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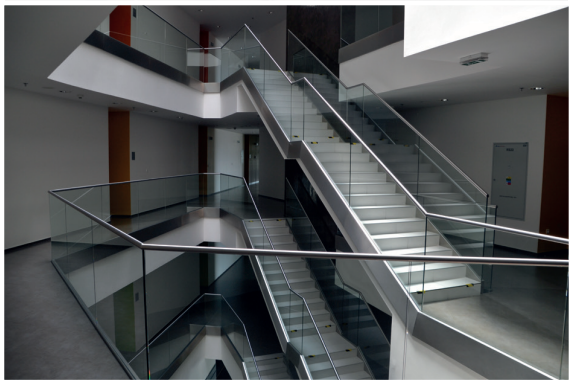

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EDITORIAL

Dear Readers,

The journal "Zdravotníctvo a sociálna práca" (*Health and Social Work*) was renamed in 2021 to International Journal of Health, New Technologies and Social Work.

Our long-term effort is to gradually acquire for the journal European significance and be included in international databases. Starting by issue No. 4 in 2016, the journal accepted the Harvard style of referencing, and changed guidelines for the authors. The aim of the changes was to move closer to the standard in international journals published in English in the area of health and helping professions. The editors are aspiring for registration in other relevant international databases. Since last 2020 the journal has published all articles in English only.

The journal "Zdravotníctvo a sociálna práca" (*Health and Social Work*) was established in 2006 at Faculty of Health and Social Work blessed to P.P. Gojdič in Prešov and St. Elizabeth University College of Health and Social Work in Bratislava. In 2020, the 15th year of the journal was published.

Previously professional journal, within 5 years developed into an international, peer-reviewed scholarly journal, published quarterly (4 issues per year). The journal is published by the St. Elizabeth University of Health and Social Work in Bratislava. The journal became international in 2009. The journal is published and distributed in the Slovak Republic and also in the Czech republic.

Since 2011, the journal is published both in print and as electronic issues, available from: www.zdravotnictvoasocialnapraca.sk. Starting by issue No. 3 in 2014, the scope of the journal has broaden and the journal is covering health sciences, such as Public Health, Nursing, Laboratory Medicine, but also helping professions such as Social Work or Pedagogy. Collaboration with Faculty of Health and Social Work of Trnava University in Trnava was initiated.

The journal is indexed in the following databases: Central and Eastern European Online Library – CEEOL (since 2018), Bibliographia Medica Slovaca (BMS), and Slovak reference database CiBaMed.

The part of journal is Supplementum, to publish abstracts from international conferences organized by the St. Elizabeth University of Health and Social Work in Bratislava. In 2020, the conference was planned, similarly to last year, in Ustroń, Poland. Due to the unfavorable epidemiological situation, the conference was postponed by the organizers to October 2021.

Prof. Miron Šramka, MD, DSc.
redactor-in-chief

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COVID-19 and the nervous and sensory system

COVID-19 a nervový a zmyslový systém

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ABSTRACT **Objectives:** The aim of the survey was to find out what the possible consequences are of the COVID-19 disease on the nervous and sensory systém and to propose a method of using artificial intelligence.

Material and methods: Recent research has shown that the risks to patients due to severe acute coronavirus 2 respiratory syndrome (*SARS-CoV-2*) differ most significantly depending on age and the presence of underlying comorbidities such as: cardiovascular disease, hypertension, diabetes and others. Monitoring of patients as a result of disease COVID-19 on the nervous and sensory systems are very important for the treatment of patients at the earliest stage effects. We performed a detailed selection of articles describing the effects of COVID-19 on the nervous and sensory system.

Results: We made a clear summary of the main consequences of COVID-19 on the nervous and sensory system and suggested a way to use artificial intelligence.

Conclusion: We confirmed research that artificial intelligence methods have the potential to accelerate prediction, especially for the possible consequences of COVID-19 on the nervous and sensory system.

Key words: COVID-19; Comorbidities; Nervous system; Anosmia; Ageusia; Artificial intelligence

ABSTRAKT **Ciele:** Cieľom prieskumu bolo zistiť, aké sú možné následky ochorenia COVID-19 na nervový a zmyslový (senzorický) systém a navrhnúť metódu využívania umelej inteligencie.

Materiál a metódy: Nedávny výskum ukázal, že riziká pre pacientov v dôsledku závažného akútneho respiračného syndrómu koronavírusu 2 (*SARS-CoV-2*) sa najvýznamnejšie líšia v závislosti od veku a prítomnosti základných komorbidít, ako sú: kardiovaskulárne choroby, hypertenzia, cukrovka a iné. Sledovanie pacientov na následky ochorenia COVID-19 na nervový a zmyslový systém sú veľmi dôležité pre liečenie pacientov v čo najskoršom štádiu následkov. Vykonali sme podrobný výber článkov popisujúcich účinky COVID-19 na nervový a senzorický systém.

Výsledky: Urobili sme prehľadné zhrnutie hlavných dôsledkov COVID-19 na nervový a zmyslový systém a navrhli sme spôsob použitia umelej inteligencie.
Záver: Výskum nám potvrdil, že metódy umelej inteligencie majú potenciál na urýchlenie predikcie, najmä pokiaľ ide o možné následky COVID-19 na nervový a zmyslový systém.

Kľúčové slová: COVID-19, Komorbidity, Nervový systém, Anosmia, Ageuzia, Umelá inteligencia

Abbreviations:
CT – Computer Tomography
MR – Magnetic Resonance
COVID-19 – Coronavirus Disease 2019
SARS-CoV-2 - Severe acute respiratory syndrome coronavirus 2
WHO - World Health Organization
CNS - Central nervous system
PNS - Peripheral nervous system
SS - Sensory system
CVD - Cerebrovascular diseases
SRS - Stereotactic Radiosurgery
AI - Artificial Intelligence
ML - Machine Learning
CAD - Computer-aided Diagnosis
VR - Virtual Reality
AR - Augmented Reality

INTRODUCTION

The World Health Organization declared the outbreak of COVID-19 a threat to international public health on 30 January 2020 and a pandemic on 11 March. World research laboratories have found that the risks in patients due to severe acute respiratory syndrome coronavirus 2 (*SARS-CoV-2*) vary most significantly with age and the presence of an underlying comorbidity (Fang *et al.* 2020). Comorbidities have been observed in the global population as follows by significance: cardiovascular disease, hypertension, diabetes, chronic obstructive pulmonary disease, cancer, and chronic kidney disease. Observations of frequent hypercoagulable conditions in patients with COVID-19 lead more frequently to stroke. Neurosurgical treatment of the consequences of Spanish influenza (Dvorak *et al.* 1973) also drew attention to the study of infectious, para-infectious, post-infectious consequences (*SARS-CoV-2*) on sensory system

COVID-19 is similar to influenza. Common symptoms include fever, cough, fatigue, shortness of breath or difficulty breathing, and loss of smell (WHO 2019a). Complications may include pneumonia and acute respiratory distress syndrome it can lead to death.

A drop in SpO2 below 92% can severely impair heart and brain function. No symptoms of respiratory distress were observed in some COVID-19 patients with low SpO2. Their brains responded to low oxygen levels with silent hypoxemia (Tobin *et al.* 2020; Couzin-Frankel *et al.* 2020). Patients with such low blood oxygen levels should be unconscious, but patients are able to talk and have minimal anxiety. During the expected second wave of a pandemic, such patients will not need to undergo unnecessary intubation and pulmonary ventilation. In the case of neurological symptoms, it is advisable to give the patient a brain MRI examination.

COVID-19 cerebrovascular diseases are at increased risk of COVID-19 infection (Fang *et al.* 2020). Cerebrovascular ischemic strokes often occur in COVID-19 (Avula *et al.* 2020; Beyrouti *et al.* 2020; Morassi *et al.* 2020; Zhao *et al.* 2020), as well as intracerebral haemorrhaging (Morassi *et al*. 2020; Al Saiegh *et al.* 2020) cerebral sinus thrombosis (Li *et al.* 2020; Lodigiani *et al.* 2020; Oxley *et al.* 2020) and transient ischemic events (Benussi *et al.* 2020). In the case of cerebrovascular diseases, it is advisable to give the patient a brain CT examination. Data from a German multicenter cohort of COVID-19 patients and published data from the literature suggests that patients with a severe course of COVID-19

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have an increased risk of acute stroke, underscoring the necessity of clinical neurological monitoring in patients infected with *SARS-CoV-2*. Multicenter cohort consisted of 165 patients, with RT-PCR–confirmed COVID-19 who were admitted to the four participating hospitals between. At the time of data acquisition, eight patients were still hospitalized. (Siepmann *et al.* 2020). Hypercoagulable conditions and cerebrovascular diseases are rare in some acute viral infections but are often a neurological complication of COVID-19. (Fridman *et al.* 2020).

CONSEQUENCES OF COVID-19 ON THE NERVOUS SYSTEM

Protecting the population from COVID-19 and its consequences requires the necessary clinical, diagnostic, and epidemiological studies. A distinction needs to be made between non-specific complications such as hypoxic encephalopathy, acute neuropathy, including infectious, para-infectious, and post-infectious encephalitis, as well as hypercoagulable conditions causing stroke, from those caused by the new coronavirus *SARS-CoV-2.* Recognition of neurological disease associated with COVID-19 patients in whom the respiratory infection is mild or asymptomatic will be challenging. If primary COVID-19 has occurred with smell and taste disorders, the patient should be isolated as soon as possible (Moein *et al.* 2020). These patients can have serious neurological consequences. Neurological disorders are increasingly occurring in the central nervous system (CNS) and the peripheral nervous system (PNS) and may occur in the absence of other clinical signs. Acute cerebrovascular disease is another serious complication of COVID-19.

Clinical signs of neurological disease associated with COVID-19 and the effects of coronavirus on the nervous system lead to neurological and psychiatric diseases (Varatharaj *et al.* 2020). Published changes and diseases are reported as being mental status, encephalopathy, encephalitis, neuropsychiatric diagnoses, psychosis with a neurocognitive dementia-type syndrome, and affective disorders (Ellul *et al.* 2020).

Encephalitis

Inflammation of the brain parenchyma is caused by an infection or immune defence of the body associated with COVID-19. Neurological symptoms begin mostly from the onset of respiratory symptoms, preceded by cough and fever with irritability, confusion, and decreased consciousness, sometimes associated with seizures (Bernard-Valnet *et al.* 2020; Sohal *et al.* 2020) and psychotic symptoms (Vollono *et al.* 2020), or rhombencephalitis (Wong *et al.* 2020). A patient with ataxia had a brain lesion that extended to the spinal cord (Craik *et al.* 2020).

Encephalopathy

Changes in personality, behaviour, cognition, disorders of consciousness, including clinical manifestations of delirium or coma, have been reported (Slooter *et al.* 2020). In patients with encephalopathy and COVID-19 who have not been reported to have brain inflammation, it can be caused by hypoxia, drugs, toxins, and metabolic disorders (Solomon *et al.* 2012). CNS symptoms had severe respiratory disease. It has occurred as acute disseminated encephalomyelitis (Zanin *et al.* 2020; Zhang *et al.* 2020), multifocal demyelination syndrome (Dugue *et al.* 2020; Helms *et al.* 2020; Mao *et al.* 2020; Paniz-Mondol *et al.* 2020; Zhou *et al.* 2020) acute hemorrhagic necrotizing encephalopathy (Poyiadji *et al.* 2020) and myelitis (Zhao K *et al.* 2020).

PNS disorders and muscular disorders

Guillain-Barré syndrome is an acute poly-radiculopathy characterized by rapidly progressive symmetrical limb weakness and sensory disturbances. Neurological symptoms that

began after respiratory or systemic disorders in COVID-19 patients with Guillain-Barré syndrome included limb weakness, and loss of sensation (Toscano *et al.* 2020). Excluding Guillain-Barré syndrome, the symptoms also included facial nerve involvement, dysphagia, (Camdessanche *et al.* 2020), respiratory failure (Zhao H *et al.* 2020), ophthalmoplegia (Gutiérrez-Ortiz *et al.* 2020, Dinkin *et al.* 2020), ataxia with areflexia, acute vestibular syndrome (Escalada-Pellitero *et al.* 2020), and rhabdomyolysis (Jin *et al.* 2020). Fischer Miller syndrome is included among other neuropathies (Gutiérrez-Ortiz *et al.* 2020).

Disorders of sensory functions

Disorders of sensory functions. Loss of smell (anosmia) and taste (ageusia), frequent symptoms of COVID-19, combined with other symptoms or in isolation could be useful diagnostic markers (Lodigiani *et al.* 2020; Spinato *et al.* 2020). Unusual smell and taste in patients are linked to COVID-19. Patients report a loss of smell and taste 7 days before the appearance of fever and respiratory difficulties (Ellul *et al.* 2020; Sedaghat *et al.* 2020). Such patients should be quarantined. Patients with viral infections of the upper respiratory tract also have a temporary or permanent loss of smell and taste. These symptoms are more common in COVID-19 cases with a subjective loss of smell or taste. A higher percentage of smell loss is detected when the testing is done using objective methods that measure the smell function. Most patients first notice problems with smell, but because smell is often necessary as a supplement to taste, these symptoms are often linked. Patients with COVID-19 who did not have smell problems had a worse course of the disease and were more often hospitalized and placed in the intensive care unit. Patients with smell dysfunction had a milder course of the COVID-19 disease. The loss of smell in patients infected with COVID-19 may be the first or the only symptom of the disease. Loss of smell and taste could serve as a screening tool because these symptoms appear earlier. Loss of smell is one of the first and sometimes the only one symptom in up to 25% of COVID-19 patients. The ability of the *SARS-CoV-2* coronavirus to enter olfactory tissue may be a pathway for brain infection (Ellul *et al.* 2020; Whitcroft *et. al.* 2020).

Olfactory epithelium and smell test

A standardized questionnaire on the loss of smell was used. Patients' loss of smell was evaluated using 8 questions from a standard olfactory identification test called "Sniffin Sticks", which includes 16 scented pens that patients identified every 30 seconds. Patients labelled the scents from a choice of three descriptive terms: normosmic (normal odor), hyposmic, or anosmic. In studies, the loss of smell occurred in 87% of COVID-19 patients compared to in only 56% of patients who detected taste disorders. The most common symptoms were loss of smell and headaches. Half of the patients did not have the ability to recognize the basic tastes (salty, sweet, bitter, sour) and also experienced headaches, myalgia, cough, loss of appetite, and abdominal pain with diarrhoea. Patients experiencing loss of smell and taste also had ear-, nose- and throat-related symptoms. Anosmia could be a reliable way to predict whether a patient will have a cough and fever. Patients with COVID-19 regained their sense of smell within a few weeks. Specific cell types in the olfactory epithelium were restored much faster than the lower airway cells, which were restored in a couple of months. Temporary loss of smell (anosmia) is the main symptom and one of the first and most frequently reported indicators of COVID-19. Loss of smell and taste may be caused by diseases other than coronavirus, but to determine the cause it is necessary to test patients for COVID-19 (Ellul *et al.* 2020).

