Musculoskeletal symptoms in support staff in a large telecommunication company

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Abstract. Primary objective: The primary objective of this study was to determine the extent and severity of the musculoskeletal problems in office workers in a telecommunication company.
Research design: Questionnaire survey was conducted to assess the prevalence of musculoskeletal disorders’ symptoms, their perceived intensity and interaction with ability to work among office workers.
Methods and procedures: The Cornell Musculoskeletal Discomfort Questionnaire and Cornell Hand Discomfort Questionnaire developed by the Human Factors and Ergonomics Laboratory at Cornell University were used on a sample of 140 office workers in a telecommunication company.
Main outcomes and results: Discomfort/pain/ache at the wrist level was reported by 86.5% for the left side and 95.5% for the right side. Additionally, discomfort/pain/ache was reported by 77.5% of the sample for neck and 31% of the sample for the left and 50% for the right shoulder region. At the hand site, the area in the distal proximity of the wrist was the most affected site being indicated in 90% of cases for left side and 95% of cases for the right side.
Conclusions: An overview of problems associated with the body parts in office work may allow targeted prevention and intervention.

Keywords: Office work, musculoskeletal symptoms, upper extremity, survey

1. Introduction

There has been an increase in the proportion of time spent in a static posture and an increase in the repetitive movements with evolution of work [3]. Therefore, appropriate information is needed for targeted ergonomic prevention and interventions. Due to extensive computer usage, increase in musculoskeletal morbidity of upper extremity among data entry workers has been reported [8,9,15,26]. Musculoskeletal symptoms among data entry personnel may be linked to both poor workstation design and psychosocial factors such as stress, time constraints, decision making [4,10,21].

Previous studies reported association between computer work and pain and/or discomfort in different upper extremity regions [1,10,14]. The keyboard design has been proven to influence the typing position modifying the shoulder rotation, forearm supination and wrist angle of deviation in both ulnar-radial deviation and flexion-extension planes [11,13,17,18,29,32]. Also, using numeric keypads requires the operator to position the shoulder in greater abduction in order to fit the workstation design [6]. The neck and upper extremity are the most exposed areas for musculoskeletal problems in data entry operators [26]. The highest risks are for hand, wrist and arm [23,26]. Excessive wrist extension or flexion [18] is present in different degrees depending on the type of keyboard used (slope angle). Also, ulnar deviation occurs indirectly as a compensation of the arm abduction, and directly due to the...
need to reach the far left or right keys [18,36]. Also, workstation configuration (desk height, chair design, computer screen angle) has an important effect on the neck and back stress level.

Continuing to work in a poorly designed workstation/job causes a loss in productivity because the need for spontaneous breaks in order to mitigate the pain cannot be overlooked [19]. Primary ergonomic interventions (e.g. introduction of micro rest periods, task rotation and, device redesign fitting workstation to person) that address the problem before it appears can decrease the productivity loss. Moreover, they are superior in effectiveness and costs when compared to secondary interventions.

This study provides a complete overview of the musculoskeletal disorders symptoms prevalence and their characteristics (perceived intensity level, localization, their effect on work performance (interference with the ability to perform the required tasks, etc.) among office workers.

2. Methods

2.1. Subjects

All employees typing at least 4h/day in a large Canadian telecommunication company branch were potential subjects for the study. Out of the 140 potential subjects, 89 completed questionnaires were returned for a response rate of 69.6%. The female to male ratios were similar in the respondent and non-respondent groups, making the data representative for gender distribution in the population under study. Data regarding non-respondents (22 women with a mean age of 25.5 years and 29 men with a mean age of 25.1 years) were provided by the company. The respondents consisted of 39 women (mean age: 24.8 years, range: 19–40 years) and 50 men (mean age: 23.5 years, range: 19–49 years). Subjects included in the study met the following inclusion criteria: computer usage of at least 4 hours/day for 5 days/week, touch-typing ability and ability to read and write English well. The subjects received and read the information letter before responding to questionnaire. Ethics approval was granted by the Human Research Ethics Board of the University.

