Key risk factors associated with musculoskeletal disorders in computer work

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Abstract

Many complaints of arms, neck and shoulder among computer workers have been reported in the literatures. In order to prevent these musculoskeletal disorders (MSD), to understand work related risk factors more is necessary. This study was aimed at identifying the key ergonomic risk factors for three types of computer workers in Taiwan. The surveyed subjects included 50 college staffs, 31 programmers, and 37 computer drawers. The modified OSHA computer workstation checklist was adopted to identify ergonomic risk factors and quantify the degree of each factor for the subjects. The revised Nordic Musculoskeletal Questionnaire (NMQ) was also applied for evaluating the level of disorders among all of the 118 surveyed subjects. The Pearson product-moment correlation analysis was conducted to obtain the correlation between each risk factor and the corresponding MSD. The surveyed results revealed that poor neck and shoulder postures, years of occupation, and age were the key factors that caused the MSDs. For the 118 subjects, the most popular complaint was on the eyes (74% of the respondents), followed by the neck (69%) and the right shoulder (68%). These findings of the current study can be applied in determining adequate ergonomic interventions to reduce the MSDs in computer work.

Keywords: Work related Musculoskeletal Disorders, CANS, Health care ergonomics, Risk assessment method for MSD

1. Introduction

Industry revolution promoted the world flourishing. Human beings then combined machineries and computers to shorten the production time with the occurrence of information revolution. However, the application of a computer is not limited to the industrial practices. Computers have adapted everyone’s life including working, educating and playing. Because of the convenience of computers, the population of using computers increases day by day that can’t be restrained. Although the applications of computers bring the advantages, the problems are also accompanied. It looks like an easy activity while using a computer, but it will bring healthy problems if we overly rely on computers. For examples, if you watch the computer for a long time, the fatigue of eyes and pain of shoulders will happen; the carpal tunnel syndrome will occur while using a mouse overly; the low back pain may result from a long-term improper sitting position.

In order to prevent computer users from musculoskeletal disorders, it is necessary to let the users understand whether there are any ergonomic
risks in the work settings and work conditions. The main purpose of this research was to investigate the relations between ergonomic risk factors and musculoskeletal disorders, and to find out the key risk factors. The results can help computer users to understand the critical ergonomic risk factors, which should be noticed and eliminated especially.

2. Literature review

Musculoskeletal disorders (MSDs) usually happened on the neck, shoulders [1,2], and upper limbs [3] while using a computer for a long time. These disorders may be contributed to individual characteristics, ergonomic risk factors, and work organizations. Working time is also an important risk factor. Nordin and Frankel found that bones or muscles would be seriously injured after accumulating disorders for a long time [4]. In addition, Kumar indicated that abnormal or unnatural movement also could lead to injuries. Muscle fatigue had been proven to be an important factor resulting in musculoskeletal injuries [5].

Wu et al. have established simple software for self-checking ergonomic risks in computer operation [6]. This software was based on OSHA’s computer workstation checklist and each check item only have two options, which were ‘yes’ and ‘no’. It can’t respond to different levels of risk factors [6]. Taking ulnar deviation as an example, different degrees of deviation may cause different levels of harmfulness to the wrist. But it still lacks quantitative data to interpret different levels of ergonomic risk factor. This study was thus to investigate various ergonomics risk factors, and to understand whether different levels of risk factors lead to different degrees of MSDs.

3. Method

3.1. Subjects

This study mainly focused on the workers who must use computers for a long time everyday. Three professions were selected to investigate. These professions included college staff, programmer and drawer. Fifty workers were surveyed for each profession, and totally 150 workers participated in this study. Table 1 shows the characteristics of the surveyed workers.

<table>
<thead>
<tr>
<th>Characteristic of the surveyed workers</th>
<th>College staff</th>
<th>Programmer</th>
<th>Drawer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>39.06</td>
<td>29.42</td>
<td>28.1</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162</td>
<td>171</td>
<td>167</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>55.3</td>
<td>64.35</td>
<td>63.8</td>
</tr>
<tr>
<td>Years of occupation (years)</td>
<td>12.5</td>
<td>3.6</td>
<td>5.25</td>
</tr>
<tr>
<td>Work days per week (day)</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Work hours per day (hour)</td>
<td>7.79</td>
<td>8.56</td>
<td>8.27</td>
</tr>
</tbody>
</table>

3.2. Ergonomics risk factors investigation

The investigated factors were based on OSHA’s computer workstation checklist. We modified many checked items to have 5 to 6 options. Different levels of each risk factor could be described in terms of numerical data. For instance, how about the posture of your head and neck when you use your computer? (1) stretch! (2) bend forward or backward about 1 to 10 degrees (3) bend forward or backward about 11 to 30 degrees (4) bend forward or backward about 31 to 45 degrees (5) greater than 45 degrees. In order to increase the checklist’s reliability, we surveyed these risk factors by interviews with the workers. The working life, work environment and working postures of the surveyed workers were recorded.

