THE EFFECT OF THE UNFAVORABLE POSITION OF THE BODY DURING COMPUTER OPERATION ON THE NECK, SHOULDER REGION AND UPPER EXTREMITIES

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ABSTRACT

INTRODUCTION: Continuous static load during computer work results in gradual development of pathological changes in musculature of the upper back, neck, and arms.

OBJECTIVE: The aim of this paper was to identify problems in the area of the neck, shoulder area and upper limbs associated with static load on employees working on a computer.

METHODS: The study was conducted on 162 workers, aged 20 to 60, in the city of Siroki Brijeg, Bosnia and Herzegovina, during 2011. A questionnaire consisting of parts of two standardized questionnaires: "Workplace Appraisal on the Keyboard" from ergonomics in professional therapy, and a questionnaire for upper limbs from the Maastricht region (MUEQ) have been used. Complaints were sought on at least one problem related to the aforementioned anatomical structures present in a minimum duration of one week over the past 12 months.

RESULTS: Out of a total of 162 workers, 110 have or have had problems in the past. The number of hours spent on the computer, the years spent at the workplace, the presence of the symptoms, the location of the same, have a statistical significance. Numerous workers do not have a custom work desk, and many of them have not sought adequate medical assistance.

CONCLUSION: Long-lasting static work on the computer can be a predisposing factor for the appearance of certain problems on the structures of the neck, shoulder area and upper limbs. An inadequate desk may also have a negative impact on the problem.

Key words: cumulative traumatic disorders, musculoskeletal disorders, computer.

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INTRODUCTION

With the appearance of computers, and with increasing use of the same, more and more questions pose to the impact of computer use on human health. Seating on an appropriate computer work restricts body mobility. A large number of employees have a workplace that is not adapted, that is, which requires a forced and unnatural position of the upper back, the neck and the head. Continuous retention of the body in such an inappropriate position has resulted in increased strain on certain muscle groups. In this way, the pathologic changes in the muscles of the upper back, the neck and the arms are progressively developed. These pathological changes over a certain period may result in chronic musculoskeletal problems. Pains caused by inflammatory and degenerative processes in overloaded tissues are reported (1). If such overload lasts for a longer period of time, pathological changes may occur on the tendons, tendons and even joints.

Static strain is significant if it lasts more than 10 seconds, if the moderate strain is held for one minute or more, if the effort of 30 % of the maximum power

lasts more than five minutes. In some places of work, such as computer work, the body position is almost constant. This is called a fixed or static workstation, operational tasks only refer to limited movements involving fingers, hands, or head movements. Science that deals with the interaction between man and his workplace is called ergonomics. It is a multidisciplinary science that is named after the Greek word "ergon" (work) and "nomos" (law). The goals of ergonomics are to improve productivity, safety, comfort and quality of work.

Various researches on the topic of muscle overcrowding have been studied during computer work. IJmker et al. provide reports of harmful effects due to computer usage and provides a number of proofs about the relationship between working time spent using the computer and the frequency of "arm-to-hand" and "shoulder and neck" symptoms and disturbances (2). About these symptoms as well as their effect on the extent of productivity loss among employees, and the link between the intensity of pain, physical and psychosocial factors and employee productivity loss, is addressed by Van den Heuvel et al. research (3). Eltayeb et al. conducted a research on the quality of work environment and the presence of complaints in the event of pathological changes in zones: neck, shoulders, upper arm, forearm, elbow and wrist (4). Research was conducted on 600 workers on computers in 2002 at the GAK (National Social Security Institution) and 54 % of them complained of at least one complaint about these structures. The presence of the symptoms was on the neck and shoulders (33 % and 31 %), accompanied by complaints on the arms and upper arms (11 % to 12 %), and on the elbow, forearm and wrists (6 % to 7 %).

In a second study conducted by Eltayeb et al. prospective longitudinal cohort study with 24-month follow-up worked (5). This study was carried out between December 1999 and January 2002 among computer office workers at the National Social Security Institution GAK (Gemeentelijk Administratie Kantoor) in Maastricht and Heerlen in the Netherlands. In this longitudinal study among computer office workers, they found that the report of complaints in the neck region was similar to shoulder complaints, however, much higher than forearms/hands complaints, which corresponds with the results of previous studies.

