making in these contexts must be based on technical criteria and solid scientific evidence. The inclusion of variables such as the square wrist sign could contribute to improving these processes. Provided that its validity is properly established. This underscores the need for studies that integrate clinical and occupational perspectives. As well as evaluation processes. (Tassara et al., 2023)

Within this framework, the present study aims to analyze the frequency of occupational carpal tunnel syndrome and its possible association with the square wrist sign in workers evaluated by a disability determination board. The objective is to provide evidence that contributes to strengthening knowledge about the factors involved in this condition. Likewise, it seeks to support the development of more precise prevention and evaluation strategies. The study is framed within the need to integrate clinical and anthropometric variables in the analysis of CTS. In this way, it is expected to contribute to the field of occupational health. Particularly in the Colombian context. And to generate inputs for future research. (Shaukat et al., 2025)

MATERIALS AND METHODS

Study design

An observational, cross-sectional, descriptive-analytical study was conducted to evaluate the incidence of occupational carpal tunnel syndrome (CTS) and its association with the square wrist sign in workers assessed by a disability qualification board. The study was carried out in 2023 at the Regional Disability Qualification Board of Atlántico, Colombia, based on clinical and occupational assessment records.

Population and sample

The study population consisted of workers referred for evaluation due to suspected CTS. A total of 80 participants with confirmed diagnosis were included. Inclusion criteria comprised workers with clinically confirmed CTS, while exclusion criteria included traumatic CTS and severe comorbidities that could confound the analysis. A non-probabilistic convenience sampling approach was used, based on record availability.

Variables

The dependent variable was the diagnosis of CTS (presence/absence), including its classification as occupational or non-occupational. The main independent variable was the wrist index, defined as the ratio between anteroposterior and transverse wrist diameters, with a cutoff point of ≥0.7 indicating the presence of the square wrist sign. Additional variables included age, sex, occupation, body mass index, daily working hours, years of exposure, and percentage of ergonomic exposure.

Data collection

Anthropometric measurements were obtained using a digital caliper (vernier caliper) to ensure precision in wrist diameter assessment. Sociodemographic and occupational data were collected through a structured questionnaire and job task analysis. All measurements followed standardized procedures to ensure reliability and reproducibility.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics® version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated, including means, standard deviations, and frequency distributions.

For inferential analysis, one-way Analysis of Variance (ANOVA) was applied to compare wrist index means between groups with and without CTS, followed by Fisher's Least Significant Difference (LSD) post hoc test. Associations between categorical variables were evaluated using the Chi-square (χ^2) test.

The strength of associations was estimated using Odds Ratios (OR) with 95% confidence intervals (95% CI). Statistical significance was set at $p < 0.05$.

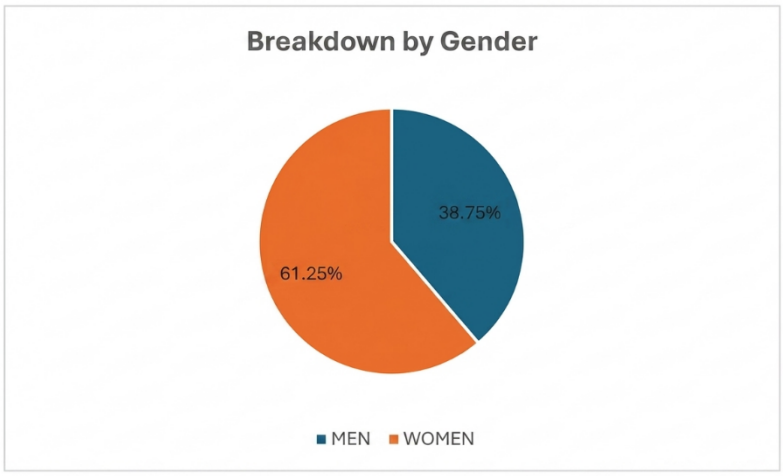
Ethical considerations

The study adhered to ethical principles for research involving human data. Confidentiality and anonymity of participants were ensured, as only secondary data from institutional records were used. The study complied with national and international ethical standards for health research.

RESULTS AND DISCUSSION

Figure 1.

