

Risk Factors for Health Disorders in Computer Operators in Telecom Serbia

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Computer operators are at risk to develop health disorders related to prolonged computer use. We assessed the occupational risk factors for computer-related health disorders and evaluated health conditions of 939 Serbian computer operators. Musculoskeletal (55.8%), ocular (27.3%) and mental disorders (7.1%) were reported most frequently. Risk factors for health disorders, in both male and female populations, were age; overtime work; negative working atmosphere; awkward posture at work; the presence of vibrations, noise, dust and chemical pollution in the workplace. Negative working atmosphere, body mass index > 30, total job tenure and duration of exposed employment were risk factors for developing health disorders only in males, while smoking was a risk factor only in the female population. Our study showed high prevalence of musculoskeletal and ocular disorders in Serbian computer operators. More effective preventive measures are necessary to improve computer operators' health.

computer operators risk factors health disorders

1. INTRODUCTION

Over the past decades, using computers has become an integral part of many occupations. The introduction of computer data processing changed the character of the office job. Prolonged computer use exposes workers to a high visual and sensory load and using a mouse and a keyboard implies repetitive movements of the upper extremity. Computer operators are also exposed to static overload of the spine and to environmental working factors like noise, vibrations, dust, chemical pollution and adverse microclimatic conditions. Other factors can also influence the health of those

workers, e.g., work organization, and psychosocial and personal risk factors. The most frequent health disorders of computer operators are ocular, musculoskeletal and mental.

Musculoskeletal disorders (MSDs), especially those of the upper extremities and the neck, are the most common occupational health problem computer operators report; they account for most work-related lost time [1, 2]. Complaints of the arm, neck and shoulder include MSDs not caused by acute trauma or by a systemic disease [3]. Repetitive hand movements lead to overload of the neck and of upper extremity muscles and tendons; prolonged sitting posture leads to overload of the

low back. Computer operators are, therefore, at risk to develop disorders such as sustained pain in the upper extremities neck and low back, wrist tendonitis, carpal tunnel syndrome, epicondylitis, trapezius muscle strain and even thoracic outlet syndrome. Computer operators very frequently report ocular disorders, the so-called computer vision syndrome (tired eyes, irritation, redness, eyestrain, blurred vision and double vision) [4]. Headache has also been described as a secondary disturb in computer operators; asthenophy, MSDs or stress can cause it. Stress-related disorders are other frequent complaints related to prolonged computer use. Computer operators describe their symptoms as fatigue, sleeplessness, irritability, anxiety, mental confusion and loss of appetite.

The occurrence of a “computer disease” is related to the quality of equipment, working conditions and the use of preventive measures as well as to personal predisposition and other factors in the workplace.

The aim of our study was to investigate the occupational risk factors that may lead to computer-related health disorders and to evaluate health conditions of computer operators employed in the biggest Serbian telephone company, Telecom Serbia, by using a self-administered questionnaire.

2. SUBJECTS AND MATERIALS

Between January and December 2008, health disorders of 939 computer operators of Telecom Serbia were assessed with a questionnaire recommended by the Serbian Expert Group for Work Safety. A specialized team for assessing health risk designed the questionnaire. The team consisted of qualified physicians, psychologists, electronic and mechanical engineers, and occupational safety engineers.

The questionnaire was self-administered; it contained 58 questions divided into five groups. The first group covered demographic features and general information on the workers (gender, age, body mass index [BMI], workplace, total job tenure, duration of exposed employment and smoking).

The second group contained questions on the working environment; the workers were asked to report noise, vibrations, dust and chemical pollution in their workplace.

The third group included questions on working time and working conditions (overtime work; shift work; working on holiday; monotonous work; inadequate breaks; negative working atmosphere, e.g., bad communication or a conflict with colleagues; awkward posture at work).

The fourth group covered the presence of chronic diseases that started before the beginning of work as a computer operator (previous illnesses and health disorders).

The fifth group had questions on the presence of current health complaints, which were divided into physical and mental disorders. Physical complaints included musculoskeletal complaints (pain, stiffness, tingling, trembling and cramps in the neck, shoulders, back, upper and lower extremities and, in particular, in the upper extremity used for working with a computer mouse); ocular complaints (irritated eyes, tired eyes, eyestrain, dry eyes, watery eyes, blurred vision, double vision); respiratory complaints (a runny or blocked nose, dry and/or itching throat, dry cough); cardiovascular complaints (tachycardia, palpitations, varicose veins); gastrointestinal complaints (reduced or increased appetite, constipation); and dermatologic complaints (irritated and dry skin, wet palms). Mental health complaints included frequent headaches (defined as over two times a week), dizziness, difficulty concentrating, fatigue, nervousness, tenseness, sleeplessness.