2.2. Procedure

The subjects were explained the questionnaire. The Cornell Hand Discomfort Questionnaire developed by the Human Factors and Ergonomics Laboratory at Cornell University were used in order to gather data. The questionnaires began with demographic questions regarding gender, age, hand dominance, years of practice, number of hours per shift, percentage of work time spent typing. Also a question regarding their knowledge of proper ergonomic settings for the workstation was included. Subjects were allowed to spend as much time as they needed to answer each question. The researcher answered any questions that arose during the administration of the questionnaire but provided no assistance on content. The subjects were not allowed to consult other respondents or discuss with them before or during the study. This was achieved by having all the subjects filling the questionnaires at the same time in different cubicles.

2.3. Data analysis

All categorical answers for every subject were entered into a SPSS spreadsheet and coded with numerical values. For questions with only one possible answer, numerical values (e.g. 0, 1, 2) were used. For multiple choice questions, where more than one answer was possible, each possible answer was coded “0” for “No” and “1” for “Yes”. Mean and standard deviation (SD) were used to present the demographic data such as age, number of years of experience, hours per shift, percentage of work time spent typing. Data regarding prevalence of symptoms, their perceived intensity as well as the impact on job tasks were presented as percentages of subjects reporting pain/discomfort for each hand region and body part. Ordinal regression was used in order to assess the effect of age, hours per day working on a PC, percentage of time working on a keyboard, hours per shift and years of experience on the presence/absence of musculoskeletal symptoms on various body regions and hand areas as well as perceived symptoms intensity level and their interaction with subjects’ ability to work (to perform the required tasks without the need to stop due to discomfort). An alpha level of 0.05 was chosen.

3. Results

3.1. Body regions

The percentage of respondents indicating symptoms for each body part and hand region, as well as the symp-
Table 1
The percentage of respondents indicating symptoms for each body part, symptoms’ intensity level and their interaction with work performance

<table>
<thead>
<tr>
<th>Region</th>
<th>Ache/pain/discomfort frequency</th>
<th>Intensity level</th>
<th>Interference with work</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
<td>1–2/w</td>
<td>3–4/w</td>
</tr>
<tr>
<td>Neck</td>
<td>22.5</td>
<td>48.3</td>
<td>13.5</td>
</tr>
<tr>
<td>Shoulder right</td>
<td>50.6</td>
<td>38.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Shoulder left</td>
<td>69.7</td>
<td>20.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Upper back</td>
<td>64.0</td>
<td>21.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Upper arm right</td>
<td>82.0</td>
<td>12.4</td>
<td>5.6</td>
</tr>
<tr>
<td>Upper arm left</td>
<td>91.0</td>
<td>5.6</td>
<td>3.4</td>
</tr>
<tr>
<td>Lower back</td>
<td>25.8</td>
<td>44.9</td>
<td>12.4</td>
</tr>
<tr>
<td>Forearm right</td>
<td>84.3</td>
<td>10.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Forearm left</td>
<td>87.6</td>
<td>10.1</td>
<td>0</td>
</tr>
<tr>
<td>Wrist right</td>
<td>4.5</td>
<td>58.4</td>
<td>29.2</td>
</tr>
<tr>
<td>Wrist left</td>
<td>13.5</td>
<td>60.7</td>
<td>21.3</td>
</tr>
<tr>
<td>Hsp/Buttocks</td>
<td>73.0</td>
<td>15.7</td>
<td>6.7</td>
</tr>
<tr>
<td>Thigh right</td>
<td>92.1</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Thigh left</td>
<td>92.1</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Knee right</td>
<td>80.9</td>
<td>9.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Knee left</td>
<td>80.9</td>
<td>10.1</td>
<td>3.4</td>
</tr>
<tr>
<td>Lower leg right</td>
<td>91.0</td>
<td>4.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Lower leg left</td>
<td>89.9</td>
<td>5.6</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Table 2
The percentage of respondents indicating symptoms for each hand region, symptoms’ intensity level and their interaction with work performance

