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# Trapezius muscle rest time during standardised computer work – A comparison of female computer users with and without self-reported neck/shoulder complaints

S. Thorn [a,b,*], K. Søgaard [c], L.A.C. Kallenberg [d], L. Sandsjö [a,b], G. Sjøgaard [c], H.J. Hermens [d], R. Kadefors [a,b], M. Forsman [a,b]

[a] National Institute for Working Life, Box 8850, SE 402 72 Göteborg, Sweden
[b] Department of Product and Production Development, Chalmers University of Technology, Göteborg, Sweden
[c] National Institute of Occupational Health, Copenhagen, Denmark
[d] Roessingh Research and Development, Enschede, The Netherlands

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**Abstract**

Work related musculoskeletal disorders (WMSDs) in the shoulder/neck area are a common and increasing problem among European computer workers, especially women. Long-term low-level workloads with low degree of muscle rest are a potential risk factor for developing WMSDs. The purpose of the present study of female computer users (age 45–65 years) in Denmark and Sweden was to investigate if subjects with self-reported neck/shoulder complaints (cases, $N = 35$) show less trapezius muscle relative rest time (RRT) than controls ($N = 44$) when performing standardised short-term computer work tasks in controlled laboratory conditions. Surface electromyography (EMG) signals were recorded bilaterally from the upper trapezius muscles during a type, edit, precision and colour word stress task. Besides RRT, 10th percentile RMS values were calculated. On the average, 15 of the cases and 18 of the controls showed analysable EMG files per task. For the colour word stress task, the results showed lower RRT values and higher 10th percentile RMS amplitude levels among cases compared to controls. No such signs could be found for the other tasks performed. The present results indicate an increased motor response to a psychological stressor among subjects with self-reported neck/shoulder complaints.


*Keywords:* Muscle rest; EMG; Computer work; Musculoskeletal disorders

## 1. Introduction

Work related musculoskeletal disorders (WMSDs) in the shoulder/neck area are a common problem among European computer workers, especially women (e.g., Jensen et al., 2002; Wigaeus Tornqvist et al., 2001), in spite of the relatively low muscle activation levels required. The use of computers at work has increased substantially during the last decade, and several studies report augmented problems with increased computer usage (Blatter and Bongers, 2002; Fogleman and Lewis, 2002; Jensen, 2003; Wigaeus Tornqvist et al., 2001).

The Cinderella hypothesis postulates that long-term low-level workloads with low degree of muscle rest can cause selective over-usage of low-threshold muscle fibres, leading to WMSDs (Hägg, 1991). Based on this theory, it has been hypothesised that a low degree of muscle rest is a risk factor for development of WMSDs. This hypothesis is supported by a one-year prospective study of light manual work (Veiersted et al., 1993), where surface electromyography (EMG) was recorded and a regression analysis showed that a low amount of short muscle rest periods (gaps) predicted future development of WMSDs. More-

* Corresponding author. Present address: National Institute for Working Life, Box 8850, SE 402 72 Göteborg, Sweden. Tel.: +46 31 50 16 48; fax.: +46 31 50 16 10.
*E-mail address:* stefan.thorn@arbetslivsinstitutet.se (S. Thorn).

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over, an extensive prospective study of computer users showed a significant association between perceived muscular tension and an increased risk for developing neck pain (Wahlström et al., 2004). A low degree of muscle rest may persist also after the development of disorders or complaints. Significantly higher median trapezius EMG activity and a tendency towards lower degree of muscle rest has been reported from computer users who perceived muscular tension at least a few times per week during the past month (Wahlström et al., 2003). In cross-sectional field studies of medical secretaries (Hägg and Åström, 1997) and cashier workers (Sandsjö et al., 2000) performing ordinary work activities, significantly lower muscle rest was demonstrated among workers with self-reported shoulder/neck complaints compared to those without. Two similar studies of office workers (Nordander et al., 2000; Vasseljen and Westgaard, 1995), however, did not support these results. Since these studies mainly were performed in daily life situations, this inconsistency might be related to inter-individual differences that are hard to control, e.g., work tasks, ergonomic environment, etc. Comparative studies of muscle rest during standardised computer work tasks in controlled environment are therefore of high interest since they can show which physical and mental demands may trigger different muscular behaviour among workers with self-reported shoulder/neck complaints compared to those without. Currently, such studies are lacking. In the EU funded project 'Neuromuscular Assessment of the Elderly Worker (NEW)' (Merletti et al., 2004), EMG data have been assessed from female computer workers during standardised computer work in laboratory setup. The project included cross-sectional data from women with self-reported neck/shoulder complaints (cases) and those without (controls). The objective of the present study was to utilise data collected in the NEW project to investigate if cases show less muscular relative rest time (RRT) than controls when performing standardised, short-term (2–5 min) computer work tasks with various elements of physical and mental demands.

