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WORK ENVIRONMENT AND HEALTH IN VDT USE. AN ERGONOMIC APPROACH

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Work-related health complaints were analysed in 90 operators of visual display terminals (VDT) and in 130 control office workers in regard to their assessment of environmental factors and work organization. The most common work-environment-related complaints concerned dry or stuffy or smoky air, poor ventilation, passive smoking and high temperature (14–71%). Fatigue (78%), headache (53%) and eye disturbances (48%) were more pronounced in VDT operators than in the other workers. Among the complaints relating to work organization the most important were lack of autonomy for both groups (26–34%) and the pressure to be productive for VDT operators. Physical factors accounted for 11.5–41% of the variation in the work-related health problems; VDT use accounted for only 1.9–7.5%. The high rate of work-related complaints and health symptoms seemed to be related more to personal, environmental and organizational characteristics than to VDT use.

Key terms:

health status, occupational exposure, office workers, organization of work

Frequent complaints of discomfort at work and work-related health problems among office workers are positive indications of the existence of ergonomic deficiencies: poorly designed workplace or structured job and poor work-environment conditions (1). Many studies suggest that the responsible agents are lighting-technical, chemical and biological micropollution parameters (2, 3). Most health problems associated with working with video display terminals (VDTs) appear to be similar to those encountered in more traditional office work, although some of them are aggravated by office work (4–6).

The objective of the study was to present, by means of descriptive analysis, subjective assessment of the work environment conditions with regard to VDT use and health and to find out, by multiple correlation analysis, the extent to which the factors related to work environment and VDT use influence the report of health symptoms and job satisfaction.

SUBJECTS AND METHODS

The study group was composed of 220 office workers, 35% men and 65% women, representing a response rate of 89%. The group included 90 workers working with VDTs more than 20 hours/week and 130 control workers working with VDTs less than 20 hours/week. The mean and range of the workers' collective age was 42.8 years; 23-63. Fifty-two per cent of the workers had a medium educational level, 19% had high and 29% low educational attainment.

All subjects completed a questionnaire giving information on the number of hours of VDT use, job satisfaction, indoor air and environmental problems, work related health symptoms in previous month and personal details. An environmental inspection that evaluated the characteristics of the offices failed to establish the presence of indoor air quality problems in the air-conditioned study building. Statistical analysis was carried out by means of methods of descriptive analysis and by the step-down multiple linear regression model.

The results are expressed also as index of inadequate work environment, index of inadequate health status and index of inadequate work organization.

Index of inadequate work environment (IWE) is the number of inadequate work-environment-related conditions (poor air quality, poor ventilation, noise, inadequate lighting, high temperature, uncomfortable working area, passive smoking) per worker.

Index of inadequate health status (IHS) is the number of work-related health disorders in previous month (eye problems, upper airway irritation, headache, fatigue, lack of concentration, skin disorders) per worker.

Index of inadequate work organization (IWO) is the number of inadequate job characteristics (pressure to be productive/high work speed, small possibility of work control/autonomy, many work demands, small possibility for social contact with colleagues) per worker (7).

RESULTS

The group under study was subdivided into two subgroups according to VDT use. Table 1 shows data concerning their individual characteristics. The VDT

workers were mostly younger persons and women. Almost one-half of all workers were smokers; 50% VDT operators: 42% controls.

Table 1 Individual characteristics of examined workers

Characteristics	VDT operators (n=90)		Control workers (n=130)	
	n	%	n	%
Men	26	29*	61	47
Women	64	71	69	53
Smoking	45	50	55	42
High education level	25	28	46	35
Age	39.3 ± 8.74*		46.1 ± 7.86	
Employment duration	13.2 ± 3.25		19.1 ± 3.71	

* $\bar{X} \pm SD$

The most common work-environment-related complaints are listed in Table 2. The highest frequency of negative opinions was for poor air quality (VDT operators 71% : controls 47%), passive smoking (43% : 37%) and thermal conditions (43% : 26%); these were more often reported by VDT operators. About forty per cent of all subjects complained of poor lighting.

Table 2 Prevalence of work related complaints according to VDT use

Work related components	VDT operators (n=90)		Control workers (n=130)		χ^2	P
	n	%	n	%		
Poor lighting	32	36	55	42	1.01	N.S.
High temperature	39	43	34	26	7.08	< 0.01
Noise	26	29	21	16	5.13	< 0.05
Dry/stuffy/smoky air	64	71	62	47	12.68	< 0.01
Poor ventilation	37	33	15	20	25.77	< 0.01
Uncomfortable working area	13	14	34	26	4.34	< 0.05
Passive smoking	39	43	48	37	0.91	N.S.

