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RENDÉSZETTUDOMÁNY

Empirical Partial Results on the Working Environment of the On-Duty Staff of the Disaster Management Service and the Psychological Effects Caused by Emergency Calls

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Introduction: Our previous study published a comprehensive study on the impact of organisational culture and health status on the work environment of the County Operations Management Service under the County Operations Department of the National Directorate General of Disaster Management of the Ministry of the Interior. In this article, we present the perceptions of the examined staff about the working environment and the effects caused by those requesting emergency calls.

Aims: One of the objectives of our comprehensive research was to get to know the ergonomic conditions of the working environment of the staff and to reveal the psychological burden of emergency calls on the staff.

Methods: The data collection took place in the second half of 2024, using a questionnaire. A total of 347 people filled out the questionnaire, nationwide, 84% of the total population at that time. The data obtained were processed using the SPSS Statistics 25 programme.

Results: Based on the results, the evaluation of computer technical conditions exceeded the theoretical average ($M = 3.34$; $SD = 1.31$; $t[346] = 4.84$; $p < 0.001$), which indicates that employees generally consider the technical equipment to be adequate. Only in the case of several physical-ergonomic factors did the evaluations fall significantly short of the theoretical average. The greatest psychological burden during the reception of calls from those requesting

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assistance was caused by aggressive communication (M = 4.57; SD = 2.61) and announcements in an abusive tone (M = 4.57; SD = 2.86).

Conclusion: The workload of dispatch services is subject to a dual challenge: physical ergonomics and psychological strain. The yellow results correspond with a high critical probability to the general workload factors of other dispatch services performing the task. This pattern suggests that, in addition to technical and ergonomic developments, the most effective interventions should be sought in the targeted support of the emotional resilience and psychological coping strategies of on-duty personnel, which offers solutions that are relevant and standardisable for the entire sector.

Keywords: disaster management on-duty personnel, ergonomics, emergency calls, stress

Introduction

Workplace ergonomics deals with the workplace of people, the workplace processes carried out there and the coordination of the tools used in the work process from such aspects that the physiological and psychological health of the employees is satisfactory. Scientific studies of the human-machine relationship were sporadic and less organised until the end of the 1940s. During the Second World War, numerous military technical devices were developed, which often had unexpected effects in practice. During the investigation of these unexpected situations, it was concluded that the new technology does not always correspond to the human abilities of the people who controlled the device. The effort to match the person to the work during the selection and training of the person performing the control did not prove to be sufficient. There were situations when even the most appropriate selection and training methods did not allow the technical exploitation of the potential inherent in the system, due to the limitations of the human factor (Klein 2018).

During their work activities, people interact with various components of the work system: with equipment, tools and furniture, forming sensory and energetic interfaces, and with the organisation and the environment, forming environmental, cognitive and organisational interfaces. People – with their organisation, mind and psyche – implement these interactions as a system, and the task of ergonomics is to model these interactions and search for forms of compliance that ensure comfortable, efficient and safe performance of human activities, taking into account the capabilities, limitations and other characteristics of the person (Vidal 2000).

Following Karwowski, we distinguish three groups of ergonomics in the traditional sense: physical, cognitive and organisational ergonomics (Karwowski 2005). However, this grouping no longer covers the changes resulting from industrial and technological developments, the new human roles, burdens and risks emerging in the digital and cyber environment. Industry 4.0 (digitalisation, cyber-physical systems, artificial intelligence, robotics, automation) is bringing about such changes in the areas of work, the work environment, human identity and social connectivity that they go beyond traditional

ergonomic frameworks. The "human cyber-identity", constant online presence, work in virtual spaces and related new types of burdens such as cognitive and psychological overload, information overload, identity theft, loss of privacy, AI-based surveillance, cyberattacks, a sense of loss of control, constant online presence are emerging. Since ergonomics in the classical sense does not address these issues, cyber ergonomics has been defined as a new field, which forms a kind of bridge between human factors, digitalised work systems, risk management and health protection aspects (Pouyakian 2022).

