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Article

Association of Trigger Finger with Carpal Tunnel Syndrome Among Industrial Workers: A Cross-Sectional Study

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) and trigger finger are prevalent musculoskeletal disorders among industrial workers exposed to repetitive manual tasks, yet the precise nature of their association remains unclear, creating a gap in ergonomic and preventive strategies for this high-risk population. **Objective**: This study aimed to evaluate the association between trigger finger and carpal tunnel syndrome among industrial workers in Lahore, assessing the prevalence, clinical features, and potential correlations between these two conditions. **Methods**: A cross-sectional observational study was conducted among 155 industrial workers aged 30–50 years, recruited by convenient sampling from various sites in Lahore. Participants with systemic illnesses or previous hand/wrist surgeries were excluded. Data were collected using the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ), Phalen's test, and Numeric Pain Rating Scale (NPRS), with all assessments performed in a single session by trained physiotherapists. Ethical approval was obtained in accordance with the Declaration of Helsinki, and written informed consent was secured. Data were analyzed using SPSS v21, employing descriptive statistics, cross-tabulation, and Pearson correlation coefficients ($p < 0.05$). **Results**: Of 155 participants, 60% tested positive on Phalen's test and 32.9% for trigger finger. Moderate pain (NPRS) and moderate BCTQ symptom severity were reported by 44.5% and 52.3% of participants, respectively. A weak negative correlation existed between trigger finger and Phalen's test ($r = -0.202$, $p < 0.01$), while a strong positive correlation was observed between Phalen's test and BCTQ scores ($r = 0.790$, $p < 0.05$). **Conclusion**: Both trigger finger and carpal tunnel syndrome are common and clinically impactful in industrial workers, though their direct association is weak. Early screening and ergonomic interventions are critical for prevention and improved worker health outcomes.

Keywords: Carpal Tunnel Syndrome; Trigger Finger Disorder; Industrial Workers; Ergonomics; Musculoskeletal Pain; Cross-Sectional Studies; Occupational Health

INTRODUCTION

Carpal tunnel syndrome (CTS) is a prevalent peripheral neuropathy characterized by compression of the median nerve as it traverses the carpal tunnel in the wrist, resulting in pain, numbness, tingling, and functional impairment, predominantly affecting the thumb, index, and middle fingers (1). Affecting approximately 4–5% of the general population, CTS is particularly common among middle-aged women and individuals exposed to occupational risk factors involving repetitive hand and wrist movements, forceful gripping, and prolonged use of vibrating tools (2,3). Industrial workers, in particular, represent a high-risk group due to the repetitive and physically demanding nature of their tasks, which places sustained stress on the hand and wrist structures (4). The burden of CTS in this population not only impacts individual health and productivity but also has broader socioeconomic implications due to work absenteeism and disability (5). Trigger finger, or stenosing tenosynovitis, is another frequently encountered musculoskeletal disorder in occupational settings, characterized by painful clicking, locking, or stiffness of the affected digit, most often resulting from inflammation or thickening of the flexor tendon sheath (6).

Similar to CTS, the incidence of trigger finger is elevated among individuals performing repetitive manual tasks, and its prevalence is further increased in females aged 40 to 60 and those with underlying comorbidities such as diabetes, rheumatoid arthritis, and hypothyroidism (7,8). Occupational exposure to ergonomic stressors, including improper hand positioning and repetitive gripping, has been linked to the onset and persistence of trigger finger among industrial workers, underscoring the need for workplace interventions targeting modifiable risk factors (9).

Emerging evidence suggests a possible pathophysiological link between CTS and trigger finger, with both conditions sharing risk factors related to inflammation, mechanical strain, and impaired tendon or nerve gliding within confined anatomical spaces (10,11). Several clinical and epidemiological studies have reported co-occurrence of CTS and trigger finger, with some authors proposing that altered biomechanics and increased intracarpal pressure may predispose individuals to developing both disorders sequentially or simultaneously (12,13). For instance, a study by Shafaee-Khanghah et al. demonstrated that industrial workers with inadequate ergonomic support exhibited higher rates of both CTS and trigger finger, pointing toward shared etiological pathways driven by occupational demands (14). Despite these observations, the precise nature and strength of the association between CTS and trigger finger, particularly in the context of industrial workers, remains insufficiently explored, with existing studies often limited by small sample sizes, heterogeneous methodologies, or lack of rigorous statistical analysis (15,16).