Among the factors related to the way work was organized (index of inadequate work organization/occupational stress factor) the most important was small possibility of work control for both groups (34% : 26%) and high work speed for VDT operators (28% : 12%; $P < 0.01$) (Table 3).

Table 3 Occupational stress factor according to VDT use

Stress factors	VDT operators (n=90)		Control workers (n=130)		χ^2	P
	n	%	n	%		
High work speed	25	28	16	12	8.39	< 0.01
Small possibility for work control	31	34	34	26	1.76	NS
Many work demands	13	15	12	9	1.44	NS
Small possibility for contact with colleagues	9	10	14	11	0.03	NS

Table 4 shows the prevalence of work related groups of symptoms in VDT operators and traditional office workers. There was an overall increased prevalence of fatigue in both groups of workers (VDT operators 78% : controls 37%; $P < 0.01$).

Table 4 Prevalence of work related groups of symptoms according to VDT use

Symptoms	VDT operators (n=90)		Control workers (n=130)		χ^2	P
	n	%	n	%		
Eye irritation	43	48	21	16	25.78	< 0.01
Upper airway irritation	6	7	21	16	4.45	< 0.05
Headache	49	53	39	30	12.11	< 0.01
Fatigue	70	78	48	37	35.70	< 0.01
Lack of concentration	33	36	14	11	21.23	< 0.01
Skin disorders	8	9	14	11	0.21	NS

Headache and eye disturbances were reported by almost one half of the VDT operators. The less common symptoms were the upper airway irritation and skin disorders. The VDT operators complained more often of all health symptoms except of upper airway irritation.

Table 5 Indices of inadequate work environment (IWE), of inadequate health status (IHS) and of inadequate work organization (IWO) according to VDT use

Index	VDT operators (n=90)		Control workers (n=130)		t	P
	\bar{X}	SD	\bar{X}	SD		
Inadequate work environment	2.93	1.20	1.84	1.01	7.26	< 0.01
Inadequate health status	4.64	1.94	2.94	2.73	5.48	< 0.01
Inadequate work organization	1.57	0.93	1.00	0.74	5.27	< 0.01

The number of health symptoms per worker (Table 5) was higher for VDT operators than for the other office workers (IHS=4.6 : 2.9). The former reported more often that they suffered from poor indoor air and work environment conditions (IWE=2.9 : 1.8) as well as from poor work organization (IWO=1.6 : 1.0).

To assess the combined effect of several exposure factors (VDT use, poor air quality, poor ventilation, uncomfortable working area, high temperature, passive smoking, lighting, noise) and to determine the relative impact of single factors on health symptoms, multiple regression analyses were done (Table 6). The stepwise model was used starting first with each of the variables singly, then using the variables which predicted the highest variation (8).

Table 6 Health symptoms: effects of VDT use and of certain factors of work environment

Symptoms		VDT	PAQ	PV	UWA	HT	PS
A. Eye irritation	r	0.24*	0.52**	0.48**	0.34**		
	B	0.13	0.28**	0.31**	0.29**		
	Beta	0.14	0.30	0.30	0.26		
	p.r	0.18	0.35	0.36	0.33		
B. Headache	r					0.33**	0.29*
	B					0.32	0.28*
	Beta					0.31	0.28
	p.r					0.30	0.28
C. Fatigue	r	0.28*	0.26*	0.33*		0.21*	
	B	0.19	0.24*	0.25		0.17	
	Beta	0.16	0.24	0.22		0.18	
	p.r	0.20	0.25	0.23		0.19	
D. Lack of concentration	r	0.34*		0.33			
	B	0.31		0.31**			
	Beta	0.31		0.32			
	p.r	0.30		0.32			
E. Skin disorders	r		0.27*		0.49**		
	B		0.11		0.35**		
	Beta		0.18		0.46		
	p.r		0.20		0.47		

VDT - VDT use;
 PAQ - Poor air quality;
 PV - Poor ventilation;
 UWA - Uncomfortable working area;
 HT - High temperature;
 PS - Passive smoking;

r - Coefficient of linear correlation
 pr - Coefficient of partial correlation
 R² - Coefficient of determination
 R - Coefficient of multiple correlation

A. Const - 0.0961; R, 0.65; R², 0.42
 B. Const - 0.2123; R, 0.34; R², 0.11
 C. Const - 0.1849; R, 0.48; R², 0.23
 D. Const - 0.1628; R, 0.45; R², 0.20
 E. Const - 0.0363; R, 0.53; R², 0.28

* P < 0.05
 ** P < 0.01

Poor air quality, poor air ventilation, uncomfortable working area and VDT use accounted for 41% of the variation in the eye complaints. The respective shares of these four factors in the total variance of the eye problems were 24.5, 9.3, 6 and 1.9%. Likewise, the work environmental conditions explained 28% of

the total variation in skin disorders, 23% of the fatigue, 20% of the lack of concentration and 11.5% of the variation observed for headache. The VDT use accounted for only 7.5% of the total variation observed for lack of concentration, for 2.6% of the variation concerning fatigue and 1.9% of the variation pertinent to the eye irritation.