The concept and areas of ergonomics

The word ergonomics was first defined by Polish-born Wojciech Jastrzębowski in 1857 in his publication *An Outline of Ergonomics, Or the Science of Work, based upon Truths Drawn from the Science of Nature.* The same term was introduced by K. F. H. Murrell in 1949, who, in the same year, was one of the founders of the Ergonomics Research Society (which is now the Chartered Institute of Ergonomics and Human Factors).[3]

The word ergonomics – "the science of work" – comes from the Greek words ergon (work) and nomos (laws). Ergonomics is the science of understanding interactions between people and other elements of a system, and the profession that applies theory, principles, data, and methods in design to optimise human well-being and overall system performance. Ergonomics is not a field-specific, but a multidisciplinary, user-centered, integrative science. Its principles are rooted in socio-technical values, such as:

- people as tools
- technology as a tool to help people
- promoting quality of life
- respecting individual differences
- responsibility to all stakeholders[4]

The task of ergonomics is multifaceted and complex. On the one hand, it is responsible for improving usability, efficiency and safety, as well as for carefully selecting and designing machine displays and controls. On the other hand, it is responsible for creating a suitable working environment based on all this, along with the general layout and details of workstations. In the simplest human-machine models, a structure is used by an operator. At the same time, the human-machine system always operates in some kind of environment, which has a reciprocal effect on each other. The operator's performance is determined, for example, by the temperature and humidity of the working environment, the lighting of the room or even the level of noise (Nádori et al. 2012: 274–275).

As John R. Wilson (2000) puts it, ergonomics is not only concerned with physical or anatomical characteristics, but also takes into account psychological, organisational, technical and social factors. Its aim is not only to match the individual to the task, but also to consciously design the task, the work, the system to human capabilities. This concept

[3] See https://oshwiki.osha.europa.eu/hu/themes/ergonomics
[4] See https://iea.cc/about/what-is-ergonomics

requires a complex, holistic approach, taking into account the entire human-system interaction, its technical, organisational, social and economic context.

Physical ergonomics

Physical ergonomics deals with the anatomical, anthropometric, physiological and biomechanical characteristics of humans. It includes topics such as posture, physical activity involving material handling, repetitive movements, work-related musculoskeletal disorders, workstation layout, safety and health. Its primary goal is to design work environments, equipment and task conditions that are in harmony with the dimensions, range of motion and load capacity of the human body. Physical ergonomics is based on three fundamental professional pillars:

- anthropometry, which involves the study of the dimensions, proportions and reach ranges of the human body and determines how a work environment can be adapted to human variability
- work physiology, which studies how muscle work, load intensity and energy expenditure affect fatigue and performance
- environmental ergonomics, which analyses the impact of external environmental conditions – such as temperature, humidity, lighting, noise and air quality – on human performance and comfort

Physical ergonomics is not only important from a health protection perspective but also from an economic perspective, as it contributes to increasing workplace productivity and the sustainability of work (Vidal 2000).

Cognitive ergonomics

Cognitive ergonomics is of increasing importance in the modern, information-rich work environment. Its goal is to design tools, interfaces, work environments and procedures based on the laws of human information processing that support human performance, reduce errors, and improve safety (Branaghan–Lafko 2019). Cognitive ergonomics deals with mental processes, perception, memory, reasoning, motor response, mental workload, decision-making, human-computer interaction, human reliability and workplace stress (Sikné Lányi – Schanda 2014). This segment of ergonomics examines how mental processes such as perception, information processing and decision-making affect human performance and safety in human-machine interactions. This is particularly challenging in work environments where there is an increase in information that requires rapid perception and filtering of relevant stimuli. Attention is easily impaired under time pressure and stress, which can lead to cognitive overload. Research shows that mental load is strongly related to decision accuracy and task completion time, especially in the presence of perceptual uncertainty or multitasking. In human-machine collaboration, decision-making is influenced not only by the complexity of the task, but also by the transparency

of the system and the avoidance of cognitive biases. According to the cognitive process model, human-machine interaction is a circular process.

Organisational ergonomics

The field of organisational ergonomics is the design of optimal organisational structures and processes. By optimising structures, workflows, and corporate rules, it simultaneously improves system performance and employee well-being. The design of the workplace environment has a decisive influence on the quality of human-machine interaction. An ergonomic workplace reduces musculoskeletal strain and mental stress, increases performance and satisfaction. Organisational solutions such as task variation, job rotation, and clear communication channels reduce fatigue and the occurrence of repetitive strain injuries. Simulation environments and AI-based design platforms are becoming increasingly important in the design of ergonomic work systems, where the goal is to create a balance between efficiency and human comfort. Flexible, human-centred workspaces that adapt to anthropometric differences and cognitive needs play a fundamental role in the concept of Industry 5.0. The human being is not seen as an "operator", but as a creative problem solver, supported by intelligent systems [Ioniță–Anghel–Boudouh 2025].