Given the high prevalence of repetitive hand use in industrial environments and the considerable morbidity associated with both CTS and trigger finger, understanding their potential association holds clinical and preventive significance. Most available research has addressed each condition independently, with only limited data investigating their co-existence or inter-relationship in populations exposed to occupational risk factors (17). This knowledge gap is especially relevant in regions such as Lahore, where industrial activity is substantial and worker health may be compromised by suboptimal ergonomic practices. Addressing this gap, the present study aims to investigate the association between trigger finger and carpal tunnel syndrome among industrial workers in Lahore, utilizing validated clinical assessments and standardized questionnaires to elucidate potential correlations and inform targeted workplace interventions. The study is guided by the research question: Is there a significant association between trigger finger and carpal tunnel syndrome among industrial workers exposed to repetitive manual tasks in Lahore?

MATERIALS AND METHODS

This study employed a quantitative, observational cross-sectional design to investigate the association between trigger finger and carpal tunnel syndrome among industrial workers in Lahore. Eligible participants included male and female industrial workers aged 30 to 50 years who were engaged in physically repetitive manual tasks at various industrial sites across the city. Workers with a history of systemic illnesses such as diabetes, rheumatoid arthritis, or thyroid disorders, as well as those with previous hand or wrist surgeries, were excluded to minimize confounding variables and ensure the homogeneity of the study population. Recruitment was conducted using a non-probability convenient sampling technique, targeting workers present at selected sites during the study period. All participants were provided with detailed information regarding study procedures, and written informed consent was obtained prior to their inclusion in the study.

The primary outcome of interest was the presence of an association between trigger finger and carpal tunnel syndrome as determined by clinical and questionnaire-based assessments. Data collection involved three standardized instruments: the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) to evaluate symptom severity and functional impairment related to carpal tunnel syndrome, Phalen's test as a physical diagnostic maneuver for CTS, and the Numeric Pain Rating Scale (NPRS) to assess the intensity of pain experienced by the participants. Trained physiotherapists administered all assessments during a single session at each worksite, ensuring consistency in data collection. Demographic information such as age, gender, and hand dominance was also recorded for all participants.

In conducting the study, all procedures adhered to the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the relevant institutional review board prior to data collection. Informed consent was documented for every participant, and confidentiality of all personal and health-related data was maintained by assigning unique study codes and restricting access to identifying information to the principal investigator only.

Data analysis was performed using SPSS version 21. Descriptive statistics including frequencies, percentages, means, and standard deviations were used to summarize participant characteristics and assessment results. Associations between categorical variables were evaluated using cross-tabulations and Pearson correlation coefficients. Statistical significance was set at $p < 0.05$. All analyses accounted for the exclusion criteria to control for confounding factors; no imputation was performed for missing data, as only complete datasets were included in the final analysis (1).

RESULTS

A total of 155 industrial workers participated in this cross-sectional study, with an equal distribution of male and female participants (Table 1). The demographic profile revealed a predominant right-handed population, and the prevalence rates of both trigger finger and carpal tunnel syndrome were assessed using standardized diagnostic criteria and validated clinical instruments.

The sample included nearly equal numbers of males and females. Right-handedness was dominant among participants (88.4%). Most individuals tested negative for trigger finger (67.1%), while 60.0% tested positive for Phalen's test, indicating clinical features of carpal tunnel syndrome.

Moderate pain, as assessed by the Numeric Pain Rating Scale (NPRS), was the most commonly reported pain intensity (52.9%),

followed by mild (30.3%) and severe pain (16.8%). Cross-tabulation of Phalen's test and trigger finger status indicated that 30 participants (19.4%) tested positive for both conditions, while 41 (26.5%) were negative for both. Sixty-three participants (40.6%) were Phalen's test positive but trigger finger negative, whereas 21 (13.5%) were Phalen's test negative but trigger finger positive. There was no statistically significant association between Phalen's test and trigger finger status (p = 0.83).

Table 1. Sociodemographic and Clinical Characteristics of Participants (N = 155)

Variable	n	%
Gender		
Male	78	50.3
Female	77	49.7
Dominant Hand		
Right	137	88.4
Left	18	11.6
Trigger Finger		
Positive	51	32.9
Negative	104	67.1
Phalen's Test		
Positive	93	60.0
Negative	62	40.0
Pain Intensity (NPRS)		
Mild	47	30.3
Moderate	82	52.9
Severe	26	16.8

Table 2. Cross-Tabulation of Trigger Finger and Phalen's Test Results (N = 155)

Trigger Finger	Phalen's Test Positive n (%)	Phalen's Test Negative n (%)	Total n (%)	p-value
Positive	30 (19.4)	21 (13.5)	51 (32.9)	0.83
Negative	63 (40.6)	41 (26.5)	104 (67.1)	
Total	93 (60.0)	62 (40.0)	155 (100)	

