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Promoting Work Well-being: Professional Burnout & Occupational Stress

Edited by: Alexander-Stamatios Antoniou

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Promoting Work Well-being:
Professional Burnout & Occupational Stress

Effects of Work Stressors and Ergonomic Standards on the Psychological and Physical Well-Being of Intensive Computer Users

Chapter 11

Anastasia Kindyni & Alexander-Stamatios Antoniou

Introduction

Computers are indispensable in the office workplace and their use has expanded rapidly to bring about efficiency. With this rapid introduction of highly sophisticated technology, a major shift has occurred in the way people use and work with it. The introduction of computers in the workplace have many advantages, such as the complex systems control, the document preparation, the ability to carry out work processes and many others. Usually computerised jobs are sedentary and require more cognitive processing and mental attention, than physical energy expenditure, but the production demands are high, with constant work pressure and little decision-making possibilities (Smith, 1997). Consequently, many jobs that require daily use of computers have been found to be stressful (Smith, 1984, 1987a) (cited in Smith, 1997).

Stress associated with the adoption to the new technology is not fundamentally different from the stress experienced in other modern work environments. Nevertheless, major shifts in work practice deriving from these changes have given rise to situations that are different from those traditionally known. The consequences are observed in various outcome variables such as subjective discomfort or unhappiness, difficulties in job performance, biochemical and physiological indicators of health (Briner & Hockey, 1988).

Job stressors and computer use

Smith (1997) has made a review of representative studies from several countries that illustrate the adverse health effects of computer use and the psychosocial factors that produce them. According to this review, although the specific job factors that produce stress vary according to the job category, there are several job stressors that are common among different job categories. These were: (1) high job demands (e.g. heavy workload, work pressure, increased work pace), (2) lack of control over the work process and/or inability to participate in decisions, (3) a high level of task difficulty combined with inadequate skills, (4) monotony, lack of variety or lack of tasks content, (5) poor supervisory relations or lack of supervisory support, (6) technology problems (e.g. computer slowdowns, break downs, which increase the perception of work load and decrease control over the task being performed) and (7) a fear for job security (Smith, 1997). Kindyni & Antoniou (2002) have identified some other work stressors related with computer use such as: working under time pressure, lack of time to accomplish a task, insecurity for the future career, no clear career development, lack of understanding and support from the supervisors, feeling of being underestimated, no clear payment and lack of the opportunity to develop skills.

Briner and Hockey (1988) summarized the major problems which are the potential sources of stress in computer operators, as shown in Table 11.1. Many of these problems are common with the stressors of other workplaces, though they can have unexpected complications when applied to computerized work, but some others are uniquely related to the specific work environment. Aborg et al. (1993) have found that work tasks without mental and physical variation increase the risk of developing mental stress and musculoskeletal diseases (cited in Aborg, Fernstrom, & Ericson, 1998). Factors of the work organization, such as the nature

Table 11.1 *Principal sources of stress in computer-based work*

Human factors constraints	***Work demands***
Workstations layout	Changes in work pattern
VDU and keyboard design	Increased cognitive load
Hardware characteristics	Temporal and structural changes
Interface design	Constraints on planning and work strategies
	Opportunities for control and discretion
Organizational decisions	***Personal characteristics***
Introduction strategies	
Implementation and job impact	Stress tolerance
Training and user support	Cognitive skills
Long-term strategies	
Constraints on communication and social interaction	

of the task activities, employee training, availability of assistance, supervisory relations, and workstation design can lead to stress reactions and adverse health outcomes (Smith, 1997).

Physical well-being of computer users

Work that predisposes computer use is a complex, multifaceted physical work environment, with interactions among the various dimensions of the workstation and equipment, the speed of data entry, the position and lighting of visual targets (screen and documents) and the job content (Punnett & Bergqvist, 1997). Despite the low level of physical load, a great number of computer users contact musculoskeletal disorders such as neck, shoulders, arm and back pain problems.

