The relationship between hand paraesthesia and occupational factors: results from a population study

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Objectives. To investigate the association of occupational factors, both physical and psychosocial, with hand paraesthesia, and whether any such associations differ according to the concurrent presence of neck and upper limb pain (NULP).

Methods. A questionnaire was mailed to an age-stratified random sample of 9596 adults. All subjects were asked about hand paraesthesia in the past 4 weeks. Information was obtained on respondents’ main job (the job held for the longest time), whether this job involved any of six neck or upper limb activities on most or all days of the working week, and questions on the psychosocial aspects of the work environment. The questionnaire also asked about NULP according to a preshaded manikin.

Results. A total of 5133 people replied to the survey (adjusted response 53.5%). Of these, 1592 reported abnormal feelings in the hands (prevalence of 31.9%). Prolonged gripping, prolonged bending of the neck forwards, working with arms at/above shoulder height, low job control, many changes in tasks and low job support were independently associated with hand paraesthesia. Among responders also reporting NULP, working with arms at/above shoulder height and many changes in tasks were independently associated with hand paraesthesia; prolonged gripping was linked to hand paraesthesia in the absence of NULP.

Conclusions. Hand paraesthesia is associated with physical and psychosocial workplace factors, although different work-related factors were associated with hand paraesthesia according to the concurrent presence of NULP, suggesting that these symptoms may not always be mediated in the same way.

Key words: Hand, Occupation, Paraesthesia, Psychosocial factors, Questionnaire, Upper limb.

Paraesthesia, as distinct from pain, is usually defined as abnormal or disturbed skin sensations, e.g. feelings of numbness, tingling or pins and needles [1, 2]. In the hand, these symptoms are often transient but chronic hand paraesthesia can be an uncomfortable and distressing condition. Hand paraesthesia has largely been studied within the context of carpal tunnel syndrome [3, 4]. However, although distinct patterns of numbness and tingling in the hand are characteristic of this condition [5–8], not all paraesthesia in the hand is associated with carpal tunnel syndrome [9–11]. Alternative explanations for hand paraesthesia may include problems involving the neck or upper limb sites proximal to the hand, such as the impingement of one or more nerve roots as a consequence of cervical spondylosis [12], thoracic outlet syndrome [13] or nerve entrapment at various sites in the arm, e.g. ulnar nerve entrapment [14].

There have been few population studies exploring the association of occupational factors with hand paraesthesia, in contrast to the growing body of literature regarding work-related risk factors for carpal tunnel syndrome [15–17]. In particular, little is known about the influence of psychosocial factors of the work environment, e.g. the perception of being able to control the way you work in your job, on hand paraesthesia. A population study of hand paraesthesia allows us to identify potential work-related risk factors for this problem in the community, and does not suffer from the bias associated with sampling from a workplace setting. By investigating the work-related physical and psychosocial factors associated with hand paraesthesia in the presence and absence of neck and upper limb pain (NULP), we can also gain insight into the possibility that symptoms of numbness and tingling in the hand may be mediated differently, depending on the occupational factors involved.

The primary aim of this study was to investigate the association between hand paraesthesia and (i) specific work activities involving the neck and upper limbs, and (ii) psychosocial factors of the work environment, in a general adult population. A secondary aim was to determine the independent work-related factors associated with hand paraesthesia alone, and those associated with symptoms in the presence of NULP, in this population.

Methods

Subjects and study design

In this cross-sectional study, a postal questionnaire was used to measure the 4-week period prevalence of hand paraesthesia and NULP, and to collect information on occupational history. North Staffordshire Local Research Ethics Committee granted approval for the study and data collection occurred from 2001 to 2002.

Approximately 98% of the UK population are registered with a general practitioner (GP) [18]; thus the GP register is regarded as being representative of the general population in the UK [19]. The study population was adults aged 18–75yr on the general practice database of the North Staffordshire District Health Authority, UK. From this population, we randomly sampled 10,000 adults in equal numbers from four age groups: 18–44, 45–54, 55–64, 65–75yr. This sample size would provide at...
least 99% power to detect a 5% difference in prevalence of hand paraesthesia at a two-tailed 5% significance level.