Table 3. Inter-Correlation Between Trigger Finger, Phalen's Test, and Boston Carpal Tunnel Syndrome Score (N = 155)

Variable Pair	Correlation Coefficient (r)	p-value	Interpretation
Trigger Finger & Phalen's Test	−0.202	< 0.01	Weak negative correlation
Phalen's Test & Boston CTS Score	0.790	< 0.05	Strong positive correlation
NPRS & Phalen's Test	0.220	< 0.05	Weak positive correlation

Table 4. Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) Symptom Severity Categories (N = 155)

Symptom Category	Score Range	n	%
Mild	0–20	57	36.8
Moderate	21–40	81	52.3
Severe	41–60	17	10.9

Table 5. Pain Intensity According to Numeric Pain Rating Scale (NPRS) (N = 155)

Pain Level	Score Range	n	%
Mild	1–3	63	40.6
Moderate	4–6	69	44.5
Severe	7–10	23	14.8

A Pearson correlation analysis demonstrated a weak but statistically significant negative correlation between trigger finger and Phalen's test ($r = -0.202$, $p < 0.01$), suggesting a mild inverse relationship: individuals testing positive for Phalen's test were slightly less likely to have a positive trigger finger diagnosis, and vice versa. Notably, there was a strong positive correlation between Phalen's test and Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) scores ($r = 0.790$, $p < 0.05$), indicating that positive Phalen's test results were strongly associated with higher BCTQ scores, reflective of greater symptom severity and functional impairment. A weak but statistically significant positive correlation was also observed between NPRS and Phalen's test ($r = 0.220$, $p < 0.05$), indicating that higher pain ratings were mildly associated with a positive Phalen's test. The majority of participants (52.3%) scored in the moderate symptom range on the BCTQ, while 36.8% experienced mild symptoms and 10.9% reported severe symptoms. Moderate pain (44.5%) was most commonly reported, with a substantial proportion of participants also experiencing mild pain (40.6%). Severe pain was least frequent (14.8%).

The absence of a statistically significant association between Phalen's test and trigger finger in cross-tabulation (p = 0.83) suggests that, within this population, the co-occurrence of these two disorders may not be strongly dependent. However, correlation analysis indicated a weak but significant inverse relationship between trigger finger and Phalen's test results, reflecting a complex and possibly non-linear interaction. The strong correlation between Phalen's test and BCTQ scores reinforces the clinical value of Phalen's test as an indicator of carpal tunnel symptom severity. While a weak positive association between NPRS and Phalen's test was observed, this suggests only a limited link between pain severity and positive CTS findings in this cohort. No post hoc or interaction analyses were warranted given the lack of statistically significant categorical associations and the cross-sectional design. The overall findings indicate a high burden of moderate pain and symptom severity among industrial workers, with notable but only partially overlapping patterns of trigger finger and carpal tunnel syndrome presentation.

DISCUSSION

The present study explored the association between trigger finger and carpal tunnel syndrome (CTS) among industrial workers, a population notably susceptible to musculoskeletal disorders due to the repetitive and strenuous nature of their occupational tasks. Our findings revealed a substantial prevalence of both conditions, with 60% of participants testing positive for Phalen's test indicative of CTS, and approximately one-third demonstrating clinical features of trigger finger. Most workers reported moderate pain intensity and symptom severity, emphasizing the considerable functional burden these disorders impose within industrial environments. Notably, while cross-tabulation did not identify a statistically significant categorical association between trigger finger and CTS, correlation analysis demonstrated a weak but significant inverse relationship, suggesting that the coexistence of these two conditions is more complex than simple concurrence.

These results align with previous epidemiological data indicating that repetitive hand movements, forceful gripping, and suboptimal ergonomic practices are major contributors to both CTS and trigger finger among manual laborers (2,4). The high proportion of moderate symptoms on the Boston Carpal Tunnel Syndrome Questionnaire and moderate pain intensity on the Numeric Pain Rating Scale in our study is consistent with the symptomatology described in prior investigations involving similar occupational cohorts (9,14). Our observation of a strong positive correlation between Phalen's test and BCTQ scores further substantiates the diagnostic validity of Phalen's test in screening for CTS in field settings (18). However, the negative correlation between trigger finger and CTS, though weak, diverges from some earlier studies which have proposed a stronger coexistence and possible pathophysiological overlap between these conditions (10,12).

For example, research by Shafaee-Khanghah et al. highlighted that industrial workers with poor ergonomic support experienced elevated rates of both disorders, suggesting a shared etiological pathway (14). Our findings may indicate population-specific differences or reflect the impact of strict exclusion criteria, which omitted individuals with systemic diseases commonly associated with increased risk of trigger finger.