Now, in September 2020, the first case was published online that a patient after infection with severe acute respiratory syndrome with coronavirus 2 (*SARS-CoV-2*) was subsequently diagnosed with Parkinson's disease without a previous family history of this disease (Cohen ME

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et al. 2020). Within isolation period of 3 weeks, this patient noticed that his handwriting had changed and was harder to read it than before. Immune activation in the olfactory system can eventually lead to misfolding of α-synuclein and the development of Parkinson's disease (Lema *et al.* 2013) which is often preceded by anosmia, a common feature of *SARS-CoV-2* infection (Vaira *et al.* 2020).

Stereotactic radiosurgery

In brain surgery, stereotactic radiosurgery (SRS) is an ideal non-invasive treatment modality in the current pandemic environment. It is used in the treatment of intracranial malignancies, benign tumours, vascular malformations, and neuropathic pain (Liaw *et al.* 2020). It is performed as an outpatient procedure with minimal personal protective equipment, usually requiring only one session. SRS does not require endotracheal intubation or the use of high-performance devices, thus reducing the risk of exposure to infectious aerosols and bone dust present in open surgery (Liaw *et al.* 2020; Zacharia *et al.* 2020).

In the long term, we assume that, as a result of the post-infectious autoimmune disease COVID-19, changes in the nervous system may develop over the course of 10 years and longer, up to the rest of the patients' lives, as a result of the pandemic. Similar results occurred with Parkinson's disease after Spanish influenza (Dvorak *et al.* 1973).

Data analysis and artificial intelligence

In the years since the onset of SARS, supportive tools using artificial intelligence have been developed to diagnose, monitor, and predict the disease. Many publications on the use of artificial intelligence (AI) for neurodegenerative diseases appeared (Belic et al. 2019; Raghavendra *et al.* 2019). AI and machine learning (ML) created numerous applications in computer-aided monitoring and diagnostics of neurodegenerative movement disorders (Belic *et al.* 2019). An overview of research using ML methods to perform quantitative analysis of MR image data indicates using the study of Parkinson´s disease (Xu *et al.* 2019).

Currently, the use of MR and CT scans is as one of the possible effective and useful tools for the diagnosis of COVID-19 and its possible consequences. Methods of analysis of radiological image data obtained from COVID-19 patients showed the need to perform a CT scan of the brain after a sudden stroke. MR brain scans are suitable for the analysis of pathological changes in patients with neurological symptoms (Moriguchi *et al.* 2020; Wong *et al.* 2020) and their use evaluated the effects of COVID-19 on the brain. MRI examination revealed lesions that enhanced the haemorrhagic margin within the bilateral thalamus, median temporal lobes, and subinsular areas (Poyiadji *et al.* 2020). Brain MRI scans revealed abnormal findings (Kandemirli *et al.* 2020). COVID-19 is associated with metabolic and coagulative disorders. EEG studies of focal central nervous system (CNS) lesions showed a general slowing of EEG and their results have evaluated the effects of COVID-19 on the brain.

Recently, there have been rapid advances in computerized technology, including wearable devices, virtual reality (VR) and augmented reality (AR), mobile internet, and robot assistant systems. These new-generation assessment tools can produce real-time, programmable, and safe measurements of neurological deficits (Asakawa *et al.* 2019). New technologies using Virtual Reality (VR) and Artificial Intelligence (AI) changed the processing and interpretation of the medical data on central nervous system diseases such as for diagnosing Parkinson's disease and stroke (Ruzicky *et al.* 2020). The Virtual Reality methods have the potential to accelerate rehabilitation and increase the motivation of selected groups of patients after stroke and PD (Sramka *et al.* 2020). In recent years, very few studies have helped quantify the motor properties of Parkinson's disease, which have evaluated the

disease in a "free-living" environment using mobile devices (Dorsye *et al.* 2020). This phenotyping could help us to use artificial intelligence to evaluate the possible consequences of COVID-19 objectively and effectively in the future.

Regarding new variants of *SARS-CoV-2*, 10 more countries reported (British variant) B117 cases, raising the total to 80 across all six of the WHO's regions. For B1351, 10 more countries have confirmed cases, putting that total at 41 across four WHO regions. And for P1, two more countries detected cases, raising the number to 10 across four of WHO's regions (WHO 2021).

Situation in Slovakia of the disease on the British variant B117. The laboratories of the Public Health Office of the Slovak Republic (UVZSR) as well as other state and private laboratories were involved in the survey. Together, they examined 1962 samples from February 3 by RT-PCR of clinical samples. The British variant B117 of the new coronavirus *SARS-CoV-19* was confirmed in 74% of these samples, which is one of the highest values in Europe (Public Health Authority of SR - UVZSR, 2021).

For this reason, when investigating the consequences of COVID-19 disease, it will be necessary for artificial intelligence to distinguish the date of detection of the disease with the possibility to identify variants of the coronavirus *SARS-CoV-2.*

CONCLUSIONS

The ongoing COVID-19 pandemic and expectations of the development of collective immunity of the world's population suggest that the total number of patients with neurological disease could increase in the future. Neurological complications, especially encephalitis and stroke, can cause lifelong disability in patients. This will require long-term care and potentially serious health and social problems, as well as economic costs.

In relation to the protection, prevention and treatment of public health, as well as the need for long-term care in these areas, it is important to focus on the following research activities: to analyse current COVID-19 disease monitoring solutions in patients with mild, moderate and severe disease; to design subjective and objective parameters realizable in a database divided into structured textual data from images (CT, MR, PET / CT), processing of speech and patient history; find comprehensive applications for the acquisition, evaluation and interpretation of patient data and implement comprehensive applications, including the necessary testing; evaluate the proposed applications in terms of their applicability in real life; to design methods of image processing and statistical analysis of input image and text data; implement artificial intelligence methods to predict the development of COVID-19 based on generated data; use the proposed artificial intelligence methods to predict the development of COVID-19; and apply all of these results to other similar diseases and pandemics.

Patients with COVID-19 have many neurological symptoms, such as headache, ataxia, impaired consciousness, hallucinations, stroke and cerebral hemorrhage.

Researchers from the National Institute for Neurological Disorders and Stroke (Myoung-Hwa L *et al.* 2021) are still looking for clear evidence of destructive viral invasion of the brain patients, pushing researchers to consider alternative explanations of how *SARS-CoV-2* determines neurological symptoms.

Also, in a study involving 100 patients (Puntmann *et al.* 2020), which were recently recovered from Covide-19, was found by MRI of the heart, that the cardiac involvement in 78 patients (78%) and persistent inflammation of the myocardium in 60 patients (60%), which was independent of their initial overall diagnosis before COVID-19.

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The effects of vaccines on COVID-19 are also monitored and it is therefore necessary to constantly investigate, in addition to the long-term consequences of COVID-19, to monitor the consequences of vaccination in selected high-risk patients in the long term.

CONFLICT OF INTEREST

The authors hereby declare no conflict of interest.

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COVID-19 and EYE

COVID-19 a oko

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ABSTRACT

Introduction: This article was designed to highlight the incidence of ocular manifestations in patients diagnosed with coronavirus (COVID-19), which results from severe acute respiratory syndrome.

Findings: Extremely intense respiratory disease COVID-19 (*SARS-CoV-2*) is a novel infection that is causing a progressive pandemic in 2020. In spite of the fact that patients afflicted with *SARS-CoV-2* by and large show respiratory symptoms, atypical signs, for example, conjunctivitis, are additionally observed. There are a number of cases where transcriptase polymerase chain reaction tests (RT-PCR) on tears have demonstrated the presence of the infection. Notwithstanding this, the transmission of the infection through tears remains unclear.

Conclusion: Although coronavirus (COVID-19), is the primary respiratory disease, it has also been shown to be present in the eye or in the conjunctival swab or in tears. Several cases are described where the patient had no other problems, only conjunctivitis. That is why it is necessary to pay attention during the examination itself, that conjunctivitis does not have to be only viral or bacterial, but it can also point us to the general coronavirus disease.

Key words: COVID 19, ocular infection, conjunctiva, transmission

ABSTRAKT

Úvod: Tento článok bol spracovaný s cieľom poukázať na výskyt prejavov na oku u pacientov s diagnostikovaným koronavírusom (COVID-19), ktorý vzniká v dôsledku ťažkého akútneho respiračného syndrómu.

Zistenia: Extrémne intenzívne respiračné ochorenie COVID-19 (*SARS-CoV-2*) je nová infekcia, ktorá spôsobuje progresívnu pandémiu v roku 2020. Napriek tomu, že pacienti postihnutí *SARS-CoV-2* väčšinou majú respiračné príznaky, môžu mať aj atypické príznaky, napríklad konjunktivitídu. Existuje niekoľko prípadov, keď testy na transkriptázovú polymerázovú reťazovú reakciu (RT-PCR) na slzách preukázali prítomnosť infekcie. Napriek tomu zostáva prenos infekcie prostredníctvom sĺz nejasný.

Záver: Napriek tomu, že koronavírus (COVID-19) je primárne respiračne ochorenie, dokázala sa jeho prítomnosť aj v oku, respektíve vo výtere zo spojovkového vaku alebo v slzách. Sú popisované viaceré prípady, kedy pacient nemal žiadne iné ťažkosti, iba

konjunktivitídu. Práve preto je potrebné aj pri samotnom vyšetrení dbať na to, že konjunktivitída nemusí byť len vírusová či bakteriálna, ale môže nám poukázať aj celkové ochorenie koronavírusom.

Kľúčové slová: COVID 19, očná infekcia, spojovka, prenos

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is caused by a novel coronavirus, the severe acute respiratory syndrome coronavirus-2 (*SARS-CoV-2*). The disease has quickly become a worldwide health problem since it first appeared in December 2019 in China (World Health Organization 2020).

The fundamental clinical highlights of COVID-19 are upper respiratory symptoms, myalgias and diarrhea, but conjunctivitis has additionally been portrayed as a clinical manifestation associated with *SARS-CoV-2* infection. Evidence of the presence of *SARS-CoV-2* RNA in conjunctival secretions and tears has been also reported in patients with COVID-19 (Xia *et al.* 2020; Chen *et al.* 2020).

SARS-CoV-2 as a novel coronavirus is an enveloped positive-sense RNA virus that is expectionally contagious and has caused an enormous worldwide episode. Although the primary routes of transmission of *SARS-CoV-2* infection are via respiratory droplets and contact with infected objects or surfaces, other routes of transmission, such as the ocular route, should not be overlooked, as *SARS-CoV-2* RNA has been detected in tears and conjunctival secretions from patients with COVID-19. Along with other COVID -19 symptoms may occur conjunctivitis or it may be the only sign and symptom of the disease (Güemes-Villahoz *et al.* 2021).

SARS-CoV-2 adds passage into cells by official on the angiotensin change via catalyst 2 (ACE-2) receptor, which is spread in various tissues, including the conjunctiva. During the SARS-related covid flare-up in 2003, an investigation showed that medical personnel experienced a higher danger of SARS contamination when there was unprotected eye-to-eye connection with discharges. There are increasing reports indicating that some COVID-19 pneumonia cases began with conjunctivitis as an underlying side effect after contact with ill patients. Detection of viral RNA by switch transcriptase-polymerase chain reaction (RT-PCR) can be valuable in the early detection of *SARS-CoV-2* disease and in taking appropriate isolation measures. Therefore, determining whether *SARS-CoV-2* is dispatchable by contact with the conjunctiva is an important consideration that warrants investigation (Raboud *et al.* 2010; Wan *et al.* 2020; Ozturker 2020).

DISCUSSION

The prevalence ranges from 0.8%, detailed by Guan et al. in an investigation that included 1099 patients with laboratory-confirmed COVID-19, to 31.6% in a case series that was also carried out in China (Huang *et al.* 2020; Guan *et al.* 2020).

SARS-CoV-2 RNA has been recognized in visual liquids of patients with COVID-19 both with and without conjunctivitis. Be that as it may, gathering tears and visual discharges for *SARS-CoV-2* location appear to offer a restricted demonstrative benefit. Based on current literature, *SARS-CoV-2* can be identified in the swab tests taken from the conjunctiva by the RT-PCR strategy. (Zhou *et al.* 2020; Ulhaq, Soraya 2020)

During the progressing COVID-19 pandemic, there have been a few compositions distributed in the writing with respect to different visual signs of the infection. In our methodical audit, we saw that the general level of the visual signs was around 11% from the meta-examination of studies. The major ophthalmic highlights announced with

COVID-19 were ocular pain, redness, and follicular conjunctivitis. Since a portion of these reports were distributed in mid 2020 when the WHO had proclaimed COVID-19 as a pandemic, there is a critical concern with respect to the extrapulmonary signs of COVID-19 and danger of transmission of the sickness through visual liquids. A few creators have distributed suggestions on the utilization of defensive eye stuff to evade expected transmission of the sickness. These recommendations involve strategies to prevent transmission of the disease among ophthalmologists and contact lens practitioners, and from aerosols generated from ocular procedures such as cataract surgery and non-contact tonometry (Aggarwal *et al.* 2020; Sengupta *et al.* 2020; Sadhu *et al.* 2020; Jones *et al.* 2020; Romano *et al.* 2020; Lai *et al.* 2020).

The information from eight examinations remembered for the pooled investigation uncovered a critical extent of different visual highlights, explicitly visual acuity decline, redness, release and follicular conjunctivitis. Different examinations likewise announced comparative visual signs. Nonetheless, it should be noticed that few examinations depended on itemized and comprehensive surveys and patient meetings, which were played out a few days after the patients were released from the medical clinic (Aggarwal *et al.* 2020; Sengupta *et al.* 2020; Sadhu *et al.* 2020; Jones *et al.* 2020; Romano *et al.* 2020; Lai *et al.* 2020; Wu *et al.* 2020). Subsequently, the information from the examinations could experience the ill effects of review inclination. Likewise, it isn't certain whether these visual highlights were previous or happened because of COVID-19 disease. For example, highlights, dry eyes, tingling and foreign body sensation might be profoundly common in everyone given the high rate of dry eye illness. Also, certain examinations have included medical care laborers who might be more sharpened on detailing different indications. Medical services laborers don't speak to everybody and this should be thought of while deciphering the consequences of these investigations. Then again, in perilous circumstances, the more extreme clinical indications may overshadow ophthalmic highlights, which may go unnoticed (Aggarwal *et al.* 2020; Zhang *et al.* 2020; Tostmann *et al.* 2020; Marinho *et al.* 2020; Shimmura *et al.* 1999).