For this reason, a research of the workplace of persons working on a computer in the area of city of Široki Brijeg (Bosnia and Hercegovina) was conducted. On the one hand, it is desirable to establish the possible presence of musculoskeletal problems among employees and, on the other hand, their awareness of the measures that can be taken.

The aim of study

The aim of this study is to know the effect of the computer work position on the aforementioned anatomical structures and thus on the quality of life and work processes.

METHODS

Study design

Retrospective study was conducted. Testing involves a number of employees working on a computer in the area of the city of Široki Brijeg (Bosnia and Hercegovina). The data were collected by the author of this research. The study included a total of 162 randomly selected employees from 20 to 60 years of age. The employees were informed about the study in an appropriate way and only those employees who agreed to participate were included in the study. Complaints on at least one problem with the structure of the neck, shoulder region and upper limbs at least one week in the past 12 months were reported at each employee. For this study, a questionnaire was created that was divided into the workplaces of the selected group, explaining the importance of their cooperation.

Participants

As a criteria for inclusion of employees in the study we used: age over 20, female gender, computer work and voluntary consent to study, as well as use of data for further processing. All respondents signed the informed consent at the end of the questionnaire. As a criterion of exclusion in the study, we used refusal of testing, and possible mistakes in data processing by the the author of this research.

Questionnaire:

The questionnaire (Table 1) consists of two standardized questionnaires: "Keyboard workstation assessment" from ergonomics in occupational therapy and taken from Guidance note for the prevention of occupational overuse syndrome in keyboard employment and the Maastricht upper extremity questionnaire, MUEQ, used to investigate complaints on neck and upper extremities (CANS, Complaints of Arm Neck and Shoulder) (4,6).

The questionnaire included basic patient information, including the name, family name, year of employment and the company in which they work. Furthermore, the questionnaire encompassed adjustment of the work table people working on computers and years spent at that workplace. Concerning questions about ailments, employees are asked about the locality of the pain, the type of discomfort, how long the pain has been present and what they did about it, therefore, what type of treatment they have been taken.

The questionnaire can be used by supervisors and experts in occupational health and safety and will help identify problems related to specific jobs.

Statistical analyses

Means and standard deviations were calculated for the baseline characteristics. The frequency of problems in the indicated anatomic structures was calculated by means of a Chi-squared test. The SPSS for Windows was used for data analysis, version 23.0 (SPSS, Chicago, IL). The value considered to be statistically important its $p<0.05$.

RESULTS

The study was conducted on women's employees in the area of city of Široki Brijeg, (Bosnia and Hercegovina), considering the fact that women are of different age in which job descriptions are represented on computer work.

The study covered a total of 162 women of different ages.Baseline characteristics of the employees are shown in Table 2. Based on the data, the mean value of age representation was 40 years. In same table, we can see the hours spent on the computer. Mostly, it was about working on computer a full-time. There is statistical significance in the number of hours spent on the computer as well as the number of years spent in the same workplace. Further, statistical significance can be seen in the presence of symptoms where we can see that 110 of them have certain symptoms, also significant is the fact that most of them did not seek adequate health care. A number of employees had problems during work but also during free time, 90 of them employees, while the statistical significance of the presence of pain on the hands and fingers was also apparent ($p<0.001$; Table 2).

Table 3. shows the presence of pain by anatomical areas and type of treatments. Based on the data we came to the conclusion that the neck was the most heavily loaded with the symptoms while the symptoms in distal regions from the shoulders were less, which was also statistically significant. If we look at the treatments done by the employees, we can see that a small number of people tried to address these problems by receiving adequate help ($p<0.001$; Table 3).

If we look at Table 4. we can see that the shoulders are most affected by the symptoms. Table 5. shows us the customization of the work desk for employees working on a computer. As seen in Table 5. we can see that the workplace, taking into account all the points, is well-adapted.

