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Prevalence of carpal tunnel syndrome in the peeling area of the aquaculture industry at a shrimp packing plant in Ecuador

Prevalencia de síndrome de túnel carpiano en área de pelado en industria acuícola en una empacadora de camarón en Ecuador

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SUMMARY

Introduction: Carpal Tunnel Syndrome (CTS) is one of the most common musculoskeletal disorders among workers who perform repetitive tasks.

Objective: To determine the prevalence of CTS in the peeling area of a shrimp packing plant in Ecuador, comparing it with a less exposed control group such as machine operators.

Methodology: A cross-sectional analytical observational study was conducted using occupational medical records from January 2022 to June 2024. The total population included 194 female workers in the peeling area and 100 in the machine sorting area.

Results: The results showed that 20.6% of workers in the peeling area had CTS, compared to only 8% in the control area. The most affected group was between 60 and 64 years of age, with the right hand being the most affected (82.5%). Most cases occurred in workers with 16 years of seniority. Statistical analysis yielded a Prevalence Ratio (PR) of 2.99 (95% CI: 1.34–6.66), indicating that workers in the peeling area are almost three times more likely to develop CTS than those in the control area.

Conclusions: There is a strong association between intensive work in the peeling area and the onset of CTS. The implementation of ergonomic preventive measures and longitudinal studies that include psychosocial factors is recommended to mitigate this condition and improve the well-being of workers.

Keywords: ergonomics, median nerve, occupational risks.

RESUMEN

Introducción: el síndrome del túnel carpiano (STC) es una de las afecciones musculoesqueléticas más frecuentes entre los trabajadores que realizan tareas repetitivas.

Objetivo: determinar la prevalencia del STC en el área de pelado de una empacadora de camarón en Ecuador, comparándola con una de control menos expuesta como el clasificado de máquina.

Metodología: se empleó un estudio observacional analítico transversal, utilizando registros médicos ocupacionales de enero de 2022 a junio de 2024. La población total incluyó a 194 trabajadoras del área de pelado y 100 del área de clasificado de máquina.

Resultados: los resultados mostraron que el 20.6% de las trabajadoras del área de pelado presentó STC, en comparación con solo el 8% en el área de control. El grupo más afectado estuvo entre los 60 y 64 años, siendo la mano derecha la más comprometida (82.5%). La mayoría de los casos ocurrieron en trabajadoras con 16 años de antigüedad. El análisis estadístico arrojó una Razón de Momios de Prevalencia (RMP) de 2.99 (IC 95%: 1.34–6.66), indicando que las trabajadoras del área de pelado tienen casi tres veces más probabilidad de desarrollar STC que las del área de control.

Conclusiones: existe una fuerte asociación entre la actividad laboral intensiva en el área de pelado y la aparición del STC. Se recomienda la implementación de medidas preventivas ergonómicas y estudios longitudinales que incluyan factores psicosociales para mitigar esta afección y mejorar el bienestar de las trabajadoras.

Palabras Clave: ergonomía, nervio mediano, riesgos laborales.

INTRODUCTION

According to the World Health Organization (WHO), musculoskeletal disorders have been defined as the leading cause of work absenteeism, with upper limb disorders being most directly related to repetitive static force and potentially worsening when performing such activities¹. Musculoskeletal disorders encompass a range of inflammatory and degenerative conditions that affect the muscles, bones, nerves, tendons, ligaments, joints, cartilage, and discs of the spine, and can be either acute or chronic, localized or diffuse².

Carpal tunnel syndrome (CTS) is caused by compression of the median nerve as it passes through the transverse carpal ligament of the wrist. It is characterized by sensory and motor symptoms and signs in the area related to the median nerve, mainly distal to the wrist. CTS is the most common entrapment neuropathy, with prevalence rates in the general population ranging from 6 to 19% depending on the case definition, and with a consequent predominance in women³. The diagnosis is clinical, characterized by symptoms such as paresthesias in the hand, specifically in the first three fingers and the palmar surface of the hand, which predominate. Weakness or atrophy may also be observed in the short abductor muscle of the thumb or the opponens pollicis muscle of the thumb⁴.

The annual incidence of CTS is 1 case per 1,000 people⁵⁻⁶, with a significantly higher prevalence in females and in workers who perform repetitive and forceful tasks⁷.

