

Health in digital environment: Challenges and solutions

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ABSTRACT

Office work is associated with movement restrictions, muscle stress, burnout and other risk factors that negatively affect the health of working - age people. The coronavirus epidemic has changed the labour market: neither employers nor employees were prepared to tackle the challenges of moving to remote work. Therefore, search for solutions to preserve health of remote workers in the context of self-isolation and digital transformation is a priority medical and social task. Pilot research for examination of the office-workers state included interviews, psychological, neurological tests and methods of instrumental visualization. The aim of the study was to identify the signs of the emotional impact of remote work and develop exercises to prevent physical inactivity, as well as technologies for monitoring of individuals' health. The survey revealed that 80% of office workers have stress and burnout in an epidemic situation, as well as a loss of interest in work and professional achievements. Burnout was accompanied with increased irritability, sleep disorders. Neurological examination revealed muscle spasms and "tunnel" neurovascular disorders in the cervical spine and postural displacement in all persons. Electrophysiological research indicated cerebral acidosis and brain hypoxia in 50% of examined individuals. The programs for postural correction and cerebral metabolism included special coordination and breathing exercises. Recommendations to healthy lifestyle and workplace reorganization were given to all persons. Digital transformation is a challenge that requires changes in legal, organizational, psychological and infrastructural approaches to preserve the health of remote workers in the new environment.

Keywords: Sport medicine, Digital transformation, Office work, Postural stress, Coordination gymnastics, Breathing gymnastics, Remote workers.

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INTRODUCTION

The beginning of the 21st century was marked by the rapid development of information and communication technologies (ICT), labour automation, which changed all spheres of the economics and led to creation of new digital professions. Office workers had become in demand at every enterprise, due to the introduction of electronic document management and big data processing. Business centres and offices were opened everywhere, often in unsuitable premises, in place of “repurposed” industrial facilities, with large non-segmented spaces (open space), or, conversely, with “closed” spaces without natural light, ventilation and other violations of occupational health / technique of industrial safety.

Office work became attractive and prestigious, but, from the other side, it was associated with certain health affected risk factors. Staying at the computer for 8 hours and more, physical inactivity at the working place (postural stress), discrepancy of the ergonomic parameters of the workplace with the expected norms, emotional burnout; sleep and eating behaviour disturbances: irregular schedule, many allergens - this is not a complete list of risk factors that negatively affect labour productivity and professional longevity in general.

Psychologists, neurologists and psychiatrists sounded the alarm because they identified a kind of professional stress in office workers, which was characterized by a triad of manifestations. This complex of psychological, psychosomatic and behavioural disorders, which has developed in office workers due to the impact of various factors of the working environment, has received the definition of “office syndrome” (Danilov et al., 2011; Dontsov et al., 2016). Psychological manifestations included emotional outbursts, impaired concentration, loss of self-esteem and self-confidence, feelings of inadequacy, helplessness and guilt, and anxiety) (Baksansky et al, 2021). Physical manifestations of office syndrome included back pain, muscle tension, stiffness in the body, headaches, insomnia, chronic fatigue, increased blood pressure, the development of varicose veins. Behavioural manifestations were characterized by a loss of interest in work, decreased in labour activity and criticality, loss of punctuality and neglect of duties, eating disorders - switching to fast food, constant increasing use of coffee and alcohol (Janwantanakul et al., 2011).

The term “burnout”, coined by H. Freudenberger (Freudenberger et al., 1974) and K. Maslach in the 1980-90s (Maslach et al., 1996; Maslach et al., 2001), also proved to be very appropriate in the “office context”. This term was suitable to describe certain psychological states observed in people working both in the system of helping professions “person-person” (Vlakh et al., 2015) and in the system of digital technologies “person-computer”. The risk group began to include office workers: digital specialists, managers, dispatchers, bank employees, accountants, whose work is associated with labour automation, physical inactivity, stereotyped movements and at the same time, with great responsibility. The COVID-19 epidemic affected not only the population’ health, but also had a significant impact on the labour market: in the face of an unexpected and emergency epidemic situation, young and middle-aged office workers were transferred to remote work. In general, 2020 saw a surge in international activity on remote work issues as a timely, natural response of governments and international organizations to the coronavirus epidemic. The conditions of self-isolation became a real challenge for both employers and employees, who were not ready to solve all the problems associated with organizing “home offices”, both in legal, organizational and psychological terms.