Following initial mailing of the questionnaire, a reminder postcard was sent to all non-responders 2 weeks later. We sent all remaining non-responders another questionnaire after a further 2 weeks.

Questionnaire

Outcome measures. The main outcome measure was the presence of hand paraesthesia. All respondents were asked to answer this question: ‘In the past 4 weeks, have you had any abnormal feelings in your hands (for example tingling, pins and needles, loss of sensation)’? Those responding positively to this question were asked to report in which hand(s) the symptoms occurred (both; right; left), and the time since initial onset of abnormal feelings (less than 4 weeks ago; one to 6 months ago; more than 6 months but less than 12 months ago; 1–5 yr ago; more than 5 yr ago).

Our study design did not permit us to classify respondents according to clinical criteria [5], and so we did not collect information on the precise distribution of paraesthesia in the hand.

Measurement of exposure. Participants were asked to complete a grid question, which asked for details of up to five most recent jobs (job title, area of work, start date, end date) held for at least 12 months. Within the grid question, respondents were asked to indicate whether or not their jobs involved any of six work activities on most or all days of the working week. The activities were chosen on the basis that they involved repetitive movements or sustained postures of the neck and upper limbs; similar descriptions of work activities have been used in other studies [20–22]. The work activities were:

- Repeated lifting or carrying of heavy objects
- Prolonged gripping or holding of an object
- Bending neck forwards for prolonged periods
- Carrying out repeated movements with fingers
- Carrying out repeated movements with wrist
- Working with one or both arms at or above shoulder height.

From the jobs recorded by the respondent, the one that had been held for the longest time was designated as the respondent’s main job. We only identified a main job for those respondents who held for at least 12 months. Within the grid question, respondents were asked to indicate whether or not their jobs involved any of six work activities on most or all days of the working week. The activities were chosen on the basis that they involved repetitive movements or sustained postures of the neck and upper limbs; similar descriptions of work activities have been used in other studies [20–22]. The work activities were:

- Repeated lifting or carrying of heavy objects
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- Bending neck forwards for prolonged periods
- Carrying out repeated movements with fingers
- Carrying out repeated movements with wrist
- Working with one or both arms at or above shoulder height.

From the jobs recorded by the respondent, the one that had been held for the longest time was designated as the respondent’s main job. We only identified a main job for those respondents who provided complete information in the grid question; those with two or more main jobs held for the same length of time were not included. Information on the psychosocial aspects of respondents’ main job was collected using questions based on the Karasek model [23], similar to those of other studies [21, 24]. Scoring was based on a five-point adverbial scale (‘none of the time’ to ‘all of the time’). The questions were:

Can/could you control the way you worked in this job?
Is/was your work physically demanding in this job?
Do/did you perform/perform in this job change during your time in this job?
Do/did you get job satisfaction from your work in this job?
On the whole, were your supervisors or managers supportive in this job?

Other questions. Respondents were asked to answer a pre shaded NULP manikin question [25], questions about spare time activities involving repeated movements of arms or hands, and demographics. The Townsend Deprivation Index was used as a measure of multiple deprivation [26]. The deprivation score is calculated from four 1991 Census variables (unemployment, overcrowding, non-car ownership and non-home ownership); high scores indicate high deprivation.

Statistical analysis

For the main outcome, we calculated the crude associations between the 1-month prevalence of hand paraesthesia and (i) specific work activities and (ii) psychosocial factors, in relation to the respondents’ main job. Since data collection was cross-sectional, we used odds ratios (ORs) with 95% confidence intervals (CIs), rather than risk ratios, to estimate these associations. Associations were also tested using the $\chi^2$ test. Multivariable analysis was carried out using logistic regression to investigate independent associations with hand paraesthesia. Two such analyses were carried out: (i) a partial model, in which the covariates were age, sex and Townsend category; and (ii) a full model, in which the covariates were all sociodemographic variables, work activities and psychosocial factors. The full regression analysis was carried out for all respondents and also stratified according to the presence and absence of NULP.