In CTS, also known as “delayed median nerve palsy,” in addition to the anatomical components on the palmar side of the wrist, it is the clinical manifestations, both sensory and motor, that mark the diagnosis. It is a condition that affects the physical, psychological, social, and occupational aspects of workers⁸⁻¹⁰.

It can affect one or both hands, mainly in women over the age of 45¹¹⁻¹⁵. However, many patients experience improvement with conservative treatments, a small percentage may require surgical intervention to relieve nerve compression(;) in addition, chronic medical conditions such as diabetes mellitus, hypothyroidism, and rheumatoid arthritis, which contribute to inflammation and metabolic changes, increase the individual risk of developing CTS¹⁶.

Occupational factors play a significant role in the development of carpal tunnel syndrome, particularly in industries that involve repetitive hand and wrist use¹⁷. Jobs involving repetitive movements, such as continuous finger manipulation, assembly line work, carpentry, and hairdressing, significantly increase the risk¹⁸.

Vibration is another significant occupational hazard; the use of tools such as jackhammers and chainsaws can cause repeated microtrauma, leading to inflammation and compression of the median nerve¹⁹.

The objective of the study was to determine the prevalence of carpal tunnel syndrome associated with work activities in the peeling area of a shrimp packing aquaculture industry.

METHODOLOGY

Cross-sectional analytical observational study; data were obtained from periodic occupational medical records collected during the period from January 2022 to June 2024. Members of the company working in the peeling areas were included in the study. Female workers in the machine sorting area were included as a control group.. This was done to subsequently calculate the Momio Prevalence Ratio (MPR), which measures the probability of a female worker in the peeling area having STC compared to a female worker in another area (the control area).

There were 194 female workers in the peeling area, and it was decided to use information from all workers in that area. In the control area, where shrimp are manually separated or sorted according to specific criteria, a total of 100 women were present. The 100 female workers in the machine sorting area served as the control population of unexposed workers who could potentially develop CTS.

The following variables were taken into account for this study: Prevalence and severity of carpal tunnel syndrome (CTS), diagnosed by the company's medical staff. Distribution of hands affected by the syndrome. Length of service of the workers. Age. Control group (unexposed) machine sorting area. Functional impact and degree of disability caused by CTS.

Frequency and percentage tables were created for the specified variables, and the protocols outlined in the Declaration of Helsinki were followed for data management and analysis.

RESULTS

Table 1 presents the results for all female workers with CTS in the peeling area, comprising a total of 194 workers, with 40 positive cases, representing 20.6% of the sample.

Table 1. Women with STC in the peeling area.

	n	%
Has STC	40	20.6
Does not have STD	154	79.4

Table 2 shows the detailed distribution of women with STC (40 women) by age range.

Table 2. Age range of the 40 women with CTS in the peeling area.

Age group (years)	n	%
45 - 49	1	2.5
50 - 54	11	27.5
55 - 59	2	5.0
60 - 64	26	65.0

Table 3 shows that most cases of carpal tunnel syndrome occur in the right hand, with 82.5% (because that is the dominant hand), while 17.5% of cases occur in the left hand. It also shows that most cases of carpal tunnel syndrome occur among

workers with 16 years of service, representing 77.5% of the sample, while the lowest incidence occurs in workers with 9 years of service, with 2.5% of the total cases in the sample.

Table 3. Distribution of carpal tunnel syndrome by affected hand and years of service in the peeling area of the aquaculture company.

	n	%
Affected hand		
Left hand	7	17.5
Right hand	33	82.5
Years of service		
8	2	5.0
9	1	2.5
12	6	15.0
16	31	77.5

Table 4 presents the results for all female workers with STC in the machine sorting area, based on a sample of 100 women randomly selected as a control group of unexposed workers. There were a total of 8 positive cases of STC, i.e., 8% of cases were positive for this area.

Table 4. Women with STC in the machine sorting area

	n	%
Has STC	8	8.0
Does not have STC	92	92.0

Table 5 presents detailed information on STC cases in both the peeling and machine classification areas, with the former serving as the exposure area and the latter as the non-exposed or control area for calculating the RMP value. The calculated RMP is 2.99, with a 95% confidence level.

Table 5. Comparison of the peeling area with the machine sorting control area for the calculation of the RMP value.

