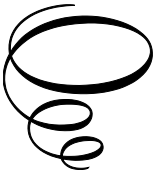
Promoting Health for Computer Users in the Workplace

Promoting Health for Computer Users in the Workplace

Edited by

Monika Kumm

Cambridge
Scholars
Publishing



Promoting Health for Computer Users in the Workplace

Edited by Monika Kumm

This book first published 2024

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-0364-0780-3
ISBN (Ebook): 978-1-0364-0781-0

TABLE OF CONTENTS

FOREWORD

People spend an increasing number of hours on their computers and smart devices, which is directly affecting their physical and mental health. Using smart devices for multiple hours can lead to back and neck pain, aching hands and wrists, and tired eyes. In addition, constant screen time can lead to sleep disorders and mental health problems. Therefore, it is essential to consciously monitor time spent on computers and implement healthier lifestyle measures.

Work environment and working hours both have an impact on our health. A good knowledge of a healthy working environment is essential to maintain a healthy lifestyle. Recognising and avoiding risk factors of stress caused by excess screen time benefits employees and employers. Workplace health promotion and well-being are essential for raising awareness about potential health risks and helping workers avoid them to lead a more fulfilling life. Computer users often sit too long, leading them to live a sedentary lifestyle. They should pay more attention to movement and physical activity. This contributes to excessive strain on the body over time and may lead to health problems. If the tension is mild to moderate, appropriate precautions should be taken to avoid permanent damage. Work environment analysis at regular intervals may prevent all these unfavourable conditions.

Sitting constantly for long hours, we underuse our muscles. Muscles need both movement and rest. Muscular work improves blood circulation and boosts metabolism. Exercise is not only good for the joints, but it also promotes thinking, regulates emotions, and improves sleep. Therefore, the body needs an alternation between sitting and standing.

If you already have mild health problems, certain activities might help you to recover. Relaxing baths, physical exercise, and spa treatments are suitable for relieving muscular tension. Tap water, mineral water, and therapeutic mud can be used for bathing. Such therapeutic baths have a complex effect

on the body. One of the elements of such baths is heat. Besides that, biologically active organic and mineral substances in the mineral water and mud also have benefits. Massage and water aerobics can also help people to deal with stressful work situations.

In addition to physical inactivity, computer users also suffer from unhealthy eating habits. Long hours in front of the screen can lead to untimely snacking and consuming excessive amounts of high-calorie foods. Similar problems arise when working in the office, such as too few stretch breaks and unhealthy snacks. Chapter 4 of this booklet sets out dietary and physical activity recommendations for the people working with computers and suggestions for employers to implement in the office.

Working long hours on the computer leaves a mark on mental health, both positively and negatively. On the positive side, computers often enable workers to complete tasks more efficiently. However, the adverse effects are related to addictions or the infliction of stressful situations like cyberbullying. In recent years, online working or meeting environments have become popular. This has led to the emergence of "Zoom fatigue". Chapter 5 provides suggestions on how to participate in online meetings more healthily.

In summary, this collection is intended for:

- employers and occupational health and safety professionals to draw their attention to the impact of computer work on workers' health and to create an employee-friendly working environment and support health-promoting activities;
- for the employee to invest wisely in their health and to be able to recognise the first signs of both mental and physical health problems;
- counsellors, teachers, physiotherapists, and other professionals working with people who can change workers' health behaviour.

We would like to thank the authors of the articles in the collection: Toomas Põld, Viiu Tuulik, Varje-Riin Tuulik, Mai Vaht, Eve Sooba, Krete Junson, Merike Sisask and Airi Värnik.

The collection of articles “Promoting Health for Computer Users in the Workplace” has been produced with the support of the European Regional Development Fund, which funded the project “Developing the Field of Health Promotion and Rehabilitation – Supporting Entrepreneurship through the Implementation of Research and the Promotion of Domestic and International Cooperation” (project no. 2014-2020.5.04.19-0372).

—Monika Kumm, PhD
Editor of the collection

ABBREVIATIONS

BMI – Body Mass Index
BMR – Basal Metabolic Rate
CT – Computed Tomography
EEG – Electroencephalography
EMF – External Electromagnetic Field
ENMG – Electroneuromyography
EU – European Union
EU-OSHA – European Agency for Safety and Health at Work
FoMO – Fear of Missing Out
IT – Information Technology
MSDs – Musculoskeletal Disorders
NEAT – Non-Exercise Activity Thermogenesis
PA – Physical Activity
PAL – Physical Activity Level
QOL – Quality of Life
RCT – Randomized Controlled Trial
REM – Rapid Eye Movement
SWS – Slow Wave Sleep
TEF – Thermic Effect of Food
TENS – Transcutaneous Electrical Nerve Stimulation
VAS – Visual Analogue Scale
VILPA – Vigorous Intermittent Lifestyle Physical Activity
WRMSDs – Work-Related Musculoskeletal Disorder