Software ergonomics

The central concept of software ergonomics is usability, which refers not only to the usability of the software, but also to the security of the user interface, user satisfaction and support for efficient work. Software ergonomics also includes the exploration of user needs, interface design and usability testing. The goal of software ergonomics is to develop software that is easy, comfortable and not mentally taxing for the user to use. In a broad sense, the concept includes the ergonomics of software creation and subsequent use, and in a narrow sense, it is limited to human-computer interaction during use. The field is part of cognitive ergonomics and is also related to the analysis of human-machine systems (Sikné Lányi – Schanda 2014).

Cyber ergonomics

The concept of "cybergonomics" is associated with the name of Pouyakian, who first described this new dimension of ergonomics in 2022. Cyber ergonomics is the study of human performance, health and well-being in an environment defined by Industry 4.0 and cyber technologies. The use of the concept is not yet widespread in international and domestic literature, and no references can be found to it. Due to the lack of a proper equivalent for the term "cybergonomics", we will hereinafter refer to this concept as cyber ergonomics, following the territorial division of ergonomics. Cyber ergonomics not only focuses on the physical or cognitive loads of digital systems, but also examines

the complex, multidimensional human consequences resulting from the excessive use of technology. One of these phenomena is cyber syndrome, which develops progressively. Cyber syndrome is a set of physical, social and mental disorders that affect people due to the improper use of technology or excessive interaction with cyberspace (Ning et al. 2018).

The issue of ergonomics is of paramount importance in the working environment of the on-duty staff of the disaster management. The staff's daily work involves computer-using and mission control system programmes such as PAJZS, DÖMI and KAP, which require them to have the necessary skills to use them confidently. In accordance with the legal requirements, the organisation makes every effort to create the most ideal and most suitable environment for continuous work on a monitor. The size, adjustability and position of the computer, monitors, keyboard, mouse and the tables and chairs fundamentally determine the working conditions. Prevention is vital, as the job carries several risk factors (e.g. prolonged viewing of a monitor, sitting, higher stress factor) that can have a negative impact on health in the long term. Maintaining and improving health is a joint commitment of the employer and employee in a workplace in which both parties must participate.

In the operation of an organisation, ergonomics is traditionally primarily associated with the protection of employee health and safety and is rarely seen as a strategic factor. This approach significantly limits the potential of ergonomics, as most organisations do not recognise that ergonomic approaches can have a direct and measurable impact on the performance of the entire organisation. In many cases, management treats ergonomics only as a "mandatory obligation", thus not considering it as a tool that could contribute to the achievement of strategic goals. Ergonomics has its real impact when it is not only used to fulfil occupational health and safety regulations but is also integrated into corporate planning and control processes. Dul and Neumann (2009) distinguish between the current situation and the desired state: in the former, ergonomics appears in isolation, in the latter, it strengthens performance, quality, flexibility and innovation as part of strategy creation and operational development. Ergonomics becomes a true strategic resource when the organisation is able to move from "protective ergonomics" with a health and safety focus to "proactive, business ergonomics" that simultaneously supports human well-being and organisational value creation.

Presentation of partial results of an empirical study

Study conditions

The research was carried out among the on-duty staff of the disaster management using the method of written questioning and a questionnaire. An online questionnaire containing 37 questions was sent to all county directorates and the capital directorate using Google Forms, which was completed by 347 people between 15 September 2024 and 5 December 2024 with nationwide coverage, 84% of the total on-duty staff at that time.

Hypothesis, objective, methodology

One of the assumptions of our research is that the overall ergonomic picture of the work environment of the on-duty staff of the disaster management is satisfactory, and the increased psychological burden on the staff is primarily caused by calls from the public. Our research goal was to explore the ergonomic situation of the county police department, to learn the staff's opinion about their work environment, and to look for connections between individual ergonomic conditions and the state of the staff. In our survey, we focused specifically on the psychological burden resulting from receiving alarms, and what emotional and stress effects different types of calls, such as calls from adults, children, and callers with aggressive or abusive communication, have on the person receiving the phone call. The questionnaire used in the survey examined ergonomic aspects along several questions (questions 24–28 of the questionnaire). The data obtained during the survey were processed with the IBM SPSS Statistics 25 programme, using statistical tests and procedures in accordance with the rules of research methodology.