DISCUSSION

The main purpose of this study was to determine how work on computer and eventual irregularities in equipping the work space can influence on anatomical structures of the neck, shoulders an upper extremities. This research has shown that many employees spend a lot of time working on a computer. Also, many of them work there for more than 15 years. Combination of these two facts, long lasting computer work that lasts a long time has led to problems with the structure of the neck, shoulder region and upper extremities. Because of this long-term strain we have the fact that many employees have certain symptoms. Studies conducted show that out of a total of 162 respondents have or have had problems in the past year (110 of them, which would be 67.9 % of the respondents). The worrying fact is that the problems remain after work in 47 % of respondents

and that 72.7 % of those who had symptoms did not seek adequate medical help. Most subjects had neck problems (67.9 %), in their shoulders (53.1 %), while symptoms in the upper arm, shoulder and forearm were 12.9 % to 15.4 % of subjects. The complained about wrist and hand had about 27.8 % employees. It is also significant that the right arm is much more represented, which could be justified by the greater number of right-handed workers as well as using the mouse on the keyboard (Table 4).

Only a few items can be excluded: unnecessary rotation of the trunk and backrest support the lower part of the spine, while adaptability to the height of the work desk is the biggest problem (Table 5). Taking into account the country in which we live and where not enough attention is paid to the equipment of the work desk, the situation is still satisfactory.

Comparative work, similar research was conducted in the Netherlands, the Maastricht Structured Questionnaire (MUEQ), where 264 workers were tested on the computer (4). Studies show that 54 % of respondents pointed at least one objection to problems in the neck, shoulder, and arm. The highest respondent complained about neck and shoulder problems (33 % and 31 %), then upper and upper (11 % to 12%), forearm and hand (6 % to 7 %). The results showed that the MUEQ, the Maastricht structured questionnaire, has satisfactory reliability when used to document neck, palate and upper extremity problems among computer employees in the Netherlands.

Repetitive work can create cumulative health problems, while proper ergonomic measures can avoid such harmful effects and instead promote health conditions which are both efficient and agreeable, emphasized Grand Jean in his work (7). It is also significant that the right arm is much more represented, which could be justified by the greater number of right-handed workers as well as using the mouse on the keyboard. Looking at ergonomic access to the workplace we could be said to be quite satisfactory given that in the country where we live does not give too much importance to the equipping of the work space. Much research into the effects of long-lasting, recurring work on the structures of the neck, shoulder area and upper limbs has been made. Many of them point to the problem and try to find a way to reduce it. Adaptation of the work place, ergonomic approach, is just one of the ways that can help with that.

The curved keyboard, instead conventional, straight keyboards reduced ulnar deviation by 2.2 degrees +/- 0.7 ($p < 0.01$). The new curved keyboard achieved its design goal of reducing discomfort and promoting more neutral wrist postures while not compromising users' preferences and typing performance (8). In evaluation of the ergonomics of three computer keyboards (OPEN, FIXED and standard), it was concluded that the FIXED design has the potential to improve hand posture and thereby reduce the risk of developing cumulative trauma disorders of the wrist due to keyboard use (9). Between 1966 and 2005 its identified thirty-nine epidemiological studies examining associations between computer use and MSD (Musculoskeletal Disorders) outcomes. It appears that the most consistent finding was the association observed between hours keying and hand/arm outcomes (10).

In the second review, Waersted et all examines the evidence for an association between computer work and neck and upper extremity disorders (11). Results of a total of 22 studies show limited evidence for a causal relationship between computer work per se, computer mouse and keyboard time related to a diagnosis of wrist tendonitis, and for an association between computer mouse time and forearm disorders. Limited evidence was also found for a causal relationship between computer work per se and computer mouse time related to tension neck syndrome, but the evidence for keyboard time was insufficient. Insufficient evidence was found for an association between other musculoskeletal diagnoses of the neck and upper extremities, including shoulder tendonitis and epicondylitis, and any aspect of computer work.

A relationship between the performance of work and the occurrence of neck and upper limb musculoskeletal disorders is evident. These disorders are a significant problem within the European Union with respect to ill health, productivity and associated costs. The classification and the need for standardized diagnostic methods for assessment of neck and upper limb musculoskeletal disorders are reviewed, are

emphasized by Buckle and Devereux (12). The study of Day et all provides initial support for the effectiveness of workplace-based massage therapy as part of a comprehensive workplace health strategy (13). With this approach, he proved that massage treatments at work, received weekly for a four-week period, significantly reduced strain and blood pressure.