According to a survey, conducted by the Society for Human Resource Management (SHRM), 71% of employers experienced difficulties switching to remote work; 65% of them noted that it was difficult to maintain the morale of their team, and more than a third have faced the difficulties associated with the corporate culture and productivity of employees and the regulation of vacation time (SHRM, 2021).

In the Russian Federation, a sharp jump in the volume of remote work in 2020 was also due to the spread of coronavirus infection. Since the prevalence of COVID-19 was the highest in Moscow, strict requirements were introduced for the transfer of employees to remote work. Moscow employers were obliged to transfer at least 30% of employees to a remote work format. About 40% of employers practiced remote work in their team in October 2020, and already 51% of employees worked remotely in December (Kotyakov, 2020; Bill No 973264-7, 2020). By May 2021, most enterprises retained a “*hybrid*” work format.

Therefore, study of psychological stress impact and search for solutions to preserve health of remote workers in the context of self-isolation and digital transformation is a priority medical and social task of our days.

Aim of the study

To study the impact of remote work on health, identify the signs of the emotional burnout and develop solutions for the prevention of physical inactivity as well as technologies for monitoring of individuals’ health in digital environment.

MATERIALS AND METHODS

52 patients (35 women and 17 men, age of 42 ± 8 years, (office staff, remote workers) with combined myofascial pain in the cervical part of the vertebral column and burnout were examined. Idea of the pilot project was to create new protocol, including screening technologies (Safonicheva et al., 2015; Janda, 1983).

Methods of investigation of the remote office-workers state included interviews, psychological, neurological tests and methods of instrumental visualization. Clinical neurological study was performed, according to the generally accepted scheme and principles of functional medicine, systematized at the Departments of Sports Medicine and Medical Rehabilitation (Safonicheva, 2020). Pilot research was organized in I.M. Sechenov Moscow State Medical University (Sechenov University of Life Sciences).

1) The neuropsychological study was carried out to examine the cognitive sphere, emotional stability of patients.

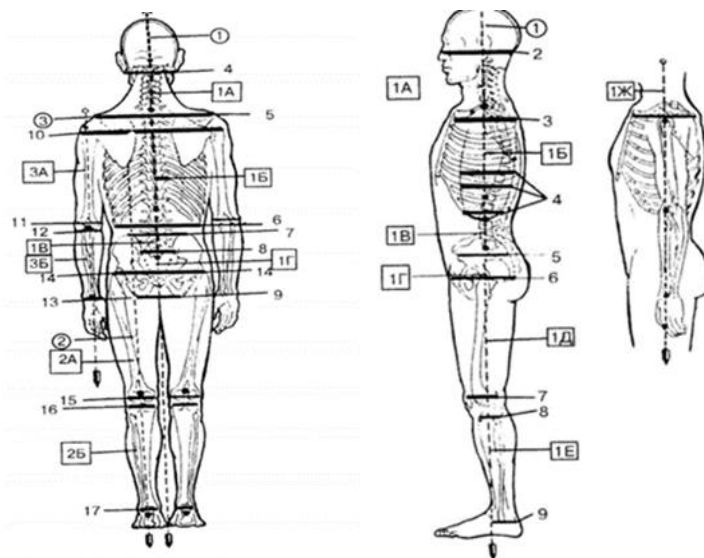


Figure 1. “Norm model of optimal body posture”.

2) Visual diagnostics and kinesiological testing were performed on the basis of the three-dimensional coordinate axis method (Kogan et al., 1991) to compare the body position of patient in the “*initial state*” with the “*Normative model of optimal body posture*” (Figure 1).

Method of visualisation allowed to assess the condition of all vertebral regions, symmetry of the shoulder girdle line for revealing a violation of posture, postural muscle imbalance, and pelvic dysfunction. Optimal body posture is an important condition for global circulation in blood system (“*closed loop*” system) and in lymphatic system (“*open loop*” system) to keep homeostasis and mechanisms of self-regulation at the optimal level. Cerebral metabolism, brain plasticity, neurogenesis and brain development are depended on blood circulation (supply of oxygen, plastic substances) and venous, cerebrospinal and glymphatic fluids timely outflow, which is especially important to the brain (Safonicheva et al., 2015). Optimal body posture - “*corridor of norm*” is important condition for health protection (Safonicheva, 2000; Ivanichev, 2011).