Service area	STC present	STC not present	p-value (χ^2)
Peeling	40	154	0.009
Machine classification	8	92	
Confidence: 95% CI: [1.34 – 6.66]			
Calculated RMP value		2.99	

DICUSSION

The results obtained in this study indicate a significant prevalence of carpal tunnel syndrome (CTS) in the peeling area of a shrimp packing plant, at 20.6%, compared to 8% in the control area. This finding is consistent with the report by Estrada Torres⁵, who highlighted that CTS has a higher incidence in people exposed to forced postures and repetitive tasks, which clearly describes the working conditions in the peeling area. The nearly threefold increase in risk (RMP 2.99) is in line with the findings of Hagberg et al.²⁰, who reported that between 50% and 90% of CTS cases occur in occupations with a high burden of repetitive manual movements.

The predominance of cases in women over 60 years of age is also consistent with the literature, which indicates a higher prevalence in women between 40 and 60 years of age^{12,14}. This pattern may be related to anatomical and hormonal factors, as suggested by Amo et al.¹⁵, as well as underlying chronic diseases such as diabetes or rheumatoid arthritis¹⁶.

The greater involvement of the right hand (82.5%) reflects the dominant and repetitive use of this limb during work tasks, which supports the findings of Madison²¹, who described paresthesias and weakness in the first three fingers of the hand as key characteristics of CTS. The high prevalence among female workers with more than 16 years of service reinforces the influence of exposure time as a risk factor, as previously suggested by Tejedor and Andani¹³ in their multivariate analyses of occupational factors.

In addition, recent literature has highlighted that psychosocial factors, such as work stress, may also contribute to the onset or exacerbation of CTS²²⁻²³. In this context, workers in the peeling area may face operational pressures or mental loads that intensify symptoms, even if not directly quantified in this study.

Taken together, these results underscore the need for personalized ergonomic interventions and occupational surveillance programs that address both physical and psychosocial factors, as suggested by Arévalo Sánchez et al.¹⁷ and researchers at the University of Navarra Clinic²⁴.

Among the study's limitations, it is worth noting that, despite its objectives and findings, several limitations remain that should be addressed in future research. First, the retrospective nature of the data collection presented in this design allows for the possibility of selection bias and heterogeneity in the periods of risk exposure among female workers in the peeling area. Second, this study relied on exposure tests and controlled for confounding factors, such as age, personal medical history, and other specific ergonomic factors, in this analysis, which may help mitigate reporting bias for the association of interest. Finally, the results of this research are general for the aquaculture industry and other occupational settings, such as occupational exposure, as they may lead to greater risk exposure.

CONCLUSIONS

In the peeling area, 40 women out of 194 workers (20.6%) had symptoms of CTS. On the other hand, in the classification with the machine area, 8 out of 100 randomly selected women had CTS.

The final RPM analysis showed a value of 2.99 with a 95% CI of 1.34 - 6.66. This indicates that female workers in the peeling area are approximately three times more likely to develop STC compared to female workers in the machine classification area.

The statistical significance of these results suggests a strong and significant association between work activity in the peeling area and the occurrence of CTS.

RECOMMENDATIONS

These results underscore the need to implement preventive measures focused on improving ergonomics and workload in the peeling area to reduce the prevalence of this condition among female workers.

Longitudinal studies are recommended to monitor the incidence and progression of carpal tunnel syndrome (CTS) over time. This will enable us to identify patterns of development and assess the long-term effectiveness of ergonomic interventions and occupational safety and health programs.

In addition to physical factors, it is essential to examine the influence of psychosocial factors on the prevalence of CTS. Work stress, mental workload, and job satisfaction can influence the onset and severity of CTS. Future studies should investigate these relationships to provide a more comprehensive description of risk factors. Expand the sample to include workers from different sectors of aquaculture and other similar industries. This will enable us to determine whether the results of this study apply to other occupational groups and help identify specific factors in various types of work that contribute to the development of CTS. These future research directions will not only deepen our understanding of CTS and its risk factors but also contribute to the development of more effective strategies for preventing and treating this disease in the workplace.

BIOETHICAL ASPECTS

This study was conducted using secondary data from the company's routine occupational medical records. These records are part of the occupational health surveillance activities that are mandatory for companies under Ecuadorian regulations. The data were analyzed retrospectively, aggregated, and anonymized. The study followed the ethical principles established in the Declaration of Helsinki and the Singapore Declaration on Data Protection

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AUTHOR CONTRIBUTIONS

ALB: Conception, design, drafting, and revision of the article.

KES: Design, data analysis, and article revision.

RACT: Data analysis, drafting, and article revision.

All authors approved the final version of the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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