The distributed examinations likewise raise a worry that COVID-19 can have ocular manifestations (explicitly follicular conjunctivitis) as the first and in some cases the sole sign of the illness. Pooled information from three investigations in our meta-examination uncovered that visual side effects might be the main appearance in roughly 2.2% patients as it were. As ophthalmologists, it is critical to know about such introductions and keep a high record of clinical doubt of COVID-19 in such patients. Likewise, examination of pooled information uncovered that 6.91% of the patients with visual appearances experienced extreme pneumonia. A hyper-coagulable state causing blood vessel and venous thromboembolic inconveniences has been depicted in serious instances of COVID-19. In any case, none of the investigations portrayed any highlights identified with visual thrombotic entanglements (Aggarwal *et al.* 2020; Wu *et al.* 2020; Zhang *et al.* 2020; Hong *et al.* 2020; Zhou *et al,* 2020; Lan *et al.* 2020; Xie *et al.* 2020; Cui *et al.* 2020; Klok *et al.* 2020).

CONCLUSION

In summary, visual manifestations, e.g., redness, pain and conjunctivitis may occur in individuals with COVID-19. The contagiousness of the disease from visual fluids remains uncertain, and the speed of detection of viral RNA from conjunctival swabs/tear fluid by RT-PCR is poor. Particularly thoughtful screening can help ordinaries, ophthalmologists, and intensivists treat their patients and establish rules for home defences, including ocular equipment. Later on, strong information collection, examination and

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breakdown is useful to get a better understanding of the danger of visual transmission and the general incidence of visual disease in COVID-19.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest in connection with the published article.

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The role of environment during the COVID-19 pandemic

Úloha environmentu v pandémii COVID-19

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ABSTRACT **Introduction:** Droplets transmit *SARS-CoV-2*; however, it is important to address the individual environmental components as potential transmission risks.
Findings: It has been shown that the virus can be on various surface materials (metals, plastics, wood, etc.) as well as on the hands of people surviving several hours. However, to date, there is no scientific evidence of food coronavirus transmission. Using DNA / RNA detection technology, genetic material from the virus has also been detected in wastewater samples taken from wastewater treatment plants since March 2020 in the Netherlands. The fact that the RNA of the new *Corona virus* (COVID-19) was detected in the wastewater doesn't mean that it is an active, live virus.
Conclusion: Food does not pose an epidemiological risk in terms of *SARS-CoV-2* coronavirus transmission. Since the virus can survive on surface materials for several hours, everyone should follow the recommendations of public health authorities and customers in shops when washing their hands by not touching foods other than those they intend to buy in order to prevent by contamination with pathogens that may be on their hands. Detection of RNA virus in wastewater can help the epidemiologist to study the spread of the epidemic, to detect the onset of the next wave of infection, and to evaluate the presence of the virus in the community, especially to express asymptomatic individuals.

Key words: Wastewater, Food, Environmental risk, Coronavirus

ABSTRAKT **Úvod:** *SARS-CoV-2* sa prenáša kvapôčkami, napriek tomu je dôležité sa venovať aj jednotlivým environmentálnym zložkám ako potenciálnym rizikám prenosu.
Zistenia: Bolo preukázané, že vírus môže na rôznych povrchoch materiálov (kovy, plasty, drevo atď.) ako aj na rukách osôb prežívať niekoľko hodín. Doteraz však neexistujú vedecké dôkazy o prenose koronavírusu potravinami. Pomocou techník detekcie DNA/RNA bol zistený genetický materiál z vírusu aj vo vzorkách odpadových vôd odobratých z čistiarní odpadových vôd od marca 2020 v Holandsku. Fakt, že bolo v

odpadovej vode detegované RNA nového *Corona* vírusu (COVID-19) neznamená, že sa jedná o aktívny, živý vírus.
Záver: Potraviny nepredstavujú epidemiologické riziko z hľadiska prenosu koronavírusu *SARS-CoV-2*. Vzhľadom na fakt, že vírus je schopný prežiť na povrchoch materiálov niekoľko hodín, každý by sa mal pri umývaní rúk riadiť odporúčaniami orgánov verejného zdravotníctva a zákazníci v obchodoch by sa nemali dotýkať iných potravín než tých, ktoré majú v úmysle kúpiť, aby sa tak predišlo ich kontaminácii patogénom, ktorý sa môže nachádzať na ich rukách.
Detekcia RNA vírusu v odpadových vodách môže pomôcť epidemiológom študovať šírenie epidémie, pomôcť skôr zachytiť nástup ďalšej vlny nákazy a vyhodnotiť prítomnosť vírusu v komunite, najmä s cieľom exprimovať asymptomatických jedincov.

Kľúčové slová: Odpadové vody, potraviny, environmentálne riziko, Koronavírus

Abbreviations:
COVID-19 – Coronavirus Disease 2019
EFSA – European Food Safety Authority
SARS-CoV-2 - Severe acute respiratory syndrome Coronavirus 2
WHO - World Health Organization

INTRODUCTION

The *SARS-CoV-2 coronavirus* belongs to the family of *Coronaviridae. It* falls within the genus of *Betacoronaviruses*, including the *SARS-CoV* and *MERS-CoV coronaviruses*, but *SARS-CoV-2* is genetically different from others coronaviruses. *SARS-CoV-2* stands for severe acute respiratory syndrome coronavirus 2. It may be translated into other languages as "the second *SARS coronavirus*". The prefix corona refers to the protein spikes on the virus' surface that resemble a crown. *SARS* (severe acute respiratory syndrome) is a disease that emerged in China in 2002 and 2003. The current pandemic is caused by a coronavirus that appears to be closely related to the one that caused the *SARS* epidemic 18 years ago. All of these viruses crossed the interspecies barrier: they had been transmitted from animals to humans and consequently spread in the human population (Public Health Authority of the Slovak Republic, 2020).

Coronaviruses are pleomorphic RNA viruses (round, oval to oblong in shape) with spiral symmetry, ranging from 60 to 220 nm in size. The envelope contains characteristic spike-shaped protrusions. The most common symptoms of the disease include coughing, shortness of breath, body temperature above 38 °C, pneumonia and, in case of complications the disease may result in death. The incubation period is 2 to 10 days. The *SARS CoV-2 coronavirus* is a respiratory virus transmitted between people mainly via airborne droplet infection. Transmission occurs primarily through contact with an infected person who emits infectious droplets in the surrounding air when they talk, cough, or sneeze. The biggest threat of the new *SARS-CoV-2* lies in the fact that it is airborne (spreading by droplet infection) and can also be transmitted by infected people with only very mild symptoms or no symptoms at all (Public Health Authority of the Slovak Republic, 2020).

The survival time of the virus depends on several factors such as the initial virus concentration, the type and smoothness of the surface, the temperature and the relative humidity. Coronaviruses are sensitive to chlorination and ultraviolet (UV) light disinfection (Feinstone, Taylor, 2004; Lai, Cheng, Lim, 2005; Darnell Derraik *et al.* 2020). The virus can be inactivated within a minute using common disinfectants such as 70% ethanol or 0.1% sodium hypochlorite. High temperatures, high pH values, sunlight, and the most common disinfectants are basic means capable of deactivating the virus (Carraturo *et al.* 2020).

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The *SARS-CoV* strains are generally able to survive up to 96 hours in human biological specimens, such as faeces, sputum, and serum. They are much less stable in urine, probably depending on the inhibiting pH values, and the presence of urea (Duan *et al.* 2003). The virus is stable in faeces (and urine) at room temperature for a minimum of 1–2 days. The virus is more stable (up to 4 days) in stool from diarrhoeal patients (which has a higher pH value compared to normal stool) (Carraturo *et al.* 2020). Residues of faeces and urine that may contain this genetic material are continuously flowing into the sewage system. However, this does not mean that the virus will automatically spread.

AIM

The aim of the work as a comprehensive publication is to point out the influence of selected environmental risk factors in the transmission of the new *SARS-CoV-2* virus and to summarize the existing knowledge on this issue.

FINDINGS

Coronavirus in Wastewater

Studies have shown the occurrence of *CoV* in wastewater samples. The extreme infectiousness of *SARS-CoV-2* led many countries to suggest the monitoring of wastewater in order to evaluate the presence of the virus in the community, mainly to estimate the asymptomatic individuals and to quantify the potential infection risks of wastewater and solid waste.

After the spread of the new *SARS-CoV-2* virus, research was also conducted in Slovakia. Experts from the Bratislava Water Company took wastewater samples from the wastewater treatment plants in Devínská Nová Ves, Holíč, Modra, Petržalka, Pezinok, Senec, Senica, Skalica, Šaštín-Stráže and Bratislava-Vrakuňa. All tests detecting the presence of the *SARS-CoV-2* coronavirus in wastewater samples in ten treatment plants managed by the Bratislava Water Company in the Bratislava and Trnava regions were negative, which confirmed the minimal spread of the disease among the population at that time (TASR, 2020).

The persistence of *SARS-CoV-2* was also evaluated in wastewater at the Amsterdam Schiphol Airport (Tilburg, Netherlands) and at the wastewater treatment plant in Kaatsheuvel (Netherlands), where samples were collected from February to March 2020. The quantitative monitoring of the virus found traces of the new coronavirus in the airport wastewater and in the wastewater treatment plant samples collected in March 2020. The results of the monitoring turned out to be crucial, as they allowed the presence of *SARS-CoV-2* to be associated with the occurrence of the first COVID-19 cases in the Netherlands. The genetic material from the virus was indeed detected in the wastewater samples taken from the wastewater treatment plants starting from March 2020, while the first official COVID-19 cases in the Netherlands were registered on 27 February 2020. Subsequently, on 25 March 2020, the Dutch institutes announced that they had discovered the RNA of the new coronavirus (COVID-19) in untreated wastewater using DNA/RNA detection techniques. RNA is the genetic material in viruses, comparable to single-stranded DNA. It is very important to note that scientists have not detected "live" viruses in untreated wastewater. The applied method was not able to identify the presence of viable viruses or the potential to infect humans. This detection method is especially relevant because it is now possible to determine how much the virus has spread among the population by sampling municipal wastewater. This can help epidemiologists study the spread of the epidemic. However, this method needs to be further developed. Several countries and their institutes are working on the same detection methods (Medema *et al.* 2020).

A press release focusing on this research raised serious concerns among people handling wastewater and laboratory employees, mainly

because it was titled "Coronavirus detected in wastewater". The National Institutes of Health and the World Health Organisation are very clear on this issue and reiterate that the new **coronavirus is unstable in a water/wastewater environment** (Association of Water Companies, 2020).

The fact that the RNA of the new coronavirus (COVID-19) was detected in wastewater does not mean that it is an active, viable virus. Employees who come into contact with sewage are protected by personal protective equipment, which minimizes the risk of coronavirus infection. Their work is an indispensable part of our everyday lives. At a time of increased need for hygiene during a pandemic, it is necessary to ensure a continuous supply of drinking water to all sectors of our lives and efficient wastewater collection and treatment.

Treatment plant employees should steer clear of direct contact with wastewater and places where the water from equipment in mist droplets escapes into the ambient atmosphere. As a matter of course, drinking is forbidden.

Employees must wear personal protective equipment, including protective clothing, gloves, boots, protective eyewear, face mask, and/or FFP3 respirator during the performance of any activities that may result in potential contact with wastewater. Also, they are to adhere to all nesessary sanitary measures:

- not touching eyes, nose, or mouth with unwashed hands,
- washing hands before meals and after going to the toilet,
- sneezing or coughing into one's elbow.

Fecal excretion of *SARS-CoV* has been a significant safety concern over the past decade, but in the case of *SARS-CoV-2* **no cases of *SARS-CoV* or *SARS-CoV-2* infections transmitted by sewage or sludge have been reported since April 2020.** Some studies conducted on viruses similar to the human immunodeficiency virus (HIV) assessing the persistence of the virus in these categories for the time necessary for the pathogen to be considered a risk to human health have shown that the risk is highly unlikely. Also, it is difficult for the virus to survive during water treatment to which it is normally subject (Carraturo *et al.* 2020).

At wastewater treatment plants, pathogens are already being removed from raw water. As a result of the oxidation of water and all substances that it contains in aerobic wastewater treatment plants, the water is purified and disinfected. It has been shown that 99% of all pathogenic microorganisms present in raw wastewater are eliminated during the aerobic treatment due to oxidation. In addition to biomass, aerobic wastewater treatment's final products are water and carbon dioxide, i.e. harmless and odourless gases. The WWTP system may also be retrofitted with chlorination or UV lamp disinfection to disinfect effluent-treated wastewater. Another possibility is to install purification by membrane microfiltration with chlorination, where all particles including bacteria will be filtered out.

Coronavirus in Food

According to the current opinions of the European Food Safety Authority (EFSA) and the World Health Organization (WHO), **there is no scientific evidence for coronavirus transmission through food.** However, it has been established that the virus can survive for several hours on various material surfaces (metals, plastic, wood, etc.) and on hands. According to current knowledge about the described coronavirus transmission pathways and their limited ability to survive outdoors, food is unlikely to be a source of infection (EFSA 2020).

A study analysing the surface stability of the virus in the air and on various surfaces was published in the prestigious medical journal *The New England Journal of Medicine.* An international team of scientists has accurately imitated the way the new coronavirus spreads through the environment. The analysis and

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evaluation of the stability of samples in aerosols and their decomposition rate on various surfaces produced interesting results. The viability of the tested *SARS-CoV-2* and *SARS-CoV-1* viruses varies in the aerosol, i.e., particles we cough out or spread into the air by breathing and talking and on different surfaces. The virus can survive for hours in the air and a couple of days on surfaces. The virus's viability in aerosols is 3 hours, on steel and plastic surfaces 72 hours (3 days), on copper surfaces is 4 hours, while on cardboard surfaces it can survive for 24 hours (Figure 1) (van Doremalen *et al.* 2020). These discoveries resulted from experiments conducted in a controlled environment and must be interpreted with utmost caution for the real-world environment. As such, it should be emphasized that the viability of the viruses was monitored under experimental conditions, i.e., at controlled relative humidity and temperature, and to this day, there is no evidence that contaminated packaging exposed to various environmental conditions and temperatures transmits the infection (Derraik *et al.* 2020). Nevertheless, it is necessary to take into account various concerns stating that the virus present on the skin may be transmitted to the respiratory system (e.g. through contact with the face) and thus people packaging and handling food, including consumers, should follow the instructions of the public health authorities related to good hygiene practices, including regular and thorough hand washing.