3) Clinical neurological examination was conducted to identify the role of myotonic “*compression-tunnel*” syndromes in the cranial-vertebral region and biomechanically significant disturbances in the cervical spine for affecting the cerebral blood flow (Kipervas, 1991). Kinaesthetic diagnostics was carried out using the methods of palpation to assess the level of sensitivity, skin turgor, kinetics of superficial and deep fasciae of the neck, state of tone and local tension (Janda, 1985).

4) The purpose of the neurophysiological examination of the patients by the neuro-energo-cartography (NEC) method was to assess the cerebral metabolism, adaptive capabilities of the brain, as well as interhemispheric interactions in the initial state and after the rehabilitation measures. The check was carried out on a computer software system NEC, created in the laboratory of age physiology of the brain Research Centre of Neurology (under the guidance of professors V. F. Fokin and N.V. Ponomareva, patent № 2135077 A61B5 / 04, 08.27.1999).

It is known that one of the main links in the development of pathological processes can be a deficit in the delivery of energy substrates and violation of the oxygen supply of brain structures, as well as a change in the acid-base balance at the border of the blood-brain barrier. NEC-method was registered the constant potential level (CPL) — the slow electrical activity, reflecting the integrated metabolism of various brain zones (Fokin et al., 1999). The detector of material energy processes in the brain was considered to be the CPL - the magnitude of the stable difference in the mV range, which is recorded between the brain and the referred area. According to CPL – amplitude, we could measure the degree of acidosis in the brain tissues. Sources of CPL were the potentials of the blood-brain barrier and vascular potentials in referred area. The registration was carried out at the NEC computer - software complex.

CPL of the brain is a type (variability) of slow electrical processes, it integrally reflects the membrane potentials of neurons, glia and blood-brain barrier. The main potential-organizing ions for CPL - are the ions of Hydrogen (Fokin et al., 2002). CPL registration was carried out in five leads: frontal, central, occipital, and two temporal – right and left (Fz, Cz, Oz, Td, Ts), according to the 10-20 scheme. The projections of the CPL-recording areas correspond to the main cerebral arteries: the anterior cerebral (two), middle cerebral (two) and vertebral basilar (Figure 2).

The process of venous blood and cerebrospinal liquor outflow restriction lead to changes in acid-based balance in the brain tissues – to brain hypoxia and acidosis (oxygen and glucose insufficiency).

THE NEURO-ENERGO-CARTOGRAPHY (NEC) method

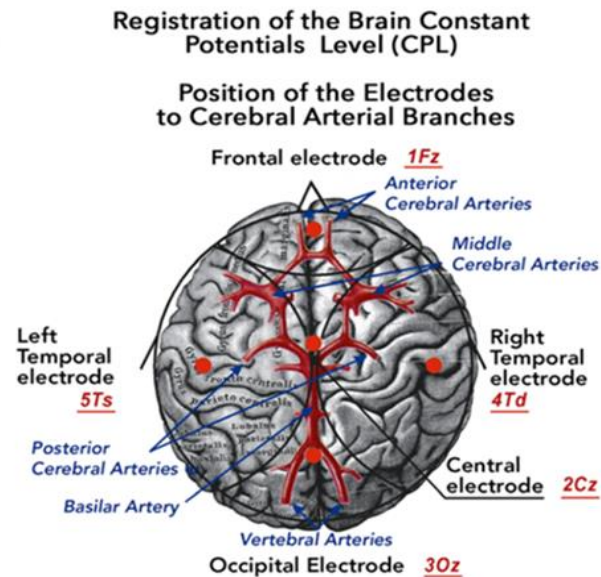


Figure 2. CPL scheme registration.

RESULTS

The survey revealed that 80% of office workers have stress and “*burnout*” in an epidemic situation, as well as a loss of interest in work and professional achievements. Burnout was accompanied with increased irritability, sleep disorders. Main complains in patients were: headache, fatigue, memory, eating behavioural disorders. All patients had impairments in cognitive, emotional, and personal status; violation of the motivational sphere, decreased concentration of attention and loss of interest (this even related to taking care of their own health). Somatic disorders were revealed in all patients: persistent muscle pain, a sense of “*stiffness*”, frequent pain (thorax, cervical, lumbar spine), various joint pain (without redness), shortness of breath.