Bias in the main associations was assessed in four ways. First, non-response bias was investigated by looking at the response to the three questionnaire mailings. This was done on the assumption that the factors underlying late response are similar to those underlying non-response, and that late responders are therefore most representative of non-responders; a similar strategy has been used in a previous study of neck pain [27]. Second, recall (information) bias was addressed by confining the analysis to responders who were still working and whose current job was their main job. Third, we assessed ‘cause-effect’ by restricting the analysis to responders whose hand paraesthesia did not predate their main job. Lastly, we analysed the data to account for the possible confounding factor of leisure activities involving repetitive arm or hand movements.

Statistical significance was set at $P \leq 0.05$ (two-tailed). Statistical analysis and random sampling were carried out using SPSS version 11.5 (2002; SPSS, Chicago, IL, USA).

Results

Prevalence of hand paraesthesia

Figure 1 summarizes the response to the survey questionnaire and the questions on hand paraesthesia. The age-standardized prevalence of hand paraesthesia was 29.2%. Of the 1592 people reporting hand paraesthesia, 741 (46.9%) reported having symptoms in both hands, 433 (27.4%) in the right hand only and 405 (25.6%) in the left hand only.

Sociodemographic and general health characteristics of responders

Table 1 shows the prevalence of hand paraesthesia with age, sex, social deprivation and handedness. Prevalence differed across age bands ($\chi^2 = 24.2$, 3 df, $P < 0.001$), and was highest among the age categories 55–54 yr and 55–64 yr. Prevalence differed little between men and women ($\chi^2 = 0.73$, 1 df, $P = 0.394$). Higher levels of social deprivation were associated with an increased percentage of cases ($\chi^2_{\text{adj}} = 32.3$, 1 df, $P < 0.001$). Many more adults were right-handed than left-handed, but similar proportions of right-handed and left-handed responders reported paraesthesia ($\chi^2 = 0.37$, 1 df, $P = 0.543$). However, symptoms were more common in the dominant hand: excluding responders with bilateral symptoms, those with only right-hand symptoms were more likely than those with only left-hand symptoms to be right-handed, and correspondingly for responders with left-hand symptoms ($\chi^2 = 11.26$, 1 df, $P = 0.001$).

Association between work activities and hand paraesthesia

The crude associations between work activities involving the neck and upper limbs and hand paraesthesia are shown in Table 2.
Exposures to these regular physical tasks were all significantly associated with increased symptoms. Responders whose main jobs entailed prolonged gripping or holding of an object had more than double the likelihood (odds) of abnormal feelings in the hands. The excess prevalence associated with each of these work activities was 11.9% for repeated lifting/carrying of heavy objects, 15.1% for prolonged gripping, 13.7% for prolonged bending neck forwards, 9.7% for repeated finger movements, 11.6% for repeated wrist movements and 13.9% for working with one/both arms at shoulder height or above.

**Table 1. Prevalence of hand paraesthesia in total and stratified by respondent characteristics**

<table>
<thead>
<tr>
<th>Hand paraesthesia</th>
<th>Yes</th>
<th>No</th>
<th>Odds ratio</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (all responders)</td>
<td>1592 (31.9%)</td>
<td>3400 (68.1%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age category (yr)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–44</td>
<td>222 (25.4%)</td>
<td>653 (74.6%)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>45–54</td>
<td>432 (34.2%)</td>
<td>831 (65.8%)</td>
<td>1.53</td>
<td>1.26, 1.85</td>
</tr>
<tr>
<td>55–64</td>
<td>487 (34.3%)</td>
<td>932 (65.7%)</td>
<td>1.54</td>
<td>1.27, 1.85</td>
</tr>
<tr>
<td>65–75</td>
<td>451 (31.4%)</td>
<td>984 (68.6%)</td>
<td>1.35</td>
<td>1.12, 1.63</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>702 (31.3%)</td>
<td>1543 (68.7%)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>890 (32.4%)</td>
<td>1857 (67.6%)</td>
<td>1.05</td>
<td>0.94, 1.19</td>
</tr>
<tr>
<td>Townsend category</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affluent</td>
<td>340 (27.8%)</td>
<td>881 (72.2%)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Moderately affluent</td>
<td>567 (30.2%)</td>
<td>1309 (69.8%)</td>
<td>1.12</td>
<td>0.96, 1.32</td>
</tr>
<tr>
<td>Moderately deprived</td>
<td>490 (35.0%)</td>
<td>911 (65.0%)</td>
<td>1.39</td>
<td>1.18, 1.65</td>
</tr>
<tr>
<td>Deprived</td>
<td>185 (40.7%)</td>
<td>270 (59.3%)</td>
<td>1.78</td>
<td>1.42, 2.22</td>
</tr>
<tr>
<td>Handedness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left-handed</td>
<td>121 (30.6%)</td>
<td>275 (69.4%)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Right-handed</td>
<td>1461 (32.0%)</td>
<td>3099 (68.0%)</td>
<td>1.07</td>
<td>0.86, 1.34</td>
</tr>
</tbody>
</table>