In 2005, 282 computer office workers at a mobile telecommunication company and three banks in Khartoum, Sudan, are investigated for complaints of the arm, neck and/or shoulders (CANS). The highest incidences were found for neck and shoulder symptoms (64 % and 41 % respectively). Complaints of the arm, neck and/or shoulders (CANS) in general and computer-related disorders affect millions of computer office workers in Western developed countries (14). Guided claims that repetitive strain injuries include a group of disorders that most commonly develop in workers using excessive and repetitious motions of the neck and upper extremity (15). Namely, repetitive strain injury may be manifested by cervical syndrome, tension neck syndrome, thoracic outlet syndrome and frozen shoulder syndrome. Common injuries involving the elbow, wrist and hand include epicondylitis, carpal tunnel syndrome and ulnar nerve entrapment.

Occupational CTDs (cumulative trauma disorders) have become a common problem in the workplace. These disorders are costly to the employer, the worker, and society in terms of time lost from work and resulting disability. Because the goal of the workplace is to maintain the health and safety of the employee, an educational approach to hand, wrist, elbow, and shoulder use is essential to prevent, decrease, or eliminate the risk of occupational CTDs of the upper extremity (16).

The possibility of educative effect on employers and employees is thought to guide this work. The fact is that these studies are normally carried out in the world, and that regulations on safety and health protection are in place when working with computers, as well as the training of workers. The neighboring country, Croatia, has adopted The Rulebook on Computer Work.

The Rulebook on Computer Work is known as the Rulebook on Safety and Health at Work with Computer Made by the Ministry of the Economy, Labor and Entrepreneurship, Zagreb, 10 May 2005 (OG 69/05), which begins apply from 14 June 2007. years.

Limitation of study

The potential limitation of this study was a relatively small number of employees, as the survey was conducted in only one city. However, indicating that a larger number of employees have some disadvantages in the aforementioned anatomical structures, gives us the right to conclude that something is wrong with the burden of workload. Also, a structured questionnaire was used for this research, and we can not verify the truthfulness of the employee's response as to whether the working space was properly adapted to the prescribed instructions, although the employees were provided with instructions to estimate the suitability of the works desk.

What is already known on this topic

It is well-known that the disadvantageous position of upper extremities during computer operation over a longer period may result in the appearance of certain problems resulting from overuse syndrome. Unfortunately, in the country where we live in Bosnia and Herzegovina, due attention is not paid to the ergonomic approach to the work table, also the initial symptoms of the problems on anatomical structures,the neck, shoulders and upper extremities, are ignored and thus can lead to to the potential long-term consequences.

What this study adds

According to the results of our study, we need better education to recognize the early symptoms of overload, information on the adequate equipment availability, so the use of research questionnaire can help us to point out irregularities, point out the initial symptoms and help us to with use of minimial investment and adaptation of the workplace we can diminuite work-related problems, that ultimately can be result with benefit of both, employees and businesses.

CONCLUSION

Our study showed that that out of a total of 162 respondents have or have had problems in the past year, 110 of them, which would be 67.9 % of the respondents. During this study, we confirmed that inadequate exposure of certain anatomical structures to computer work, in this case the neck, shoulder area and upper extremities, can be a predisposing factor for the emergence of certain traumatic damage. Some employees had problems even in leisure time, 47 % of them, which greatly affected their quality of life. It is worrying that workers are not well educated to recognize the early symptoms of overuse syndrome and many of them have not sought adequate help.

The results of this questionnaire call for a more serious approach to addressing them and to set guidelines for taking measures to raise awareness of the risks of inadequately tailored jobs and the consequences of overloading the body caused by an unnatural position and static effort that lasts for a longer period of time. The initial symptoms can not be ignored because serious damage can occur, which is very difficult and long-lasting. Early therapy and education is the key to preventing further damage. Namely, only one who feels good and healthy can give good and quality work.

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Conflict of interest

The author declare that have no conflict of interest.