CHAPTER ONE

HEALTH EFFECTS OF A FORCED POSTURE

TOOMAS PÕLD
Chief Medical Officer, Occupational Health Doctor
Qvalitas Medical Centre
Jalgpalli 1, 11312 Tallinn, Estonia

VIIU TUULIK
Occupational Health Doctor
Qvalitas Medical Centre
Narva mnt 7, 10117 Tallinn, Estonia

Introduction

People spend a large part of their waking hours at work, which can affect their health to a great extent. Knowledge of a good working environment and recognising and avoiding risk factors can help workers and employers improve their work environment. **A responsible employer creates a safe workspace for their employees.** When the latter knows the risks at work, they know how to protect themselves from potential hazards and physical harm. Only healthy workers in an employee-friendly work environment can ensure the success of the company and the quality of the work (Merisalu, Saava, and Soon, 1999).

This chapter discusses upper limb musculoskeletal overuse syndromes associated with using electronic devices like a mouse and keyboard, as well as circulatory problems related to sitting in a forced posture. It examines whether the health of computer workers may be affected by electromagnetic fields associated with computer work.

Musculoskeletal Disorders

Until now, it was widely believed that intensive computer work primarily threatens eye health. Better monitors and more ergonomic workstations have reduced this risk and led to fewer complaints about eye fatigue after a workday. Studies also show that computer work increases the risk of developing musculoskeletal disorders (MSDs). Specialists believe there is some decline in the prevalence of the disease in this field, but more statistical data is needed to support definite conclusions.

The European Agency for Safety and Health at Work (EU-OSHA) reports that MSD is the most common work-related health problem in the European Union (EU), with 60% of workers reporting related health problems, making it the most common occupational disease in the EU (de Kok et al., 2019). The impact of MSDs not only includes distress but also involves economic costs and is, therefore, one of the priorities of the occupational health sector in the EU. In 2007, the European Commission designed measures to prevent MSD (including EU-wide legislation). Member states of the EU and the social sector organisations in Europe have prioritised these needs since 2014 (de Kok et al., 2019).

Symptomatic expression of MSDs in computer users may include syndromes that cause pain in a specific anatomical region, such as neck, shoulder, elbow (e.g., epicondylitis) or lower back (e.g., lumbar pain) (Boocock et al., 2009). Interaction of muscle strains can affect multiple anatomical areas (myofascial pain syndrome, chronic overlapping pain conditions) and cause a significant impact on their functional capacity. In severe chronic cases, movement dysfunction may develop, making it impossible to perform even the simplest repetitive movements necessary for daily computer work (Mediouni et al., 2014).

A growing number of studies confirm that the more aware a worker of ergonomics is, the fewer the complaints (Hoe et al., 2018). Prevention of work-related health problems or reduction in already caused damage can be achieved by improving the work environment. The work environment significantly impacts performance, and a good working environment is safe for workers. Awkward posture, uncomfortable positioning of work equipment

(screen, keyboard, computer mouse, etc.), repetitive movements with few breaks, and constant rushing can lead to overuse-related pain. However, **more ergonomic positioning of the equipment, forearm support, appropriate position and design of the computer mouse can reduce complaints** (Wærsted, Hanvold, and Veiersted, 2010).

The most common work-related and occupational diseases are overuse syndromes. **In general, four out of five recorded work-related illnesses are MSDs** (Põld et al., 2006).

Generally, it is difficult to determine the onset of the disease, and symptoms are barely noticeable. According to the cumulative approach, each repetitive movement causes microtrauma or wear and tear to tissues and joints. If the excessive workload continues, the pain will first appear for a shorter time and then become chronic. Initially, it is mainly limited to localised muscle or tendon pain that disappears with adequate rest. Persistent pain is caused by inflammatory and degenerative changes in overworked tissues and affects the joints and surrounding tissues.

When the joints are at an unnatural angle due to poor posture or the ergonomics of the workstation, and there is no movement, the muscles struggle to maintain posture. When a muscle is under constant tension, the supply of oxygen-rich blood to the muscle is disrupted, and inflammation-causing breakdown products accumulate in the overloaded area. **The more unnatural the posture is, the more work the muscle has to do to maintain its posture.** The closer the movement is to the body's midline, so-called neutral or physiological or good posture, the less muscle tension it causes. Conversely, in the case of strenuous muscle work in one position, the muscle tires out since the reduced blood supply does not provide the nutrients needed, and the person begins to feel discomfort and pain. In cases of too few breaks, while working with computers, the following chain of events is likely to get triggered in the overused body region: static muscular load > muscle pain > swelling of surrounding tissues > spread of inflammation into the joints > limited mobility > reduced work capacity.