Exposures to these regular physical tasks were all significantly associated with increased symptoms. Responders whose main jobs entailed prolonged gripping or holding of an object had more than double the likelihood (odds) of abnormal feelings in the hands. The excess prevalence associated with each of these work activities was 11.9% for repeated lifting/carrying of heavy objects, 15.1% for prolonged gripping, 13.7% for prolonged bending neck forwards, 9.7% for repeated finger movements, 11.6% for repeated wrist movements and 13.9% for working with one/both arms at shoulder height or above.

**Association between psychosocial factors and hand paraesthesia**

Psychosocial factors in the main job were also associated with increased reporting of hand paraesthesia (Table 2). A \( \chi^2 \) test for linear trend for these associations yielded the following test statistics: job control, \( \chi^2 = 33.5, 1 \text{ df}, P < 0.001; \) physical demand, \( \chi^2 = 56.4, 1 \text{ df}, P < 0.001; \) change in tasks, \( \chi^2 = 8.9, 1 \text{ df}, P = 0.003; \) job satisfaction, \( \chi^2 = 4.1, 1 \text{ df}, P = 0.042; \) and job support, \( \chi^2 = 28.8, 1 \text{ df}, P < 0.001. \)
Repeated lifting of heavy objects  
No\textsuperscript{b} 556 (25.5%) 1623 (74.5%) 1.00  
Yes 669 (37.4%) 1122 (62.6%) 1.74 1.52, 1.99  

Prolonged gripping of object  
No\textsuperscript{b} 519 (24.0%) 1646 (76.0%) 1.00  
Yes 706 (39.1%) 1099 (60.9%) 2.04 1.78, 2.34  

Prolonged bending of neck  
No\textsuperscript{b} 478 (24.0%) 1512 (76.0%) 1.00  
Yes 747 (37.7%) 1233 (62.3%) 1.92 1.67, 2.20  

Repetitive finger movements  
No\textsuperscript{b} 389 (25.0%) 1169 (75.0%) 1.00  
Yes 836 (34.7%) 1576 (65.3%) 1.39 1.18, 1.64  

Repetitive wrist movements  
No\textsuperscript{b} 400 (24.1%) 1258 (75.9%) 1.00  
Yes 825 (35.7%) 1487 (64.3%) 1.75 1.52, 2.01  

Arms at/above shoulder height  
No\textsuperscript{b} 713 (26.4%) 1623 (73.6%) 1.00  
Yes 512 (40.3%) 758 (59.7%) 1.88 1.64, 2.17  

Control the way you work  
Partial model\textsuperscript{a}  
All of the time\textsuperscript{b} 239 (26.8%) 653 (73.2%) 1.00  
Most of the time 343 (28.0%) 880 (72.0%) 1.07 0.88, 1.29  
Some of the time 244 (34.2%) 470 (65.8%) 1.42 1.15, 1.76  
A little of the time 115 (37.7%) 190 (62.3%) 1.65 1.27, 2.18  
None of the time 127 (40.6%) 186 (59.4%) 1.87 1.42, 2.44  