The answers were *yes* or *no*, except in the questions in the first and fourth groups. The subjects were then divided in two groups: workers with health disorders and workers without health complaints.

We analysed the correlation between the presence of health disorders (defined as one or more current physical and/or mental complaints) and the features of the workplace, working time and working conditions as well as the demographic characteristics of the study population.

Data were analysed with SPSS version 17. We calculated the mean and standard devia-

tion, and confidence interval (95% CI) and odds ratio (*OR*) when appropriate. Depending on the scale and type of data distribution Student's *t* test and χ^2 analysis were used to compare groups. Multiple regression analysis included the risk factors that were statistically significant in univariate analysis; $p < .05$ was considered statistically significant.

3. RESULTS

3.1. Demographic Characteristics

Of the 939 subjects, 652 (69.4%) were male, 287 (30.6%) female. The mean (*SD*) age, total job tenure and duration of exposed occupation were, respectively, 43.9 (8.21), 19.28 (8.60) and 10.92 (8.39) years. There was no significant difference between genders in age, but there was a significantly longer total job tenure ($p = .002$) and duration of exposed employment ($p < .010$) in male workers.

3.2. Health Disorders

Six hundred and sixty-five workers (70.8%) reported health complaints: 277 (41.7%) were male and 388 (58.3%) female. Physical complaints included disorders of the musculoskeletal, ocular, cardiovascular, dermatologic, respiratory and gastrointestinal systems; 642 workers (68.4%) reported them. The most frequent physical complaints were MSDs, reported by 524 (55.8%) workers, and ocular and visual problems reported by 256 (27.3%) workers.

Mental complaints were present in 67 workers (7.1%). Forty-four (4.7%) workers had both physical and mental complaints. Table 1 reports the

prevalence of health disorders. Health complaints (physical, mental and overall) were significantly more frequent in women than in men ($p < .001$).

3.3. Risk Factors for Physical and Mental Disorders

The effects of the following risk factors on health were examined: age and gender; BMI > 30 ; smoking; total job tenure and duration of exposed employment; shift work; overtime work and working on holiday; monotonous work; inadequate breaks; negative working atmosphere; awkward posture; and the presence of vibrations, noise, dust and chemical pollution (Table 2).

Total job tenure and duration of exposed employment were not correlated with the presence of physical and mental health complaints as well as smoking, shift work, monotonous work, working on holiday and inadequate breaks.

Risk factors for the presence of health disorders (defined as one or more current physical and/or mental complaint) were age (*OR* 2.12; 95% CI [1.74, 2.86]; $p = .002$); female gender; overtime work; negative atmosphere in the workplace; awkward posture; vibrations; noise; dust and chemical pollution in the workplace; in univariate analyses.

In multivariate analysis, independent risk factors for the presence of health disorders were age (*OR* 1.05; 95% CI [1.03, 1.07]; $p < .001$); female gender (*OR* 2.62; 95% CI [1.85, 3.70]; $p < .001$); negative working atmosphere, (*OR* 2.78; 95% CI [1.68, 4.61]; $p < .001$); awkward posture (*OR* 4.69; 95% CI [3.23, 6.83]; $p < .001$) and vibrations in the workplace (*OR* 2.27; 95% CI [1.64, 3.15]; $p < .001$). Those five risk factors accounted for 25% of the difference between the groups of workers with and without health complaints; the other 75% were caused by other risk factors.

Risk factors for physical disorders (one or more physical complaints) were age (*OR* 3.00; 95% CI [2.62, 3.98]; $p = .003$); female gender (*OR* 3.12; 95% CI [2.10, 4.23]; $p < .001$); overtime work (*OR* 2.59; 95% CI [2.02, 3.17], $p = .010$); negative working atmosphere (*OR* 3.31; 95% CI [2.13, 4.05]; $p < .001$); awkward posture (*OR* 6.07; 95% CI [5.28, 7.41]; $p < .001$); vibra-

TABLE 1. Prevalence of Health Disorders ($n = 939$)

Health Complaint	Prevalence (%)
Musculoskeletal	524 (55.8)
Ocular	256 (27.3)
Respiratory	27 (2.9)
Cardiovascular	52 (5.5)
Gastrointestinal	64 (6.8)
Dermatologic	19 (2.0)
Mental	67 (7.1)