According to the World Health Organization (1985), Work-Related Musculoskeletal Disorders arise when people are exposed to work activities and work conditions that significantly contribute to the development or exacerbation of Musculoskeletal Disorders (MSDs), but not acting as the sole determinant of causation (cited in Buckle & Devereux, 1999). Such conditions of pain and functional impairment may affect, besides others, the neck, shoulders, elbows, forearms, wrists and hands.

Punnet and Bergvist (1997) have reviewed 56 epidemiological studies on computer work and upper extremity musculoskeletal problems and have concluded that computer or general keyboard use was the causative agent of hand and wrist disorders and that computer use was associated with neck and shoulder disorders (cited in Blatter & Bongers, 2002). The positions and the angles of the workstation components (e.g. keyboard design, mouse, workstation dimensions, the position of the display unit, the chair, etc) can influence the user's body postures and thus lead to musculoskeletal pain or disorders. The musculoskeletal disorders appear as pains at the neck, shoulders, upper limb and low back and also at hands and wrists.

Data input devices

The keyboard and the mouse are the primary data input devices. Their location, height and slope, in combination with other workstation dimensions, determines the angles of the wrist, elbow, and shoulder joints and the magnitude of static muscle loading as the operator maintains the arm positioned over the keyboard or on the mouse (Punnett & Bergqvist, 1997). Among work related upper extremity disorders, Carpal Tunnel Syndrome (CTS) has the biggest impact in the professional computer users' health (Fagarasanu & Kumar, 2003) and is highly related to the use of the keyboard and the mouse. CTS is the most common nerve compression and is considered as the most common and costly repetitive strain illness (Advance Chiropractic, 2000) (cited in Fagarasanu & Kumar, 2003). The main cause of this syndrome is the repetitive motion and this usually exceeds the frequency of 30/min during a visual display unit task, which is the highest acceptable motion (Bergamasco et al., 1997) (cited in Fagarasanu & Kumar, 2003). Apart from the repetitive motion, the total time when the wrist is extended is increased by the use of the mouse that also strains the hand by forcing repetitive use of one of the fingers and by the sustained pinching required to hold it and move it.

The use of the keyboard can also influence the posture of the body. It has been found that keyboard users tend to incline the trunk backwards and to flex shoulders, in order to compensate for the higher keyboard levels, and thus extreme arm flexion might cause high levels of discomfort (Liao & Drury, 2000). Cook and Kothiyal (1998) conducted a study, the results of which, in accordance with a number of other studies, indicated that mouse users could be at risk of developing MSDs of the neck and shoulders due to work postures adopted during mouse use. Karlqvist, Hagberg, and Selin (1994) reported that mouse operation also led to long periods of shoulder flexion and outward rotation, with mouse users spending up to 81% of time with the shoulder rotated outward as opposed to 65% of time for keyboard operators. Blatter and Bongers (2002) found that using a mouse 6-8h/day is not more harmful than using a keyboard 6-8h/day.

Visual targets

While performing a computer based task, screen glare and visual contact with the objects of the task (screen, documents, and keyboard) interfere with the body posture of the user (Punnett & Bergqvist, 1997). The visual target height determines the gaze. As far as the horizontal gaze is concerned, the visual targets should be right in front of the trunk and for VDU operations the gaze inclination is determined by the visual target height and the viewing distance target (Delleman & Berndsen, 2002). An experiment conducted by Delleman and Bernsden (2002) showed that, for touch-typing VDU operation, the gaze inclination to the screen or a document should be 6°-9° (range 0°-15°) below the horizontal (Delleman & Berndsen, 2002). When the visual targets are not correctly placed, the users rotates the head in order to have the demanded visual contact with them. Faucett and Rempel (1994) found that the amount of head rotation was significantly related to severe pain in the shoulders, neck and upper back (cited in Hanse, 2002).

Prolonged and constrained sedentary work

The work being done by computer users requires many hours of sitting. Sitting reduces energy consumption and helps the worker to adopt a stable posture when performing his/her task. Despite the advantages of sitting, there are several factors which contribute in general discomfort from prolonged and constrained sedentary work. DeMatteo et al. (1992), found that the number of symptoms per worker was statistically significantly correlated with self-reported workstation design problems and indirectly with lack of postural mobility (cited in Punnett & Bergqvist, 1997). The position of the back while seated is also important for the muscle load in the neck and shoulders and thus when the cervical spine is kept vertical the muscle load in the neck and shoulders is significantly lower (Aaras, Horgen, & Ro, 2000).

