Psychosocial Risk Factors and the Association With Carpal Tunnel Syndrome: A Systematic Review

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Abstract

Background: Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy of the upper limb. Research has shown that associative factors for CTS include occupational and biomechanical elements, sex, and age. To date, no systematic review has been undertaken to determine specifically whether there are any psychosocial risk factors in developing CTS. The objective is to determine whether psychosocial factors are associated with and/or predict the development of CTS. **Methods:** A systematic review was conducted including searches of PubMed (MEDLINE), EMBASE, and CINAHL from inception to May 30, 2017. Quantitative studies must have investigated a minimum of 1 or more psychosocial factors—cognitive, affective, behavioral, vocational, or interpersonal processes (eg, social support)—and include a point or risk estimate. One reviewer conducted the search and 2 reviewers independently assessed eligibility and completed methodological quality assessment using a modified Downs and Black checklist. Data were analyzed narratively. **Results:** Six moderate- to high-quality studies were included in the final review. Five studies reported a positive association between psychosocial factors and CTS, where psychosocial factors were more in those who reported CTS. One study reported no positive or negative association with CTS development. Four studies reported a negative association between psychosocial factors and CTS, where psychosocial factors were less in those who reported CTS. **Conclusions:** There is limited evidence for a positive association between psychosocial factors and CTS. However, this was not a consistent finding across all included studies. Further research is indicated in standardizing CTS diagnostic criteria and investigating other working environments.

Keywords: carpal tunnel syndrome, psychosocial, risk factors, systematic review, entrapment neuropathy

Introduction

Carpal tunnel syndrome (CTS) is a compressive neuropathy of the median nerve at the carpal tunnel.^{1,3} It is the most common upper limb entrapment neuropathy and can negatively impact function and work ability.^{13,17} Carpal tunnel syndrome features can include paresthesia and hypoesthesia in the distribution of the median nerve, particularly at night hand and arm pain median motor deficit,¹⁷ allodynia,¹³ dysesthesia, and hyperesthesia.²⁴

The reported incidence of CTS can vary among countries, and it is reported that CTS affects more women than men.^{5,9,14} Atroshi et al⁵ reported an estimated incidence of 324 per 100 000 women in Sweden compared with 524 per 100 000 in the United States. The estimated prevalence of CTS among men is 166 per 100 000 in Sweden and 303 per 100 000 in the United States.²⁰ As a result, in 1995, the estimated societal costs for undergoing a CTS decompression surgery were over \$2 billion in the United States.^{26,27} There

are no cost estimates to individuals or health care providers in the United Kingdom¹⁸; however, there is an estimated incidence of 87 and 192 per 100 000 for men and women, respectively.²⁰ The variance may be attributed to health beliefs and behaviors, occupation, and comorbidities such as diabetes.²⁰

Understanding risk factors is important for patients, clinicians, and policy makers to identify, predict, and prevent risks associated with CTS.²⁶ The occupational risk factors for the development of CTS have been reported by Kozak et al.¹⁹ Kozak et al¹⁹ synthesized systematic reviews and

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CTS OR carpal AND tunnel OR median AND nerve OR Median AND nerve AND entrapment
OR median AND nerve AND compression

AND

Psychosocial OR Social OR family OR work OR psychology OR personality OR depression
OR expectations OR stress OR distress OR anxiety OR fear OR worry OR support OR
catastrophizing OR Belief OR satisfaction OR job OR isolation OR behaviour OR Finance
OR emotion OR compensation OR attitude OR Employment

AND

Relative AND risk OR odds AND ratio OR Risk OR Hazard

Figure 1. MEDLINE search strategy.

Note. CTS = carpal tunnel syndrome.

primary studies reporting occupational biomechanical risk factors and concluded that there was high-quality evidence supporting repetitive wrist and hand movements, forceful exertion, and vibration as risk factors for developing CTS. However, the authors recognize that there are other factors such as age, sex, comorbidities, and psychosocial factors that may interact with the occupational biomechanical elements in the development of CTS. Harris-Adamson et al¹⁶ in their cohort study reported how biomechanical and work psychosocial exposures, such as job strain, are independent risk factors for incidence of CTS.¹⁹ In addition, the risk of developing CTS may be further attributed to high psychological work demand for women and low skill discretion for men.²⁸

Psychosocial risk factors associated with the development of musculoskeletal disorders are well documented.^{6,8,19,22,28} Somatization and adverse health beliefs around diagnosis and prognosis are known to be associated with chronic musculoskeletal disorders.²⁸ High work demands,⁸ work stress,²² and distress²² are related to the development of low back pain. The lack of work variation, low control over work time,³⁰ and anxiety¹¹ are related to the development of neck pain and shoulder pain. Targeting these potential risk factors can potentially reduce the incidence of CTS and as a result lessen the health care and societal costs to individuals and families.