TABLE 2. Risk Factors for Health Disorders in Computer Operators

Risk Factors	OR	95% CI	p
Gender (female:male)	2.08	[1.55, 2.79]	<.001
Smoking	1.01	[0.75, 1.34]	.968
Shift work	1.24	[0.89, 1.71]	.225
Monotonous work	0.99	[0.64, 1.52]	.943
Overtime work	1.33	[1.01, 1.77]	.042
Working on holiday	1.02	[0.75, 1.37]	.956
Inadequate breaks	1.28	[0.96, 1.70]	.103
Negative working atmosphere	3.22	[2.02, 5.15]	<.001
BMI > 30	1.17	[0.84, 1.62]	.395
Awkward posture	3.69	[2.76, 4.69]	<.001
Vibrations	2.92	[2.19, 3.90]	<.001
Noise	2.09	[1.52, 2.89]	<.001
Dust	1.52	[1.14, 2.03]	.004
Chemical pollution	1.67	[1.20, 2.34]	.002
	$\bar{x}_1$	$\bar{x}_2$	
Age (years)	43.43	45.28	.002
Total job tenure (years)	19.32	20.48	.059
Duration of exposed employment (years)	11.41	12.19	.213

Notes. $\bar{x}_1$ —mean value in workers with health complaints, $\bar{x}_2$ —mean value in workers without health complaints (control group), OR—odds ratio, CI—confidence interval, BMI—body mass index (kilograms/metre²).

tions (OR 3.28; 95% CI [2.19, 4.33]; $p < .001$); noise (OR 2.20; 95% CI [1.07, 3.19]; $p < .001$); dust (OR 1.63; 95% CI [1.38, 2.18]; $p = .003$) and chemical pollution (OR 1.87; 95% CI 1.98, 2.15]; $p = .010$).

There was no difference in risk factors between subgroups of physical disorders (musculoskeletal, ocular, cardiovascular disorders, etc.).

Risk factors for mental disorders were female gender (OR 4.31; 95% CI [1.36, 5.36]; $p < .001$); inadequate breaks (OR 2.89; 95% CI [0.58, 3.03]; $p = .040$); negative working atmosphere (OR 4.71; 95% CI [2.44, 6.01]; $p < .001$); awkward posture (OR 3.31; 95% CI [1.71, 4.17]; $p = .002$) and vibrations (OR 3.67; 95% CI [1.06, 4.35]; $p < .001$).

We also analysed the risk factors in the male and female populations separately (Table 3).

Risk factors for developing one or more physical and/or mental health complaints in male workers were age, total job tenure, duration of exposed employment, overtime work, inadequate breaks, negative working atmosphere, BMI > 30, awkward posture, vibrations, noise, dust and

chemical pollution in the workplace, in univariate analyses.

Four independent risk factors in a multivariate analysis explained the difference between male workers with and without health disorders in 20.5%: age (OR 1.05; 95% CI [1.02, 1.08]; $p < .001$); negative working atmosphere (OR 3.60; 95% CI [1.95, 6.66]; $p < .001$); awkward posture (OR 3.37; 95% CI [2.23, 5.09]; $p < .001$) and vibrations in the workplace (OR 2.20; 95% CI [1.48, 3.26]; $p < .001$).

Risk factors for developing one or more physical and/or mental health disorders in female workers were age, smoking, overtime work, awkward posture, vibrations, noise and chemical pollution in the workplace. Four independent risk factors in multivariate analysis explained the difference between female workers with and without health disorders in 30.3%: age (OR 1.05; 95% CI [1.01, 1.09]; $p = .011$); awkward posture (OR 6.36; 95% CI [3.48, 11.64]; $p < .001$); vibrations (OR 2.77; 95% CI [1.57, 4.90]; $p < .001$) and chemical pollution (OR 7.04; 95% CI [1.15, 43.25]; $p = .035$).

TABLE 3. Risk Factors for Health Disorders in Computer Operators by Gender

Risk Factors	Gender					
	Male			Female		
	OR	95% CI	p	OR	95% CI	p
Smoking	0.88	[0.60, 1.29]	.500	2.10	[1.20, 3.67]	.005
Shift work	1.31	[0.85, 2.01]	.197	1.61	[0.89, 2.91]	.095
Monotonous work	1.24	[0.74, 2.07]	.383	1.04	[0.36, 2.94]	.930
Overtime work	1.46	[1.00, 2.14]	.039	2.83	[1.61, 4.98]	<.001
Working on holiday	1.36	[0.93, 1.99]	.095	1.05	[0.55, 1.98]	.875
Inadequate breaks	1.32	[0.91, 1.93]	.013	2.49	[1.57, 5.54]	<.001
Negative working atmosphere	0.27	[0.15, 0.48]	<.001	0.58	[0.23, 1.46]	.204
BMI > 30	1.60	[1.09, 2.36]	.013	2.41	[0.63, 9.44]	.144
Awkward posture	6.69	[2.48, 5.50]	<.001	14.33	[7.35, 28.22]	<.001
Vibrations	2.89	[1.97, 4.23]	<.001	7.39	[3.90, 14.12]	<.001
Noise	2.00	[1.32, 3.02]	<.001	4.47	[2.28, 8.78]	<.001
Dust	1.99	[1.37, 2.90]	<.001	2.51	[1.33, 4.76]	.002
Chemical pollution	2.19	[1.47, 3.24]	<.001	9.57	[1.90, 92.22]	<.001
	$\bar{x}_1$	$\bar{x}_2$	p	$\bar{x}_1$	$\bar{x}_2$	p
Age (years)	43.62	45.56	.009	42.89	44.98	.042
Total job tenure (years)	19.84	21.49	.032	17.79	19.07	.230
Duration of exposed employment (years)	12.29	14.21	.020	8.87	9.39	.572