Breakdown by Gender

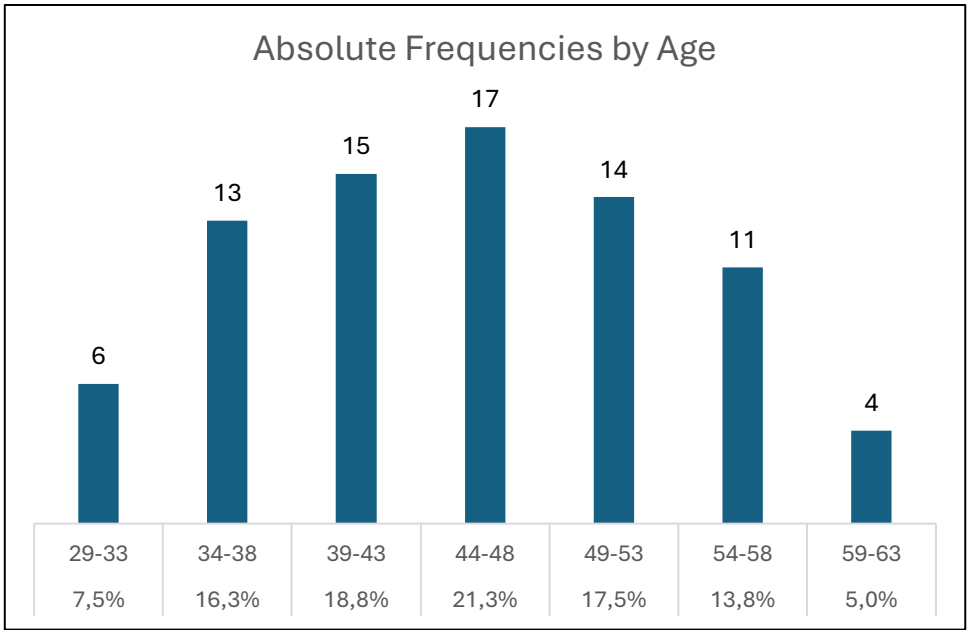


Source: From the study itself (2026)

In the studied sample, a greater representation of women than men was observed, with 61.25% and 38.75%, respectively. This distribution indicates that women constitute the majority group in the study, which may influence the interpretation of the results, particularly in the analysis of variables related to carpal tunnel syndrome. Since the literature reports that this condition is more prevalent in the female population, this composition may reflect known epidemiological trends. However, it is also important to consider that this overrepresentation may introduce bias if not properly controlled in the statistical analyses. Therefore, it is recommended that the results be interpreted in light of this distribution and, whenever possible, that sex-stratified analyses be conducted to identify specific differences between men and women.

Figure 2.

Absolute Frequencies by Age



Source: From the study itself (2026)

The data in the graph show that the highest concentration of participants falls within the middle age groups, particularly the 44–48 age range, which has the highest percentage (21.3%), followed by the 39–43 (18.8%) and 49–53 (17.5%) groups. This indicates that the study population is primarily concentrated in mid-

working ages, where cumulative exposure to occupational risk factors may be greater. In contrast, the youngest (29–33 years) and oldest (59–63 years) groups show the lowest proportions, at 7.5% and 5.0%, respectively. This distribution suggests lower representation at the age extremes, which may be associated with shorter occupational exposure among younger individuals and possible retirement or reduced work activity among older individuals. Overall, the data reveal a central tendency in middle-aged groups, which is relevant given that the development of carpal tunnel syndrome is often associated with prolonged exposure to occupational risk factors over time.

Table 1.

Statistical Summary for Outcome—Right

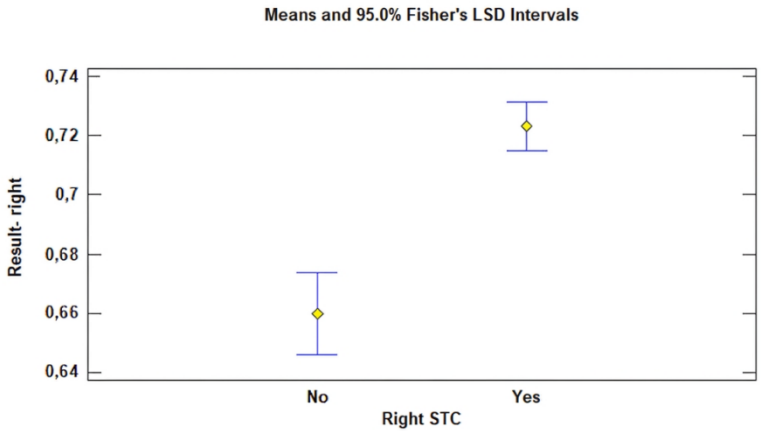
STC der	*Count*	*Mean*	*Standard Deviation*	*Coefficient of Variation*	*ANOVA p-value*
No	29	0,66	0,072	10,9%	0,000
Si	78	0,72	0,045	6,2%	