Full model\textsuperscript{b}  
All of the time\textsuperscript{b} 239 (26.8%) 653 (73.2%) 1.00  
Most of the time 343 (28.0%) 880 (72.0%) 1.07 0.88, 1.29  
Some of the time 244 (34.2%) 470 (65.8%) 1.42 1.15, 1.76  
A little of the time 115 (37.7%) 190 (62.3%) 1.65 1.27, 2.18  
None of the time 127 (40.6%) 186 (59.4%) 1.87 1.42, 2.44  

Physically demanding work  
None of the time\textsuperscript{b} 140 (24.5%) 432 (75.5%) 1.00  
A little of the time 143 (26.3%) 401 (73.7%) 1.10 0.84, 1.44  
Some of the time 224 (27.2%) 601 (72.8%) 1.15 0.90, 1.47  
Most of the time 221 (31.6%) 479 (68.4%) 1.42 1.11, 1.83  
All of the time 345 (41.9%) 478 (58.1%) 2.23 1.76, 2.82  

Tasks change in this job  
None of the time\textsuperscript{b} 275 (30.2%) 636 (69.8%) 1.00  
A little of the time 179 (30.1%) 415 (69.9%) 1.00 0.80, 1.25  
Some of the time 339 (27.8%) 880 (72.2%) 0.89 0.74, 1.08  
Most of the time 134 (35.4%) 245 (64.6%) 1.27 0.98, 1.63  
All of the time 139 (40.6%) 203 (59.4%) 1.58 1.22, 2.05  

Job satisfaction  
All of the time\textsuperscript{b} 298 (31.8%) 639 (68.2%) 1.00  
Most of the time 444 (28.4%) 1118 (71.6%) 0.85 0.71, 1.02  
Some of the time 204 (33.1%) 412 (66.9%) 1.06 0.86, 1.32  
A little of the time 68 (31.6%) 147 (68.4%) 0.99 0.72, 1.36  
None of the time 59 (42.4%) 80 (57.6%) 1.58 1.10, 2.27  

Supportive supervisors, managers  
All of the time\textsuperscript{b} 213 (27.8%) 552 (72.2%) 1.00  
Most of the time 375 (27.7%) 981 (72.3%) 0.99 0.81, 1.21  
Some of the time 252 (34.4%) 481 (65.6%) 1.36 1.09, 1.69  
A little of the time 133 (38.8%) 210 (61.2%) 1.64 1.26, 2.15  
None of the time 67 (42.1%) 92 (57.9%) 1.89 1.33, 2.68  

\textsuperscript{a}Figures are crude (unadjusted) odds ratios.  
\textsuperscript{b}Reference category for the odds ratios.

Multivariable analysis of predictors of hand paraesthesia  
The association of work activities and psychosocial factors with hand paraesthesia was independent of age, sex and Townsend category (Table 3). Prolonged gripping was still associated with twice the likelihood of having symptoms. All work tasks and psychosocial factors were significantly correlated, suggesting that they commonly occur together in the work place. Results of the full multivariable model investigating the independent effects of each of the work activities, psychosocial factors and sociodemographic characteristics are also shown in Table 3. The work activities independently associated with hand paraesthesia were prolonged gripping (P = 0.001), prolonged bending of the neck (P = 0.001) and working with arms at/above shoulder height (P = 0.015). Insufficient job control (P = 0.002) and management support (P = 0.003), and many changes in tasks (P = 0.002) were each independently associated with hand paraesthesia.

