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Medical consequences of working at the computer on human health

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Summary

Introduction
In the modern world, the computer has become a device of universal use, both at work, at home and in leisure time. Health effects resulting from working at the computer are associated with taking a wrong position while using the computer and the influence of the electromagnetic field emitted by LCD monitors. The most common health problems among computer users include eye, musculoskeletal, nervous and cardiovascular disorders.

Aim
Presenting the medical consequences of working at the computer and using the LCD monitor for human health, including the eyes, musculoskeletal system, nervous system and circulatory system.

Conclusions
Most people working at a computer sooner or later will experience various health problems. Some of these problems, such as visual disturbances, chronic venous insufficiency, neck and spine pains, will be intensified due to work with a computer. It is important to take measures to prevent the deterioration of health, by observing the principles of ergonomics while working, performing eye exercises, frequently changing the position of the body, taking breaks while working at the computer and spending free time in an active way.

Key words: computer, computer vision syndrome, muscosceletal disorder, carpal tunnel syndrome, cardiovascular disorder, LCD monitor, health

Introduction
The use of digital devices in the modern world, often for many hours each day for both professional and social purposes, is a normal phenomenon among people in all age groups [1]. The computer has become a common device and an indispensable tool in every office, where it is used to writing, collecting and processing data, performing calculations, creating graphic designs and technical drawings, constructing tables and charts [2].
Also such activities as learning, shopping or spending free time take place in front of the screen of a computer or smartphone, which inextricably linked to the limitation of physical activity. It causes the build-up of stress and brings new, unknown threats to the health of a modern man. Almost every person working with a computer feels a definite lack of some stimuli and, at the same time, an excess of others which overwhelm them [3].
With an unprecedented increase in the number of mobile device users, it is estimated that by the end of 2018 almost 84% of the world's population will use telephones, computers and laptops [4].
The results of the latest report from the Fellowes Ergotest study showed that as much as 51.6% of workplaces do not meet the requirements of ergonomics. This means that the majority of Polish employers do not provide their employees with the right conditions to work, thus exposing them to serious health problems, a decrease in motivation and, consequently, financial losses of the company [5].
Health effects resulting from working with a computer are a consequence of the influence of the wrong position during use on the one hand and the electromagnetic field emitted by LCD monitors on the other hand.
The most common health problems among computer users include eye disorders [6], musculoskeletal system, peripheral nervous system [7] and circulatory system [8].

Aim
Presenting the medical consequences of frequent working at the computer and using an LCD monitor.

The impact of working at the computer on the eyesight.
The visual symptoms associated with working at the computer include: constant blurred vision, post work distance blur and intermittent blurred vision at near, itching eyes, burning eyes, foreign body sensation and sore eyes. Computer users also complain about excessive lachrymation and blinking. People working over 4 hours per day may develop dry eye symptoms. Dry eye syndrome is more common in women than men, and more often in people who work with a computer for more than 4 hours a day [9,10].
As many as 90 percent of users of digital devices experience the symptoms of digital eye strain, which are also associated with: uncorrected refractive error (including presbyopia), accommodative and vergence anomalies, altered blinking pattern (reduced rate and

incomplete blinking), excessive exposure to intense light, closer working distance, and smaller font size [11]. Among the risk factors for vision problems are the distance of the screen monitor from the eyes, lighting intensity and contrast, as well as experience with working with a computer[12].
As a consequence of working at the computer Computer Vision Syndrome (CVS) may appear. It is defined by The American Optometric Association as a "complex of eye and vision problems related to near vision activities involving computer use"[13]. The reasons for CVS include personal predispositions as well as poor or improper working conditions (incorrect position of the body), constant looking at a fixed object and a lower frequency of eyelid blinking [14]. The incidence of CVS varies from 64% to 90% among computer users, and around 60 million people worldwide suffer from this condition [6].
Symptoms fall into two main categories: those linked to accommodative or binocular vision stress, and external symptoms linked to dry eye [1].
In Kowalska's research regarding eye conditions in office workers employed in workplaces with computers, a sensation of eye pain was declared by every second woman and every third man.
Also more women than men happened to declare abnormal visual acuity (38.3% and 21.2%, respectively) and dryness or burning under the eyelids (46.5% and 24.2% respectively) [15].