Overuse of the Shoulder Girdle and Upper Extremities

MSDs are disorders of the muscles, nerves, tendons, joints, cartilage, and spine. MSD complaints are found in up to 70% of workers, and the back, shoulders, neck and arms are the four most common body regions affected by muscle pain (Põld et al., 2006; de Kok et al., 2019). Between 2008 and 2017, women were more commonly diagnosed with work-related MSDs, such as carpal tunnel syndrome, joint pain, rotator cuff syndrome, medial and lateral ulnar epicondylitis, and other conditions related to use, overuse, and pressure of soft tissues. In males, ulnar nerve compression, dorsopathy, including lumbar or cervical radiculopathy and lumbar pain, are more commonly diagnosed. Differences may occur due to differing job responsibilities among men and women and inappropriate workloads, which can lead to changes in the body. These include a range of inflammatory and degenerative conditions (Avi, 2018).

Carpal Tunnel Syndrome

One of the most common MSDs among computer users is considered to be carpal tunnel syndrome, commonly known as Mouse Arm Syndrome. Using a computer mouse requires constant bending and moving of the wrist, which is believed to lead to an overloaded wrist. Research data do not entirely back up this claim. While some studies suggest that prolonged and intensive computer work increases the risk of carpal tunnel syndrome (Ali and Sathiyasekaran, 2006; Shiri and Falah-Hassani, 2015), other studies find that there is still insufficient data to support a causal link between computer work and carpal tunnel syndrome (Thomsen, Gerr, and Atroshi, 2008; Mediouni et al., 2014; Kozak et al., 2015). There is quite a high prevalence of carpal tunnel syndrome in the general population. Thus, it may be that it is not the computer work that causes carpal tunnel syndrome, but the carpal tunnel syndrome itself disrupts computer work.

To better understand the changes in the carpal tunnel while working with computers, a simulation study was carried out using computed tomography (CT) scans while measuring the biomechanical data (Mouzakis et al., 2014). It was found that working with a computer mouse can cause deformities in the median nerve area. Working on a keyboard also induced significant

longitudinal strain of the median nerve. This study demonstrated that an increased carpal tunnel pressure caused by an uncomfortable wrist position during computer work was directly related to the deformation of the median nerve.

The wrist bones form the wrist canal on one side and the wrist cruciate ligament on the other. In addition to the median nerve, nine flexor tendons pass through the canal. Pain may be caused by external pressure on the wrist canal and inflammation of the flexor tendons and the tendon sheaths. In some people, the wrist canal is congenitally narrower and, therefore, more strain-sensitive. Because of this anatomical peculiarity, carpal tunnel syndrome is more common in women.

Histological studies of wrist ligaments have shown that women have more elastic wrist ligaments, yet it is considered unlikely to be a direct cause of carpal tunnel syndrome (Bleecker, 1994). Wrist injuries and some medical conditions may also increase the risk of developing carpal tunnel syndrome. Obesity, pregnancy, and some autoimmune diseases are examples of co-factors considered to be related to the higher-than-average incidence of carpal tunnel syndrome.

Nerve damage is thought to be caused by swelling in the wrist canal, which in turn causes a disruption of blood flow to the nerve and nerve damage. In addition, any one of the nine flexor tendons running through the wrist can become inflamed by mounting pressure on the central nerve. Usually, sensory (afferent) nerve fibres are damaged before the motor (efferent) ones (Sevy and Varacallo, 2022). Due to these changes, the sensitivity of the first three fingers is initially impaired. During night-time, pain is experienced in the hand, often relieved by shaking the hand. In the mornings, the fingers may be numb and weak, and objects may slip from the fingers. The colour of the skin may change if the blood supply is disturbed. Wrist pain may radiate to the metacarpus and the forearm. The muscles in the aforementioned areas may also experience tension.

The authors (Wærsted, Hanvold, and Veiersted, 2010) have different opinions about the positive effects of using armrests – some neck and shoulder strain reduction was found, particularly in female workers. Neck

pain and muscle soreness in the neck area (the so-called "stiff neck syndrome") are more likely to be associated with limited breaks, but also with a keyboard being too high concerning the elbow and the use of bifocal glasses. Neck flexion of more than 20 degrees is also considered a risk factor. Neck pain is associated with using the mouse rather than the keyboard. In conclusion, **a neutral neck position and forearm support can reduce the risk of neck pain because of overuse** (Wærsted, Hanvold, and Veiersted, 2010).

Other common MSDs are tendonitis and tendovaginitis. According to the summary of the same systematic review (Wærsted, Hanvold, and Veiersted, 2010), a direct link between shoulder tendonitis and computer work is questionable. However, an insufficient rest period is a risk factor for all shoulder pain diagnoses in computer workers. Compared to the control group, keyboard users are more likely to have inflammation of the supraspinatus and biceps tendons. The risk of developing shoulder pain is higher after four hours of daily keyboard use (Wærsted, Hanvold, and Veiersted, 2010).

An inflammation of the rotator cuff sometimes causes pain in the shoulder area. The function of these four muscles is to stabilise and move the head of the humerus. The structure of the muscle tendons changes when performing repetitive forceful activities. Significant changes occur mainly when the upper arm is above the shoulder during a work activity. The blood flow is initially disturbed, and inflammation and tissue damage occur in the tendons. Lifting the arm, performing strenuous activities, and leaning on the shoulder when sleeping may cause pain (Avi, 2018).