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Table 1. Questionnaire for workplace assessment and work-related problems

Physiotherapist: Dragan Mijatović, MPT.					
Date:	Your name and surname			Year of birth	
The name of the company where you work (not obligatory)					
How long do you work in that position?			How many days do you spend per week? (Overtime is not included)		
How many hours per working day do you work on your computer?					
My desk is suitable for height.				□ No	□ Yes
I can adjust the height of my chair.				□ No	□ Yes
Can you approach the work desk without any obstacles?				□ No	□ Yes
Is the height of the chair adjusted so that your lower thighs are parallel to the floor?				□ No	□ Yes
Is the height of the chair adjusted so that your lower thighs are parallel to the floor?				□ No	□ Yes
Is the height of the backrest adjusted to support the lower part of the spine?				□ No	□ Yes
Is the angle of the backrest adjusted so that you sit upright?				□ No	□ Yes
Do your forearms work parallel to the floor?				□ No	□ Yes
While sitting upright and looking straight ahead, is your view focused on the upper edge of the monitor?				□ No	□ Yes
Is the monitor at a comfortable viewing distance?				□ No	□ Yes
Does the keyboard provide a comfortable hand position?				□ No	□ Yes
Are the objects that are often used within the reach of a hand?				□ No	□ Yes
Is there enough space for computer equipment (keyboard, ...)?				□ No	□ Yes
Is the workplace designed to prevent unnecessary turning of the neck and the upper body?				□ No	□ Yes
During the last year I had pains or complaints for at least a week in one or more of the following bodies of the region:					
Neck				□ No	□ Yes
Shoulder	□ No	□ Yes	□ Left	□ Right	□ Both
Upper arm	□ No	□ Yes	□ Left	□ Right	□ Both
Elbow	□ No	□ Yes	□ Left	□ Right	□ Both
Forearm	□ No	□ Yes	□ Left	□ Right	□ Both
Wrist	□ No	□ Yes	□ Left	□ Right	□ Both
Hand	□ No	□ Yes	□ Left	□ Right	□ Both
The longest period (in the past year) where I could not exercise my daily activities is:				days	weeks
Have I been to a doctor during the past year for these problems?				□ No	□ Yes
What kind of treatment did you receive (in the last year)?					
□ physiotherapy		□ medication		□ operation	□ other
Due to the above mentioned problems (over the past year) I was absent from work.				□ No	□ Yes
Due to problems in the last year, my actions were made more difficult:				□ in my work	□ in my free time
I feel the pain in the upper extremities after the job is done.				□ No	□ Yes
This pain disappears after a short break.				□ No	□ Yes
I feel fatigue and exhaustion in the upper extremities.				□ No	□ Yes
Tiredness and exhaustion this complaint disappears after a short rest.				□ No	□ Yes
In my fingers I feel:		□ stiffness		□ tangle	□ loss of feeling
These problems disappear after resting				□ No	□ Yes
I have swelling in my hands				□ No	□ Yes
This swelling continues after work				□ No	□ Yes
I used or used collars or braces to reduce bone-muscle pain in the upper extremities				□ No	□ Yes

Table 2. The baseline characteristics and presence of symptoms of employees enrolled in the study (N = 162)

Characteristic	No. (%) of respondents	p*
Mean age (range, years)	40 (23-61)	
≥50	37 (22.8)	
35-50	70 (43.2)	p =0.062
<35	45 (27.8)	
No data	10 (6.2)	
The number of hours spent on the computer		
≥8	7 (4.3)	
5-8	138 (85.2)	p <0.001
<5	16 (9.9)	
No data	1 (0.6)	
Years spent in the workplace		
>15	60 (37)	
10-15	38 (23.5)	
5-10	31 (19.1)	p <0.001
1-5	27 (16.7)	
<1	6 (3.7)	
The presence of symptoms		
With symptoms	110 (67.9)	p =0.001
Without symptoms	52 (32.1)	
Request for medical assistance (N=110) □		
Sought medical attention	30 (27.3)	p <0.001
Treated on its way	80 (72.7)	
The presence of difficulty (N=110) □		
Present during the work	24 (22)	
Present in leisure	52 (47)	p =0.003
Present during the work and in leisure	14 (13)	
No difficulty	20 (18)	
Problems on the hands and fingers (N=110) □		
Stiffness	27 (24.5)	
Tingling	57 (51.8)	
Loss of sensation	4 (3.6)	p <0.001
Swelling of the hands	21 (19.1)	
Swelling remain after work	13 (11.8)	

*- χ^2 (Chi-squared test) test.

□ -Numbers of employee with symptoms.