Clinical neurological examination has revealed biomechanical markers – muscular hypertension, rigidity in the shoulder girdle, elevation of the upper aperture structures, chest kyphosis, as well as multilevel myotonic and neurovascular “*tunnel*” syndromes in the cranial-vertebral zone and cervical spine. Muscle spasms, the fascia and cranial membranes kinetics restriction contributed to slowing down the cerebral blood flow and obstruction of venous outflow. Thus, the connection between burnout, pain syndrome, vascular insufficiency in the vertebral-basilar area and biomechanical changes (postural stress) in cervical spine was detected.

According to the results of NEC-method in 52 patients (age of 42 ± 8 years), changes in cerebral metabolism were detected with manifestations of brain hypoxia on the background of varying degrees of acidosis.

The digital indicators of the acid-base balance in the NEC- method were translated into colour. The acid-base balance shift in the direction of acidosis (lowering the pH and increasing the CPL) was painted in a yellow-red-brown range of colours. When the brain used more reserve mechanism of energy exchange, the redder it was painted on the picture, the higher the CPL was registered (Figures 3, 4).

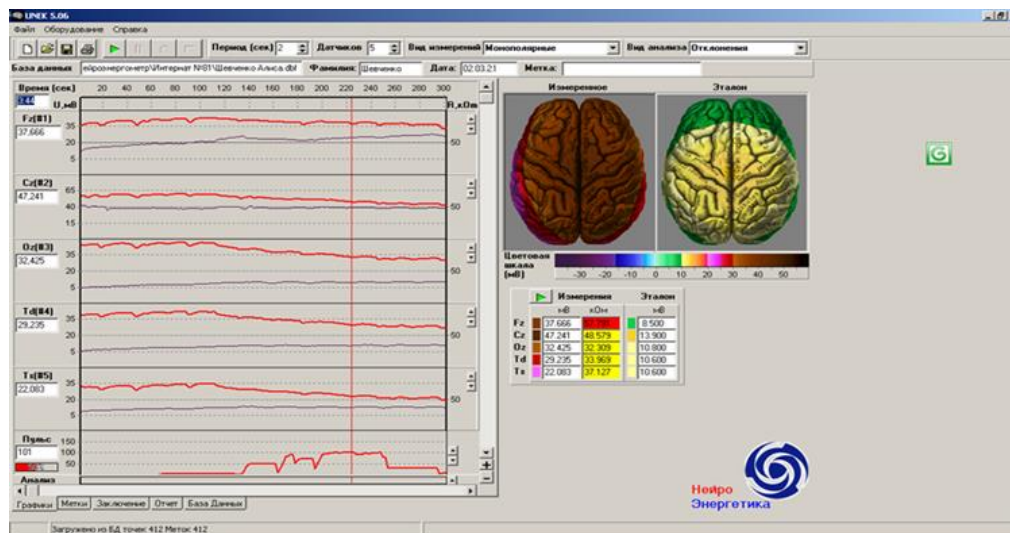


Figure 3. High level of cerebral acidosis in patient of 45 aged.