Work characteristics and their influence on physical well-being of computer users

Work organization factors influence psychological stress and mood states and can also have a direct influence on upper extremity musculoskeletal pain and discomfort (Smith, 1997). Hales, Sauter, Peterson, Fine, Putz-Anderson, Schleifer, Ochs and Bernard (1994) examined the relationship between work organization characteristics and upper extremity musculoskeletal disorders and health complaints and have identified seven psychological features of the working environment that were related to upper extremity musculoskeletal disorders: (1) a fear of being replaced by a computer, (2) increased work pressure, (3) surges in workload, (4) lack of decision-making opportunities, (5) high information processing demands, (6) high task variety, and (7) the lack of production standards.

The experience of stress is associated with poor well-being (Cox, 1980) and impacts upon a number of psychological systems to directly increase the strain placed on working muscles, and adversely affect the body's muscular repair system (Smith & Carayon, 1996). Bongers, Winter, Kompier & Hildebrandt (1993), found an association between musculoskeletal symptoms and monotonous work, high perceived workload, low control of the job and lack of social support from colleagues. They also emphasized that in particular, decision latitude, psychological load and social support are risk factors for occurrence of musculoskeletal symptoms.

The intervals during tasks with high muscular load can also affect the development of musculoskeletal disorders. The constrained posture in computer based tasks restricts the degree with which the human body can move. Liao and Drury's study showed that frequent small postural shifts could relieve postural discomfort more effectively (Liao & Drury, 2000). Another factor that could increase the effect of the physical work load is the time pressure. In a cross sectional study of VDU operators, Pot, Padmos and Brouwers (1987) found high levels of perceived time pressure associated with the reporting of upper extremity musculoskeletal complaints (cited in Hanse, 2002). Cole and Wells also found in their survey that employees who often worked to weekly and daily deadlines were more likely to report musculoskeletal disorders (Cole & Wells, 2002).

To summarize, the following hypothesis is based upon the reviewed theory and guide the data analysis: specific characteristics of the computer-based work environment and the ergonomic standards have an effect on the psychological and physical well-being of the computer users.

Methods

Participants

Questionnaires were distributed personally and with the aid of personnel within the company, (OTE). From the 100 questionnaires that were distributed, 76 were returned, a response rate of 76%. From the sample that were computer users, 46.1% of those who returned the questionnaires were women and 53.9% were men. The average age of the sample was 36 years old (SD=10.64 years). Among the participants, 15.8% had been educated up to secondary education level (lyceum), 10.5% has attended a technical school, 13.2% has attended a technical university and 38.2% has attended a general university. There was a 22.4 percentage that were educated to a different level, mainly postgraduate studies. The participants were working for an average of almost 43 hours per week (SD=8.68 hours) and the number of breaks that they had during a working day varied from 0 to 4; 25% had no break at all, 39.5% had one break, 26.3% had two breaks, 7.9% had three breaks and 1.3% had 4 breaks. Among the participants, 61.8% had familiarised easily with the computer use, 32.9% moderately and 5.3% with difficulty. Most of the computer users were right-handed (84.2%) and only a 14.5% has taken sick leave related to their work (1 missing value).

Measures

All the participants responded to a questionnaire containing questions on demographic characteristics and 4 scales which assessed work stressors, ergonomic standards, somatic symptoms and general well-being. The measures that were used in the study were selected on the basis that they were specifically appropriate for measuring workplace stressors of the specific working group, ergonomic standards that apply in the specific working environment, somatic symptoms of the computer users and their general well-being. Details of each scale used in the study are described below.

Demographic characteristics

The participants were asked to answer to 8 demographic questions, which were used in the statistical analysis as well as for the descriptive information of the sample. The questions related to gender, age, highest educational level obtained, working hours, number of breaks, familiarization with the computer use, whether they were left-handed and whether they had taken sick leave related to the nature of work.