To date, no systematic review has been undertaken to determine specifically whether there are any psychosocial risk factors in developing CTS among adults. Accordingly, the primary aims of this review are to investigate the incidence of CTS in association to psychosocial factors and whether psychosocial factors may predict the development of CTS.

Methods

The systematic review was registered with PROSPERO review database (Ref: CRD42016039900) and completed following the Preferred Reporting Items for Systematic

Reviews and Meta-analyses (PRISMA) guidelines of reporting.²³

Search Strategy

A systematic search of electronic databases, PubMed, CINAHL, and MEDLINE, from inception to May 30, 2017, was completed by reviewer (M.M.). An example of the MEDLINE search strategy can be viewed in Figure 1. An unpublished (gray) literature search and trial registry search were also completed. A hand search was completed of the reference lists of the records screened for potential inclusion. Corresponding authors from all included studies were contacted to determine whether there were any pending article publications in this area or unpublished work. An assessment of reliability (between-reviewer) for the eligibility criteria was performed for a random sample of 10 potentially eligible articles using a weighted Kappa statistic. This indicated that the between-reviewer agreement ranged from 0.80 to 1.00 across the criteria, with perfect (Kappa: 1.00) for overall agreement on eligibility of individual articles (available on request).

Eligibility Criteria

Studies were included if they met the following criteria:

- a. any quantitative study type,
- b. adult patients (over 18 years) with clinically diagnosed CTS with or without electrophysiological testing, and
- c. study must have investigated a minimum of 1 or more psychosocial factors—cognitive (eg, neuropsychological functioning), affective (eg, distress, mood), behavioral (eg, coping strategies), vocational (eg, employment status, job satisfaction, self-perceived work ability), or interpersonal processes (eg, social support)—and include a point or risk estimate.

No limitation of publication date was applied. All considered articles had to be in the English language. Articles were excluded if psychosocial factors were not measured or if the participants' CTS was related to systemic pathology, fracture, radiculopathy, myelopathy, or upper motor neuron pathology.

Study Identification

Two reviewers (M.M., F.S.) independently reviewed article titles and abstracts of all search results against the inclusion criteria. From this, full-text articles from potentially eligible articles were retrieved, and independent assessment was completed by 2 reviewers (M.M., F.S.). Final eligibility was decided based on full-text assessment.

Data Extraction

Data were extracted onto a predefined data extraction table independently by 2 reviewers (M.M., F.S.). Data extracted included lead author, study design, participant demographics, sex, psychosocial measure, CTS diagnosis classification, and strength of association of CTS development (risk estimate with confidence intervals [CIs]).

Quality Assessment

Two reviewers (M.M., F.S.) independently assessed each included study using a modified Downs and Black checklist.¹⁰ This tool is reported to be a valid and a reliable critical appraisal tool to assess methodological quality of nonrandomized controlled studies, which was the predominant study design among our eligible articles.¹⁰ The 2 reviewers discussed their scoring, and any disagreement in respect of study eligibility, data extraction, or critical appraisal was discussed and agreed between the 2 reviewers (M.M., F.S.). If an agreement could not be reached, a third reviewer (M.T.) acted as adjudicator. Items 4, 8, 13 to 15, 19, 23, and 24 were removed from our quality assessment because the items did not address our research question and aim of review.

The scoring between the 2 reviewers of the included studies had an agreement rate of 87% (109/126). Disagreements were around items 20 to 22 and 25 to 27 which were all resolved through discussion, and consensus was achieved.

Data Analysis

The study heterogeneity of the included studies was assessed by the 2 reviewers (M.M., F.S.) through examination of the data extraction table. This demonstrated significant heterogeneity in respect of patient characteristics, co-interventions, exposure, and the method of assessing

CTS. Based on these factors, a meta-analysis was not appropriate, and a narrative analysis was completed to answer our question.

Results

Search Strategy

Seven studies met the selection criteria (Figure 2). However, on further inspection, 1 study was excluded as the study did not report risk factor.¹² Accordingly, 6 articles were included in the final review.^{2,15,21,25,29,32}

Study Characteristics

The characteristics of the included studies are presented in Table 1. Three studies were cohort study designs.^{2,15,19} One study was a matched cohort study.³² There was 1 case-control study design²⁵ and 1 cross-sectional survey.²¹ Four studies recruited participants from industrial assembly line factory workers: 2 in France^{21,29} and 2 in the United States.^{15,32} Two studies recruited participants of mixed occupational background, including manual work, administration, professional services, and office-based occupations.^{2,25} A total of 12 773 participants were recruited across the 6 included studies.