Frequent strenuous movement overloads the extensor tendons of the wrist and hand. This leads to swelling, burning and stabbing pain. The pain is exacerbated during arm movements. Inflammation may occur in the dense connective tissue fibres surrounding the tendon due to prolonged excessive muscle loading, stretching and local micro-injuries. Pain, tingling, sensory disturbances, and slowness of movement characterise tendon sheath inflammation. Inflammation due to overuse of the extensor tendon sheaths of the forearm, thumb and wrist is more common (Avi, 2018).

Anatomically, the medial and lateral condyles are on either side of the elbow. When the wrist and fingers are loaded with repetitive, uniform movements, inflammation of the tendons, also known as “epicondylitis”, may develop; medial epicondylitis occurs on the inner side of the elbow, while lateral epicondylitis occurs on the outside. No direct link has been found between an exclusive use of the keyboard and the mouse in the cause of epicondylitis (Wærsted, Hanvold, and Veiersted, 2010). MSD pain often has multiple reasons; for example, in addition to strenuous computer work, lifting heavy weights amounts to additional stress on the related area.

In the past, epicondylitis was thought to be an inflammatory disease. However, studies have shown that inflammation is the cause of pain only in the acute phases. In contrast, histomorphological studies in the chronic phases have found degenerative changes in the tendon, dense irregular collagenous connective tissue, scar tissue and hypervascularisation (Cohen and da Rocha Motta Filho, 2012). Lateral epicondylitis is more common. The pain is on the outer side of the elbow but can radiate to the wrist and even the fingers. The forearm muscles may be tense, and the grip strength may be reduced. In addition to overexertion, the development of epicondylitis may be influenced by coexisting diabetes and other conditions that impair circulation (including hormonal imbalances, high cholesterol, smoking, and old age).

Even though the results of the systematic reviews do not confirm a causal relationship between carpal tunnel syndrome and computer work, using a mouse and keyboard, there are still references that supporting the forearm, lowering the level of the keyboard, and vertical positioning of the mouse might reduce the risk of tendinitis. Research has shown that pressure on the wrist during keyboard use and adopting an unnatural position of the wrist (so-called ulnar position) might increase the risk of developing tendinitis (Wærsted, Hanvold, and Veiersted, 2010).

Although MSD pain is not always proven to be causally linked to computer work (Andersen et al., 2011), it might be generalised that the risk of developing bone and muscle pain is increased when the computer work lasts more than half a workday (above 4 hours), upper limbs are far from the midline of the body and forearms lack support.

No position is recommended for sitting on a chair for more than two hours (Männik, 2022). Little or no activity during work or in free time is a risk of developing MSDs, even if there are a few changes in the body position during one work. The most effective ways to relieve muscle strain in the shoulder and neck area are dynamic strength exercises and dealing with work stress (Männik, 2022).

Suppose we pay attention to our posture and try to remain in a neutral position, move enough during breaks, and the work is variable. In that case, the probability of developing MSD is low. Organisational interventions to a workday, including breaks and autonomous time planning, are vital for preventing MSD (Hoe et al., 2018; Roquelaure, 2018).

Sitting Position and Lower Limb Circulation

The importance of lower limb circulation during computer work has been little studied. Sitting for a long time slows down the body circulation. As a result, tissue fluid accumulates in the shin and causes swelling. In addition, varicose veins (especially in women) and dangerous blood clots, i.e., deep vein thrombosis, may develop (Männik, 2022).

In the course of evolution, the human body has evolved in a way that the physiological posture can be described as standing, squatting, crawling, and walking. During standing and walking, the body weight rests on the feet. When sitting, the upper body's weight is transferred to the pelvis, gluteal muscles, and spinal cord. Blood vessels are compressed in the groin area and at the knee joint. Sitting cannot be considered a physiological position and involves changes in the blood flow to the lower body. The blood flows to the lower limb via **the femoral artery (*a. femoralis*)**, which is the distal continuation of the external iliac artery (*a. iliaca externa*).

Lower extremity atherosclerosis was already found in Egyptian mummies. With the increase in the average age of humankind, more and more people develop complications due to the progression of atherosclerosis. Risk factors either can be changed or cannot. Genetic predisposition cannot be altered, and not much can be done to the environment we live in. However, it is possible for each of us to be physically more active and to get rid of

harmful habits that have long been shown to contribute to arteriosclerosis (e.g., smoking). Most patients are afraid of circulatory disorders without really understanding the depth of it. Peripheral Arterial Disease means that the peripheral arteries are blocked, and there is a shortage of oxygen-rich blood in the limb.

