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, gender 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, to determine whether psychosocial factors are associated with and/or predicts the development CTS.

Methods:

A systematic review was conducted including searches of PubMed (MEDLINE), EMBASE and CINAHL from inception to May 30th 2017. Quantitative studies must have investigated a minimum of one or more psychosocial factors; cognitive, affective, behavioural, vocational or interpersonal processes (e.g., social support) and include a point or risk estimate. One reviewer conducted the search and two reviewers independently assessed eligibility and completed methodological quality assessment using a modified Downs and Black checklist. Data was analysed 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 was 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 was 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. Further research is indicated in standardising CTS diagnostic criteria and investigating other working environments.

PROSPERO REGISTRATION NUMBER: CRD42016039900

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is a compressive neuropathy of the median nerve at the carpal tunnel [1]. It is the most common upper limb entrapment neuropathy and can negatively impact function and work ability [12, 17]. CTS 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 [12], dysesthesia and hyperesthesia [24].

The reported incidence of CTS can vary between countries and it is reported that CTS affects more women than men [5, 8, 13]. Atroshi et al [5] reported an estimated incidence of 324 per 100,000 women in Sweden compared with 524 per 100,000 in United States of America (USA). The estimated prevalence of CTS among men is 166 per 100,000 in Sweden and 303 per 100,000 in USA [20]. As a result, in 1995 the estimated societal costs for undergoing a CTS decompression surgery were over $2bn in USA [26]. There are no cost estimates to individuals or healthcare providers in the United Kingdom (UK) [18], 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 behaviours, occupation and co-morbidities such as diabetes [20].

Understanding risk factors are 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 al [19] synthesized systematic reviews and 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, gender, co-morbidities and psychosocial factors that may interact with the occupational biomechanical elements in the development of CTS [22]. Harris-Adamson et al [15] 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, 10, 19, 22, 28]. Somatization and adverse health beliefs around diagnosis and prognosis are known be associated with chronic musculoskeletal disorders [28]. High work demands [10], work stress [22] and distress [22] are related to the development of low back pain. The lack of work variation, low control over work time [30] and anxiety [16] 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 healthcare 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 amongst 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 PRISMA guidelines of reporting [23].

Search Strategy

A systematic search of electronic databases PubMed, CINAHL and MEDLINE from inception to May 30th 2017 was completed by reviewer (MM). An example of the MEDLINE search strategy can be viewed in Figure 1. An unpublished (grey) literature search and trial registry search was 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 if 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 papers 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 papers (available on request).

Eligibility Criteria

Studies were included if they met the following criteria:

a) Any quantitative study type

b) Adult subjects (over 18 years) with clinically diagnosed Carpal Tunnel Syndrome (CTS) with or without electrophysiological testing

c) Study must have investigated a minimum of one or more psychosocial factors; cognitive (e.g. neuropsychological functioning), affective (e.g., distress, mood), behavioural (e.g., coping strategies), vocational (e.g. employment status, job satisfaction, self – perceived work ability) or interpersonal processes (e.g., 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 (MM, FS) 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 two reviewers (MM, FS). Final eligibility was decided based on full-text assessment.

Data Extraction

Data were extracted onto a pre-defined data extraction table independently by two reviewers (MM, FS). Data extracted included: Lead author, study design, participant demographics, gender, psychosocial measure, CTS diagnosis classification and strength of association of CTS development (risk estimate with confidence intervals).

Quality Assessment

Two reviewers (MM and FS) independently assessed each included study using a modified Downs and Black [9]. This tool is reported to be a valid and a reliable critical appraisal tool to assess methodological quality of non-randomised control studies, which was the predominant study design amongst our eligible papers [9]. The two reviewers discussed their scoring and any disagreement in respect of study eligibility, data extraction or critical appraisal was discussed and agreed between the two reviewers (MM, FS). If an agreement could not be reached a third reviewer (MT) acted as adjudicator.Items 4, 8, 13-15, 19 and 23-24 were removed from our quality assessment because the items did not address our research question and aim of review.

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

Data Analysis

The study heterogeneity of the included studies was assessed by the two reviewers (MM, FS) through examination of the data extraction table. This demonstrated significant heterogeneity in respect of subject 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 one study was excluded as the study did not report risk factor [11] . Accordingly, six papers were included in the final review [2, 14, 21, 25, 29, 32].

Study Characteristics

The characteristics of the included studies are presented in Table 1. Three studies were cohort study designs [2, 14, 19]. One study was a matched cohort study [32]. There was one case control study design [25] and one cross sectional survey [21] . Four studies recruited participants from industrial assembly line factory workers; two in France [21, 29] and two in United States of America [14, 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 six included studies.