Work stressors

Work stressors were assessed using 21 items, scored on a 6-point Likert scale, ranging from "it is not a stressor at all" (1) to "it is a great stressor" (6). The subscale has been previously used in a research on working stressors and coping of computer users (Kindyni & Antoniou, 2003). Factor analysis yielded the following 4 subscales and the internal consistency reliability was also measured:

1. Professional perspectives (6 items; e.g. no clear payment, no clear career development) (α coefficient =.79)
2. Organization of work (8 items; e.g. familiarisation with new equipment, file construction from information given) (α coefficient =.74)
3. Time pressure (3 items, e.g. lack of time to complete tasks) (α coefficient =.70)
4. Interpersonal relations (4 items, e.g. feeling of being underestimated in the workplace) (α coefficient =.53)

Table 11.1 shows the eigenvalues, the percentage of variance and the percentage of cumulative variance of the factors and Table 11.2 indicates the loadings of each factor.

The first 3 factors have high internal reliability. The fourth factor has a relatively low alpha coefficient, which is disputable, as the factor's loadings were statistically significant.

Ergonomic standards

Nine statements referring to ergonomic standards related to computer use were included in this subscale and the participants were asked to identify which of these apply to them.

Somatic symptoms

The somatic symptoms that the computer users may experience were assessed using 8 items, each one referring to a part of the body. The participants were asked to identify how often they felt pain and discomfort in each of the parts of the body and their answers ranged from "never" (1) to "almost always" (6).

General well-being questionnaire

The effects on general well-being of the work stressors were assessed by the General Well-Being Questionnaire (Cox, Thirlaway, Gotts, & Cox, 1983), which measures the two general features of sub-optimal health. The questionnaire included only the first factor, "worn out", which is defined by symptoms relating to tiredness, emotional liability and cognitive confusion. It consists of 12 items, scored on a 5-point Likert scale, ranging from "never" (0) to "all the time" (4).

Data analyses

The already existing factors of work stressors were tested for internal consistency and then in order to test the research hypothesis, a hierarchical regression analysis was conducted. Before proceeding to any further statistical analysis the variables were computed. Correlations analysis was conducted in order to use those variables that were highly correlated in the regression analysis. The regression analysis was carried out firstly for the general well being as one of the two dependant variables of the study. At step 1 the demographic variables were entered simultaneously. At step 2, the four factors of the work stressors and the ergonomic standards were entered simultaneously. Then the regression analysis was conducted for the second dependant variable, the somatic symptoms. At step 1 the demographic variables were entered simultaneously. At step 2, the four factors of the work stressors and the somatic symptoms were entered simultaneously.

Results

Table 11.4 presents the range, mean, SD and correlations of all study variables. The correlation matrix showed significance between general well-being, two demographic variables: gender ($r = -.27$, $p < .05$) and sick leave related to the nature of

Table 11.2 *Eigenvalues, % of variance and % of cumulative variance for the factors of the work stressors subscale*

Factors	Eigenvalue	% of variance	% of cumulative variance
Professional perspectives	7,55	35,97	35,97
Organization of work	2,02	9,63	45,60
Time pressure	1,86	8,84	54,45
Interpersonal relations	1,35	6,41	60,86

Table 11.3 *Factor loadings for the work stressors subscale*

Factors	Loadings
Professional perspectives	
1. Not clear payment for the tasks I perform	0,358
2. Not clear professional perspectives	0,533
3. Not clear career development	0,542
4. Lack of opportunities for career development	0,781
5. The effort for training for the work	0,257
6. Insecurity for future work	0,470
Organization of work	
1. Lack of power	0,346
2. Sharing the technical equipment with others in the office	0,227
3. Excessive work load	0,164
4. Familiarization with new equipment	0,764
5. Memorizing of numbers, codes and other details	0,677
6. File construction from information given	0,667
7. Lack of variety in my work	0,465
8. The requirement to know everything about the system	0,631
Time pressure	
1. Lack of time to complete my tasks	0,769
2. Working under the pressure of deadlines	0,880
3. Lack of time to comprehend the content of my work	0,357
Interpersonal relations	
1. The "policy" of the office	0,60
2. Lack of understanding and support from the supervisors	0,12
3. Feeling of being underestimated in the workplace	0,14
4. Restricted contact and communication with people	0,18