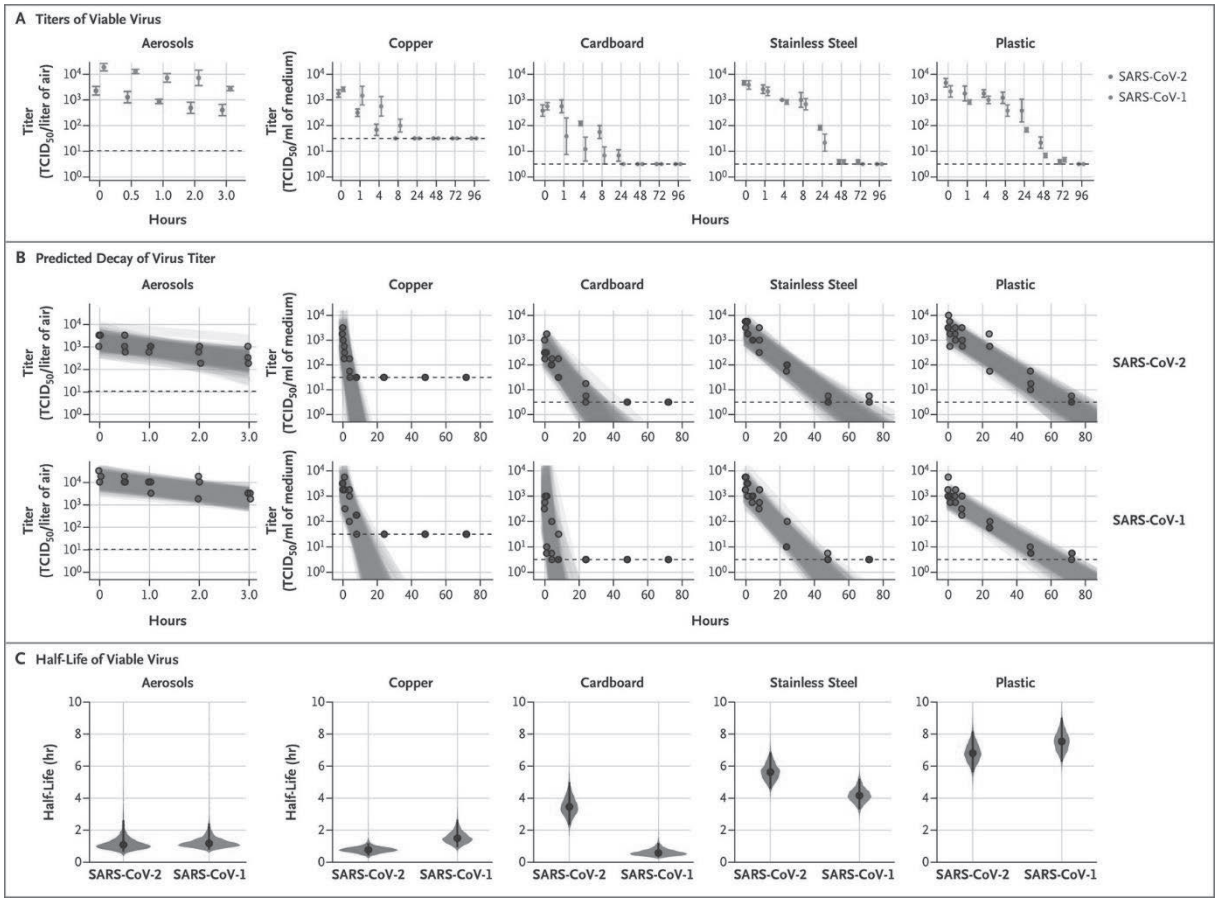

Figure 1. Viability of *SARS-CoV-1* and *SARS-CoV-2* in Aerosols and on Various Surfaces (Source: van Doremalen *et al.* 2020)

Food production in the EU is governed by strict hygiene rules and their application is subject to official control. The purpose of the hygiene inspections that have to be carried out by food businesses is to prevent food contamination by all possible pathogens, therefore their aim is also to prevent food contamination by the virus responsible for COVID-19. All these requirements are the subject to regular educational measures in the food sector so that people working in the food sector know how to work hygienically. Good hygiene practices required at all levels of food production include, in particular, cleaning and, where necessary, disinfecting food facilities and equipment between production batches, avoiding cross-contamination between various food categories and food at different stages of the production process (e.g. raw versus cooked food), personal hygiene including washing and sanitising hands, wearing gloves and masks where necessary, using special sanitary clothing and shoes, or staying at home, away from the workplace, if one feels sick. Furthermore, in the current circumstances, the food industry should limit its external contacts to the absolute necessary, for example with suppliers or trucks while keeping a distance from the drivers (EU Directorate-General for Health and Food Safety, 2020; WHO, 2020).

Although official controls are part of a safe food chain, the current restrictions (including the possible risk-based postponement of some official control activities) are not considered a threat to the food safety. Food safety is primarily achieved through preventive measures (good hygiene practices). Food business operators have to demonstrate that such preventive measures are always in place during food production and that they are effective by means of checks and testing on their production process and food. This is in turn inspected by the food safety authorities. Even where a lockdown may affect the forms of official controls, it does not affect the safety of food produced. In this regard, the Commission adopted a Regulation allowing Member States to carry out control actions in a way compatible with movement restrictions to limit the spread of COVID-19, under appropriate safeguards, so that food safety not be compromised (EU Directorate-General for Health and Food Safety, 2020).

Specific protocols have been established within the food processing industry to safeguard the health of employees. These measures come in addition to regular food hygiene and workers' safety practices, and they adapt to the possibilities on the ground. Such measures include social distance while at work, plexiglass when distance cannot be maintained, no contact between truck drivers and the food facility, more hand sanitisers at disposal, no more workers than strictly necessary in the facility, or working from home where possible. Under the special recommendations for COVID-19 now in place, any person showing symptoms indicative of COVID-19 is requested to stay at home to prevent the spread of the virus (EU Directorate-General for Health and Food Safety, 2020).

Even in cases where people might be infected while not yet sick (asymptomatic carriers of the virus), the existing legislation minimizes the risk of virus particles coming into contact with food. Every person working in a food-handling field must maintain a high degree of personal hygiene including wearing suitable, clean and, where necessary, protective clothing, and constantly adhere to good hygiene practices (regular handwashing, no sneezing or coughing when producing or handling food, etc.). Food business operators must train their employees on properly using personal protective equipment and remind them of how important it is to follow instructions on personal hygiene and social distancing during breaks at work. There is every reason to believe that the existing sanitation measures are as effective with COVID-19 as with other microbiological risks. Furthermore, food businesses should perform additional sanitation measures when appropriate, based on risk, all the

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more in the event an employee tests positive to the virus. These measures, combined with the fact that food is not known to be a source of transmission, assure the safety of food production (EU Directorate-General for Health and Food Safety, 2020).

Employees who need to manipulate food (for example, cutting meat, slicing meat or dairy products, cleaning fish, packaging fruit and vegetables) wear gloves and frequently replace them, or otherwise often wash their hands. Consumers should also play their role. **As a general good hygiene practice, customers in shops should not handle food other than what they intend to purchase, so as to avoid contaminating it with any pathogen that may be present on their hands.**

Retailers are also recommended to manage the entrance of external suppliers of products and services (cleaning, etc.). As the virus responsible for COVID-19 is mainly resistant to smooth inert surfaces such as plastic and stainless steel, retailers must clean these surfaces frequently: for example, shopping carts or self-scanning devices. Regular disinfection of supermarket hand baskets should take place. Retailers may also invite customers to bring their shopping bags. It is also essential to ensure a safe physical distance between people as advised by public health authorities, for example, by marking the floor at certain intervals and limiting the number of people present in the shop at the same time. Retailers can also recommend that consumers use shopping carts to maintain that distance. Food tastings for promotional campaigns should be avoided. When retailers provide sanitation measures, they must insist that customers make use of them, and in the case of single-use gloves that they are appropriately disposed of. If face-to-face service is needed and where it is not possible to maintain a safe distance among people, putting a glass or plexiglass screen between cashiers and customers (e.g. at checkout counters) is recommended. It is also recommended to encourage the use of debit/credit card payments, preferably contactless, instead of cash. Periodical disinfection of the card payment tool as well as the conveyor belt on the checkout counter is also recommended (EU Directorate-General for Health and Food Safety, 2020).

Food at Home

Washing hands thoroughly with soap and warm water before and after shopping is particularly important as it will protect ourselves as well as others. It is equally important to observe all hygiene rules in the kitchen that usually protect people from food poisoning. Food should be stored properly, and any contact between the food consumed raw and cooked food must be avoided. It is suitable to discard outer packaging before storage (for example, cardboard boxes where there is an inner plastic package) while keeping track of key information such as use-by date. Fruits and vegetables should be systematically washed with clean water, especially if they are not going to be cooked (*SARS CoV-2* will not survive cooking). It is necessary to avoid contamination of kitchenware (knives, plates, etc.) by carefully washing them with detergent in between using them for different food ingredients. It is important to respect cooking instructions (time, temperature) for food intended to be eaten cooked. Before preparing or cooking food one should wash one's hands with warm water and soap. Refrigerator and kitchen surfaces should be cleaned routinely, though with increased frequency. The precautions against COVID-19 should not make one forget the standard rules to avoid food poisoning when cooking at home that still apply and protect people from food-borne illnesses that would further burden the healthcare facilities (EU Directorate-General for Health and Food Safety, 2020).

CONCLUSION

There is no evidence to date that food has been a source or vehicle of infection. Theoretically, as is the case for any contact surface contaminated by an infected person, be it a door handle or other surface, food could also lead to indirect contamination through touching it. This is why everybody should follow the recommendations of public health authorities on the washing of hands.

Long-term exposure to contaminated environmental sources, as well as long-term contact with aerosols generated during wastewater and surface water treatment, and insufficient cleaning of foodstuffs and surfaces, can potentially lead to an increased risk of transmission. Therefore, the proper use of appropriate personal protective equipment (PPE), in particular masks fitted with filters, by employees of the healthcare system, water treatment and waste treatment facilities and industry sectors in general throughout the production chain ensures the low survival rate of *SARS-CoV-2* in the environment, and owing to an adequate use of disinfection procedures it is possible to presume that the risk associated with its further transmission may be low.

There is a correlation between the results of the determination of *SARS-CoV-2* RNA fragments in wastewater and the results of national mass testing, and, according to scientists, the monitoring of ***SARS-CoV-2*** **in wastewater could potentially be used to detect the onset of the next wave and identify new disease outbreaks.** However, environmental surveillance should not be used as a substitute for close monitoring of COVID-19 cases.

Conflict of Interest
None

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Computer use during the COVID-19 pandemic

Práca s počítačom počas pandémie COVID-19

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ABSTRACT **Introduction:** In the midst of the COVID-19 pandemic, the majority of occupations worked from home for epidemiological reasons. This situation resulted in physical inactivity and an increase in stress that could negatively affect the locomotor apparatus, musculoskeletal system and other systems, as well as lead to vision impairment and mental health deterioration.

Methods: The emergence of individual locomotor apparatus disorders and syndromes when using mobile devices is the result of failure to maintain good posture as well as unsuitable working conditions when working in the home environment. The presented article focuses on suggestions regarding an ergonomic environment, appropriate exercises, the importance of proper exercise habits, as well as exercises aimed at preventing visual impairment and applying stress management methods.

Results: Appropriate preventive measures have been proposed, as well as the option of using the latest available means of distance therapy during the pandemic through telerehabilitation and virtual reality, as well as artificial intelligence.

Conclusion: Preventive measures regarding computer use during the COVID-19 pandemic proposed in the article will mitigate the impact of negative consequences that working from home entails.

Keywords: COVID-19, computer use, working from home, musculoskeletal system disorders, locomotor apparatus, nervous and vision system disorders, mental health, telerehabilitation, exercise, virtual reality, artificial intelligence.

ABSTRAKT **Úvod:** V rámci pandémie COVID 19 z epidemiologických dôvodov sa vo väčšine profesii pracuje formou Home office. Táto situácia prináša nedostatok pohybu a stres, ktoré môžu negatívne vplývať na statopohybový-skeletálny aparát a ďalšie systémy- napríklad poruchy zraku a duševného zdravia.

Metódy: Vznik jednotlivých statopohybových porúch a syndrómov pri práci s mobilnými zariadeniami je výsledkom nedodržiavania základných posturálnych princípov a nevhodných pracovných podmienok pri práci v domácom prostredí. Poukázali sme na

návrhy zamerané na vytvorenie ergonomického prostredia, vhodných cvičení, dôležitosť správných pohybových návykov, ako aj cvičenia zamerané na predchádzanie zrakových porúch a metód na zvládanie stresu.

Výsledky: Boli navrhnuté vhodné preventívne opatrenia aj možnosti využitia najnovších dostupných prostriedkov dištančnej terapie počas pandémie pomocou telerehabilitácie a virtuálnej reality ako aj umelej inteligencie.

Záver: Preventívne opatrenia počas pandémie COVID-19 pri práci s počítačom navrhnuté v článku zmiernia dopad negatívnych následkov pri práci formou Home office.

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Kľúčové slová: COVID-19 a práca s počitačom, Home Office , poruchy skeletomuskulárneho aparátu , poruchy statopohybového aparátu , poruchy nervového a zrakového systému, psychické zdravie, telerehabilitácia, cvičenie, virtuálna realita, umelá inteligencia

INTRODUCTION

In the midst of the COVID-19 pandemic, the majority of the working population is working from their home environment for epidemiological reasons. The present situation causes stress and results in physical inactivity that can lead to disorders of the locomotor apparatus, musculoskeletal system, and nervous system, as well as vision impairment and mental health disorders. During the current pandemic period, it would be appropriate to take measures to reduce these difficulties, as well as to design a set of exercises aimed at developing exercise habits focusing on posture improvement, employing visual exercises and, last but not least, applying stress management methods.

As a result of the COVID-19 pandemic, several restrictions have been introduced preventing people from going out and restricting movement in general, as well as banning social gatherings. These restrictions can in turn negatively affect the population and have serious health implications. People working from home should be instructed on how to create an ergonomic working environment at home and maintain it afterwards. In an office, good workplace ergonomics are usually maintained and the working environment is adjusted accordingly. When working from home, such an environment is rarely established, resulting in unsatisfactory conditions. An ergonomic working environment as part of the integrated care for employees consists of applying an effective form of back pain prevention measures in the workplace. These can be introduced as a preventative measure, both primary and secondary, especially in occupations with an increased risk of developing these difficulties.

Inappropriate ergonomics during computer use affects several systems of the human body. An improper seating position not only causes vertebrogenic difficulties, but can also affect the nervous, circulatory, cardiovascular and digestive systems, and, ultimately, mental health. Health problems during computer use may occur as a result of repetitive, excessive, and disproportionate strain. Insufficient physical activity as a result of sitting still for long periods of time weakens the muscles and thus reduces physical fitness. As a result, weakened muscles may be unable to provide adequate protective support for joints and the spine, which is also one of the reasons for the faster onset of degenerative joint changes, as well as a greater risk of musculoskeletal injuries.