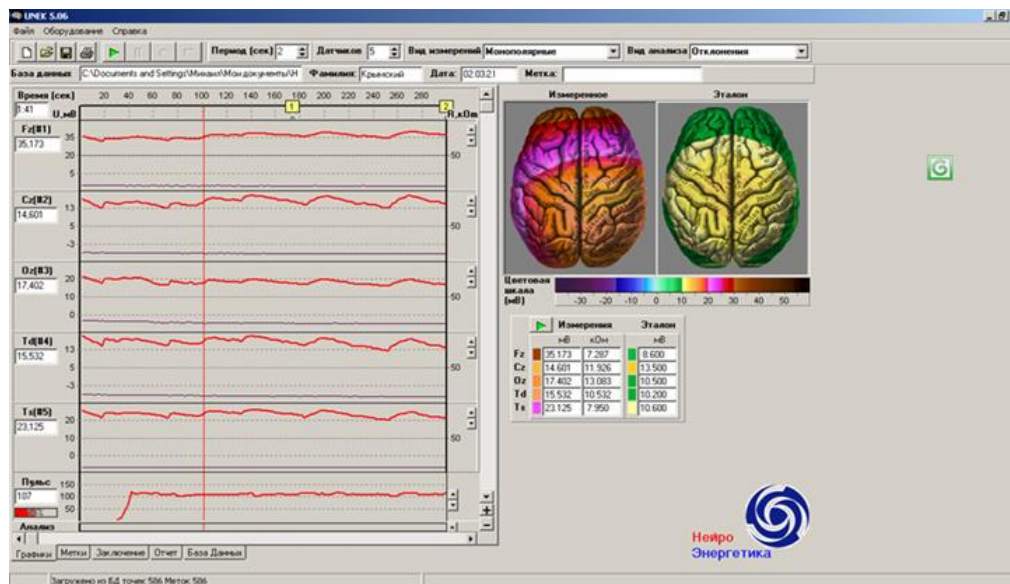


Figure 4. Middle level of cerebral acidosis in patient of 42 aged.

Electrophysiological research indicated cerebral acidosis and brain hypoxia in 50% of examined individuals. According to the study, there was the direct connection between disorders in cerebral metabolism with the state of tone of the shoulder girdle muscles. We suggested that the cause of the development of the brain hypoxia and cerebral acidosis could be “*tunnel*” muscle-tonic syndromes leading to compression of the main vessels of the neck (Kipervas, 1991). The analysis of risk factors and indicators of functional disorders – muscle imbalance, postural stress damage in the crano-vertebral region and neurological syndromes indicated the common mechanisms of their formation (Safonicheva, 2006).

Thus, in the examined patients, the manifestations of the “*office syndrome*” were revealed. These disorders affected the psychological, psychosomatic and behavioural levels, which required an integrated approach to rehabilitation.

Methods of non-drug rehabilitation

People can maintain their emotional and cognitive well-being in the face of acute or chronic challenges, and this ability is defined as resilience (Davydov et al., 2010).

Methods of resilience management were: 1) physical (strength- and endurance-based) activity, 2) cognitive training, 3) postural and coordination gymnastics, 4) breathing and yoga techniques, 5) soft-tissue manual therapy.

The scheme of non-specific correction of muscle disturbances, restoration of the optimal body posture using soft-tissue techniques was worked out in Sechenov University at the Department of Sports Medicine and Medical Rehabilitation (Shimarova et al., 2020).

Stages of the soft-tissue therapy were:

1) Unloading the main collectors of lymph system in subclavicular area. Soft-tissue technique was devoted to structuring tissues, removing fixation between superficial and deep fascia for decompression of subcutaneous vessels.

2) Relaxation of pectoralis major, minor muscles and adductors of the shoulder.

3) Myofascial technique was devoted to remove the compression of the jugular veins and lymph duct in the place of their flowing into subclavicular veins.

4) Relaxation of the respiratory diaphragm.

5) Restoration of the neck muscles tone for normalizing of blood circulation and brain hypoxia removing. Duration of the procedure – 35-40 min, number of procedures was 7 – 9.

Treatment had an impact for all mechanisms of office – syndrome and burnout formation in remote workers, due to changes in the quality of the afferent flow and positive effect to the patient's mental sphere. After the rehabilitation course we receive positive results: postural muscle balance was restored, the “tunnel” neurovascular syndromes in patients were removed, state of the cerebral metabolism was normalized, emotional background and cognitive functions were improved (Figures 6, 7).

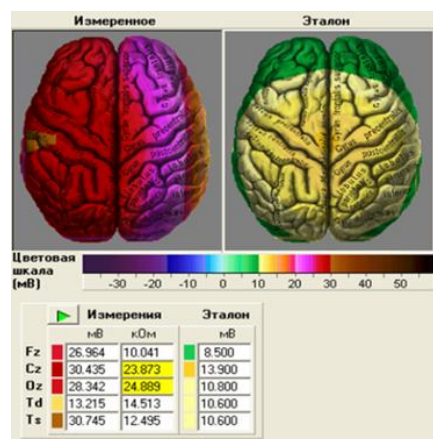


Figure 5. Dynamics in cerebral acidosis in patient aged 45 years.