work ($r = -.26$, $p < .05$); the work stressors: professional perspectives ($r = .37$, $p < .01$), organization of work ($r = .25$, $p < .05$), time pressure ($r = .29$, $p < .05$) and interpersonal relations ($r = .26$, $p < .05$); the ergonomic standards ($r = -.39$, $p < .01$) and the somatic symptoms ($r = .43$, $p < .01$). Somatic symptoms were correlated with 3 demographic variables: educational level ($r = -.23$, $p < .05$), how easily they familiarised with computer use ($r = .25$, $p < .05$) and sick leave ($r = -.38$, $p < .01$); three of the factors of work stressors: professional perspectives ($r = .28$, $p < .05$), time pressure ($r = .30$, $p < .01$) and interpersonal relations ($r = .29$, $p < .05$).

Regression analysis

Hierarchical regression analysis was conducted for the two dependent variables and those of the independent ones with which there was a significant correlation.

Regression analysis on general well-being

Table 11.5 shows the results of the hierarchical multiple regression analysis on the general well-being scores. An equation based upon the sick leave and the gender of the participants explains a 10.7% of the change in the general well-being ($F_{(2, 64)}$ = 3.84, p <.05). Examination of the β values reveals that they were non-significant. When including the work stressors and the ergonomic standards in the equation, they accounted for a 15% change of the variance of general well-being ($F_{(5, 59)}$ = 2.38, p <.05). At this step, only the ergonomic standards had a negative significant predictive value (β = –.25, p <.05). The four factors of work stressors did not have any significance.

Regression analysis on somatic symptoms

Table 11.6 shows the results of the hierarchical multiple regression analysis on the general well-being scores. An equation based upon sick leave, the highest education level and the familiarization with the computer use explains a 26.6% of the variance on somatic symptoms ($F_{(3, 63)}$ = 7.61, p <.001). At this step, sick leave has a greater predictive power (β = –.45, p < 001), with lower contribution of the highest educational level (β = –.21, p <.01). The beta value of the familiarization did not show any significance. When including the four factors of work stressors and the ergonomic standards, the F change was not significant.

Discussion

According to the hypothesis, the work stressors and the ergonomic standards should have an effect on the psychological and physical well-being of the sample. The results of the current study did not support the hypothesis. The only significant result was the predictive effect of the ergonomic standards on general well-being. As reported from Briner and Hockey (1988) and Smith (1997), one of the principal sources of stress in computer-based work is the workstation design. It was interesting to find that there was a significant relation between the general well-being and the physical well-being of the participants. The two dependant variables were highly correlated, showing a relationship between them. The study failed to appropriately analyze the impact of stress. It is not yet known whether the experience of stress partly moderates the relationship between work design and management, on the one hand, and the report of pain on the other, or whether it moderates the effects of the former on the latter (Randall, Griffiths, Cox, & Welsh, 2002).

Another issue that may have affected the results of the present study is the size of

Table 11.4 *Descriptive statistics for the variables among all participants*

Variable	M	SD	α	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Demographic variables																		
1 Gender	1.54	.50		1.00	.20	−.03	.09	.04	−.04	.03	.07	−.21	−.23	−.13	−.18	.14	−.15	−.27*
2 Age	36.21	10.64			1.00	.22	.45**	−.12	.06	.05	.03	−.17	.03	−.20	−.02	.03	−.00	.04
3 Highest educational level	3.41	1.34				1.00	.37**	−.15	−.51**	.16	−.02	−.03	−.10	−.02	−.08	.19	−.23*	−.15
4 No. of working hours	42.76	8.68					1.00	−.12	.04	.04	−.08	.14	0.3	.14	.03	.09	.16	−.01
5 No. of breaks	1.21	.96						1.00	.14	−.13	.01	−.13	−.13	−.11	−.12	.10	.03	.00
6 Familiarization	1.43	.60							1.00	−.11	−.07	.10	.26*	.07	.25*	−.27*	.25*	.14
7 Are you left-handed	1.84	.37								1.00	.25*	−.04	.05	.11	.10	.221	−.20	−.20
8 Sick leave	1.85	.36									1.00	−.12	−.12	−.05	−.03	.27*	−.38**	−.26*
Work stressors																		
9 Professional perspectives	23.01	6.02	.79									1.00	.74**	.81**	.67**	−.11	.28*	.37**
10 Organization of work	26.15	6.59	.74										1.00	.67**	.69**	−.18	.20	.25*
11 Time pressure	12.63	3.66	.70											1.00	.60**	−.09	.30**	.29*
12 Interpersonal relations	14.56	3.90	.53												1.00	−.17	.29*	.26*
13 Ergonomic standards	14.09	1.99	.60													1.00	−.21	−.39**
14 Somatic symptoms	24.29	7.51	.84														1.00	.43**
15 General well-being	17.27	7.88	.87															1.00