Quality Assessment

The quality assessment scoring of the six included studies was very good, the mean score over the eight 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?* (Criteria 1), *Are the main*

outcomes to be measured clearly described in the Introduction or Methods section? (Criteria 2) and *Are the characteristics of the patients included in the study clearly described?* (Criteria 3). The most common criteria that studies scored least favourably on were criteria 12, *Were those subjects who were prepared to participate representative of the entire population from which they were recruited?* Criteria 20; *were the main outcome measures used accurate (valid and reliable)?* And Criteria 22, *were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same time?*

Carpal Tunnel Syndrome (CTS) Diagnosis Classification

The six 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 Phalen's test *or* if a definite diagnosis based on nerve condition velocity [21]. Werner et al [32] utilised 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 msec 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 sensory testing of the ulnar nerve [2]. One study included participants with a CTS diagnosis through physician examination or previous CTS treatment *and* numbness, tingling, pain, or paraesthesia in the hand, wrist, arm, or forearm within one month of the date of diagnosis of CTS [25]. Anderson et al [2]combined self-

reported symptoms in a median nerve distribution and physician interview for CTS diagnosis. One study utilised clinical assessment findings only, patients were included if there were symptoms related to median nerve distribution of paraesthesia for one 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 Factors Measurement

Two studies assessed job control using the Karasek's Job Control Questionnaire [2, 32]. Furthermore, Anderson et al [2] also assessed personal characteristics (negative affect and "type A" behaviour) through self-administered questionnaires. Roquelaure et al [29] used a self-assessment of psychological demand and social support alongside the General Health Questionnaire (GHQ-12) to measure psychological status. One study measured psychological job demand, work decision latitude scales and social support was measured using the Job Content Questionnaire (JCQ) [14]. One study collected information on psychosocial risk factors through participants' medical records and a telephone interview [25]. LeClerc et al [21] assessed psychological and psychosomatic wellbeing 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 paper. Five studies reported a positive association between psychosocial factors and CTS where psychosocial factors was more in those who reported CTS. A GHQ-12 score over the 90th percentile (i.e. over 18.5), indicating high psychological distress, (Odds Ratio (OR) 4.3; 95% CI: 1.0 to 18.6) [29] and “Psychological problems” (OR 2.34; 95% CI: 1.42 to 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 to 1.80) [2]. Furthermore, a poor social network was also positively associated with CTS development (OR 1.2; 95% CI: 0.7 to 2.2) [2]. There was a small (non-significant) positive association between “type A behaviour” and CTS symptoms (OR 1.1; 95% CI: 0.70 to 1.80) [2].

A high psychological work demand score (Hazard Ratio (HR) 1.57; 95% CI: 1.06 to 2.33) [14] and a high job strain (high demand and low control) was positively associated with CTS (HR 1.86; 95% CI: 1.11 to 3.14) [14]. Furthermore, a high job demand (OR 1.3; 95% CI: 0.9-1.8) [2], low level of job control and dissatisfaction (OR 1.59; 95% CI: 1.04 to 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 to 7.14).

4 studies reported a negative association between psychosocial factors and CTS where psychosocial factors was less in those who reported CTS. High social support (HR 0.54;

95% CI: 0.31 to 0.95) [14], high hierarchical control of work performed (OR 0.5; 95% CI: 0.20 to 1.30) [29], more co-worker support (OR 0.69; 95% CI: 0.48 to 0.99) [32] and a high decision latitude (HR 0.73; 95% CI: 0.51 to 1.04) [14] were negatively associated with CTS. Whereas, Anderson et al [2] reported low job control was negatively associated with CTS (OR 0.9; 95% CI: 0.70 to 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 and "type A behaviour" and CTS. Four moderate to high quality studies reported a negative association between psychosocial factors; high decision latitude, high hierarchical control of work, more co-worker support and high social support and CTS. One study reported that time pressures at work had no positive or negative associations 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" behaviour) through self-administered

questionnaires, General Health Questionnaire (GHQ-12), Job Content Questionnaire (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 [32]. The standardisation of CTS diagnostic criteria is essential for clinicians and researchers alike in order 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 behaviour, 'nonverbal pain behaviour' 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 one longitudinal study with a small sample size.

Psychosocial stressors may have a synergistic effect on pathophysiological at the level of the person leading to poor tolerance of minor symptomology consistent with being at risk of CTS; catastrophising and associated illness behaviours 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 e.g. 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 prexisting condition [30].

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 pathohophysiological 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 healthcare settings. This would improve the generalisability 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. Firstly, six studies were identified and included which were highly heterogeneous. This can question the strength of the narrative analysis and how generalisable 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. Whilst it is recognised that psychosocial factors are mutli-dimensional complex interactions, there was variability of the psychosocial measurement tool used across the included studies, adopting a more standardised approach in future research may enable a meta-analysis to be completed.

CONCLUSION

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 behaviour”) 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 co-worker support and high social support) and CTS, where these psychosocial factors was 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.

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Figure Legends:

Figure I – MEDLINE Search Strategy

Figure II – Flow Diagram