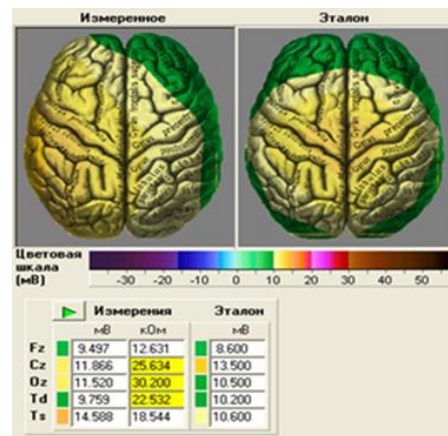


Figure 6. Dynamics in cerebral acidosis in patient aged 42 years.

All the observed patients were given recommendations on adherence to a healthy lifestyle and arrangement of the workplace in compliance with ergonomic parameters. It was recommended to get up from the table every 45 minutes and do midline crossover and breathing exercises. All the observed patients were given recommendations on adherence to a healthy lifestyle and arrangement of the workplace in compliance with ergonomic parameters. They were instructed to get up from the table every 45 minutes and do special gymnastics with movements, crossing the midline, as well as breathing exercises aimed at relaxing the muscles of the neck, shoulders, chest, and diaphragm. During the course of rehabilitation, the patients studied a set of balancing exercises to maintain an optimal body posture.

Telemedicine technologies were used to monitor personal health - Skype sessions once a week.

DISCUSSION

It is known that the structure of health is made up of several factors - genetics, ecology and environment, lifestyle and health care system. The contribution of these factors is distributed in different ways: the leading role is played by lifestyle - 55%, genetic factors - 15-20%, ecology and environment - 15-20%, and the healthcare system - 10-15%. Although office syndrome and burnout are not medical diagnoses, these generalized definitions have come to indicate both occupational risk factors and unhealthy office worker' lifestyle that generally led to chronic diseases.

In 2010-2015 the World Health Organization (WHO) announced the beginning of an epidemic of noncommunicable diseases (NCDs) or an epidemic of "lifestyle diseases", since by this time the number of annual deaths due to four classes of diseases (cardiovascular, bronchopulmonary, cancer and diabetes mellitus) exceeded 36 million people (WHO, 2015).

At first, this term "Epidemic of Chronic NCDs" caused controversy, since earlier epidemics were associated only with infections.

However, the losses from NCDs, which accounted for about 75% of the total morbidity and about 86% of the total mortality, were so significant that WHO suggested to use this very term (Golubnitschaja et al., 2020).

Over the past 10 years, WHO has announced several “*epidemics*” among residents of cities and megalopolises - an epidemic of obesity, an epidemic of neurodegenerative diseases, an epidemic of mental disorders and depression.

The mentally exhausted person has become the personification of the appearance of modern cities, where modern infrastructure and business centres have replaced factories and plants. However, office jobs have led not to an increase in the quality of life, but, on the contrary, to its decrease.

Epidemics of chronic non-communicable disease turned out to become challenges to health systems, employers and workers who had to find solutions (Golubnitschaja et al., 2016).

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WHO has developed a number of programs to coordinate healthy lifestyle. One such program is the WHO “*Global Action Plan to increase the level of physical activity 2018–2030*”. This program includes several initiatives (WHO, 2014).

1. An active society: the implementation of information campaigns to change the lifestyle, awareness-raising work, the introduction of IT systems and innovation technologies.
2. An active, healthy and accessible environment: integrating urban and transport planning strategies, ensuring equitable access to places for walking, cycling and other physical activity.
3. Active systems: optimizing development institutions and governance, multisectoral partnerships, and workforce capacity to drive research.
4. Active people: making programs and services available in a variety of ways that encourage people of all ages to engage in regular physical activity.
5. Preventive health aspects: introduction of systems for examining and counselling patients on the issues of increasing physical activity in primary and secondary medical and social care facilities. Health systems were encouraged to develop programs for increasing the level of physical activity in workplaces, sports and religious institutions, and in open public places.