## 2. Method

Data from questionnaires and physical measurements from elderly female computer users (defined as age 45–65 years) in Denmark and Sweden were analysed. In Denmark, the participants were employees of an insurance company, a ministry department, or an administrative unit at a hospital. The participants in Sweden were employees of a regional branch of the Swedish National Labour Market Administration. To be included in the present study, the computer users were required to: (1) have worked at least 5 years with computer job tasks, (2) work at least 20 h a week, and (3) have less than 3 months out of work, except for vacation, during the last 5 years. A division into neck/shoulder cases and controls was made using self-reported data from the standardised nordic musculoskeletal questionnaire (NMQ) (Kourinka et al., 1987). The inclusion criteria for cases were: (1) neck/shoulder complaints for more than 30 days during the past year, and (2) less than three additional body regions with complaints >30 days. The inclusion criteria for controls were: (1) less than 8 days of complaints in the neck/shoulder area during the past year, and (2) less than three additional body regions with complaints >30 days. The controls may be regarded rather as non-cases, since they are not general population controls. For simplicity in terminology we will, however, retain the term controls.

In total, 79 subjects (35 cases, 44 controls) were studied. Mean age was 53.3 (SD: 5.0) years for cases and 55.6 (4.9) years for controls. The average body mass index (BMI) was 25.7 (3.9) and 24.6 (3.1) $kg/m^2$ for cases and controls, respectively. For each work task, on the average 15 (range: 14–16) of the cases and 18 (12–21) of the controls showed analysable EMG files (Table 1). The typing and editing tasks rendered the fewest number of analysable files. Most common reasons for disregarding the files were too low signal-to-noise ratio and/or 50 Hz disturbance problems (maximum signal amplitude less than 3 times the disturbance amplitude with the muscle at rest). For the group

Table 1
Median and P10 RMS activity levels and RRT results for cases vs. controls on mouse and non-mouse side of the trapezius muscle

| Variable | Number of subjects | | Median RMS activity level (%MVE) | | P10 RMS activity level (%MVE) | | RRT result (% time) | |
|---|---|---|---|---|---|---|---|---|
| Task | Case | Control | Case | Control | Case | Control | Case | Control |
| *Trapezius mouse side* | | | | | | | | |
| Typing | 14 | 19 | 9.9 (5.4–28.2) | 8.7 (3.0–16.0) | 5.7 (1.3–19.8) | 5.7 (0.9–8.9) | 0.1 (0–6.7) | 0.1 (0–12.3) |
| Editing | 14 | 12 | 8.5 (1.9–30.8) | 8.0 (4.7–15.4) | 4.3 (1.0–17.9) | 4.3 (1.1–8.1) | 0.3 (0–9.5) | 0.2 (0–9.4) |
| Precision | 15 | 21 | 3.5 (1.0–6.4) | 2.0 (0.7–5.4) | 1.6 (0.6–4.0) | 1.0 (0.3–3.7) | 3.5 (0–53.8) | 12.1 (0–70.1) |
| Stress | 15 | 21 | 3.1 (0.8–12.3) | 1.4 (0.6–7.9)[#] | 1.2 (0.4–6.3) | 0.6 (0.2–4.1) | 4.5 (0–68.8) | 33.7 (0.5–84.1)[*] |
| *Trapezius non-mouse side* | | | | | | | | |
| Typing | 14 | 18 | 8.6 (5.4–9.9) | 7.5 (4.5–14.7) | 4.9 (2.5–7.0) | 4.3 (1.5–6.8) | 0 (0–1.0) | 0.3 (0.1–6.2) |
| Editing | 14 | 12 | 6.6 (2.2–8.5) | 7.0 (3.5–11.4) | 2.5 (0.7–4.8) | 2.9 (1.7–6.1) | 2.8 (0–15.9) | 1.0 (0–5.0) |
| Precision | 15 | 20 | 1.0 (0.6–2.9) | 1.4 (0.7–4.5) | 0.5 (0.3–2.1) | 0.5 (0.2–1.7) | 55.6 (0.7–76.3) | 39.9 (1.3–75.5) |
| Stress | 16 | 21 | 2.1 (1.1–4.9) | 1.8 (0.6–2.4) | 1.1 (0.4–1.8) | 0.6 (0.3–1.0)[#] | 8.1 (3.0–42.9) | 26.8 (10.9–82.2)[#] |

Group median values (lower-upper quartiles) are shown. [*]Indicates cases significantly different from controls, [#]indicates a tendency of a corresponding difference ($p < 0.1$).