Another manifestation of muscle changes is the development of muscle imbalance – the shortening and overstraining of the upper trapezius muscles, levator scapulae, and pectoral muscles. The muscles on the back of the thighs and hip flexors are shortened and the abdominal and sciatic muscles get weaker. Probably the most common consequences of sitting still for a long

period of time are the overloading of tissues (muscles, tendons, ligaments) and functional spine disorders (Vařeková *et al.* 2019).

In the case of a long-term unilateral static load, i.e. when sitting without changing position, muscle tension increases. At the site of increased muscle tension, changes in tissue pH occur and nerve endings get irritated (Plačková 2019). Most spasms are palpably painful and contain trigger points. Left untreated, spasms can directly affect the range of motion and can result in various deformities – kyphosis, forward head posture, shoulder blade elevation.

The following spinal disorders are among the most common:

The most common one concerns a **functional disorder** that affects the skin, subcutaneous tissue, fascia, muscles and joints of the spine, usually leading to structural changes and degenerative changes (Gúth 2019).

Cervicocranial syndrome: accompanied by pain radiating to the head. Blockages of the upper cervical spine and head joints are present.

Cervicobrachial syndrome: cervical spine pain radiating to the upper limb; the maximum pain is in the shoulder and arm. However, differential diagnosis is important (frozen shoulder syndrome, rotator cuff injury).

In the thoracic spine, disorders are the result of intervertebral and costotransverse joint blockages.

Lumbago: pain that suddenly appears in the area of the lumbar spine following a sharp or uncoordinated movement. **Root syndromes** radiating pain to the lower limbs may also develop.

Improper positioning of the musculoskeletal system when sitting at a computer for a long period of time can cause painful affections in other areas as well:

Lateral epicondylitis (tennis elbow): pain in the area of the elbow joint and painful trigger points in the area of the extensor tendons of the outer forearm.

Carpal tunnel syndrome: this emerges as a result of overusing the wrist and hand and causes narrowing in the carpal tunnel, which subsequently suppresses the median nerve. It is one of the most common occupational upper limb injuries.

De Quervain's disease: overuse of tendons on the thumb side of the wrist, which narrows the space for tendon movement and is accompanied by pain.

Jumper's knee: an improper seated and one-sided static position can also result in lower limb disorders, spanning muscle and tendon shortening, such as the patellar ligament, and the onset of pain in the area below the patella.

Achilles tendinitis (back of the heel) and plantar fasciitis, heel spurs (underside of the heel): the most common causes of heel pain. They occur with excessive overuse, with the strain lasting a long time, but also when one is standing or sitting for a long period of time or walking barefoot.

Repetitive strain injury: non-specific symptoms including multiple symptoms from overuse. The most common musculoskeletal disorders related to computer use include back, shoulder, elbow, and wrist pain, hand tendonitis, and thumb and finger pain.

PREVENTION OF COMPUTER-USE-RELATED DISORDERS

In order to prevent the occurrence of the aforementioned disorders as much as possible, it is recommended to take regular breaks during computer use and to perform physical and visual exercises throughout. The preferred physical exercise includes stretching and relaxation exercises (Kolárová *et al.* 2019). It is also important to adjust the ergonomic conditions at the workplace, work equipment, and adhere to the

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proper seated posture principles. It is recommended to use an adjustable office chair with armrests for the elbows, or alternate by sitting on a balance mat (exercise ball, wobble cushion).

Ergonomics also includes choosing the right mouse and keyboard, choosing the right furniture and its arrangement, room and desk lighting (natural or artificial). The computer monitor should be placed at eye level. If you are using a laptop, you should purchase an external keyboard and an adjustable laptop stand.

When choosing the right mouse and keyboard, make sure the mouse fits comfortably in the palm of your hand, and pressing keyboard keys is comfortable. It is important to choose a mouse pad with wrist rest support to ensure a neutral position of the wrist joint. The keyboard should be placed directly in front of the computer user, and the user's elbows should be approximately the same height as the keyboard row with the G and H keys.

When sitting, feet should rest firmly and comfortably on the floor. There must be sufficient space for legs and knees under the desk. When sitting, it is important for hips, knees and ankle joints to maintain a 90-degree angle. Body weight should be distributed evenly over the entire seat and backrest. The backrest should be adjusted so that its shape corresponds to the natural curve of the lower part of the spine and should not extend beyond the lower edge of the shoulder blades, as is shown in Figure 1.

In order to prevent the development of vertebrogenic disorders as much as possible, it is necessary to take regular breaks during work and to perform physical exercises, as is shown in Figure 2 (Bartolčiová 2019).

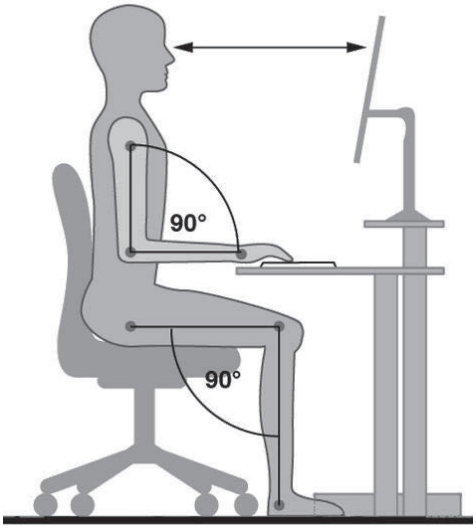

Figure 1: Ergonomics when working with a computer. (Source: http://www.barkhamofficefurniture.co.uk/)

Eye and sicca syndroma by computer working

The surface of the eye is constantly moistened by the tear film, which consists of mucinous, lipid and water components. If there is a failure in one of them, this leads to dry eye. Dry eye syndrome is one of the most frequent ophthalmological diseases and 15-17% of the population suffers from this disease. The tear film in this condition plays an important role because it is the first optical interface of the eye. It provides lubrication of the eye surface, protects the cornea, has an antibacterial effect, keeps the surface homeostasis and provides a small amount of nutrition to corneal epithelium.

This disease is multifactorial and is so serious that untreated can lead to serious complications to vision loss. Social status and work environment can significantly affect the people who are already receiving or have as yet undetected syndrome "dry eye" (Černák 2009).

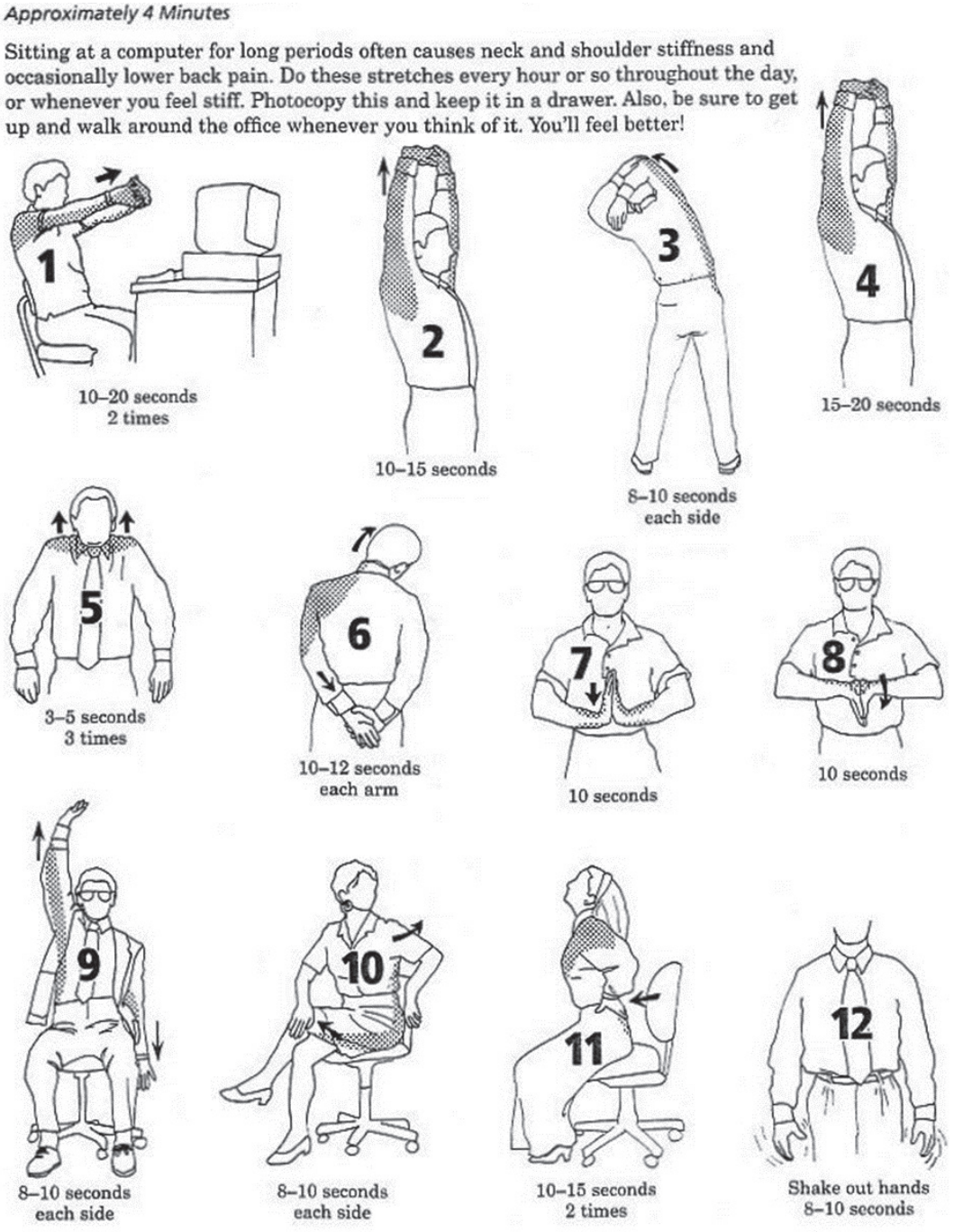

Figure 2: Stretching exercises when working with a computer.
(Source: Joe Yoon: Better Stretching 2000)

Over the last twenty years, there have been several proposals for a precise definition of dry eye syndrome. Finally, two of these proposals were the result of an international consensus in which recognized experts agreed on the elements that the resulting definition will contain.

The first complete definition came from the Industry Dry Eye Workshop / National Eye

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Institute, which defines dry eye syndrome as a tear film disorder due to tear deficiency or excessive evaporation that causes damage to the ocular surface and is associated with ocular discomfort. At the International Dry Eye Workshop (DEWS 2007), a new innovative definition was proposed that reflects the latest research findings at the time. The definition is: dry eye syndrome is a multifactorial disease of the ocular surface and tears, which results in symptoms such as discomfort, visual disturbances, instability of the tear film with potential damage to the surface of the eye. This is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface. Dry eye syndrome is referred to as multifactorial disease. Although virtually all diseases are multifactorial, this means that the onset of the disease is associated with a large number of other conditions for the disease. Commonly accepted risk factors for the development of dry eye syndrome include female gender, aging, androgen deficiency, contact lens wearers, past refractive surgery, but also the systemic effects of some drugs (Rolando, 2001, Schein, 1997; Brewitz, 2001).

Light reflections and effects have a direct effect on the eye load reflections, light quality and location of light sources. Light affects work efficiency and mental state employee. When working with the display unit symptoms may appear more than 4 hours a day such as burning eyes, redness of the eyes, dry eyes, a feeling of pressure in the eyes, a feeling of eye strain overgrown headache, headache, increased tearing of the eyes, slow focus, blurred image. Long-term, unilateral overload of small muscles eyes caused by keeping the eyes unusually stiff position aimed at a constant distance from the monitored object in the development of humanity is unparalleled. It leads to a gradual overload of one and weakening of the second group of eye muscles providing movement of the pupils and the whole eye. I the disorder leads to a gradual decrease in vision abilities. Decreased nutrition and corneal moisture is a result of lack of eyelid function. It is used in the development of humanity positive advantage - block time needed subconscious blinking, to increase continuous monitor workload.

The result is a reduction in blinking is tear shedding automatically triggered as needed from the lacrimal glands they contain for the cornea of the eye the only way of supplying oxygen, nutrients, antibodies, moisture and ensure the removal of metabolic waste products, as well as surface cleaning of the eye and the connector from dust, bacteria, fungi and irritants. The main cause is a long-term, excessive and continuous load vision when working with the display unit.

The negative consequence is a reduction in blinking. Working with the display unit for more than 2 hours requires after two hours to interrupt at 5–10 minutes and include eye gymnastics. After 3 hours it takes 10-15 minutes and active regeneration. Eye gymnastics will not only protect us from health problems, but will help increase the feeling overall well-being at work and increase the range performed work, its quality, thoroughness and regularity,

Gymnastics protect the eyes from health difficulties, will help increase the feeling of overall well-being at increase the scope of work performed and its quality. Exercises during long-term computer work (Černák 2009; Horkovičová 2014).

How can we help?

Look away from the imaging unit (monitor) and focus it on any farther point in the room (focus on whether there is any small spot, etc.), look over and over several times selected point.

Roll (roll) your eyes without moving your head. Look into the upper left corner of your field of vision field and then move your eyes diagonally to the right bottom corner. It will take about six seconds.

Then return the eyes to the natural position and repeat it certain in the opposite direction from upper right to left bottom corner. (It will be eased

unilaterally in the long run overloaded and tired eye muscle). Eyes look to one side and then close the lids. Open eyelids and eyes look to the other side and again close the lids.

Blink in succession until you feel moisture in the corners of the eyes from shed tears. (It will save sufficient moisture on the surface of the eye, and ensure nutrition and thus corneal translucency). Regeneration and rehabilitation of the eyes when working with display unit needs to be done already while working with the display unit.

Telerehabilitation and Video Conferencing

During the ongoing COVID-19 pandemic, a new rehabilitation and education method called telerehabilitation is being brought to the forefront.

Telerehabilitation is the provision of rehabilitation services over a distance using telecommunications technology as the delivery medium. The scope of telerehabilitation includes patient examination, therapeutic interventions, patient performance monitoring, education, and patient training (Russell, 2007). Telerehabilitation has the potential to significantly increase the availability of the service because of its ample application options (Cox *et al.* 2018; Robinson, Williams, Curtis, Bridle & Jones, 2018). These include web applications, video conferences, telephone calls, virtual reality, and the use of sensors in mobile phones and other devices, such as heart rate monitors, accelerometers, and pulse oximeters (Wednesday & Hána 2016). Telerehabilitation programmes are highly beneficial for vertebrogenic algic syndrome patients in foreign and domestic video consultations with a therapist.

Telerehabilitation options – telerehabilitation must be supervised by a licensed therapist. Communication via telecommunication technologies can be divided into synchronous and asynchronous modes.