<table>
<thead>
<tr>
<th>Hand area</th>
<th>Ache/pain/discomfort frequency</th>
<th>Intensity level</th>
<th>Interference with work</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
<td>1–2/w</td>
<td>3–4/w</td>
</tr>
<tr>
<td>A right</td>
<td>87.6</td>
<td>5.6</td>
<td>0</td>
</tr>
<tr>
<td>A left</td>
<td>95.5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B right</td>
<td>84.3</td>
<td>11.2</td>
<td>0</td>
</tr>
<tr>
<td>B left</td>
<td>94.4</td>
<td>1.1</td>
<td>0</td>
</tr>
<tr>
<td>C right</td>
<td>85.4</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>C left</td>
<td>91.0</td>
<td>4.5</td>
<td>2.2</td>
</tr>
<tr>
<td>D right</td>
<td>74.2</td>
<td>18.0</td>
<td>2.2</td>
</tr>
<tr>
<td>D left</td>
<td>91.0</td>
<td>5.6</td>
<td>2.2</td>
</tr>
<tr>
<td>E right</td>
<td>58.4</td>
<td>32.6</td>
<td>3.4</td>
</tr>
<tr>
<td>E left</td>
<td>84.3</td>
<td>10.1</td>
<td>4.5</td>
</tr>
<tr>
<td>F right</td>
<td>4.5</td>
<td>66.3</td>
<td>19.1</td>
</tr>
<tr>
<td>F left</td>
<td>10.1</td>
<td>78.7</td>
<td>10.1</td>
</tr>
</tbody>
</table>

*Area A: index, middle finger and the medial half of the ring finger. Area B: lateral half of the ring finger and the fifth finger. Area C: thumb. Area D: the palmar side of the hand bordered by the metacarpophalangeal joints (distal) and the thenar and hypothenar eminences (proximal). Area E: thenary eminence. Area F: the distal border of the wrist.

5.8% of the subjects reported symptoms with 7.9% having one or more than one episode of discomfort/pain per day. A third of respondents (34.8%) reported an interaction between symptoms and their ability to work. At the shoulder level 30.3% (for the left side) and 49.4% (for the right side) of the respondents reported pain, with 14.6% (left) and 21.3% (right) of them having moderate or very uncomfortable levels. In 15.7% of cases, work was affected and performance impaired. Wrist had the highest prevalence of musculoskeletal symptoms: 95.5% of the respondents for the right and 86.5% of the respondents for the left side reported pain/discomfort/ache. In as many as 33.7% (for the left side) and 44.9% (for the right side) of cases, work was affected by symptoms at this level.

3.2. Hand areas

Also, the thenar area and the area distal to the wrist were the hand regions with the highest prevalence of ache/pain/discomfort. As many as 90% for left side and...
95% for the right side of the subjects indicated area F (distal border of the wrist) as the site for musculoskeletal symptoms, with 48% for the right side and 58% for the left side for females and 38% for the right side and 30% for the left side for males having the work ability decreased by the symptoms. These figures relates to the ones above in which similar MSDs’ symptom prevalence and percentage of workers reporting work performance being affected by the symptoms.

From the six hand areas included in the questionnaire, only at the area F (the area surrounding the distal border of the wrist) level, the symptoms were statistically significantly influenced by the percentage of total working time spent typing \((p = 0.001, \text{OR} = 0.19 - 0.076 \text{ for the right hand and } p = 0.025, \text{OR} = 0.005 - 0.068 \text{ for the left hand}).\) Also, at the right side, both symptoms’ intensity level and symptoms-work ability interaction were influenced by the time typing \((p < 0.001, \text{OR} = 0.032 - 0.104, \text{and } p = 0.004, \text{OR} = 0.016 - 0.080, \text{respectively}).\) For the other hand areas (A to E), the effects were not statistically significant \((p > 0.05)\).

### 3.3. Work-related variables

The effect of age, hours per day working with a PC, percentage of time working on a keyboard, hours per shift and years of experience on the presence/absence of musculoskeletal symptoms on various body regions and hand areas as well as symptoms intensity level and their interaction with subjects’ ability to work was assessed by an ordinal regression using SPSS. Age, hours of PC work per day and hours per shift did not have a statistically significant effect on the presence of symptoms, their intensity level, and ability to work.