Association of hand paraesthesia with work activities and psychosocial factors, according to NULP  
The association between physical and psychosocial workplace factors and hand paraesthesia in the full multivariable model, stratified according to the presence or absence of NULP, is shown in Table 4. In the presence of NULP, two factors were independently associated with hand paraesthesia: working with arms at/above shoulder height (P = 0.042) and change in tasks most or all of the time (P = 0.002). In the absence of NULP, the only significant independent association with hand paraesthesia was prolonged gripping (P = 0.027).
Discussion

This population study has shown, for the first time, that hand paraesthesia is associated both with specific work activities involving the neck and upper limb, and with psychosocial factors of the work environment. Since physical tasks and psychosocial factors are likely to occur in combination in the workplace, we adjusted each work-related factor for the others, and identified prolonged gripping, prolonged bending of the neck, working with arms at or above shoulder height and perceptions of low job control, many changes in tasks and poor job support as being independently associated with hand paraesthesia. Interestingly, the work activities associated with hand paraesthesia were of a sustained rather than a repetitive nature; by contrast, many studies have shown that carpal tunnel syndrome is associated with repetitive and forceful work activities [7, 15, 16, 28, 29]. Although our study design did not permit identification of specific upper limb disorders, we suggest that this discrepancy with our study may be partly explained by the majority of cases in our population study not being carpal tunnel syndrome, since the distribution of numbness and tingling in the hand associated with carpal tunnel syndrome is rare (about 1%) amongst the total occurrence of these symptoms [7].

According to our findings, individuals are at least risk of hand paraesthesia if: (i) aged 18–44 yr; (ii) not exposed to physical factors (particularly repeated lifting of heavy objects, prolonged gripping of objects, prolonged bending of the neck and working with arms at or above shoulder height); and (iii) not perceiving themselves to have a poor psychosocial work environment (particularly in relation to little job control, many changes in tasks and little supervisor support). In our data, on the basis of the UK Standard Occupational Classification [30], managerial/professional occupations (e.g. production, works and maintenance managers, teachers, chartered accountants and lawyers) have a high probability of fitting this work description. A young secretary who commonly does repeated finger movements as part of the job has no additional risk providing that the job does not entail those work activities or psychosocial factors that are significantly predictive of hand paraesthesia. In comparison, an older secretary (aged 55–64 yr) is 1.65 times more likely to have hand paraesthesia. Furthermore, a person aged 55–64 yr who has an occupation that involves prolonged gripping of objects, prolonged bending of the neck and perceives little job control (such as is commonly the case, according to our data, for a number of skilled trade workers, e.g. glass ceramic makers, decorators and finishers) has four times (i.e. 1.65 × 1.38 × 1.35 × 1.30) the estimated likelihood of hand paraesthesia compared with an adult aged 18–44 yr with no physical/psychosocial risks, and nearly two-and-a-half times (i.e. 1.38 × 1.35 × 1.30) the estimated likelihood compared with an adult of the same age with no such risk factors.

The association of hand paraesthesia with work-related factors was influenced by the concurrent presence or absence of NULP, and provides support for a distinction in the mediation of symptoms of hand paraesthesia. In responders reporting NULP, working with arms at or above shoulder height was associated with symptoms of numbness and tingling; it is possible that this sustained posture may result in hand symptoms mediated by pathologies proximal to the hand, involving pain in the neck, shoulder or arm. Perception of many changes in tasks in the work environment was also linked with more hand symptoms in responders who were still working and whose current job was their main job; there were significant, independent associations with gripping (OR = 1.51), bending neck (OR = 1.41), raised arms (OR = 1.48), change in tasks (OR = 1.54) and job support (OR = 1.49). To address cause–effect, we further restricted the above analysis to those with hand abnormalities for less than 12 months, revealing similar patterns of associations: gripping (OR = 1.30), bending neck (OR = 1.44), raised arms (OR = 1.28), change in tasks (OR = 1.46) and job support (OR = 1.13). These associations were not statistically significant due to the smaller size of this subgroup.

Non-response and confounding

After adjusting the full model for the potential confounding factor of spare-time activities that use repeated movements of the hands or arms, the relationship between physical and psychosocial factors of the workplace and hand paraesthesia persisted. For example, the OR for the association with prolonged gripping was 1.37 (P = 0.001) compared with 1.38 (P = 0.001) before additional adjustment.

Non-responders were more likely to be male and younger than responders [25]. However, the association between physical and psychosocial workplace factors and hand paraesthesia was similar across the three waves of mailing response. For example, in relation to repeated lifting of heavy objects the associations were OR = 1.74, 1.91 and 1.61 for wave responses 1, 2 and 3, respectively.