Source: Compiled by the author (2026)

Individuals diagnosed with carpal tunnel syndrome in their right hand tended to have an average squareness ratio of 0.72, whereas those without this diagnosis had an average ratio of 0.66. Since the p-value of the ANOVA is less than 0.05, it can be concluded that the differences identified in the table above are statistically significant at the 95% confidence level; furthermore, the graph of Fisher's LSD test supports this conclusion.

Figure 3.

Results: Right-handed



Source: Compiled by the author (2026)

Table 2.

Statistical Summary and ANOVA Table for the Right Hand

Relation	Yes	No	Total
Yes	57 (97%)	2 (3%)	59 (55%)
NO	21 (43%)	28 (57%)	49 (45%)
Total	78 (72%)	30 (28%)	108 (100%)
Chi-square	Valor-p	0,000; OR: 38 IC (8,3 – 173,6)	

Source: Compiled by the author (2026)

From the table, it can be concluded that 97% of individuals with a wrist index greater than 0.7 in the right hand have a diagnosis of carpal tunnel syndrome. Since the p-value of the chi-square test is less than 0.05, it is concluded that there is an association between a right wrist index greater than 0.7 and the diagnosis of carpal tunnel syndrome. Based on the odds ratio, it can be concluded that individuals with a wrist index greater than 0.7 have a 38-fold higher likelihood of being diagnosed with carpal tunnel syndrome compared to those with a wrist index below 0.7.

Table 3.

Statistical Summary and ANOVA Table for the Left Hand

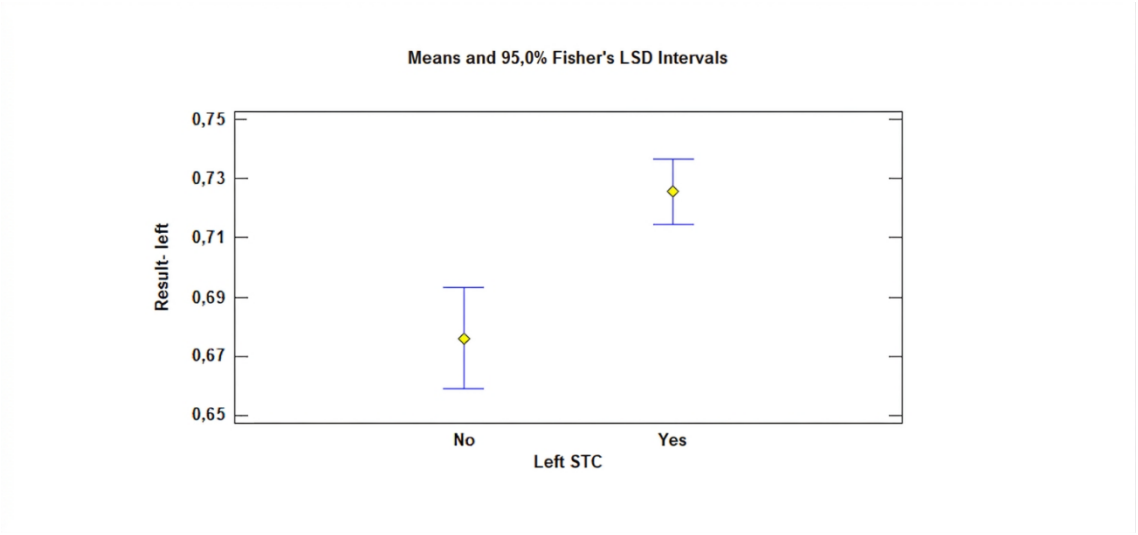
STC Izq	Count	Mean	Standard Deviation	Coefficient of Variation	ANOVA p-value
No	29	0,675862	0,0950382	14,0618%	0,0009
Si	70	0,726	0,0495311	6,82247%	

Source: Compiled by the author (2026)

Individuals diagnosed with carpal tunnel syndrome in the left hand tended to have an average wrist index of 0.72, whereas those without this diagnosis had an average value of 0.67. Since the ANOVA p-value is less than 0.05, it can be concluded that the differences identified in the previous table are statistically significant at a 95% confidence level. Additionally, the Fisher's Least Significant Difference (LSD) test plot supports this conclusion.