Cold Hands and Feet

Persistent cold hands and feet are among the most common signs of cardiovascular dysregulation. It affects healthy or underweight people with low blood pressure who work sedentary. Stress, despair, smoking, diet, and getting a cold all contribute to the cause. A cause of the circulatory disorder may be hereditary or hidden in the weak nervous system. The aforementioned may also cause transient circulatory disturbances, including occasional dizziness and blurred vision from sudden changes in blood flow, as well as a tendency to faint.

In the veins of the lower limbs, working muscles and healthy venous valves help the blood to flow upwards. However, prolonged sitting in a forced position can significantly impact the circulation; blood flow in the veins can get obstructed, and blood clots are formed behind the valves, which can further get detached, enter into the circulation, and reach the lungs while walking. The risk of deep vein thrombosis increases with a history of leg swelling, skin hardening, and venous diseases. Pregnancy is also one of the causes of valve damage.

While the so-called aspirin regimen significantly reduces the risk of blood clots in the arteries, it has little to no effect on venous circulation. Compression stockings, special leg exercises, and exercises can help to stimulate circulation.

Varicose Veins are Frequent and a Bothersome Problem

Varicose veins are the result of venous valve dysfunctions and loss of elasticity of the vein walls. As a result, blood flow to the heart is disrupted, and swelling, pain, cramps, tightness, and heaviness develop in the legs. To alleviate this discomfort, **one should take a brief position with the legs**

bent at the knees, as briefly as possible; this will avoid obstructing the blood flow in the veins. The function of the muscle pump is vital. This can be activated by walking and tensing the tibialis posterior muscle to boost venous blood flow back from the legs. The latter can also be boosted by lying down with the legs elevated above the body.

Recently, there have been talks about the formation of "phantom capillaries" associated with small pericytes in the capillaries (Bergers and Song, 2005). Pericytes are contractile cells that wrap around the cells of small blood vessels (endothelial cells in capillaries and venules). Pericytes regulate capillary blood flow and the removal of cellular viable debris (phagocytosis) (Winkler, Bell, and Zlokovic, 2011). Pericytes stabilise endothelial cell maturation, which is necessary to maintain capillary integrity (Fakhrejahani and Toi, 2012). They help cells in the inner walls of blood vessels (endothelium) to differentiate, proliferate and form new blood vessels. Ageing affects pericyte remodelling (Birbrair et al., 2013). Pericytes ensure the proper functioning of the lining of the blood vessels (endothelial cells) and keep the cells healthy. It has been shown that the **health of pericytes can be improved by encouraging blood flow in the legs by jumping or lifting the heel a few times during the day to tense the tibialis anterior**. This last exercise can also be done while sitting at a desk without interrupting work.

Furthermore, evidence shows that a link between human physical activity and performance depends on the receptor of the protein Piezo1 (proteins that sense blood flow on the surface of blood vessels) at the molecular level. Although the receptor is not lost in humans due to lack of exercise, its signal transmission becomes weaker due to slower blood flow, and the density of capillaries that carry blood to the muscle decreases. This can initiate a downward spiral of circulatory deterioration, making resistance training even more difficult in the future (Bartoli et al., 2022).

Possible Effects of Electromagnetic Fields on Computer Users

People who work in rooms with computers (open offices) may be exposed to electromagnetic fields. It is thought that this sensitivity may be individual.

The nervous system is based on bioelectrical processes and is, therefore, affected by external electromagnetic fields (EMFs). Short-term controlled electric and magnetic fields are successfully used to treat neurological and psychiatric diseases. However, prolonged exposure to uncontrolled EMFs can cause unpredictable disturbances in the nervous system. Prolonged exposure to EMFs can cause stress and affect mental health.

Information and communications technology (computers, mobile communications, etc.) is based on electromagnetic processes, and the user is inevitably exposed to electromagnetic fields. The potential effect of EMFs on humans can be twofold. Firstly, EMFs directly affect bioelectrical processes, altering brain rhythms (Hinrikus, Bachmann, and Lass, 2011). Secondly, the indirect effect, whereby EMFs induce oxidative stress (Schuermann and Mevissen, 2021), may result in the activation of inflammatory processes and deterioration of well-being, which in turn may lead to stress.

Physiological changes in the brain caused by EMFs and depression are similar. The intensity of the electroencephalographic (EEG) signal increases, particularly in the alpha and beta bands (Knott et al., 2001; Croft et al., 2008). A balance between the lower and the higher frequencies is altered (Hinrikus et al., 2009; Suhhova et al., 2009). The fractal dimension, which describes the complexity of the signal structure, increases (Hinrikus et al., 2011; Ahmadlou, Adeli, and Adeli, 2012). Human sensitivity to electromagnetic fields varies (Leung et al., 2011). The changes in the EEG are apparent in up to 30% of young healthy people (Hinrikus et al., 2008).