Recall bias and cause–effect

In order to address recall bias, we restricted the full regression analysis to responders who were still working and whose current job was their main job; there were significant, independent associations with gripping (OR = 1.51), bending neck (OR = 1.41), raised arms (OR = 1.48), change in tasks (OR = 1.54) and job support (OR = 1.49). To address cause–effect, we further restricted the above analysis to those with hand abnormalities for less than 12 months, revealing similar patterns of associations: gripping (OR = 1.30), bending neck (OR = 1.44), raised arms (OR = 1.28), change in tasks (OR = 1.46) and job support (OR = 1.13). These associations were not statistically significant due to the smaller size of this subgroup.
with upper limb problems [31]. The association of many changes in tasks with pain in the neck or the proximal part of the upper limb may, again, result in paraesthesia in the hand via, for example, nerve impingement or entrapment in the neck or arm.

By contrast, in those with no NULP, only prolonged gripping was associated with hand paraesthesia; this is not unexpected, since gripping involves sustained forceful use of the hand and finger joints, and not the nerve root at the neck level. Furthermore, in these cases, there was no significant association between hand paraesthesia and an adverse psychosocial working environment. This supports the suggestion of a purely mechanical problem localized to the hand.

Cases of hand paraesthesia may be transient. For example, in a study of workers pruning vines, 90% of cases began during the pruning period and ended after the season [32], suggesting that a relatively short exposure allowed the hand to recover. The authors concluded that the development of hand paraesthesia in vineyard workers was different from that observed in industrial workers since most recovered without medical treatment after the pruning season. In our general population, we found that in over 60% of cases, the symptoms started at least 12 months ago, indicating chronic conditions that were not of recent onset.

This study is susceptible to a number of possible biases. For example, we attempted to counter the ‘healthy worker effect’ (workers who perceive they have work-related conditions leave their job, so only the ‘healthy’ workers remain) by designating our study to include both current and past workers, sampled from a general population. Recall bias may occur if those who recall specific neck and upper limb activities at work, or perceive an adverse psychosocial work environment, are more likely to recall hand paraesthesia subsequently, leading to an overestimate of the association. Efforts to reduce this effect were made in two ways. First, we gathered all symptom information before that related to potential risk factors in the questionnaire. Second, we looked at the association between hand paraesthesia and work-related risk factors in responders whose main job was their current job; associations were still evident in this population subgroup. Although the direction of cause and effect cannot be determined from cross-sectional data, when we restricted the analysis to those respondents whose hand paraesthesia did not predate their main job, a significant association remained. The stability of the prevalence rates and statistical associations across the waves of mailing response also makes it reasonable to assume that our estimates are representative.

We realize that in this study there may have been alternative, non-occupational causes of hand paraesthesia for which we have not been able to account and which therefore may limit our conclusions. For example, it is possible that underlying conditions like diabetes, alcohol abuse, disorders of the central nervous system or rheumatoid arthritis could account for some cases of paraesthesia [2, 14], although there is no reason to suspect that such conditions act as confounders of any of the occupational associations reported. Leisure activities involving repetitive arm or hand movements could have also influenced our results; however, the pattern of associations persisted in our study after controlling for this potential confounder.

Although we cannot speculate on the associations of specific neck and upper limb disorders with occupational factors from our data, we have attempted to look at the reporting of distinct symptoms—hand paraesthesia and NULP—and their interaction. Indeed, it has been proposed recently that an objective and descriptive approach to the grouping of symptoms may further the progress of classification of neck and upper limb disorders [8]. This population study provides evidence that the physical and psychosocial workplace factors associated with hand paraesthesia differ according to the concurrent presence of NULP. These results suggest that (i) symptoms of numbness and tingling may not always be mediated in the same way, and (ii) the nature, and possibly combination, of the occupational factors involved in a job may result in different patterns of hand paraesthesia and NULP. This information has potential use for assessing the risks involved in different neck and upper limb work activities, in order to develop preventative workplace strategies.

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### References