Both percentage of total working time using a keyboard \((p < 0.001, \text{Odds Ratio (OR)} = 0.033 - 0.086)\) and number of years of experience \((p = 0.002, \text{OR} = 0.149 - 0.645)\) had a statistically significant effect on the symptoms at the neck area. When the OR interval does not include the “0” value, the effect is statistically significant. Also, they had a statistically significant effect on neck symptoms’ intensity level \((p < 0.006, \text{OR} = 0.014 - 0.086 \text{ and } p < 0.014, \text{OR} = 0.072 - 0.624, \text{respectively})\) and their interaction with work ability \((p < 0.001, \text{OR} = 0.055 - 0.153 \text{ and } p = 0.002, \text{OR} = 0.179 - 0.799, \text{respectively})\). For the shoulder level, musculoskeletal symptoms were statistically significantly influenced by the percentage of total working time spent using a keyboard \((p = 0.003, \text{OR} = 0.014 - 0.068)\). Also, the same variable had a statistically significant effect on symptoms intensity at the shoulder level \((p = 0.025, \text{OR} = 0.007 - 0.100)\) and symptoms-work interaction \((p = 0.011, \text{OR} = 0.016 - 0.129).\) At the wrist level, the percentage of total working time spent typing had a statistically significant effect on the musculoskeletal symptoms for both right and left hands \((p = 0.05, \text{OR} = 0.001 - 0.052 \text{ and } p = 0.014, \text{OR} = 0.007 - 0.059, \text{respectively}).\) Wrist symptoms intensity and ability to work were not affected by the percentage of total working time spent typing \((p > 0.05)\).

### 4. Discussion

The study results demonstrate that in a population of office workers, the body parts most at risk for developing MSD are the neck, left and right shoulder, lower back and wrist. Not having a comparison group (a group of people with similar characteristics who are not exposed to office work), one cannot infer that the symptoms are entirely contributed by work with PCs. The fact that symptoms are grouped by body regions (neck, shoulders, upper back and low back and hips) demonstrate that interventions, although have to be targeted to certain problematic body regions, should be designed in order to address the body as an interconnected structure with joints and muscles that tend to compensate when adjacent structures are deviated and/or contracted. All the respondents who indicated that ability to work was impaired continued to work ignoring the symptoms and considering the pain as part of their job. Although it might seem expensive at the beginning, implementing training programs and measures that would address the associated risk factors, would decrease the number of days lost to injury and associated claim expenditures.

Having the area E and F (thenar eminence and distal border of the wrist) as the sites with the highest prevalence of MSD symptoms, demonstrate the important impact of keyboarding on upper extremity structures, especially distal joints. Less than 50% of the respondents had adjustable keyboard/mouse. The absence of adjustable input devices might have played an important role in the causation of symptoms in the tested group. Only adjustable devices are able to fit a larger proportion of population to decrease the risk of excessive wrist extension and ulnar deviation. Future research should look into the differences between MSDs symptoms prevalence levels for data entry workers with and without adjustable devices.

Although 87.6% had adjustable chairs, low back was one of the body regions with the highest incidence of...
MSD symptoms prevalence (70% for females and 80% for males). This might be due to the fact that 66.3% of the subjects did not know how to adjust and set-up their workstations in order to meet the ergonomic guidelines.

The job related risks are doubled by repetitive leisure activities with more than two thirds of the respondents (67.4%) using the home computer on a regular basis. Only accompanying the redesign interventions with training programs that would explain the necessary modifications, one would persuade workers to adopt the changes on their home computers (e.g. split keyboard with negative slope, knee, hip and elbows at 90°, mouse close to the keyboard in order to reduce shoulder abduction and external rotation).

One may think that it is possible that office workers with symptoms were more likely to respond, yielding an overestimate of musculoskeletal symptoms prevalence. However, with a response rate of 69.6% this should be less of a concern. Future research should look into the effect of work related-psychological stress on MSDs symptoms prevalence level. Also, comparing the symptoms prevalence and intensity between work settings with different workstation layout would provide useful data regarding the necessary desk and keyboard modifications.

References