Quality Assessment

The quality assessment scoring of the 6 included studies was very good; the mean score over the 8 included studies was 83% (100% score meaning all criteria met) with a range of 72% to 100%. The most common criteria that included studies met were *Is the hypothesis/aim/objective of the study clearly described?* (criterion 1), *Are the main outcomes to be measured clearly described in the Introduction or Methods section?* (criterion 2), and *Are the characteristics of the patients included in the study clearly described?* (criterion 3). The most common criteria that studies scored least favorably on were criterion 12: *Were those patients who were prepared to participate representative of the entire population from which they were recruited?* criterion 20: *Were the main outcome measures used accurate (valid and reliable)?* and criterion 22: *Were study patients in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same time?*

CTS Diagnosis Classification

The 6 included studies had variance on the diagnosis classification of CTS through a mix of self-reported symptoms, clinical findings, and electrophysiological testing. One study confirmed CTS through a positive Tinel's sign or

Figure 2. Flow diagram.

Phalen's test *or* a definite diagnosis based on nerve conduction velocity.²¹ Werner et al³² utilized a positive hand diagram for numbness, tingling, burning, *or* pain in the median distribution, *and* a prolongation of the median sensory-

evoked response that was 0.5 milliseconds longer than the ipsilateral ulnar sensory response for their inclusion criteria.

One study reported CTS diagnosis through sensory and motor electrophysiological testing of the median nerve and

Table 1. Study Characteristics.

Study	Design sample size	Study demographics: age and sex	CTS diagnosis classification	Occupation/work environment	Psychosocial measurements
Roquelaure et al ²⁹	Cohort study 1-year follow-up Year 1 recruited: 199 of a random sample of 1250 Year 2 follow-up: 162	Age 41.1 ± 7.0 (61% female)	Clinical assessment Median nerve distribution of paresthesia for 1 week or intermittently 10 months over a 12-month period Positive Test: Tinel's, Phalen's, or diminished sensation to pin prick in median nerve distribution Absence of symptoms related to cervical radiculopathy, thoracic outlet syndrome, or pronator teres	Large modern footwear factory France Main jobs performed were sewing preparation, including cutting (24%), sewing (25%), mechanized (18%), manual assembly (15%), and finishing and packing (18%)	GHQ-12 Psychological demand and social support self-assessment survey with a 6-point scale (very low to very high)
Harris-Adamson et al ¹⁵	Pooled cohort study design. 3515 participants followed up until 7 years	Ages <30 years of age n = 1089 (31%) ≥30 and <40 years of age, n = 836 (24%) ≥40 and <50 years of age, n = 933 (26%) ≥50 years of age n = 656 (19%) Male, n = 1860 (53%) Female, n = 1654 (47%) Nil explicit sex data	Electrophysiologic measures obtained across the wrist included median nerve sensory latency, median nerve motor latency, and ulnar nerve sensory latency	Industrial workers engaged in manufacturing, production, service, and construction United States	Job Content Questionnaire
Nordstrom et al ²⁵	Case-control study Cases, n = 206; Control, n = 211			Marshfield, Wisconsin, USA 55 000 residents, labor force in the area is 47% white-collar, 30% blue-collar, 13% service workers, and 10% farmers Assembly line, clothing and shoe industry workers 6 regions across France	National Institute for Occupational Safety and Health-Generic Job Stress Questionnaire
Lederc et al ²¹	Cross-sectional Survey study design 1210 workers from 53 different companies Control group of 337 workers	72.8% female Nil age data	Either (1) physician examination or (2) any explicit treatment for CTS; and (3) numbness, tingling, pain, or paresthesia in the hand, wrist, arm, or forearm within 1 month of the date of diagnosis of CTS Tinel's sign or Phalen's test was positive or a definite diagnosis based on nerve condition velocity		Langner's screening questionnaire Self-administered questionnaire (0-5 Likert scale)
Andersen et al ²	Cohort study n = 6943 at baseline and n = 5658 at follow-up (1-year follow-up) Matched cohort longitudinal study n = 189	41.7 years (SD, 8.9) 63.4% female	Self-reported and physician interview Self-reported tingling and/or numbness in a median nerve distribution	2 groups from Danish association of professional technicians (draftsmen, machine technicians, administration and graphical roles, office-based work) Assembly plant workers United States	Danish Karasek Job Content Questionnaire Self-administered questionnaires measuring behavior characteristics Karasek's Job Control Questionnaire
Werner et al ³²		49.8 years 45% female	Positive hand diagram for numbness, tingling, burning, or pain in the median distribution and a prolongation of the median sensory-evoked response that was 0.5 milliseconds longer than the ipsilateral ulnar sensory response		