The impact of working at the computer on the musculoskeletal system
Despite advances in ergonomics, muscosceletal disorder (MSD) often persist due to computer work. In Poland, musculoskeletal and connective tissue diseases are the third cause of total incapacity to work [16].
The factors that lead to disorders of the musculoskeletal system and are related to computer usage include: improperly designed computer stations, taking the wrong position of the body while seating, lack of knowledge about the correct ergonomics (no shelf for the keyboard, no mouse shelf, no footrest, incorrect monitor height) and other bad habits related to computer use [17, 18].
Forced body posture when using a computer is a burden on the musculoskeletal system and contributes to the formation or perpetuation of existing posture defects. It also causes strain on the wrists, neck pain and tendinitis. The nerves responsible for the movements of the wrist and thumb are damaged due to improper positioning of the hands while working with the computer. This can lead to numbness, tingling, thumb and tendon pain. [19].
The 2016 Loudhouse study commissioned by Fellowes indicates that Polish employees most frequently mention these symptoms related to working at the computer: back pain (72%), headache (47%), neck pain (51%) and shoulder tension (37%) [5].
Reports from the majority of studies on the subject are similar. In the report of Delp et al. more than half of respondents reported discomfort associated with the musculoskeletal system. The frequency of occurrence of MSD was: for neck / shoulders (37.2%), for upper limbs (21.7%), lower limbs (18%) and back region (34.3%). The increased risk of MSD was associated with a lower ability to adapt the computer station, work schedule, gender, age and BMI [20]. Also in the studies of Kalinienie et al. MSD was more often related to older people with more professional experience and work over 2 hours without interruption [21].
The three leading regions of musculoskeletal symptoms in the study of Cho et al. among 203 computer users were: barges (73%), neck (71%) and upper back (60%). Also, the high level of psychological stress was significantly associated with shoulder and upper back pain, while the high workload was significantly associated with back complaints. Also women complained about the shoulders more frequently [22].
The incidence of MSD in the studies of Riccò et al. concerned more than half of the respondents (53%). Significant correlation between MSD and female sex, age over 50 years

and longer exposure to computer monitor was observed - both as a result of longer work experience and longer working time (30-39 hours / week) and inadequately organized work position [23].
According to Gerr et al. daily hours of computer use is more consistently associated with upper extremity MSD than with neck and shoulder MSD [24].

The impact of working at the computer on the peripheral nervous system
When using the computer due to the forced position of the wrists associated with using the keyboard and mouse degenerative changes may occur. The so called carpal tunnel syndrome (CTS) [25], affects more often women, people over 40 with hormonal disorders, vitamin deficiencies B6 and B12, diabetes, allergic diseases and degenerative changes of the wrist [7]. In the report Mouzakis et al. that used tomography scans, it was investigated that the adopting of abnormal wrist positions while working at the computer is directly related to compression and deformity on the median nerve [26]. It was examined that although using a vertical mouse and ergonomic mouse pads reduced ulnar deviation and wrist extension, they did not reduce CTS [27].
In the meta-analysis of Mediouni et al. attempts were made to examine the connection between CTS and work at the computer, however, due to the heterogeneous exposure to work in individual studies, the results were inconclusive. Odds ratio (OR) for work at the computer in comparison to the control was 1.67, where for the use of the mouse OR = 1.94 and for the keyboard OR = 1.11 [28].
Also Thomsen et al. in their systematic review they encountered many study limitations through which it was impossible to clearly determine the impact of computer work on CTS [29].

The impact of using LCD monitors on the cardiovascular system
The electromagnetic radiation emitted by LCD monitors also affects the circulatory system. Under normal conditions, in erythrocytes, there is a biological balance between the formation and degradation of free radicals that cause extensive damage to the human body through oxidation. These changes may cause premature atherosclerotic lesions, thromboembolic events or increased inflammatory processes. Pacholski et al. they have examined that the generation of free radicals leading to an aerobic explosion increases both at increasing the intensity of the electromagnetic field, that is when approaching the screen, and with the increase in exposure to this radiation [8]. The International Agency for Cancer Research, on the basis of the available research, qualified the low frequency electromagnetic field as a possible teratogenic agent [30]. It is established that the level of the electromagnetic field causing no adverse changes is about 100 V / m, corresponding to a distance of about 50 cm [31.32]. Ascorbic acid (vitamin C), despite its antioxidant properties, however, showed little effect on reducing the generation of free radicals emitted by the action of the electromagnetic field [33]. It was also investigated that in groups exposed to extreme low frequency electromagnetic radiation, homocysteine levels (HCY), alanine transaminase (ALT), alanine aminotransferase (AST), gamma-glutamyl transpeptidase (GGT), hectrocardiography (ECG) were significantly higher than in control groups. [34, 35]. Hematocrit (HCT), white blood cell (WBC), lymphocyte and mean corpuscular volume (MCV) have also increased while platelet distribution width (PDW), mean corpuscular hemoglobin (MCH), mean platelet volume (MPV), mean cell hemoglobin concentration (MCHC)) decreased [35]. Taybeh et al. researched that people exposed to the radiation has not got poorer sleep quality comparing to control group[36]. In a big research lasting almost 6 years and including over 9000 participants, insignificant death rate from cardiovascular system related diseases was observed

[37]. The use of sit-stand workstations caused profitable changes in flow-mediated dilation and diastolic blood pressure [38].

Conclusions

Most people working at the computer sooner or later will experience various health problems. In addition, some health problems such as visual disturbances, chronic venous insufficiency, neck and spine pain may increase due to work at the computer. Therefore, it is important to take measures to prevent the deterioration of health status, by observing the principles of ergonomics at work on the computer, performing eye exercises, frequently changing the position of the body, taking breaks while working at the computer and active use of free time.

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