Synchronous communication – takes place in real time, with both parties engaged simultaneously, i.e. both the physiotherapist and the patient are online at the same time and communicate with one another, using mobile phones, computer video conferencing, or other mobile means. The so-called **asynchronous communication** comprises e-mail, discussion forums, text and multimedia messages (SMS, MMS, or other communication applications), e-learning, web applications designed for telerehabilitation, and virtual reality.

Web applications – a telerehabilitation option that has the advantage of widespread availability and the possibility of receiving automatic updates when connected to the internet. Another advantage is the automatic data transmission to a physiotherapist, who can immediately analyse them (Wednesday & Hana, 2016).

Video conferences – many studies dealing with patient telerehabilitation present video conferencing as part of a comprehensive programme associated with virtual reality, applications, or other telerehabilitation means (e.g. prescribed exercise programme or therapy session instructions). Video conferences can be used to consult a patient's condition and to evaluate changes in their health. In the context of video conferencing, Cox *et al.* (2018) also highlight the possibility of patients communicating with each other and passing information to one another.

Within telerehabilitation, accelerometers and pedometers are used most often to monitor vertebrogenic algic syndrome. Using pedometers is the cheapest and most widespread monitoring method. It is a widely-used device used for counting steps that can be connected to the phone via a mobile application using Bluetooth transmission, or a mobile phone application. It provides automatic feedback on a user's step count. Another monitoring option is the aforementioned accelerometer. As is the case with

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pedometers, patients usually wear accelerometers on their wrists or other parts of the body. However, accelerometers can provide a more accurate estimate of physical activity intensity and duration (Langer, Demeyer, Troosters, & Gosselink 2016). Telerehabilitation has great potential to overcome barriers associated with patient participation. Regular telerehabilitation also has the potential to improve patient adherence. If telerehabilitation was to become financially accessible in the future, it could become one of the available options as a viable rehabilitation alternative for patients with chronic vertebrogenic syndrome (Cox *et al.* 2018; Robinson, Williams, Curtis, Bridle & Jones 2018). It can be used via various software, such as a video conferencing system using Zoom, which allows all participants to be seen at once.

Telerehabilitation in a home training programme under the professional supervision of a physiotherapist would be provided in real time through video conferencing technology. The telerehabilitation means include web-based applications as well as communication means connecting the physiotherapist with the client in virtual reality.

Virtual reality is one of the latest available telerehabilitation means

The most common means used to mediate this therapy include a webcam, 3D virtual reality glasses, robotic gloves or video games simulating movements, such as those provided by the Nintendo Wii and Xbox gaming consoles. By playing games, clients get better, improve their muscle strength and limb functionality. To improve balance, various balance pads are used, which can be combined with 3D glasses (Středa & Hána, 2016). A study published by (Rutkowski *et al.* 2020) also examined virtual reality as an option for patient therapy. The authors used virtual reality to improve muscle strength, body stability, and balance. They concluded that the use of virtual reality by these patients was beneficial for their physical fitness.

Virtual reality system for the treatment of vision

Many people cannot see stereoscopic images in depth. The most common disorders begin already in childhood. Due to the disease COVID-19, the cause is also playing children on a computer and education from 3 years. Many children's eye diseases can be successfully treated by doctors only if they are revealed in time. Otherwise, they can permanently damage children's vision. Eye defects that are treated in children with visual therapy include, for example, amblyopia, squinting, eye movement disorders and other vision problems. Blurred vision is an eye mistake by which they suffer from about 2 to 4% of the child population. It causes the visual pathway of the eye to transmit to it visual stimuli, is not functional enough. The child does not have a sharp and spatial vision. One of eyes are more affected and need to be warmed up. Blurring may be associated with the occurrence of anisometropia, a significant difference in diopters between the eyes, and also in strabismus - squinting. Virtual reality (VR) systems have been developed to assess and treat anomalies in binocular vision.

Children are already being treated by playing in virtual reality. This minimizes their stress and children do not they do not realize that they are being treated at the same time. But according to the latest knowledge, not everything has to be lost even in the elderly. The virtual reality, the essence of which is the perception, can help three-dimensional image.

The principle of binocular vision is that the brain combines them into one visual sensation.

The Virtual Reality system is based on a systematic analysis of the subsystems from which stereoscopic vision depends: ability to converge correctly, appropriate regulation of suppression,

disparity extraction, use of disparity for depth perception and vergence control a combination of stereoscopic depth with another depth. Lack of any of these subsystems may cause stereo blindness or limit the performance of the tasks they require stereoscopic vision. The system uses VR games to enhance the features of specific and targeted subsystems.

Before the patient begins treatment with virtual reality, screening is done examination of the patient, which verifies his suitability for the given treatment and subsequently determines the treatment procedure. The examination verifies the ability of deep perception, which we must check and compare during treatment. The patient comes twice a week with that During one session, the eyesight is practiced, during which it is played using the Virtual System reality 45 minutes. Each patient is waiting for 10 to 12 sessions, after which doctors can verify positive effect of treatment. No side effects such as headache have been observed so far, eyes or dizziness. However, according to the results of previous studies, the effect of treatment may not be in the elderly people persistent and need to be repeated approximately every year.

The I-BiT™ system represents the first prototype VR-based computer system for the treatment of amblyopia, using dynamic stimuli with preferential stimulation of the amblyopic eye without the use of occlusion. This system was developed by a multidisciplinary team workforce, whose varied and unrelated skills have taken this project in a unique direction. It is exciting to be involved in new development which avoids occlusion and has the potential to improve vision in amblyopic eyes. Our early case studies are suggesting promising result.

The debate regarding the neuro-physiological basis of the stimulator continue but the authors take on board the fact that randomized control trials, which include a placebo treatment are necessary for future trials of the I-BiT™ system. As a result of the unknown mechanism of how our system works at a neuro-physiological level what constitutes a placebo treatment and a control is still under discussion. We would welcome contributions to this discussion. Further research is on-going to determine the tolerability and the efficacy of this new modality in the treatment of amblyopia.

The gold standard treatments in amblyopia are penalizing therapies, such as patching or blurring vision with atropine that are aimed at forcing the use of the amblyopic eye. However, in the last years, new therapies are being developed and validated, such as dichoptic visual training, aimed at stimulating the amblyopic eye and eliminating the interocular supression.

Dichoptic training using a virtual reality head mounted display seems to be an effective option of treatment in adults with anisometropic amblyopia. Future clinical trials are needed to confirm this preliminary evidence.

Artificial Intelligence

In the last decade, mobile companies have encouraged their customers through digital persuasion to use wearable technology in order to improve their physical performance and form healthy exercise and eating habits. Fitness trackers are a type of electronic wearable device that monitors and tracks health-related records such as steps, running distance, heart rate, calories burned, and sleep quality. The global market for these wearable devices sold hundreds of millions of devices in 2020, with a yearly increase of more than 50%. China is the largest manufacturer of smart devices on the market.

Many of these smart devices are able to identify muscle strain and remind users to practice the necessary exercises when they have been frequently using their mobile devices in a seated position. The sensors are able to transmit the data to the general practitioner's system in the event the patient's condition deteriorates.

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Advances in the miniaturisation of flexible electronics, biosensors, microfluidics, and artificial intelligence algorithms have led to wearable devices that can generate real-time medical data within the Internet of Things (Yetisen *et al.* 2019). Many fitness trackers are able to transfer data directly to a smartphone or computer, where they are subsequently evaluated. Wearable technological devices also include watches, trackers, hearing aids, thermometers, ECG devices, glucose sensors, head-mounted displays, subcutaneous sensors, electronic footwear, and electronic textiles.

These various wearable technological devices are constantly evolving, being modernised, and helping users lead a healthy lifestyle and maintaining medical data as part of the active monitoring of patients' health condition, metabolism, diagnosis, and treatment. The devices worn on the human body are able to monitor physical condition, physiological parameters and other characteristics, as well as professional rehabilitation. From the collected data, an exercise plan with video demonstrations that can be played on a mobile device or computer is then designed. When the parameters identified via artificial intelligence worsen, a treatment plan is designed instead.

Heart rate fluctuations are usually a natural occurrence in the body (in response to sleep or physical activity). However, unexplained heart rate fluctuations can signal various health problems, including viral infection. The authors in the publication (Radin *et al.* 2020) found that changes in resting heart rate and sleep patterns can predict seasonal influenza outbreaks *in real time*. The number of studies currently examining whether wearable devices can help identify the onset of coronavirus infection is increasing every day. Other studies are testing whether smartphones can help predict and detect the occurrence of COVID-19. When it comes to detecting COVID-19, a fitness tracker called WHOOP is showing promising results. This particular wearable device also uses a person's respiratory rate during sleep and heart rate data for monitoring purposes, as confirmed by clinical trials.

CONCLUSION

The present article is a summary of individual principles and procedures for computer use when working from home during the COVID-19 pandemic. It provides a narrower view of the issue at hand and shows room for improvement regarding care for the current population as part of the prevention of both vertebrogenic disorders and other associated diseases of the locomotor apparatus, and other disorders developed whilst working from home. Face-to-face interpersonal communication has transformed into human-machine communication. Proper understanding of the prevention and treatment process will significantly contribute to healthier computer use. It is necessary to educate people and enhance their knowledge about the need for proper regular physical activity.

The educational aspect is also important in terms of understanding the need for lifelong compensation and the future prevention of possible functional disorders related to a hypokinetic lifestyle and computer use. It is important that even children and adolescents observe these principles.

CONFLICT OF INTEREST

None

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Motives and barriers (kinesiophobia) for physical activity people training at the gym

Motywy i bariery (kinezjofobia) aktywności fizycznej osób ćwiczących na siłowni

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ABSTRACT

Introduction: Physical activity (PA) is one of the most important of health predictors. Exercising at the gym has gained popularity in the last few years. In this context all the motives as well as the barriers seems to be interesting while undertaking this form of activity.

Objective: It was decided to determine motives and barriers of PA of the people training regularly at the gym.

Materials and methods: 100 people aged 16 to 36 years old were examined. 27 women 21,4±1,8 years and 73 men 21,7±3,0 years. Qualification for research includement was at least 6 months of training experience and active participation in trainings. The research tool examining motives for physical activity was a questionnaire: The Motives for Physical Activity Measure – Revised (MPAM-R) and fear of movement was examined by: Kinesiophobia Causes Scale (KCS).

Results: According to MPAM-R the main motive for starting exercising at the gym was fitness. The level of kinesiophobia do not vary between women and men and in both sex is low. Multiple negative correlation of motives with kinesiophobia was found. PA is participated by people with high energetic resources, whom is taking serious care of their body. Actual percentage of women gym participation shows that motives for strength training are more complex and vary between sex.

Conclusions: People training at the gym are characterized by high level of self-motivation of PA. Social motive is the least important. Women present slightly higher level of motivation than men, especially in Fitness and Apperance motives. Number and time of workouts correlate only in men's group. People training at the gym tend to have low level of kinesiophobia.

Key words: motives for activity, kinesiophobia, barriers for physical activity

STRESZCZENIE **Wstęp**: Aktywność fizyczna (PA) jest jednym z kluczowych predyktorów zdrowia. Ćwiczenia na siłowni w ostatnich latach cieszą się coraz większą popularnością. W tym kontekście interesujące wydają się zarówno motywy jak i bariery towarzyszące tej formie aktywności.
Cel: Postanowiono zbadać motywy oraz bariery aktywności osób regularnie ćwiczących na siłowni.
Materiał i metody: Zbadano 100 osób (27 kobiet i 73 mężczyzn) w wieku od 16 do 36 lat regularnie ćwiczących w siłowniach. Motywy aktywności zbadano za pomocą The Motives for Physical Activity Measure – Revised (MPAM-R), strach przed ruchem – za pomocą zmodyfikowanej Kinesiophobia Causes Scale (KCS).
Wyniki: Głównym motywem podejmowania ćwiczeń na siłowni według MPAM-R był motyw fitness. Zarówno u kobiet jak u mężczyzn poziom kinezjofobii był niski, płeć nie różnicowała jej poziomu. Odnotowano liczne, ujemne korelacje motywów z kinezjofobią. Aktywność podejmują osoby o dużych zasobach energetycznych, troszczących się w sposób rzeczowy o swoje ciało. Aktualny wzrost uczestnictwa kobiet w ćwiczeniach na siłowni wskazuje, że motywy uprawiania ćwiczeń siłowych są bardziej złożone – nieco odmienne u obydwu płci.
Wnioski: Osoby ćwiczące na siłowniach cechują się wysokim poziomem motywów. Najmniejszą rolę odgrywa motyw: Social. Kobiety prezentują nieco wyższy poziom motywacji niż mężczyźni, szczególnie dotyczy to motywów: Fitness i Apperance. Motywy aktywności wykazują związki z liczbą treningów oraz czasem ich trwania tylko u mężczyzn. Osoby aktywne mają bardzo niski poziom kinezjofobii.

Słowa kluczowe: motywy aktywności, kinezjofobia, bariery aktywności fizycznej

INTRODUCTION

Physical activity (PA) is one of the main life style elements forming health (Knapik *et al.* 2009). Strength exercises as free time activity gained popularity in last years (Couhg 2020), and gyms are the most frequent places for recreation in free time (Featherstone 2010; Doğan 2015). Causes of popularity are diversified. Primarly body shaping possibility (Jakitic *et al.* 2018), and fact that excercises performed correctly, with proper metodology are fully safe activity (Faigenbaum 2010). An increase in numer of exercising women and elderly people is noticealbe over past years. Mainly becauese of advantages possibile to achieve by strength training, such as body shape improvement and correlated increase of self-esteem (Ziemianek *et al.* 2015), also limiting or even reducing process of sarcopenia (Frontera *et al.* 2012) and osteoporosis progression (Mosti *et al.* 2013). Also interesting is that strength exercises can be used as effective way to treat depression (Doyne 1987).

Motives of undertaking PA are vary. They are influenced by many factors such as age or sex (Kapcakova *et al.* 2015; Zach and Adiv 2015). However internal conditions correlated with personality seems to be crucial (Knapik 2011; Aaltonen 2014). The most important is to overcome barriers for PA which are in opposition to motives (Aaltonen 2014). Relation betwen motives and barriers for PA are poorly known so far. It constituted inspiration for examination of this problem. It was decided to determine motives and barriers for physical activity, if sex is differentiating factor and if they are correlated with training variables such as experience, number and time of workout.

MATERIALS AND METHODS

100 people resident in Poland, aged 16 to 36 years old were examined. The study group consisted of 27 women 21,4±1,8 yeras and 73 men 21,7±3,0 years. Participants were chosen randomly and selection was purposeful. Qualification for research includement was voluntary and at least 6 months of training experience and active participation in trainings.