Figure 4.

Left-Handed Results



Source: Compiled by the author (2026)

Tabla 4.

Frequencies for High Left to STC Left Ratio

Relation	Yes	No	Total
Yes	52 (95%)	3 (5%)	55 (56%)
No	18 (41%)	26 (59%)	44 (44%)
Total	70 (71%)	29 (29%)	99 (100%)
Chi-square	Valor-p	0,000; OR: 25 IC (6,7 – 92,7)	

Source: Compiled by the author (2026)

From the table, it can be concluded that 95% of individuals with a wrist index greater than 0.7 in the left hand have a diagnosis of carpal tunnel syndrome. Since the p-value of the chi-square test is less than 0.05, it is concluded that there is an association between a wrist index greater than 0.7 and the diagnosis of carpal

tunnel syndrome. Based on the odds ratio, individuals with a wrist index greater than 0.7 have a 25-fold higher likelihood of being diagnosed with carpal tunnel syndrome compared to those with a wrist index below 0.7.

Table 5.

Schedules for the carpio tunnel service

Office	Yes	No	Total
Administrative	15 (48%)	16 (52%)	31 (28%)
Teaching	2 (67%)	1 (33%)	3 (3%)
Operational	62 (85%)	11 (15%)	73 (67%)
Healthcare professionals	1 (50%)	1 (50%)	2 (2%)
Total	80 (73%)	29 (27%)	109 (100%)
Chi-square	Valor-p	0,0014	

Source: Compiled by the author (2026)

Based on the table, it is evident that occupations with the highest tendency to develop carpal tunnel syndrome are operational and teaching roles. Since the p-value of the chi-square test is less than 0.05, it is concluded that there is a statistically significant association between occupation and the diagnosis of carpal tunnel syndrome.

Table 6.

Occupational risk factors and incidence of carpal tunnel syndrome

Numerator	Denominator	Momios	95% LCI	*95% LCS*
Teacher	Administrative	2,13333	0,174821	26,033
Operational	Administrative	6,01212	2,31918	15,5855
Healthcare professionals	Administrative	1,06667	0,0610916	18,6241
Operational	Teacher	2,81818	0,234913	33,8089

Source: Compiled by the author (2026)

Based on the odds ratio results, it can be concluded that individuals in operational occupations have a sixfold higher likelihood of developing carpal tunnel syndrome compared to administrative workers. Among teachers, this likelihood is twice as high. Additionally, individuals in operational roles have a 2.8-fold higher likelihood of developing carpal tunnel syndrome compared to those in teaching roles.

Table 7.

Schedule of operating hours for the carpio tunnel

Hours worked	Yes	No	Total
8	56 (71%)	23 (29%)	79 (72%)
9	14 (93%)	1 (7%)	15 (14%)
10	3 (38%)	5 (62%)	8 (7%)
12	7 (100%)	0 (0%)	7 (6%)
Total	80 (73%)	29 (27%)	109 (100%)
Chi-square	Valor-p	0,0111	

Source: Compiled by the author (2026)

Since the p-value of the chi-square test is less than 0.05, it is concluded that there is a statistically significant association between the number of daily working hours and the diagnosis of carpal tunnel syndrome. Based on the bivariate table, it can be observed that the more hours individuals work per day, the greater the likelihood of being diagnosed with carpal tunnel syndrome.

Table 8.