Large companies and organizations such as Tesla, Apple, Microsoft, Google, Facebook, Amazon, Beeline began to make efforts to create an optimal “*psychological climate*”, a health-saving ecosystem for office workers, and the formation of a “*corporate culture*”. The most important conditions for team building were thinking through the company's mission, positioning it in the market, building internal and external communications. Stress management programs were prepared, motivational trainings were carried out to increase employee commitment, and collaborations with fitness centres were created, which contributed to an increase in labour productivity and preservation of employee health.

Gradually, from 2015 to 2017, the same companies began to practice the remote work format.

For example, Beeline company in 2016 developed the BeeFree Strategic Remote Work Project, which was implemented for strengthen an open corporate culture, transform internal processes and infrastructure. The Charter and the BeeFree program for remote workers were developed and posted on the website. The Program prescribed the rules and step-by-step instructions for remote work (arrangement of the workplace, weekly planning and coordination of the work schedule with the management and team members) to create a common information space on the Skype, Zoom or Google Meet sites. Also, the program includes recommendations for maintaining health (pauses for a break, doing gymnastics, adhering to a diet, etc.).

An employment contract for remote work is signed with the employee. The contract includes the clause “*Working conditions and working hours*”. A working day is set for an employee in accordance with an individual schedule.

But majority of the office workers continued to work in their traditional offices, where ergonomics, overcrowding, physical inactivity and other working conditions did not correspond to the parameters of health savings conditions.

The situation has deteriorated significantly since mid-March 2020, when WHO declared a real epidemic - the COVID-19 epidemic, which was added to the epidemic of “*lifestyle diseases*”.

The situation has deteriorated significantly since mid-March 2020, when WHO declared a real epidemic - COVID-19 epidemic.

With the announcement of the COVID-19 epidemic in March 2020, the whole world was placed in difficult working conditions: working people faced an unusual way of life, almost every person of working age, in one way or another, was forced to work from home.

A feature of remote format working is that the usual work regime is disrupted, the boundaries of working hours in the “*home office*” are blurred, physical inactivity is aggravated in the absence of the need and the ability to leave the house (when organizing a courier service for the delivery of products). In the epidemic conditions, a working person, being at the same time at home and in the office, was forced to solve both household and industrial affairs. At the same time, other family members, who were also in self-isolation, faced the same problems. Big Data analysts from MTS found that the working day of residents of the capital on a remote basis increased to ten hours on average, remote workers began to “*linger after work*” more (Starodubov, 2021).

The International Labour Organization (ILO) analysed the current situation and, in May 2020, prepared a guide for employers: “*Remote work in the context of the COVID-19 pandemic*” (ILO, 2020).

The ILO recalled that the health and safety risks associated with teleworking could increase amid the COVID-19 pandemic. These can be increased psychosocial risks in “*fit office*” settings, including a potential increase in occupational stress levels. Employers need to keep in touch with their employees on a regular basis and keep them informed of all available opportunities. For example, some employers have employee assistance programs that provide workers with confidential counselling and psychological assistance (ILO, 2020).

CONCLUSIONS

Preserving the health of the working population in the context of digital transformation is a global challenge of our time and requires decisions at the legal, organizational, psychological, and infrastructural levels:

1. Health systems should adhere to WHO recommendations for developing health interventions to combat both coronavirus and lifestyle diseases.
2. Labour legislation should make additions to regulate industrial relations in the new conditions of the remote format (working hours, vacations, working conditions, possibly telemonitoring of lunch breaks and industrial gymnastics).
3. Preventive measures of the “*office syndrome*” and “*burnout*” among specialists in digital professions are: the formation of a corporate culture in teams, the creation of conditions for employees' professional growth, a literate motivational policy, which includes social guarantees and social support, information activities aimed at the development of a pleasant social and psychological climate in co-operation, as well as an increase in emotional intelligence.
4. Correction of the “*office syndrome*” and “*emotional burn out*” requires a personalized approach with the use of modern restorative technologies (Krutko et al., 2017), an increase in stress resistance of specialists, a culture of health and trust in teams. In the context of the forced digital transformation, it will be necessary to look for an emotional balance, set up the main channel of working communications in the form of online meetings, and possibly transfer events and projects to digital rails. Understanding the risks will help identify early signs of burnout and create a conducive environment for health savings and professional longevity.

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AUTHOR CONTRIBUTIONS

All authors contributed to the study conception and design.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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