The research tool was a questionnaire containing metric part and two standardized questionnaires: for motives examination The Motives for Physical Activity Measure – Revised (MPAM-R) were used, and for barriers for PA Kinesiophobia Causes Scale (KCS). First part included following data: gender, age, training experience, time and number of workouts per week.

MPAM-R Scale examines motives for undertaking PA. It is composed of 30 statements. Respondents answer to what extent they agree or disagree with, using scale from 1 to 7, where 1 is 'I disagree completely', and 7 'I agree completely'. Statements are signed to different domain-motives of PA. Domain score is average of all statements' scores assigned to this exact domain. Domains (activity motives) are: Interest/Enjoyment, Competence, Apperance, Fitness and Social (Frederick & Ryan 1993; Ryan *et al.* 1997). Higher score, means more important role of motive.

KCS examines degree of severity of PA barriers – fear of movement. According to authors of this research tool fear of movement – kinesiophobia result from biological, as well as psychosocial causes (Knapik *et al.* 2011). Scale is composed of 20 statements and respondents decise in what degree they agree or disagree. Using scale from 1 to 5. It allows to define activity barriers in two domains: biological and psychosocial. Domain score is average of factors' scores assigned to it. The biological domains contain factors: morphologic, need for stimulation, energetic resources, power of biological drives. Psychological domain factors: self-acceptance, self-assessment of motor predispositions and care of body. Higher score means higher level of kinesiophobia.

Statistical analysis

Descriptive statistics were done: mean, median, standard deviation and ±95 % CI. For comparison according to sex U Man-Whitney test was used. Dependences between variables were calculated with Pearson correlation. Statistical significance was: $p<0.05$.

RESULTS

Descriptive statistics of motives indicate that, regardles of sex, motive: Fitness indicates with the highest level. The lowest influence on undertaking PA in whole tested group had motive: Social. Sex was differentiating in two motives: Fitness and Apperance. In both cases women had higher values. Low correlation was regarded between motive: Interest/Enjoyment and time and number of workout session per week. Also, in men population, Competence motive had poor correlation with number of workout session. In kinesiophobia, there were no difference between men and women. Weak, negative correlations were recorded in energetic resources, self-acceptance factors and time of workout (Table 1).

Correlations between motives were also analyzed (Table 2). A very strong correlation between motive: competence and motive: Interest/ Enjoyement for both genders is noticeable.

Dependance of PA motives and Kinesiophobia analysis indicated various correlations, All of them were negative. The most correlations were nocticed between fitness and competence motives. Lack of kinesiophobia correlation of motive: social is drawing attention to (Table 3).

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Table 1. Descriptive statistics of PA motives and kinesiophobia, their comparison in context of sex and their correlation with training variables

Scale: Domain	Sex	Mean (SD)	Median	±95% CI	Sex -p:	training variables:		
						1	2	3
MPAM-R: Fitness	f	6.66 (.63)	7.00	6.41-6.91	**			
	m	6.25 (.83)	6.40	6.06-6.45				
MPAM-R: Interest/Enjoyment	f	6.12 (1.03)	6.43	5.71-6.53				
	m	5.82 (1.07)	6.00	5.57-6.07			**.313***	**.343***
MPAM-R: Competence	f	6.06 (1.15)	6.57	5.60-6.51				
	m	6.01 (.99)	6.29	5.77-6.24			**.336***	
MPAM-R: Appearance	f	6.10 (1.13)	6.50	5.66-6.55	*			
	m	5.78 (.92)	6.00	5.56-5.99				
MPAM-R: Social	f	4.37 (1.41)	4.40	3.81-4.93				
	m	4.28 (1.47)	4.20	3.94-4.63				
KCS: morphologic	f	1.50 (.59)	1.50	1.27-1.73				
	m	1.53 (.77)	1.00	1.35-1.71				
KCS: need for stimulation	f	1.77 (.87)	1.67	1.42-2.11				
	m	2.02 (.98)	2.00	1.79-2.25				
KCS: energetic resources	f	1.47 (.79)	1.25	1.16-1.78				
	m	2.20 (1.12)	2.00	1.76-2.65				**-.348***
KCS: power of biological drives	f	2.20 (1.12)	2.00	1.76-2.65				
	m	2.20 (.86)	2.00	2.00-2.40				
KCS: BIOLOGICAL DOMAIN	f	1.74 (.86)	1.63	1.47-2.00				
	m	1.81 (.62)	1.69	1.66-1.95				
KCS: self-acceptance	f	1.93 (.97)	2.00	1.54-2.31				
	m	1.82 (.82)	2.00	1.63-2.01				**-.347***
KCS: self-assessment of motor predispositions	f	1.70 (.94)	1.33	1.33-2.08				
	m	1.73 (.92)	1.33	1.51-1.94				
KCS: care of body	f	2.05 (.85)	2.00	1.71-2.38				
	m	2.25 (.83)	2.25	2.06-2.45				
KCS: PSYCHOLOGICAL DOMAIN	f	1.89 (.79)	1.83	1.58-2.11				
	m	1.93 (.69)	1.75	1.77-2.10				

Legend: f – female; m – male; 1 – experience; 2 – number per week; 3 – training time; ***p<.05;** ****p<.01**

Table 2. Self-correlation of motives for exercising at the gym

Motive	sex	fitness	Interest/Enjoyment	Competence	Apperance
Interest/Enjoyment	female	**.430***			
	male	**.660****			
Competence	female		**.826****		
	male	**.629*****	**.837****		
Apperance	female	**.726*****	**.525****		
	male	**.419*****			
Social	female		**.450***	**.472***	
	male	**.361****		**.411*****	**.615*****

p<.05; **p<.01; ***p<.001

Table 3. Correlation of motives of PA and factors and domains of kinesiophobia

KCS: factors and domains	Sex	MPAM-R				
		Fitness	Interest/ Enjoyment	Competence	Appearance	Social
morphologic	female					
	male					
need for stimulation	female	**-.502****	**-.437***		**-.598****	
	male			**-.340*****		
energetic resources	female	**-.492****	**-.403***	**-.337****	**-.602****	
	male					
power of biological drives	female					
	male					
BIOLOGICAL DOMAIN	female	**-.452***			**-.593****	
	male			**-.387*****		
self-acceptance	female					
	male			**-.333****		
self-assessment of motor predispositions	female	**-.643*****	**-.481***		**-.644*****	
	male			**-.308****		
care of body	female	**-.455***			**-.538****	
	male			**-.418*****		
PSYCHOLOGICAL DOMAIN	female	**-.509****			**-.564****	
	male		**-.311***	**-.434*****		

*p<.05; **p<.01; ***p<.001

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DISCUSSION

Health is a well-being in physical, mental and social aspects. In that case pro-health behaviour analysis should consider all of three aspects. It refers to issues related with PA, which are some of the most important forming health factors (Loverty, Wright 2010).

For both sex in study group, values indicating motives intensification presented – according to applied scale, very high values for motives such as: Fitness, Interest/Enjoyement, Competence, Appearance (Table 1). It shows that this kind of PA is popular among people having high level of energetic resources, whom are taking serious care of their body. It is proved by high, negative correlation in kinesiophobia factors in women population: need for stimulation, energetic resources, self-assessment of motor predispositions and care of body (Table 3). Presented results respond with Doğan research (2015). According to this author, people excercising at the gym see theirself as efficient and productive. They believe that workouts improve their fitness as well as affect positively their metal and emotional efficiency, what improves their life control. Presented results seems to be analogous to Ziemianek *et al.* (2015) observations. Authors, based on empirical research, stated that people excercising at the gym have good level of self-esteem and self body control.

Comparision of motives according to sex, showed differences in motives: Fitness and Apperance, which had higher values in women population. It is very interesting observation. Previously gyms were associated with building typical men features, such as physical strength and male muscular body. Actual increase of women participation in exercising at the gym indicates that motives for PA are more complex and sligthly different for both sex. It was revealed that motive: Interest/Enjoyement was correleted with time and number of workouts in men population. Correlation between motive: Competance and number of workouts were also indicated, as well as correlation of motive: Fitness and motive: Social. It suggest 'traditional' motives in men population. In women population there wasn't such correlation.

Higher values of motive: Apperance should be explained by importance of look in present female body model. It is important for women to control body weight and to have slim figure. Womens exercising at the gym prefer gaining their goals by activity (Table 2). To sum-up aspects of motivation – the number of men exercising at the gym still prevail, however women whom exercise show higher motivation than men.

In consideration of accepted scale, study group presented low level of kinesiophobia. It was determined by purposed selection of young and regularly active people. In research on wide population of both sex, considering people of different ages, Knapik *et al.* (2013) noted higher level of kinesiophobia among women. In this research there were no such differences. Among women there were no correlation between kinesiophobia and workout varibles. Among men population, kinesiophobic factors: energetic resources and self-acceptance were correlated negatively with the time of workout unit. According to this, men with high energetic resources and high level of self-acceptance are willing to spend more time for workout. All noted negative correlations between motives for PA and kinesiophobia seems to be natural according to research selection. Lack of correlation between factor: morphologic and PA motives draws attention. It is explained by descriptive statistics – this factor presented minimal level of presence.

CONCLUSIONS

People training at the gym are characterized by high level of motives. Motive: Social is the least important. Women present slightly higher level of motivation than men, especially in motives: Fitness and Apperance. Number and time of workouts correlate only in mens' group. People

training at the gym tend to have low level of kinesiophobia.

CONFLICT OF INTEREST

There is no Conflict of Interest.

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Why do nurses migrate?

Zašto sestre migriraju?

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ABSTRACT **Introduction:** Sisters from middle-developed countries are migrating en masse to developed European countries.
Research objectives: The aim of our work was to examine what are the most important reasons for their departure.
Materials and methods: The survey was conducted through a questionnaire of nurses who migrated from Serbia and Bosnia and Herzegovina. 108 respondents participated and agreed to fill out the questionnaire.
Results: Most nurses work in Germany and Norway. The average working life in the profession before leaving was 6.8 years. The most common reasons are of a material nature, the desire to provide children with better conditions, overwork in the old workplace and insufficient funds for work.
Discussion: The nurses leave because of dissatisfaction with their income and working conditions. Their migration leaves the state without a much-needed profession. They leave with their families and children. What is devastating is that half of them have no intention of returning to their homeland at all.
Conclusion: It is necessary to improve working conditions and the incoms for the nurses. If the countries from which the nurses leave do not provide better working conditions for the nurses, they will soon face a serious shortage of medical staff.

Key words. Nurse. Emigration. Reasons.

APSTRAKT **Uvod:** Sestre iz srednje razvijenih država masovno migriraju u razvijene europske zemlje.
Cilj: našeg rada bio je da ispitamo koji su razlozi najznačajnji za njihov odlazak.
Materijal i metode: Ispitivanje je sprovedeno putem upitnika kod sestara koje su migrirale iz Srbije i Bosne i Hercegovine. Učestvovalo je 108 ispitanika koji su pristali da popune upitnik.
Rezultati: Najviše sestara radi u Nemačkoj i Norveškoj. Prosečan radni vek u struci pre odlaska je bio 6.8 godina. Najčešći razlog je materijalne prirode, želja da se deci obezbede bolji uslovi, preopterećenost na starom radnom mestu i nedovoljno sredstava za rad.
Diskusija: Sestre odlaze zbog nezadovoljstva primanjima i uslovima na poslu. Njihov odlazak ostavlja državu bez preko potrebne profesije. Odlaze sa porodicama i decom. Ono što je poražavajuće je, da polovina njih nema uopšte nameru da se vrati u domovinu.

Zaključak: Neophodno je poboljšati radne uslove i primanja sestara**.** Ukoliko države iz kojih sestre odlaze ne obezbede bolje uslove za rad sestara, ubrzo će se suočiti sa ozbiljnim nedostatkom zdravstvenog kadra.

Ključne reči. Sestre. Emigracija. Razlozi.

INTRODUCTION

When comparing the number of employees in health care institutions in Serbia in ten years, a decrease in the number of employees from year to year is noticeable. The total number of employees in the Republic of Serbia's health care system (health institutions in the Network Plan) in 2009 was 114,175, while in 2018, there was a decrease in the total number of employees by 12,677. As for doctors, in this period their number decreased by 842. The total number of nurses, regardless of education level, decreased from 2009 to 2018 by 3,162 (Zdravstveno-statistički godišnjak, 2019). A similar situation is in the majority of other ex-Yugoslav countries. International migration has always existed, primarily as a means to find economic opportunity (Zolot 2019; Goriot *et al.* 2017). Ex-Yugoslav nurses have been traditionally well educated in nursing. Good practicing skills and the nursing deficit are why they can easily employ in developed EU countries.

The migration of health personnel is present worldwide (Takeno, 2010; Galbany-Estragués et al., 2019). Better understanding of the reasons for mobility could help policymakers to design nursing retention programmes and ensure the sustainability of the health care system (Galbany-Estragués et al, 2019).

RESEARCH OBJECTIVES

To see out the why nurses migrate, how satisfied they are at the new place and under which conditions they would return to their homeland.

MATERIAL AND METHODS

The research was performed in the spring of 2020 year. The target population was nurses who left their nurses' jobs in Serbia and Bosnia and moved to developed countries.

The study was cross-sectional, based on a questionnaire survey. Participants' inclusion criteria were willingness to participate, aged 20–65 years (the active age group), and full-time or part-time employment as a health worker in developed European countries. The questionnaires, constructed for this purpose, were distributed through social networks to nurses-technicians. The questionnaire contained 16 questions related to three sections: the first is related to the nurses' characteristics, including sex, age, the years of work experience in the homeland, level of health institution they were employed in, the period of immigration, the country they work at the present amount. The second focused on the reasons they left their homeland. The third included questions regarding their satisfaction with the new work and intention to come back.

The questionnaires not completely fulfilled were not included in the analysis.

All data were coded, entered, and analyzed using SPSS version 20 (SPSS Inc) and Microsoft Office Excel 2010 (Microsoft Corporation, Redmond, WA, USA).

RESULTS

The questionnaire was delivered to 125 addresses, fulfilled and returned by 108 nurses (86.4%).

The results are classified into three sections.

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Section 1 (the nurses' characteristics, including sex, age, the years of work experience in homelans, level of health institution they were emploied, the period of imigration, the country they work at the present amount)

Slightly less than two thirds of participants were females (69, 63.9%).

The respondents' average age was 35.7 years, with the youngest respondent being 24 years old and the oldest 50 years old. Most respondents were in the age group of 30 to 39 years.

Before living, the participants worked in the homeland for an average of 6.8 years. 8.3% worked before leaving for more than 20 years (graph 1). 82 (75.8%) nurses worked in state-owned health institutions (57.6 stationary, 18.2% outpatients clinics).

When filing the questionnaire, 45% of nurses lived abroad for 1 -5 years, 40% for 5-10 years, and only 5,7% had been abroad for more than ten years. 69.4% of nurses migrated to Germany, 30.6% to Norway.

