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Muscular Strain and Complaints at the Upper Extremities during Office Work

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MUSCULAR STRAIN AND COMPLAINTS AT THE UPPER EXTREMITIES DURING OFFICE WORK

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INTRODUCTION

Office workers often complain of pain in the musculoskeletal system in spite of the relatively low muscular forces that need to be exerted during such work. Complaints may result from the long-term activation of the muscles needed for posture stabilisation in the workplace and from disadvantageous working conditions. In a field study on office workers, working conditions, musculoskeletal symptoms, myoelectrical activities and the work flow were investigated.

METHODS

69 employees of the German tax authority working in the same tax office were involved in the study. The working conditions were studied using a questionnaire regarding the activity of the persons, the working tools used and the local arrangement of the equipment. Musculoskeletal symptoms were investigated by applying a modified and enlarged version of the 'Nordic Questionnaire' of Kuorinka et al. [1].

For a subgroup of 13 employees, a detailed work-physiological study was performed. During total working shifts, 4 surface electromyograms (EMG) were recorded in the right shoulder/arm region of the subjects from the m. trapezius (pars descendens), m. deltoideus (pars acromialis and pars clavicularis) and from the m. extensor carpi ulnaris. Simultaneously the actual task of the persons was documented using a classification procedure described by Luttmann et al. [2]. Additionally, at four points in time during the working day (begin of the working shift, before and after the noon break, end of the shift) the subjects were asked to indicate the degree of actual musculoskeletal complaints. For this purpose a questionnaire developed by Corlett and Bishop [3] and extended by Schmidt et al. [4] was applied that is based on a schematic diagram representing the contour of the human body. The persons under study were asked to indicate painful body areas according to the pain intensity.

RESULTS

Questionnaire

In the first part of the study regarding work content, working conditions and the musculoskeletal symptoms of the 69 employees, it was found that 70% of the persons performed computer work up to 50% and paper work up to 40% of their working time. Computer work was predominantly performed using a desktop with discrete keyboard and screen; only 13% of the subjects used a laptop.

About 50% of the persons indicated complaints for at least 8 days during the last 12 months in the neck and the lower back, and about 40% and 30% in the right or the left shoulder, respectively.

Work-physiological recordings

In figure 1 typical results of the electromyographical measurements are summarized. The Electrical Activity (EA) of the right trapezius muscle, representing the rectified and time averaged raw EMG, is shown for the four most important activities (four upper diagrams) and for the total activity (lowest diagram). Findings are shown for 12 subjects, since one of the 13 subjects was excluded from the data analysis due to poor signal quality. In the right column, the mean value \pm standard deviation for the 12 persons is presented. It can be

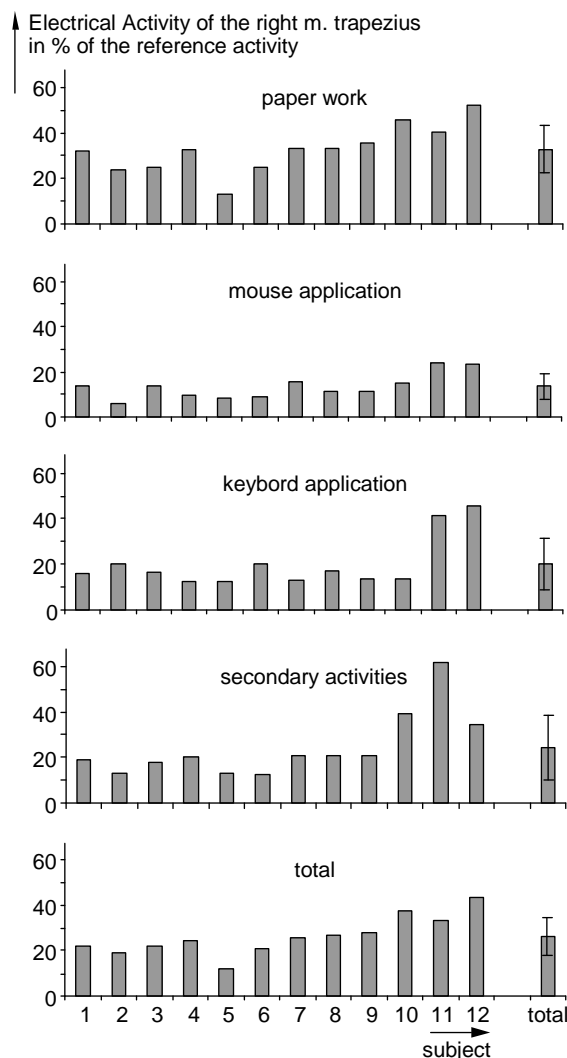


Figure 1: Mean Electrical Activity of the right m. trapezius during full working shifts for different activities for 12 persons and mean value \pm standard deviation for all persons (right column); adapted from [5]

concluded that for the trapezius muscle the highest values of the Electrical Activity were observed during paper work, whereas the lowest values were found during mouse application. During the use of the keyboard and secondary activities, intermediate EA values were recorded for the trapezius. Similar results were obtained for the other shoulder muscles. For the forearm, the highest muscular activity was found during keyboard operations.

Temporal changes in the EMGs were analysed with respect to the EMG amplitude and the frequency spectrum. A previously developed method for 'Joint Analysis of the EMG Spectrum and Amplitude (JASA)' [2, 6] was used to classify the supposed cause for the EMG change into the categories 'fatigue', 'recovery', 'force increase' or 'force decrease'. Application of this method to the EMGs of this study [7] reveals that for several persons muscular fatigue – as indicated by a time-related increase in the EMG amplitude and a

simultaneous left-shift in the EMG spectrum – was found for the hand extensor during keyboard operation and for the right trapezius muscle during paper work.

For the majority of persons an amplitude decrease and a simultaneous spectral left-shift in the course of the working shift was observed. According to the JASA method, for such EMG changes a decrease in the force production of the studied muscles during the day has to be assumed. Further analyses reveal a correlation between such time-related EMG changes and the number of actual complaints. In particular, persons with a steeper decrease in the EMG amplitude of the shoulder muscles mentioned fewer of shoulder complaints during the work day than persons with less change in the EMG amplitude.

DISCUSSION

The analysis of the temporal changes in the EMG parameters Electrical Activity and Median Frequency reveals that for some subjects muscular fatigue was found, in particular for the forearm during keyboard operations. Furthermore, for the forearm a relatively large number of complaints with the tendency to increase over the working day was indicated. These findings may refer to a connection between the development of muscular fatigue and pain, especially in the forearm where, on the one hand, static activity is needed for an exact positioning of the hand and, on the other hand, repetitive movements with high accuracy need to be performed, in particular, during typing.

For the majority of the subjects a decrease in the force production during the working day was observed. For the interpretation of this finding it may be assumed, that the working capacity of the persons is lowered in the course of the working day. Accordingly, a constant or increasing muscular activity may result in an overload for a certain part of the working day. Instead, lowering the muscular activity in the

course of the day may reflect a self adjustment of the muscular activation to the actual working capacity in order to avoid a possible overload. This finding suggests that lowering of muscular activation during the day may be helpful to prevent muscular complaints.

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