DISCUSSION

Numerous studies of office workers conducted over the past decade have shown health complaints to be more widespread among VDT users (9-11). Although analysis is somewhat limited by the use of questions concerning the perception of office workers, the results indicate that there is a relationship between health disorders and complaints about the work environment-related and organizational conditions (12).

Poor indoor air quality and poor ventilation have been identified as factors possibly having an effect upon health. Passive smoking and high temperature also seemed to affect the office workers. Room lighting which may play a relevant role in the eye strain occurrence (13), failed to produce a noticeable effect among the examined subjects.

Our study showed a high frequency of work-related health symptoms, particularly in VDT operators. Multiple regression analysis did not justify such a great VDT contribution in the explanation of the variation of health symptoms. The occurrence of some health disorders was affected also by the presence of other individual factors. Headache was reported mostly by women and by younger persons in general. According to multiple regression analysis age accounted for 12.7% and sex for 5.4% of the observed variation of the complaints concerning headache.

The high frequency of work-related complaints and health symptoms seems to be due more to environmental and organizational conditions than to VDT use (14, 15).

The following reasons for the occurrence of interactions between VDT use and environmental factors are proposed: 1. a VDT may act as an electrostatic precipitator in attracting irritative fibres and particles into the worker's microenvironment, 2. specular reflections are present on the VDT screen because of inadequate lighting and 3. the worker's susceptibility to environmental stressors in the workplace has been altered.

The number of health symptoms per worker was higher with VDT operators than with the other office workers. It showed a high correlation with the index of inadequate work organization (0.49) indicating the contribution of psychosocial environment in influencing health and well-being. However, "proneness" towards health complaints as a personal trait of workers who have chosen VDT work may play a certain role (16) and needs to be considered. In this paper, the

musculoskeletal complaints, although very important for VDT users, were not analysed.

When introducing video display units as the most widespread new technology, it is essential that the occupational health expertise be given as much consideration as technical and financial aspects. (17, 18).

Industrial programmes should incorporate the following general principles:

- encouraging employees to report early symptoms of discomfort or pain without debating the source or legitimacy
- improving the ergonomic and indoor air conditions in office workplaces
- health monitoring in office workplaces
- training all employees in the new techniques, including environmental conditions and working postures.

If improvement is not realized within 72 hours, the employee should be referred to medical treatment and ergonomic and medical measures should be attempted until a satisfactory solution is obtained.

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Sažetak

ZNAČAJKE RADNOG OKOLIŠA I ZDRAVSTVENE SMETNJE PRI RADU UZ VIDEOTERMINALE – ERGONOMSKI PRISTUP

U skupini od 90 radnika koji rade uz videoterminale i 130 ostalih službenika zaposlenih u istim radnim prostorijama prikupljeni su podaci o psihosomatskim i nadražajnim smetnjama povezanim s radom, te o procjeni nepovoljnih uvjeta radnog okoliša i organizacije rada. Deskriptivnom statističkom analizom nađena je velika učestalost umora, očnih smetnji i glavobolje osobito u radnika uz videoterminale (48-78%), koje najčešće povezuju s lošim mikroklimatskim uvjetima. Radnici se najviše tuže na suhi/zagušljivi/zadimljeni zrak, lošu ventilaciju i previsoku temperaturu zraka (14-71%). Od nepovoljnih uvjeta organizacije rada radnici obiju skupina najčešće navode nemogućnost kontrole rada (24-36%) a oni uz videoterminale i brzinu rada. Multiplom regresijskom analizom rad uz videoterminale nije se pokazao statistički značajnom varijablom za objašnjenje varijacije pojedinih simptoma (odgovoran je za 7,5% varijacije smetnji koncentracije, za 2,6% varijacije umora i 1,9% varijacije očnih smetnji). Nasuprot tome, značajke radnog okoliša odgovorne su za 41% varijacije očnih smetnji, 28% kožnih smetnji, 23% umora, 20% smetnji koncentracije i 11,5% glavobolje. Navedeni podaci upućuju na to da su u ispitanih radnika zdravstvene smetnje povezane više sa značajkama radnog okoliša i organizacije rada, kao i s nekim osobnim činiocima, nego s radom uz videoterminale.

Ključne riječi:

organizacija rada, profesionalna izloženost, službenici, zdravstveni status

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