Up until now, there is no scientific evidence to show that EMFs cause stress and mental disorders. It is complicated, if not impossible, to distinguish between the effects of EMFs and the psychological effects of long-term use of information technology (IT) equipment. However, since many studies have reliably demonstrated that the changes in brain activity and increased oxidative stress associated with EMFs, the effects of EMFs on mental health cannot be excluded. The similarity of changes in brain rhythms between EMFs and depression is a warning sign. Therefore, walking outdoors or changing a room during a break is recommended at workplaces with a higher concentration of computers.

Conclusion

Workers are increasingly expected to maintain good health and live healthy life. At the national level, there is a need to keep the ageing working population in the labour force. Occupational health and health promotion are essential in improving people's health by raising awareness about the potential health risks associated with computer work, know-how to manage them and leading a fulfilling life.

References

Ahmadlou, Mehran, Hojjat Adeli, and Amir Adeli. 2012. "Fractality Analysis of Frontal Brain in Major Depressive Disorder." *International Journal of Psychophysiology* 85, no. 2: 206–11. https://doi.org/10.1016/j.ijpsycho.2012.05.001.

Ali, K. Mohamed, and B.W.C. Sathiyasekaran. 2006. "Computer Professionals and Carpal Tunnel Syndrome (CTS)." *International Journal of Occupational Safety and Ergonomics* 12, no. 3: 319–25. https://doi.org/10.1080/10803548.2006.11076691.

Andersen, Johan H., Nils Fallentin, Jane F. Thomsen, and Sigurd Mikkelsen. 2011. "Risk Factors for Neck and Upper Extremity Disorders among Computers Users and the Effect of Interventions: An Overview of Systematic Reviews." *PLOS ONE* 6, no. 5: e19691. https://doi.org/10.1371/journal.pone.0019691.

Avi, Indrek. 2018. *Tööga seotud luu- ja lihaskonna ülekoormushaigestumiste ennetamine* [Prevention of work-related musculoskeletal disorders]. Tallinn: Tööinspektsioon. https://www.ti.ee/media/504/download.

Bartoli, Fiona, Marjolaine Debant, Eulashini Chuntharpursat-Bon, Elizabeth L. Evans, Katie E. Musialowski, Gregory Parsonage, Lara C. Morley, et al. 2022. "Endothelial Piezo1 Sustains Muscle Capillary Density and Contributes to Physical Activity." *Journal of Clinical Investigation* 132, no. 5: e141775. https://doi.org/10.1172/jci141775.

Bergers, Gabriele, and Steven Song. 2005. "The Role of Pericytes in Blood-Vessel Formation and Maintenance." *Neuro-Oncology* 7, no. 4: 452–64. https://doi.org/10.1215/s1152851705000232.

Birbrair, Alexander, Tan Zhang, Zhong-Min Wang, María L. Messi, Akiva Mintz, and Osvaldo Delbono. 2013. "Type-1 Pericytes Participate in

Fibrous Tissue Deposition in Aged Skeletal Muscle." *American Journal of Physiology-Cell Physiology* 305, no. 11: C1098–113. https://doi.org/10.1152/ajpcell.00171.2013.

Bleecker, Margit L. 1994. *Occupational Neurology and Clinical Neurotoxicology*. Philadelphia: Williams & Wilkins.

Boocock, Mark G., Jill M. K. Collier, Peter J. McNair, Marian Simmonds, Peter J. Larmer, and Bridget Armstrong. 2009. "A Framework for the Classification and Diagnosis of Work-Related Upper Extremity Conditions: Systematic Review." *Seminars in Arthritis and Rheumatism* 38, no. 4: 296–311. https://doi.org/10.1016/j.semarthrit.2007.10.006.

Cohen, Marcio, and Geraldo da Rocha Motta Filho. 2012. "Lateral Epicondylitis of the Elbow." *Revista Brasileira De Ortopedia* 47, no. 4: 414–20. https://doi.org/10.1016/s2255-4971(15)30121-x.

Croft, Rodney J., Denise L. Hamblin, Jo Spong, Andrew W. Wood, Ray J. McKenzie, and Con Stough. 2008. "The Effect of Mobile Phone Electromagnetic Fields on the Alpha Rhythm of Human Electroencephalogram." *Bioelectromagnetics* 29, no. 1: 1–10. https://doi.org/10.1002/bem.20352.

de Kok, Jan, Paul Vroonhof, Jacqueline Snijders, Georgios Roullis, Martin Clarke, Kees Peereboom, Pim van Dorst, and Iñigo Isusi. 2019. *Work-Related Musculoskeletal Disorders: Prevalence, Costs and Demographics in the EU*. Luxembourg: Publications Office of the European Union. https://doi.org/10.2802/66947.

Fakhrejahani, Elham, and Masakazu Toi. 2012. "Tumor Angiogenesis: Pericytes and Maturation Are Not to Be Ignored." *Journal of Oncology* 2012: 1–10. https://doi.org/10.1155/2012/261750.