Frequency table for jria stations by the national board

Regional	General	Employment	Total
General	26 (84%)	5 (16%)	31 (39%)
Employment	14 (29%)	35 (71%)	49 (61%)
Total	40 (50%)	40 (50%)	80 (100%)
Chi-square	Valor-p	0,0111	

Source: Compiled by the author (2026)

Since the p-value of the chi-square test is less than 0.05, it can be concluded that there is a statistically significant association between the diagnoses of carpal tunnel syndrome made by the regional board and the national board. There was an 84% agreement in the diagnosis of non-occupational carpal tunnel syndrome between the regional and national boards, whereas 71% of occupational diagnoses were consistent between both boards.

Table 9.

Frequency table: years of exposure and diagnosis of STC

Years of exposure	No	yes	Total
< 8	10 (25%)	30 (75%)	40 (37%)
8 a 14	2 (8%)	22 (92%)	24 (22%)
14 a 20	3 (18%)	14 (82%)	17 (16%)
> 20	14 (50%)	14 (50%)	28 (26%)
Total	29 (27%)	80 (73%)	109 (100%)
Chi-square	Valor-p	0,0053	

Source: Compiled by the author (2026)

Since the p-value of the chi-square test is less than 0.05, it can be concluded that there is a statistically significant association between carpal tunnel syndrome diagnoses and the workers' years of exposure. A higher prevalence of carpal tunnel syndrome is observed among workers with 8 to 14 years of experience, after which the percentage begins to decrease.

Table 10.

Frequency table: percentage of exposure and diagnosis of STC

Exhibition	No	yes	Total
40% o mas	24 (24%)	76 (76%)	100 (92%)
< 40%	5 (56%)	4 (44%)	9 (8%)
Total	29 (27%)	80 (73%)	109 (100%)
Chi-square	Valor-p	0,0402	

Source: Compiled by the author (2026)

Since the p-value of the chi-square test is less than 0.05, it is concluded that there is a statistically significant association between the percentage of exposure and the diagnosis of carpal tunnel syndrome. Individuals with an exposure level of 40% or higher have a greater proportion of carpal tunnel syndrome diagnoses.

CONCLUSIONS

Carpal tunnel syndrome (CTS) has become one of the main occupational pathologies affecting the working population, particularly in activities involving repetitive movements and biomechanical overload. Its multifactorial nature has led to the need to integrate ergonomic, organizational, and anatomical variables

into its analysis. In this study, a large proportion of workers evaluated by a disability qualification board were found to have CTS, highlighting the importance of this issue in real-world occupational assessment settings. Identifying associated factors not only improves understanding of the condition but also helps guide prevention strategies. In this context, analysis of the wrist index is particularly relevant. The inclusion of anthropometric variables expands the traditional approach to occupational risk. This contributes to a more comprehensive understanding of the phenomenon. (Alonazi et al., 2024)

The results obtained demonstrate a statistically significant association between a wrist index greater than or equal to 0.7 and the diagnosis of CTS, for both the right and left hands. Differences in mean wrist index values between groups with and without diagnosis were confirmed through analysis of variance, supporting the hypothesis of anatomical influence in the development of the syndrome. High odds ratio values also indicate a substantial increase in risk among individuals with a square wrist. These findings are consistent with trends reported in the international literature. However, the magnitude of association observed in this study is particularly high. This suggests the influence of specific occupational conditions within the studied population. Therefore, the importance of the occupational context is reinforced.

Regarding occupational variables, it was observed that workers in operational roles have a higher likelihood of developing CTS compared to those in administrative and teaching positions. Likewise, a significant association was found between daily working hours, years of exposure, and percentage of exposure with the diagnosis of the syndrome. These results confirm that workload plays a determining role in the development of musculoskeletal disorders. The accumulation of exposure over time emerges as a key factor in disease progression. Additionally, the relationship between diagnosis and occupation suggests the need for targeted interventions based on job type. This implies the design of differentiated prevention strategies. In this way, the occupational health approach is strengthened.

Finally, the study findings highlight the importance of integrating clinical, anthropometric, and occupational variables in the evaluation of carpal tunnel syndrome. The evidence supports the inclusion of the square wrist sign as a relevant indicator in epidemiological surveillance programs. It is also necessary to strengthen prevention strategies through active breaks, workstation redesign, and control of exposure to risk factors. The integration of clinical evaluation and workplace analysis is essential for informed decision-making. This approach contributes to improving workers' quality of life. It also helps reduce absenteeism and associated costs. In this sense, the study provides key contributions for practice and future research.

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