Sample presentation

The total number of respondents was 347, 97.7% of whom were men (N = 339), and only 2.3% were women (N = 8). In terms of age distribution, the highest proportion of respondents was between 45–59 years old (56.2%, N = 195). 33.7% of respondents were between 35–44 years old, while 7.2% were between 25–34 years old. Only 6 people (1.7%) were between 18–24 years old and 4 people were over 60 years old, accounting for a total of 1.2% of the sample. The majority of respondents have more than ten years of service behind them (32.85%, N = 114), and the number of those who have worked on call for more than 15 years is outstanding (29.68%, N = 103). 22.48% of those who completed the questionnaire (78 people) have served in this organisational unit for between 6 and 10 years. Only 34 people (5.19%) started working in this position in the past year, and 9.8% of respondents (18 people) stated that they had been working for between 2 and 5 years.

Partial results of the work environment study

The assessment of the ergonomic conditions of the work environment was examined using a ten-item scale, in which the values ranging from 1 to 5 indicated the level of satisfaction with the working conditions. During the analysis, the mean values of each item were compared to the theoretical mean value M = 3 with a sample t-test, which shows whether the assessment is statistically significantly different from the level considered to be satisfactory on average.

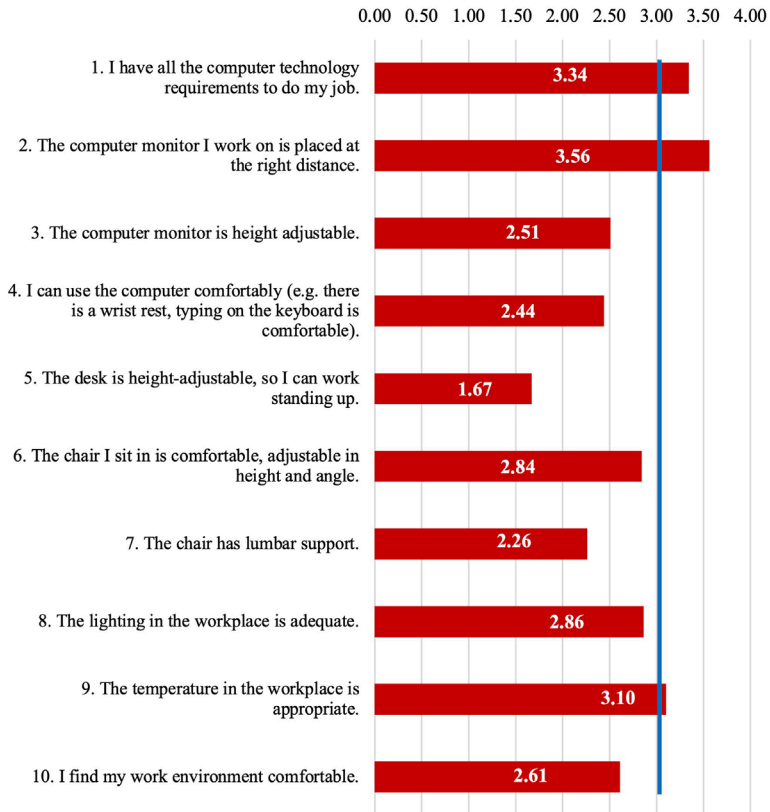

Figure 1: Average level of agreement with statements examining certain aspects of the respondent's workplace (on a scale of 1–5) (The blue line indicates the theoretical average of 3.)
Source: compiled by the authors

Based on the results, the evaluation of computer conditions exceeded the theoretical average ($M = 3.34$; $SD = 1.31$; $t[346] = 4.84$; $p < 0.001$), which indicates that employees generally consider the technical equipment to be adequate. The distance of the monitor was also positively assessed ($M = 3.56$; $SD = 1.22$; $t[346] = 8.58$; $p < 0.001$), which can be considered favourable in terms of ergonomic placement.