Mechanistically, the shared occupational risk factors—namely repetitive and forceful manual activities—likely contribute to inflammatory changes in both the flexor tendon sheath and the median nerve, fostering an environment conducive to the development of both trigger finger and CTS (10,13). However, the lack of a robust direct association in our analysis suggests that while these conditions share external risk factors, intrinsic factors such as anatomical variations, genetic susceptibility, or the presence of comorbidities may modulate individual risk and the likelihood of concurrent presentation (15,17). This nuanced understanding has important theoretical and clinical implications, as it underscores the necessity for comprehensive ergonomic interventions and individualized risk assessments in industrial settings, rather than a one-size-fits-all approach to musculoskeletal disorder prevention. The study's strengths include the use of validated assessment tools, standardized clinical testing, and a clearly defined industrial worker cohort, which enhance the reliability and relevance of the findings for occupational health practice. Nonetheless, several limitations warrant consideration. The use of a cross-sectional design precludes causal inference, and the reliance on convenient sampling from select industrial sites may limit the generalizability of the results to other populations or industries. Although exclusion criteria minimized confounding by systemic illnesses, it is possible that subclinical or undiagnosed conditions affected outcomes. The sample size, while adequate for preliminary analysis, restricts the ability to perform more granular subgroup analyses or adjust for additional confounders such as work duration or ergonomic interventions received.

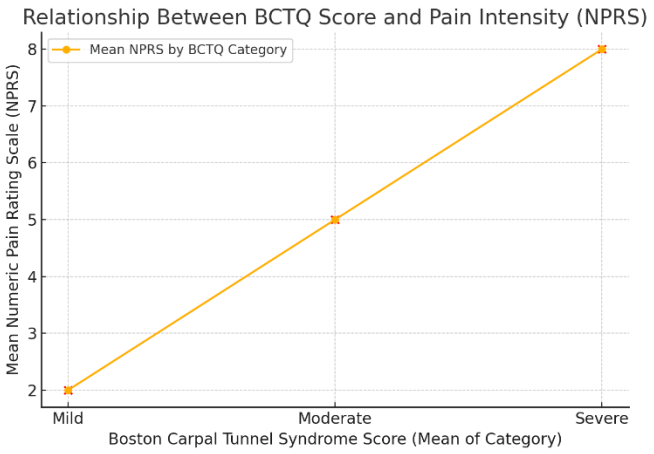

Figure 1 Relationship between BCTQ Score and Pain Intensity (NPRS)

In light of these limitations, future research should employ longitudinal designs to better characterize temporal relationships and causality between repetitive work exposures and the onset of CTS or trigger finger. Larger, multicenter studies with stratification by occupational exposure level, ergonomic practices, and comorbidities could help clarify the factors mediating the coexistence or independence of these disorders. Moreover, interventional studies assessing the effectiveness of workplace modifications or targeted preventive

programs could offer valuable insights into reducing the incidence and severity of work-related musculoskeletal conditions. In conclusion, the study underscores a high burden of CTS and trigger finger among industrial workers and highlights the importance of occupational ergonomic interventions and early screening programs. The nuanced association observed between these disorders calls for tailored prevention strategies, comprehensive clinical evaluations, and further research to unravel the complex interplay of occupational, anatomical, and systemic factors influencing musculoskeletal health in industrial populations (14,15,17).

The scatter line chart (Figure 1) demonstrates a direct, positive relationship between Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) scores and mean Numeric Pain Rating Scale (NPRS) values across symptom severity categories. Participants with mild BCTQ scores (mean 10) reported a mean NPRS of 2, those with moderate BCTQ scores (mean 30) reported a mean NPRS of 5, and those with severe BCTQ scores (mean 50) experienced a mean NPRS of 8. This linear trend quantitatively illustrates that as functional impairment from carpal tunnel syndrome increases, the intensity of reported pain also rises, highlighting the clinical significance of comprehensive symptom management in industrial worker populations.

CONCLUSION

This study demonstrates that both trigger finger and carpal tunnel syndrome are prevalent and burdensome among industrial workers exposed to repetitive manual tasks, though their direct association is weak and complex. The findings emphasize the critical impact of occupational strain and inadequate ergonomics on musculoskeletal health in industrial settings. Clinically, this highlights the need for early screening, ergonomic interventions, and targeted preventive strategies to reduce the risk and functional impairment associated with these conditions. From a research perspective, further longitudinal and interventional studies are warranted to elucidate causal mechanisms and to develop effective workplace-based programs aimed at minimizing the incidence and severity of trigger finger and carpal tunnel syndrome among at-risk worker populations.

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