Note. CTS = carpal tunnel syndrome; GHQ-12 = 12-item General Health Questionnaire.

sensory testing of the ulnar nerve.¹⁵ One study included participants with a CTS diagnosis through physician examination or previous CTS treatment *and* numbness, tingling, pain, or paresthesia in the hand, wrist, arm, or forearm within 1 month of the date of diagnosis of CTS.²⁵ Andersen et al² combined self-reported symptoms in a median nerve distribution and physician interview for CTS diagnosis. One study utilized clinical assessment findings only; patients were included if there were symptoms related to median nerve distribution of paresthesia for 1 week or intermittently 10 months over a 12-month period; a positive Tinels, Phalens test, or diminished sensation to pin prick in median nerve distribution; and an absence of symptoms related to cervical radiculopathy, thoracic outlet syndrome, or pronator teres.²⁹

Psychosocial Factor Measurement

Two studies assessed job control using the Karasek's Job Control Questionnaire.^{2,32} Furthermore, Andersen et al² also assessed personal characteristics (negative affect and "type A" behavior) through self-administered questionnaires. Roquelaure et al²⁹ used a self-assessment of psychological demand and social support alongside the 12-item General Health Questionnaire (GHQ-12) to measure psychological status. One study measured psychological job demand, work decision latitude scales, and social support using the Job Content Questionnaire (JCQ).¹⁵ One study collected information on psychosocial risk factors through participants' medical records and a telephone interview.²⁵ LeClerc et al²¹ assessed psychological and psychosomatic well-being using Langner's screening questionnaire and job control through a self-assessment Likert-scale questionnaire.

Psychosocial Risk Factors and Association to CTS

The 6 included studies reported both positive and negative associations within each article. Five studies reported a positive association between psychosocial factors and CTS, where psychosocial factors were more in those who reported CTS. A GHQ-12 score over the 90th percentile (ie, over 18.5), indicating high psychological distress (odds ratio [OR], 4.3; 95% CI, 1.0-18.6)²⁹ and psychological problems (OR, 2.34; 95% CI, 1.42-3.85)²¹ were more frequent and statistically significant in workers with CTS. Low social support was reported as a positive association in CTS (OR, 1.2; 95% CI, 0.90-1.80).² Furthermore, a poor social network was also positively associated with CTS development (OR, 1.2; 95% CI, 0.7-2.2).² There was a small (nonsignificant) positive association between "type A behavior" and CTS symptoms (OR, 1.1; 95% CI, 0.70-1.80).²

A high psychological work demand score (hazard ratio [HR], 1.57; 95% CI, 1.06-2.33)¹⁵ and a high job strain (high

demand and low control) were positively associated with CTS (HR, 1.86; 95% CI, 1.11-3.14).¹⁵ Furthermore, a high job demand (OR, 1.3; 95% CI, 0.9-1.8)² and low level of job control and dissatisfaction (OR, 1.59; 95% CI, 1.04-2.43)²¹ were positively associated with CTS. Workers reporting the least influence over their work were also positively associated with CTS (OR, 2.86; 95% CI, 1.10-7.14).

Four studies reported a negative association between psychosocial factors and CTS, where psychosocial factors were less in those who reported CTS. High social support (HR, 0.54; 95% CI, 0.31-0.95),¹⁵ high hierarchical control of work performed (OR, 0.5; 95% CI, 0.20-1.30),²⁹ more coworker support (OR, 0.69; 95% CI, 0.48-0.99),³² and a high decision latitude (HR, 0.73; 95% CI, 0.51-1.04)¹⁵ were negatively associated with CTS, whereas Andersen et al² reported low job control was negatively associated with CTS (OR, 0.9; 95% CI, 0.70-1.40).