Section 2 (the reason for migration)

Participants had the possibility to mark more answers to the question: the main reason for leaving. The reasons for emigration were mostly economic (83,3%), followed by- for the safe future of children (58.3%), working conditions (47.2%), and political situation (47.2%) (Graph 2). 30.6% wanted to change something, 11.1%left the country for family reasons.

The main reasons for dissattisfaction at work at homeland were: financial situation (91.7%), overload at work (61.1%), lack of work equipment (55.6%), inability to be promoted at work (52.8%). 38,9% of participants mentioned insufficient number of nurses mentioned (Graph 3). From the other hand, most of the nurses were satisfied with relationship with colleagues (83.3%). Only 5.6% of nurses were satisfied with amount of working duties and only 2.9% with possilility to get a promotion at work (Graph 4).

Section 3 (Satisfaction with the new work and intention to come back)

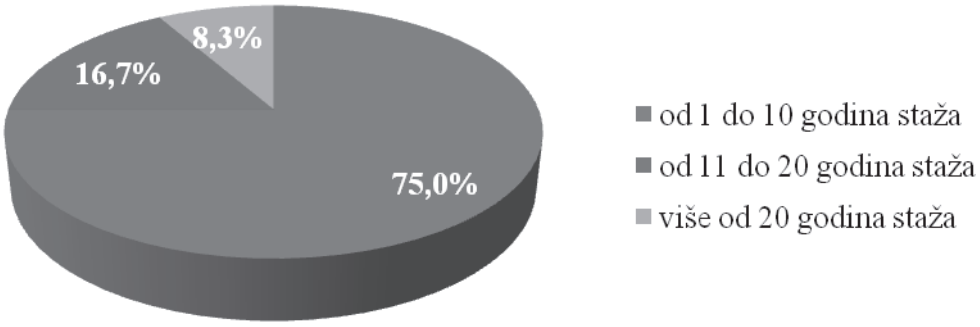
After emigration, 77,1% of nurses consider that the new environment fulfilled their expectation completely, 22.9% partially. No one failed according to expectations (Graph 5)

52,8% of nurses do not plan to ever return to their homeland. Only 16.7% intend to return to their homeland after retirement, while 30.6% does not know (Graph 6). When asked under which conditions, they would return to their homeland, 38.9% did not answer et al. From those who responded, 28% said they do not intend to return to the motherland. The rest of 33% of respondents stated the conditions under which they would be willing to consider comeback:

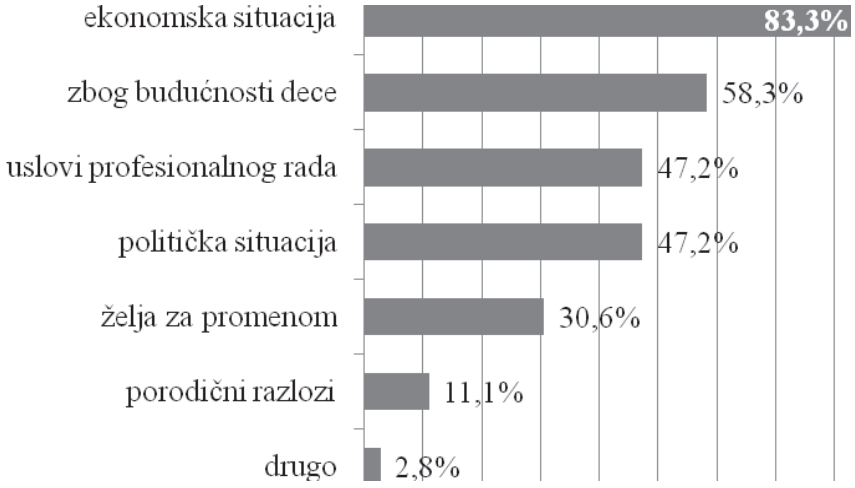
The better financial situation (55,6%)
Radical changes, no political pressure (16.7%)
Better working conditions (16.7 %)
Easier finding and getting the job (5,5 %)
Change rewarding at work (5,5 %).

DISCUSSION

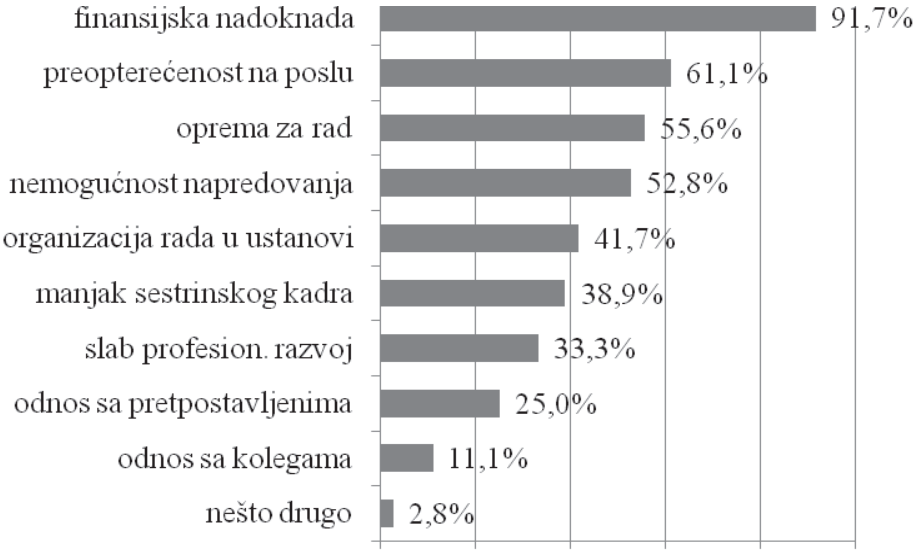
The migration of health professionals has a long history (Takeno 2010; Nelson 2013; Zolot 2019; Chiati 2019). Europe has seen an increase in migration among health professionals, which can be traced to the global financial crisis that began in 2008 and to EU expansion (OECD 2015; Galbany-Estragués & Nelson 2016). Similar situation is in Serbia. The emigration of nurses from Serbia is a problem lasting for several years. Every nurse who emigrated took with her years of experience, professional skills, personal and professional contacts, and communication skills. Developed nations have seen a 60% increase in foreign-educated healthcare professionals since 2010 (Zolot 2019). The reasons for emigration may be different. Nursing emigration from Spain is linked to job security (Galbany-Estragués & Nelson 2018). Between 2009 and 2014, job



Graph 1 Years of work experience in homeland before living (Source: own research)



Graph 2 Reasons for migration (Source: own research)



Graph 3 The reasons for dissatisfaction at work in homeland (Source: own research)

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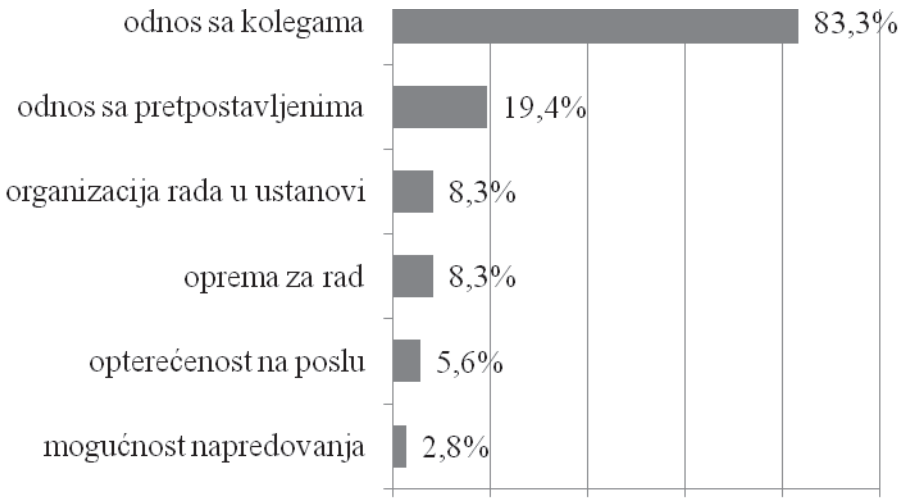
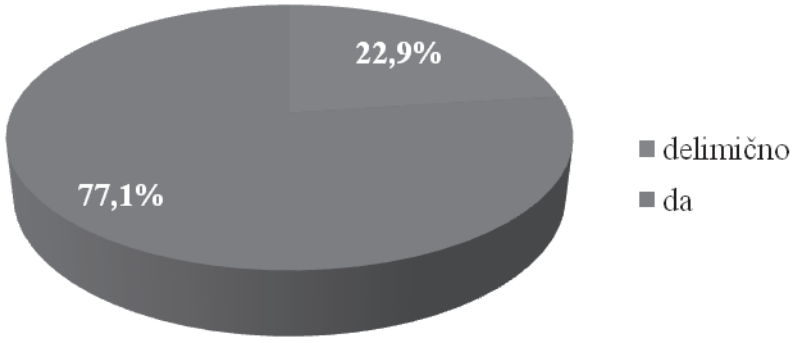
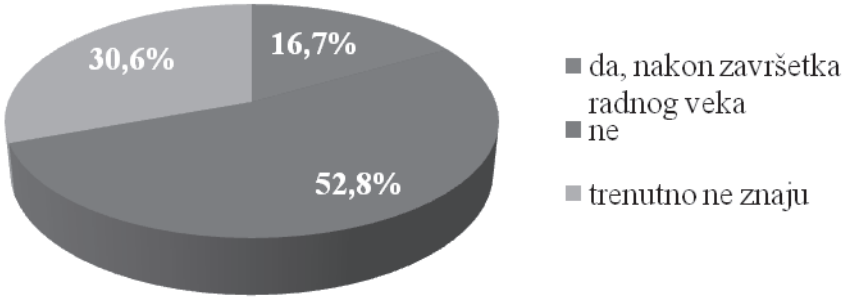


Graph 4 What are the best rated aspects of job satisfaction in Serbia (Source: own research)



Graph 5 The fulfilled expectations after the change in the environment (Source: own research)



Graph 6 Intention to get back to homeland (Source: own research)

security worsened due to the decrease in public spending, labor market reforms and the transformation of the health system, which all took place in reaction to the economic crisis (Galbany-Estragués & Nelson 2016). In Lebanon, the main reasons for migration included: shift work, high patient/nurse ratios, lack of autonomy in decision-making, lack of a supportive environment, and poor commitment to excellent nursing care (El Jardali *et al.* 2008). In Slovenija, the reasons for their relocation were different: family reunification, job search and personal causes, which were probably conditioned by their living conditions in the country from which they moved. A similar situation is in Lituania (Goštautaitė *et al.* 2018), Romania (Suciu *et al.* 2017). In ex-Yugoslav countries, Bosnia and Hercegovina and Serbia are the countries in transition in the joying EU. They struggle with many problems in health system, one of them being emigration of health workers. The departure of nurses from Serbia is a problem lasting for several years. Every nurse who emigrated took with her years of experience, professional skills, personal and professional contacts, and communication skills. Therefore, our intention was to investigate the main reasons for emigration, as well as possibilities to keep them in homeland. Among those with low income and Similar situation is in Serbia.

Based on most of the above research, the nurses emigrated mainly because of economic reasons. This is a situation conditioned by the economic development of the state. However, the work of a nurse is very demanding. Although in most ex-Yugoslav states, most nurses work with secondary school (nurse assistant in EU countries), they are qualified, the competencies are wide, and their responsibility is great. Unfortunately, they are underpaid. The health care system in developed countries requires an increasing number of qualified health workers because of the permanent increasing health care level and aging population. Due to this, and the fact that developed countries appreciate nurses' work and can reward it, health workers' status in these countries is much better than in middle developed countries like Serbia and Bosnia. Middle developed countries that educate nurses and then let them to leave will inevitably face a shortage of nurses shortly.

Another reason for dissatisfaction and emigration is overwork and insufficient equipment for work. The management of health institutions is to blame for these factors. Unfortunately, the managers of health institutions are usually doctors, who are not sufficiently educated to manage the health institution, while in developed countries, health institutions are usually managed by experts specially trained in management. These results are in agreement with the study performed with sisters working in Serbia.

In a Serbian study, the lowest scores given by respondents are in the domains of salary, a reward for work well done and working conditions (Joković *et al.* 2018).

CONSLUSSION

In this paper, we examined why sisters migrate to developed European countries. We found that it was a better salary in the first place and dissatisfaction with overwork and lack of equipment for work at the second place. Although the income depends on the country's economic development, a nurse's job needs to be valued more for the sisters to stay in the motherhood that educated them. Better conditions and equipment at work are something that depends on the management of health institutions. Until enough attention is paid to this, the sisters will continue to go to countries that provide them with better job opportunities.

CONFLICTS OF INTEREST

There is no conflict of interest.

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2 Salát D. (2015). Základy farmakoinformatiky (Basis of pharmacoinformatics). p. 173-185. In: Beňo P, Šramka M, Sabová A., Tomić Z, Salát D. Všeobecná farmakológia pre zdravotnícke odbory (in Slovak): Typi Universitatis Tyrnaviensis a VEDA SAV. 204 p. ISBN 978-80-8082-944-5.

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4 Mládková L (2014). Tacit knowledge – the human dimension of knowledge. New Delhi: Asian Research Consortium; 2014 [online] [cit.2016-06-12]. Available from:
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Revamil®

A care

Revamil je hydrofilný produkt, ktorý obsahuje 100% sterilný lekársky med, ktorý je získavaný z kontrolovaného chovu včiel, neobsahuje stopy pesticídov. Je určený na ošetrenie akútnych a chronických rán, infikovaných rán a popálenín. Rýchle hojenie je dosiahnuté v kombinácii vlhkého prostredia rany, antibakteriálnych vlastností a protizápalových účinkov prípravku Revamil.

Indikácie

- ošetrenie akútnych a chronických rán – dekubity, chronické vredy, vredy diabetickej nohy, vredy predkolenia, onkologické rany, chirurgické rany, infikované a nekrotické rany, ošetrenie popálenín (aj po opaľovaní)
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- Redukuje zápach
- Bez alergických reakcií a vedľajších účinkov

Revamil sa z veľkej časti skladá z cukrov, malého množstva vody, organických zlúčenín a enzýmov. Enzým glukooxidáza sa do medu dostáva prostredníctvom včiel a spoločne s ďalšími faktormi zaisťuje antibakteriálny účinok Revamilu. Pri kontakte s ranou sa med rozriedi s vlhkosťou rany a aktivuje sa enzým glukooxidáza. Enzým glukooxidáza je zodpovedný za kontinuálnu tvorbu veľmi malého množstva peroxidu vodíka (0,003%). Táto koncentrácia peroxidu vodíka je dostatočne vysoká na to, aby usmrtila patogénne baktérie a naopak nepoškodila ranu vo fáze hojenia.

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