3.3. Questionnaire survey for MSDs

This study took the NMQ (Nordic Musculoskeletal Questionnaire) as the basis to investigate the workers’ MSDs. But there are many items in NMQ; we must modify some items to be suitable for computer work. We deleted useless information and simplified the statements. It could help user to read easily. The modified NMQ included MSD level for each body position, pain time, pain rate, personal characteristics, working
Fig. 1  Self-reported MSD positions

3.4. Correlation analysis

The risk factors were collected in the field. The level of MSD for each body position was quantified by the modified NMQ. The Pearson correlation analysis was performed for each pair of ergonomic risk factor and MSD with the SPSS10.0 software.

4. Results and discussion

4.1. Self-reported MSDs

After taking off the invalid questionnaires, 50 respondents of college staffs, 31 respondents of programmers and 37 respondents of drawers were considered as effective responses. The total effective response rate was 78.7%.

Nineteen body positions were surveyed, and the most popular three pain positions responded from each of the surveyed professions were shown in Fig.1. Most college staffs had pains in neck (72%), right shoulder (68%) and eyes (60%). Most programmers had pains in eyes (84%), right shoulder (81%) and right wrist (68%). Most drawers had pains in eyes (86%), neck (78%) and ache-right wrist (76%).

The hours of using a computer (including typing and watching the monitor) in percentage of the work shift are shown in Fig.2. The college staffs spent 64% of their work shift to use computers, the programmers spent 71% of their work shift to use computers, and the drawers spent 80% of their work shift to use computers.

4.2. Correlations between risk factors and MSDs

All the collected data of the 118 effective respondents were analysed. The potential risk factors included 31 computer-related ergonomics risk factors and 13 social and personal characteristic risk factors. And there are 19 MSDs in different body positions. Since the correlation matrix is very big, we only listed the significant correlations (p<0.05) in Table 2. This table indicated the key risk factors that were significantly associated with the MSDs in corresponding body positions.

There are a lot of factors resulting in the MSDs. Many studies as well as this study indicated that age factor was a key cause leading to MSDs. It meant that the greater the years of occupation was the higher the occurrence rate of the computer-related syndrome would be. Besides, this study also confirmed that the musculoskeletal disorders were associated with the years of occupation, the improper postures, the time of using computer per day, the body weight, and etc.

4.3 Limitations

Because we lack professional medical background, we couldn’t examine all the syndromes of MSD. This research only let the subjects fill out the modified NMQ by themselves. For further studies, to adopt medical pathology examination is required to precisely confirm the self-reported MSDs and their serious levels.
Table 2
Key risk factors for MSDs found in this study

<table>
<thead>
<tr>
<th>Key risk factors</th>
<th>MSDs in the body positions</th>
</tr>
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<tbody>
<tr>
<td>Years of occupation and age</td>
<td>Shoulders, upper-back, arms, wrists, thighs, knees and left shank</td>
</tr>
<tr>
<td>Shoulders and upper-arms elevated or stretched forward</td>
<td>Neck, shoulders, arms, right wrist, right-shoulder, upper back and right arm</td>
</tr>
<tr>
<td>Prolonged watching a monitor</td>
<td>Neck, shoulders, arms and wrist</td>
</tr>
<tr>
<td>Poor neck postures</td>
<td>Eyes, neck, shoulders, and right-arm</td>
</tr>
<tr>
<td>Body weight</td>
<td>Upper-back, knees and left-shoulder</td>
</tr>
<tr>
<td>Prolonged working time</td>
<td>Mid-low back, upper back, left wrist and right thigh</td>
</tr>
<tr>
<td>Arms stretch forward and the angle between upper-arm and forearm is greater</td>
<td>Mid-low back and neck</td>
</tr>
<tr>
<td>Unnatural postures of wrist and palm</td>
<td>Left-shoulder, right-arm and right wrist</td>
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</table>

5. Conclusion

This study was aimed at investigating the relations between ergonomic risk factors and MSDs. We have already investigated three kinds of occupations including college staffs, programmers, and drawers. According to the research results, the most popular three pain positions of the computer users were eyes (74%), neck (69%) and right shoulder (68%). The key risk factors leading to these MSDs were greater years of occupation and age, shoulders and upper arms elevated or stretched forward, prolonged watching a monitor, poor neck postures, and etc. These results not only provide important information to the workers who use a computer frequently, but also deeply interpret the causes of musculoskeletal disorders. It is hoped to determine proper improvement ways to eliminate these key risk factors and then to prevent from occupational injuries.

References