Notes. $\bar{x}_1$ —mean value in workers with health complaints, $\bar{x}_2$ —mean value in workers without health complaints (control group), OR—odds ratio, CI—confidence interval, BMI—body mass index (kilograms/metre²).

4. DISCUSSION

The negative influence of prolonged use of computers on health is well established. Computer operators are at risk to develop musculoskeletal, ocular and stress-related disorders, the so-called computer disease.

Our study is the first one on occupational risk factors for health disorders in Serbian computer operators. We analysed health complaints of computer operators employed in the biggest Serbian telephone company, Telecom Serbia. In our study population, there was a larger percentage of male than female workers (69.4% versus 30.6%). This proportion is different from in the USA, where it is estimated that 61.8% of women and only 49.9% of men use a computer at work [5]. This difference between Serbia and USA population is principally due to the different level of education in Serbian women and a less common use of computers in the female population.

There was no difference between the mean age of male and female workers; male workers had

longer job tenure and longer duration of exposed employment than females. However, besides a shorter job tenure and a similar median age, the number of females with health complaints was greater than the number of males. Female gender has emerged as an independent risk factor for developing both physical and mental health disorders. Juul-Kristensen, Søgaard, Strøyer, et al. reported similar data; they analysed risk factors for MSDs in Denmark computer operators [6].

MSDs were the most frequent complaints in our study population, 55.8% of computer operators reported them. This proportion is higher than in a large Dutch study, where the annual incidence of the complaints of arm, neck and shoulder was estimated at 20–40% [7], and lower than in USA computer users, where the percentage of MSDs was over 60% [8].

Ocular disorders were the second most frequent disorder in our study. Ocular complaints were reported in 27.3% workers. Data in the literature on the visual disturbs of computer operators are very heterogeneous, probably depending on the use of protective devices in the workplace. In one

large Indian study, 46.3% of computer operators were affected by asthenopia [9], while in Italy this number was 63.1% [10] and in Japan only 17% of computer operators reported visual disturbances [11].

Mental complaints with the prevalence of 7.1% were the third most frequent health disorder in our study population.

Age was a risk factor for developing any work-related health disorder in computer operators; that is partially related to the increase in morbidity in the general population with age. Other risk factors for health disorders, in both male and female populations, were overtime work that increases the duration of exposure to other occupational risk factors; negative working atmosphere; awkward posture at work; the presence of vibrations, noise, dust and chemical pollution in the workplace. There were more risk factors in the male (12) than in the female population (9); negative working atmosphere, BMI > 30 and total job tenure and duration of exposed employment were risk factors for developing health disorders in males only, while smoking was a risk factor in females only.

Age, awkward posture and vibrations explained the development of symptoms in 20% of affected men, while age, awkward posture, vibrations and chemical pollution were responsible for developing health disorders in 30.3% of affected women.

It is interesting that total job tenure and duration of exposed employment were not risk factors for developing health disorders in the female population, and that negative working atmosphere influenced mainly male workers. This difference may be explained by the character, an inability to adapt, additional mental overload outside the job, but more detailed studies are necessary to explain this difference.

Interestingly, vibrations, dust and chemical pollution turned out to be significant risk factors for health disorders both in male and female workers. Even though those risk factors are not typically associated with the occurrence of computer-related health disorders, they significantly influenced the health of the computer operators in our study. That may be explained by the

frequent presence of other machines and devices in the working environment, besides computers, and by the adverse location of Telecom offices that are usually situated in the city centre. Additional factors, such as insufficient ventilation and inadequate cleaning service, may explain dust and chemical pollution in the workplace.

Our study showed high prevalence of musculoskeletal and ocular disorders in Serbian computer operators, despite good ergonomic conditions and correct use of protective devices that are currently in use in Telecom Serbia. Introducing scheduled breaks of appropriate length, recreation, antistress programmes and more careful health prevention medical programmes are necessary to improve the health of computer operators.

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