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ERGONOMIC ANALYSIS OF INFORMATICS EQUIPMENT

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Ergonomic analysis of video display units (VDUs) was carried out in an institution in Zagreb. Altogether 39 ergonomic features were analysed according to the Swedish programme Screen Checker. The VDU operators were administered a questionnaire on subjective complaints in connection with work conditions.

Six ergonomic features were found to be inappropriate. Also, a high occurrence of related subjective complaints was observed.

Active health protection of VDU operators according to the current international standards is recommended.

Key terms:
computer-human interaction, occupational
exposure, video-display terminals

Millions of people in the world use video display units (VDUs) in their workplaces and at home. It is estimated that in the USA only, there are more than 40 million computers installed at workplaces, about 25 million at homes, and 7-8 million of portable VDUs are in everyday use. Operators working intensively with VDUs spend in front of computer about 80 000 hours during their working life. Ten years ago only one out of four persons worked with a VDU. Presently, it is estimated that before the end of the century, more than two thirds of the total working force will use computers daily. All these facts have raised concern about the impact of intensive computerization of workplaces on human health (1-3).

A number of investigations about possible health hazards connected with the use of VDUs have been performed during the last decade. Attention has been placed on the potential health effects of exposure to non-ionising radiation and

on the ability of humans to adjust to new technologies (4,5). Recently, more attention has been directed to ergonomic factors related to work with VDUs (3-6).

The occurrence of different subjective complaints in VDU operators has often been reported (4, 5). Most complaints connected with the work with VDUs refer to eye problems, muscular-skeletal problems, and psychological problems (6, 7). The aim of this study was to determine which ergonomic properties of the VDU equipment in an institution in Zagreb were inappropriate according to the Swedish ergonomic recommendations, and what their impact on the subjective health status of employees was.

SUBJECTS

An investigation was carried out in a group of 49 operators aged between 19 and 35 years ($M=26.0$) who worked with VDUs for 3.5 years on average. All subjects had secondary school education. Forty-two of them were women. The group worked in the same room, entering data for six to eight hours a day.

METHODS

Ergonomic analysis of informatics equipment

Ergonomic analysis of the equipment (monitors and keyboards) and workstations was carried out according to the recommendations of The Central Organization of Salaried Employees in Sweden (Screen Checker, TCO 1986). The following ergonomic features of the equipment were analysed: screen size, flicker, contrast, character sharpness, character colour, character design, character size, line distance, ghosting, reflections, screen framing, tilting of the screen, vertical monitor adjustment, separation of keyboard, arm support, keyboard stability, keyboard height, keyboard angle, noise, keyboard reflections, key size, distance between keys. Ergonomic features of the workstations were also analysed: desk height, desk position, working surface reflections, leg room, work surfaces largeness, chairs adjustment abilities, chairs stability, seat height, seat depth, seat width, backrests height, armrests, footrests, and local illumination.

Questionnaire on subjective complaints

All subjects were administered a questionnaire inquiring about subjective complaints. The questions pertained to general data, working history, psycho-physical

discomfort connected with ergonomic features of the workplace and to the frequency and occurrence of eye, muscular-skeletal, and psychological problems relating to VDU use.

RESULTS

Six ergonomic features out of 39 listed in the TCO recommendations were found inappropriate (Table).

Table. Results of ergonomic analysis according to TCO recommendations

Ergonomic feature	TCO	Found
screen size for data entry	335 mm	* 325 mm ** 315 mm
monitor vertical adjustment	min 150 mm	* lacking ** lacking
keyboard stability	sliding test -	sliding test+
work surfaces	1.5 m	0.30 m
chair stability	yes	no
local illumination for negative contrast	yes - 500 - 800 lux	no illumination

* and ** two VDUs models both by Samsung, made in Korea

The Figure shows the operators' subjective complaints. The complaints were divided into three groups: eye problems, psychological problems and muscular-skeletal problems (7).

Among eye problems the most often reported one was the eye strain. As many as 77.6% of the interviewed persons experienced it daily or often. The symptoms of irritated eyes accompanied with headache, and burning eyes were also reported very often. As expected, psychological problems were extremely frequent. The major were fatigue, exhaustion, inertness, and dissatisfaction with the job. Among the muscular-skeletal problems painful or stiff neck and shoulders dominated. As many as 75.6% of the operators experienced it daily or often. The occurrence of neck and head pressure, and also painful or stiff arms, back and legs, was also very high.