Table 3. Presence of pain by anatomical areas and type of treatments (N=162)

Anatomical areas	With symptoms No. (%)	p*
Neck	110 (67.9)	0.001
Shoulder	86 (53.1)	0.656
Upper arm	25 (15.4)	<0.001
Elbow	22 (13.6)	<0.001
Forearm	21 (12.9)	<0.001
Wrist	45 (27.8)	<0.001
Hand	45 (27.8)	<0.001
Type of treatments		
Treatments	**With treatments No. (%)**	**p***
Physiotherapy (Except massage)	28 (17.3)	<0.001
Medicines	37 (22.8)	<0.001
Surgery	4 (2.5)	<0.001
Others (Including massage)	18 (11.1)	<0.001

*- χ^2 (Chi-squared test) test.

Table 4. The presence of symptoms depending on the side of the upper extremities (N=162)

Anatomical areas	Left side No. (%)	Right side No. (%)	Both sides No. (%)	p*
Shoulder	20 (12.3)	33 (20.4)	33 (20.4)	p =0.139
Upper arm	5 (3.1)	10 (6.2)	10 (6.2)	
Elbow	4 (2.5)	11 (6.8)	7 (4.3)	
Forearm	3 (1.8)	6 (3.7)	12 (7.4)	
Wrist	2 (1.2)	25 (15.4)	18 (11.1)	
Hand	4 (2.5)	24 (14.8)	17 (10.5)	

*- χ^2 (Chi-squared test) test.

Table 5. Adjustment of work table for employees on a computer in city of Široki Brijeg (N = 162)

Adjustment of the working table	No. (%) of respondents with positive response	p*
Work desk is appropriate height	131 (80.1)	<0.001
Table height is adjustable	54 (33.3)	0.002
Chairs height is adjustable	126 (77.8)	<0.001
Forearms are parallel to the floor	82 (50.6)	0.913
Upper thighs are parallel to the floor	123 (75.9)	<0.001
The backrest supports the lower part of the spine	80 (49.4)	0.913
The items are within reach of your hand	122 (75.3)	<0.001
There is enough space for computer equipment	122 (75.3)	<0.001
Workplace designed to prevent unnecessary rotation	80 (49.4)	0.913
View centered at the top edge of the monitor	103 (63.4)	0.018
The monitor at a comfortable distance	136 (83.9)	<0.001
The keyboard provides a comfortable hand position	111 (68.5)	0.001

*- χ^2 (Chi-squared test) test.

UČINAK NEPOVOLJNOG POLOŽAJA TIJELA TIJEKOM RADA NA RAČUNALU NA VRAT, RAMENO PODRUČJE I GORNJE UDOVE

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SAŽETAK

UVOD: Kontinuirano statičko opterećenje tijekom rada na računalu ima za posljedicu postupni razvoj patoloških promjena u muskulaturi gornjeg dijela leđa, vrata i ruku.

CILJ: Cilj ovog rada bio je identificirati probleme na području vrata, ramenog područja i gornjih udova, povezane sa statičkim opterećenjem kod radnika koji rade na računalu.

METODE: Studija je provedena na 162 radnice, u dobi od 20 do 60 godina, u gradu Široki Brijeg, Bosna i Hercegovina, tijekom 2011. godine. Korišten je upitnik koji se sastoji od dijelova dvaju standardiziranih upitnika: "Procjena radnog mjesta na tipkovnici" iz ergonomije u profesionalnoj terapiji, i upitnik za gornje udove iz pokrajine Maastricht, (MUEQ). Tražene su pritužbe na barem jedan problem koji se odnosi na navedene anatomske strukture prisutne u minimalnom trajanju od jednog tjedna tijekom proteklih 12 mjeseci.

REZULTATI: Od ukupno 162 radnice njih 110 ima ili je imalo problema u prošlosti. Broj sati provedenih na računalu, provedene godine na radnom mjestu, prisutnost simptoma, lokalitet istih, imaju statističku značajnost. Brojni radnici nemaju prilagođen radni stol, a mnogi od njih nisu tražili odgovarajuću medicinsku pomoć.

ZAKLJUČAK: Dugotrajan statički rad na računalu može biti predisponirajući čimbenik za pojavu određenih tegoba na strukturama vrata, ramenog područja i gornjih udova. Neodgovarajući radni stol također može imati negativan učinak na problem.

Ključne riječi: kumulativni traumatski poremećaji, bolesti mišićno-koštanog sustava, računalo.

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