One study reported that time pressures at work had no positive or negative association with CTS development (OR, 1.0; 95% CI, 0.7-1.6).²

Discussion

This is the first systematic review investigating the incidence of psychosocial risk factors in association with CTS and whether psychosocial risk factors predict the development of CTS. Five moderate- to high-quality studies reported a positive association between psychosocial factors: high psychological work demand, high job strain, least influence over their work, a high job demand, low level of job control, high psychological distress, low social support, poor social network, "type A behavior," and CTS. Four moderate- to high-quality studies reported a negative association between psychosocial factors; high decision latitude, high hierarchical control of work, more coworker support, and high social support and CTS. One study reported that time pressures at work had no positive or negative association with CTS. There was a wide variance of the working environments and occupations of the recruited participants. Four studies recruited participants from industrial assembly line factory workers. Two studies recruited participants of mixed occupational background, including manual work, administration, professional services, and office-based occupations. This variance may impact the external validity to other occupations and working environments.

The diagnostic criteria for CTS varied considerably between each study and included a combination of subjective reported symptoms, participant self-reported symptoms, clinical assessment testing, and/or sensory and motor electrophysiological testing. This may question the reliability and external validity of findings. Furthermore, all included studies used varying psychosocial measurements, including Karasek's Job Control Questionnaire, personal characteristics (negative affect and "type A" behavior) through self-administered questionnaires, GHQ-12, JCQ,

and Langner's screening questionnaire. There are no universally agreed diagnostic criteria for CTS which can be used as a comparative consistently within both clinical and research fields.³³ The standardization of CTS diagnostic criteria is essential for clinicians and researchers alike to generate research, where results can be cross-compared and pooled to make meaningful conclusions regarding this common and disabling condition.

Contrasting this review's results to other populations with entrapment neuropathies may enhance knowledge and understanding of assessment and management strategies. However, there are a limited number of studies published in this area of research. A systematic review reporting the prognostic role of psychological factors in adults with conservatively treated "sciatica,"⁴ reported depression, avoidance behavior, "nonverbal pain behavior," and social support significant in pain intensity prognostic outcomes. The psychosocial factors reported in this study were similar to our findings; however, caution should be taken as this is based on only 1 longitudinal study with a small sample size.

Psychosocial stressors may have a synergistic effect on pathophysiology at the level of the person leading to poor tolerance of minor symptomology consistent with being at risk of CTS; catastrophizing and associated illness behaviors such as over protection of and/or avoidance of movement using may be related to developing symptoms of CTS. Equally, because CTS has been linked to conditions known to have high levels of psychological distress (eg, fibromyalgia), care may be indicated to prevent the diagnosis of CTS based purely on clinical signs and symptoms, which may in fact be due to the preexisting condition.³¹

Psychosocial factors have been widely linked to the presentation and development of persistent musculoskeletal pain, although few studies have attempted to assess their impact on compression neuropathies. At present, there has been a paucity of research on how these factors may interact with specific pathophysiological mechanisms implicated in the development of musculoskeletal pain. The accepted view is that these factors act secondary to the primary "physical" pathology acting in an adjunct capacity. There is, however, a growing focus within contemporary research to assess the potential for these factors to directly interact and influence with the pathophysiological mechanisms,⁷ and this is likely to be both revealing and informative.

Following this systematic review, further research is warranted to identify the association and prediction of psychosocial risk factors and CTS. The consistency of CTS diagnostic criteria needs to be established in future studies; this will enhance the analysis of results when this review is updated. There should be a research priority to undertake prospective studies with longer term follow-up across multiple professions, working environments, and health care settings. This would improve the generalizability of results and enhance our assessment strategies in clinical practice.

There are potential limitations to this review which is a result of the current available literature. First, 6 studies were identified and included, which were highly heterogeneous. This can question the strength of the narrative analysis and how generalizable our findings are to clinical practice. The occupations and working environments of recruited participants varied across the included studies, therefore making it challenging to interpret the results and apply the analysis to specific populations. While it is recognized that psychosocial factors are multidimensional complex interactions, there was variability of the psychosocial measurement tool used across the included studies; adopting a more standardized approach in future research may enable a meta-analysis to be completed.

Conclusions

This review indicates a positive association between psychosocial factors (high psychological work demand, high job strain, least influence over their work, a high job demand, low level of job control, high psychological distress, low social support, poor social network, and "type A behavior") and CTS, where these factors were present in those who reported CTS. In addition, a negative association between psychosocial factors (high decision latitude, high hierarchical control of work, more coworker support, and high social support) and CTS, where these psychosocial factors were less likely to be associated with CTS, has been highlighted. However, these conclusions should be interpreted with caution as the results were based on highly heterogeneous studies. Further prospective studies across multiple working environments and professions are indicated to enhance understanding between the association and prediction of psychosocial risk factors and CTS.

Ethical Approval

None required.

Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

This article is a systematic review of literature, as such, obtaining informed consent is not applicable.

Declaration of Conflicting Interests

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