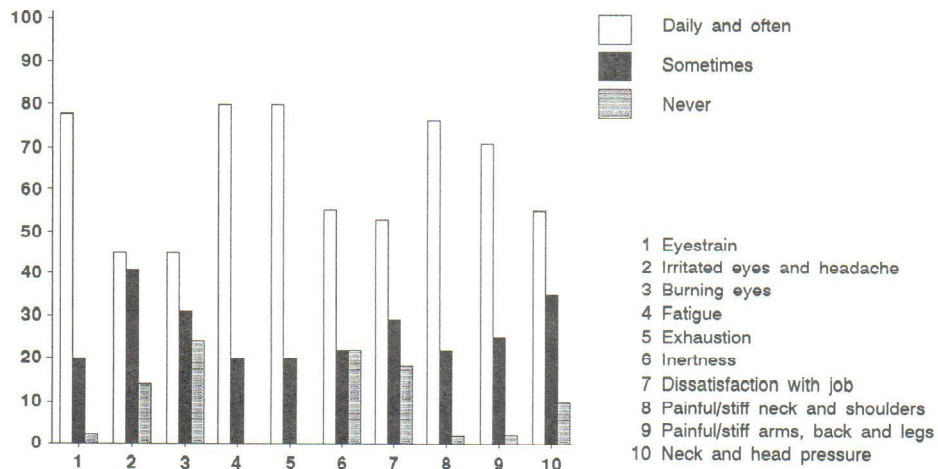


Figure. The most frequent operators' subjective complaints

DISCUSSION AND CONCLUSIONS

The visual display unit has become a major element in the modern work environment as an interface between the operator and the computer. Ergonomic and organizational concerns pertaining to different subjective complaints and health problems, motivate a number of preventive or remedial actions, directed towards the VDU entity, the workplace, the work environment, the design of the work task and work organization. A large number of national and international provisions, studies, documents and recommendations have been published (8, 9).

Ergonomic analysis in this study showed six inappropriate features: the screen too small for data entry, lack of monitor vertical adjustment, unstable keyboard, reduced work surface, unstable chair and lack of local illumination needed for monitors with negative contrast. The first three features referred to the informatics equipment.

Too small a screen forces the operator to sit too close to the screen to see the characters. This can result in a bad working posture with the risk of muscle strain, particularly in the neck and shoulders. Small text is more taxing on the eyes, reducing legibility and increasing the risk of eye strain.

It should be possible to raise or lower the monitor by at least 150 mm. The monitor must be stable at highest position. Lack of monitor vertical adjustment according to operator's anthropometric dimensions increases the loading and

muscle tension in the neck and shoulders. Reading is more stressful and tiring because of inadequate viewing angle and distance.

To ensure efficient work, the keyboard must be stable and not slide on its support. If it slides or is unstable, the work is disturbed and there is a great risk of miss-keying. This can also cause unnecessary muscle strain in the arms and shoulders because of the attempt to keep the keyboard in place on its support.

The results of study show a high incidence of subjective complaints which is in accordance with data from literature, and with the results of ergonomic analysis (1-7).

Ergonomic requirements are easily overlooked, because the operator's health problems develop slowly and it is difficult to identify them in the early stage (8-10). In this country, there are no protection standards in this field of occupational medicine and the import of computer technology is not subject to any safety regulations or procedures that are an integral part of VDU equipment installation. Also, operators get no education in ergonomics, which is obligatory in each computer course in the developed countries. Thus, an active health protection of VDU operators in this country in accordance with the existing international standards is urgently needed.

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*Sažetak***ERGONOMSKA ANALIZA INFORMATIČKE OPREME**

U radu su prikazani i komentirani rezultati ergonomske analize informatičke opreme u jednoj instituciji u Zagrebu. Analizirano je 39 ergonomskih značajki prema programu Screen Checker. Osim ergonomskih osobina opreme, ispitani su vrsta i učestalost subjektivnih smetnji vezanih uz rad s računalima. Šest značajki nije odgovaralo ergonomskim zahtjevima. Također je ustanovljena visoka učestalost smetnji vida, psiholoških problema i simptoma od strane mišićno-koštanog sustava. Rezultati upućuju na potrebu aktivne zdravstvene zaštite korisnika informatičke opreme u skladu s postojećim zaštitnim standardima u svijetu.

Ključne riječi:

interakcija računalno-čovjek, profesionalna izloženost, videoterminali

Requests for reprints

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