N = 76, *p <.05; **p <.01

Table 11.5 Hierarchical multiple regression analyses predicting the general well-being from the four factors of work stressors and the somatic symptoms

Steps	β	ΔR²
Step 1		.11*
Demographics		
Gender	–.22	
Sick leave	–.25*	
Step 2		.15*
Work stressors		
Professional perspectives	.37	
Organization of work	–.17	
Time pressure	.01	
Interpersonal relations	.02	
Ergonomic standards	–.25*	

N = 76, *p <.05; **p <.01; ***p <.001
The β values are the standardized coefficients when the variables were entered in the equation

the sample, which is relatively small, as well as the fact that the subsidiary from which the majority of the questionnaires were gathered is relatively new and the employees may not suffer from any psychological or physical effects of the computer use.

Table 11.6 Hierarchical multiple regression analyses predicting the somatic symptoms of the computer users from the four factors of work stressors, ergonomic standards and general well-being and demographics

Steps	β	ΔR²
Step 1		.27***
Demographics		
Highest educational level	–.21**	
Sick leave	–.45***	
Familiarization	.12	
Step 2		.07
Work stressors		
Professional perspectives	.24	
Organization of work	–.26	
Time pressure	.08	
Interpersonal relations	.15	
Ergonomic standards	–.03	

N = 76, *p <.05; **p <.01; ***p <.001
The β values are the standardized coefficients when the variables were entered in the equation

Implications for the computer-based work environments

Although the current study did not support the hypothesis, there is a wide range of research that illustrates the adverse effects of computer use on the psychological and physical well being of the users. Thus, the organizations are responsible for addressing these issues in order to protect the employees and increase their productivity. Smith (1997) emphasized that a holistic job design is necessary for improving the psycho-social aspects of work with visual display units and he made recommendations for improving the psychological characteristics of VDU work according to current knowledge as follows:

1. Provide organizational support to the environment of the employees and give the employees the possibility to support essential aspects of technology implementations
2. Job content should be improved by increasing task complexity, employee skills and career development
3. Job control should be given relating to the workload and the decision making
4. Protect the employees from excessive work pressure, giving possibility for social contact

With regard to the physical well-being of computer users, computer based tasks should keep the static muscle load at a minimum and the computer users should be able to adopt a work posture that allows easy variation in the work posture and work task, and consequently increases the dynamic muscle work. The workplace should be carefully designed on an ergonomic basis (adjustable chairs, backrests, ergonomically correct placement of the data input devices and the screen etc). But successful ergonomic interventions cannot be performed by ergonomists without close cooperation with management and priority should be given to such interventions, as these problems decrease productivity, quality and efficiency (Winkel & Westgaard, 1996).

Randall et al. (2002) based on the findings of their study, suggested that an attempt to reduce work stress may also help to address the problem of work-related musculoskeletal pain, especially in situations where problems with the psychosocial work environment are identified and pain in the upper extremity is prevalent in the employees. Finally, employers of workers who spend a significant amount of time working with display screen equipment are also subject to minimum legal standards through the Health and Safety (Display Screen Equipment) Regulations 1992.5, which are the result of a European Directive and thus they are obliged to ensure that the workplace addresses all the demands of this particular working environment.

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