Hinrikus, Hiie, Maie Bachmann, Deniss Karai, Wlodzimierz Klonowski, Jaanus Lass, Pavel Stepien, Robert Stepien, and Viiu Tuulik. 2011. "Higuchi's Fractal Dimension for Analysis of the Effect of External Periodic Stressor on Electrical Oscillations in the Brain." *Medical & Biological Engineering & Computing* 49, no. 5: 585–91. https://doi.org/10.1007/s11517-011-0768-5.

Hinrikus, Hiie, Maie Bachmann, and Jaanus Lass. 2011. "Parametric Mechanism of Excitation of the Electroencephalographic Rhythms by Modulated Microwave Radiation." *International Journal of Radiation Biology* 87, no. 11: 1077–85.

https://doi.org/10.3109/09553002.2011.620063.

Hinrikus, Hiie, Maie Bachmann, Jaanus Lass, Deniss Karai, and Viiu Tuulik. 2008. "Effect of Low Frequency Modulated Microwave Exposure on Human EEG: Individual Sensitivity." *Bioelectromagnetics* 29, no. 7: 527–38. https://doi.org/10.1002/bem.20415.

Hinrikus, Hiie, Anna Suhhova, Maie Bachmann, Kaire Aadamsoo, Ülle Võhma, Jaanus Lass, and Viiu Tuulik. 2009. "Electroencephalographic Spectral Asymmetry Index for Detection of Depression." *Medical & Biological Engineering & Computing* 47, no. 12: 1291–99. https://doi.org/10.1007/s11517-009-0554-9.

Hoe, Victor C. W., Donna M. Urquhart, Helen L. Kelsall, Eva N. Zamri, and Malcolm R. Sim. 2018. "Ergonomic Interventions for Preventing Work-Related Musculoskeletal Disorders of the Upper Limb and Neck among Office Workers." *The Cochrane Library* 2018, no. 10: CD008570. https://doi.org/10.1002/14651858.cd008570.pub3.

Knott, Verner, Colleen Mahoney, Sidney Kennedy, and Kenneth Evans. 2001. "EEG Power, Frequency, Asymmetry and Coherence in Male Depression." *Psychiatry Research: Neuroimaging* 106, no. 2: 123–40. https://doi.org/10.1016/s0925-4927(00)00080-9.

Kozak, Agnessa, Grita Schedlbauer, Tanja Wirth, Ulrike Euler, Claudia Westermann, and Albert Nienhaus. 2015. "Association between Work-Related Biomechanical Risk Factors and the Occurrence of Carpal Tunnel Syndrome: An Overview of Systematic Reviews and a Meta-Analysis of Current Research." *BMC Musculoskeletal Disorders* 16, no. 1: 231. https://doi.org/10.1186/s12891-015-0685-0.

Leung, Sumie, Rodney J. Croft, Raymond J. McKenzie, Steve Iskra, Beata Silber, Nicholas R. Cooper, Barry O'Neill, et al. 2011. "Effects of 2G and 3G Mobile Phones on Performance and Electrophysiology in Adolescents, Young Adults and Older Adults." *Clinical Neurophysiology* 122, no. 11: 2203–16. https://doi.org/10.1016/j.clinph.2011.04.006.

Mediouni, Zakia, Alexis De Roquemaurel, C. Dumontier, B. Becour, Hélène Garrabe, Yves Roquelaure, and Alexis Descatha. 2014. "Is Carpal Tunnel Syndrome Related to Computer Exposure at Work? A Review and Meta-Analysis." *Journal of Occupational and Environmental Medicine* 56, no. 2: 204–8.

https://doi.org/10.1097/jom.0000000000000080.

Merisalu, Eda, Astrid Saava, and Argo Soon. 1999. *Sissejuhatus töötervishoidu* [Introduction to occupational health]. Tartu: Tervishoiu Instituut.

Mouzakis, Dionysios E., George Rachiotis, Stefanos Zaoutsos, Andreas Eleftheriou, and Konstantinos N. Malizos. 2014. "Finite Element Simulation of the Mechanical Impact of Computer Work on the Carpal Tunnel Syndrome." *Journal of Biomechanics* 47, no. 12: 2989–94. https://doi.org/10.1016/j.jbiomech.2014.07.004.

Männik, Gunnar. 2022. *Ülekoormusvigastused. Vältimine. Ravi. Harjutused* [Overuse injuries. Avoidance. Treatment. Exercises]. Tallinn: Vesta.

Põld, Toomas, Anneli Kose, Aivar Sarv, and Meelis Kubo. 2006. *Luu-lihaskonna vaevused Eestis, analüüsi lõppraport* [Musculoskeletal disorders in Estonia, analysis report]. Tallinn: AS Medicover.

Roquelaure, Yves. 2018. *Musculoskeletal Disorders and Psychosocial Factors at Work. Report 142*. Brussels: European Trade Union Institute. https://www.etui.org/sites/default/files/ez_import/EN-Report-142-MSD-Roquelaure-WEB.pdf.

Schuermann, David, and Meike Mevissen. 2021. "Manmade Electromagnetic Fields and Oxidative Stress—Biological Effects and Consequences for Health." *International Journal of Molecular Sciences* 22, no. 7: 3772. https://doi.org/10.3390/ijms22073772.

Sevy, Justin O., and Matthew Varacallo. 2022. "Carpal Tunnel Syndrome." StatPearls – NCBI Bookshelf. September 5, 2022. https://www.ncbi.nlm.nih.gov/books/NBK448179/.

Shiri, Rahman, and Kobra Falah-Hassani. 2015. "Computer Use and Carpal Tunnel Syndrome: A Meta-Analysis." *Journal of the Neurological Sciences* 349, no. 1–2: 15–19. https://doi.org/10.1016/j.jns.2014.12.037.

Suhhova, Anna, Hiie Hinrikus, Maie Bachmann, and Jaanus Lass. 2009. "Effect of Modulated Microwave Exposure on Spectral Asymmetry of Human EEG." In *World Congress on Medical Physics and Biomedical Engineering, September 7–12, 2009, Munich, Germany. IFMBE Proceedings*, edited by Olaf Dössel and Wolfgang C. Schlegel, vol. 25/3: 406–9. Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-03902-7_115.

Thomsen, Jane F., Fredric Gerr, and Isam Atroshi. 2008. "Carpal Tunnel Syndrome and the Use of Computer Mouse and Keyboard: A Systematic Review." *BMC Musculoskeletal Disorders* 9, no. 1: 134. https://doi.org/10.1186/1471-2474-9-134.

Wærsted, Morten, Therese N. Hanvold, and Kaj Bo Veiersted. 2010. "Computer Work and Musculoskeletal Disorders of the Neck and Upper Extremity: A Systematic Review." *BMC Musculoskeletal Disorders* 11, no. 1: 79. https://doi.org/10.1186/1471-2474-11-79.

Winkler, Ethan A., Robert D. Bell, and Berislav V. Zlokovic. 2011. "Central Nervous System Pericytes in Health and Disease." *Nature Neuroscience* 14, no. 11: 1398–1405. https://doi.org/10.1038/nn.2946.

CHAPTER TWO

OVERUSE INJURIES, WORK STRESS AND THEIR PREVENTION

VARJE-RIIN TUULIK

Medical Doctor
West-Tallinn Central Hospital
Paldiski mnt 68, 10617 Tallinn, Estonia

VIIU TUULIK

Occupational Health Doctor
Qvalitas Medical Centre
Narva mnt 7, 10117 Tallinn, Estonia

Introduction

Nowadays, most of us are computer users in one way or another. This chapter shows how working in a sedentary position may become stressful for our body. Work stress can be described as a person's physical, mental, and emotional reactions when work demands more effort than the person has to offer. We will explain a theory of stress and will attempt to show that it is necessary to create opportunities for the body to recover to counter negative work stress. Timely prevention measures can curb the development of diseases caused by overuse. Furthermore, raising awareness about health topics at a community level is essential, promoting activities that enable people to take more control of their health, thereby strengthening it.

These days, as most of the exhaustive physical work is done by machines and chemists using protective equipment, musculoskeletal disorders

(MSDs) from forced postures have become a significant problem. In the work environment, computer users are affected by various external factors like office temperature, lighting, and background noise. For example, an office temperature below 20 °C can be an additional risk for MSDs (Tint et al., 2012). Improving working conditions is based on a work environment risk assessment. However, the nature of the work plays a more critical role than the work environment itself. Mental health is affected by excessive time pressure or mental strain. Physical health is affected by ergonomic stressors like forced posture, repetitive movements, and non-ergonomic work techniques and posture (Eesti Töötervishoiuarstide Selts, 2022).

An unfavourable work environment and work that places too much strain on the body or mind can lead to health problems over time. The work environment and the nature of the work are essential, but whether a person develops a work-related illness depends on the interaction between the environment and the human body. The latter is described by the biopsychosocial model. In earlier times, a biomedical model of health was used, according to which illness and health are a state of the body influenced by biological factors, including lifestyle, habits, diet, and physical activity (Sinisalu, 2021). The newer biopsychosocial model considers both the capacity of the body's biological system and the psychological, social, and environmental factors that influence health (Wade and Halligan, 2017).

In 1985, the World Health Organization defined work-related diseases caused by multiple factors. The work environment and the nature of work are the main, but not the only, cause of health problems (Kahn, 2010; Roquelaure, 2018).

An organism's interaction with the external environment is controlled and coordinated by the nervous system, whose resilience (adaptiveness, plasticity) is essential for maintaining the balance and health of a body. A body's ability to cope with abnormalities and changes without discomfort and pain could be referred to as a biological reserve (Männik, 2022). Even years of chronic work-related stress will not damage the body's functions or structures until the biological system finally loses its ability to cope. However, there is no reason for us to take such risks and wait until our body's reserves are exhausted. If the main aim is to prevent disease, early