On the other hand, the evaluations of several physical-ergonomic factors were significantly below the theoretical average. Monitor adjustability ($M = 2.51$; $t[346] = -5.96$; $p < 0.001$), computer comfort ($M = 2.44$; $t[346] = -7.72$; $p < 0.001$), the presence of a height-adjustable desk ($M = 1.67$; $t[346] = -20.18$; $p < 0.001$), and a chair with lumbar support ($M = 2.26$; $t[346] = -9.37$; $p < 0.001$) all showed significantly lower values. These results indicate that the ergonomic design of workplace equipment and furniture in many cases does not meet the requirements for optimal work.

The comfort and adjustability of the chair were rated moderately but significantly below average by the respondents ($M = 2.84$; $t[346] = -2.11$; $p = 0.036$), while the lighting ($M = 2.86$; $t[346] = -1.82$; $p = 0.070$) and temperature ($M = 3.10$; $t[346] = 1.39$; $p = 0.167$) did not differ significantly from the theoretical average. This suggests that the comfort conditions of the physical environment (lighting, air conditioning) are generally satisfactory, but not outstanding.

The responses to the general comfort of the work environment ($M = 2.61$; $t[346] = -5.86$; $p < 0.001$) also reflect a below-average assessment, which suggests that some of the workers do not consider their workstations to be ergonomically optimal. Overall, the results show that the ergonomic work environment of the on-duty staff of the disaster management is partially satisfactory: the technical and IT conditions are adequate, however, the physical ergonomic characteristics (adjustability, comfort elements, posture support) show significant deficiencies.

Partial results of the impact study on incoming calls

The effect of the emotional characteristics of public calls was examined using a repeated measures analysis of variance (RM-ANOVA) in which the degree of psychological strain induced by different communication situations was compared. The analysis showed a significant main effect between call types ($F[4.94; 1707.75] = 17.60$; $p < 0.001$; $\eta^2 = 0.048$), suggesting that the characteristics of each incoming call trigger different levels of stress responses in the on-call staff.

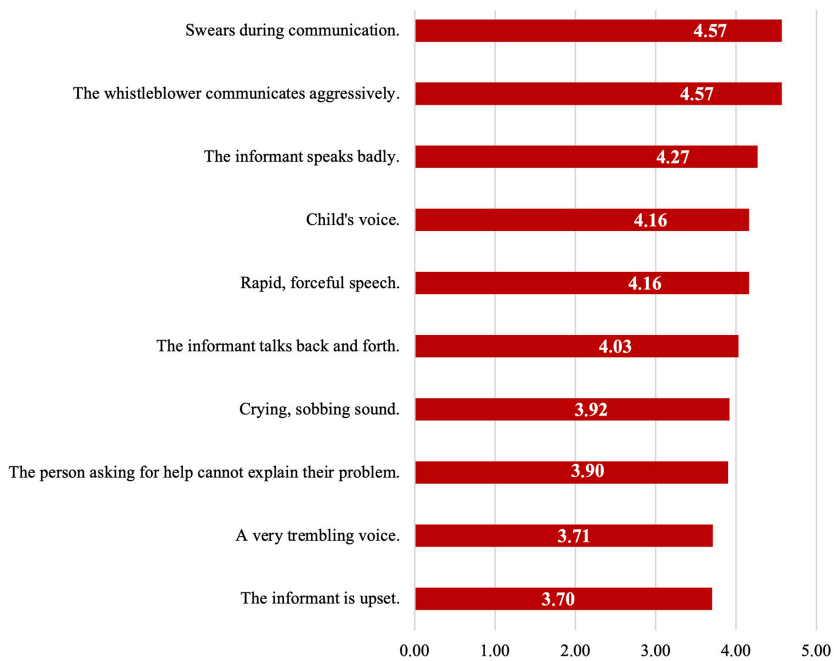

Figure 2: Average responses to each option for "How does it affect you when incoming calls are characterised by the following? (on a scale of 1–10)"
Source: compiled by the authors

Based on descriptive statistics, the greatest psychological strain was caused by aggressive communication (M = 4.57; SD = 2.61) and reports in an abusive tone (M = 4.57; SD = 2.86) which significantly exceeded the stress values of calmer but difficult-to-understand calls (e.g. "can't explain the problem" – M = 3.90; SD = 2.28). At the same time, calls with a childish voice (M = 4.16; SD = 2.45) and fast, strident speech (M = 4.16; SD = 2.29) also caused above-average strain which indicates the importance of the emotional charge and processability of the calls.

In contrast, harassed reports (M = 3.70; SD = 2.18) and communication with a strongly trembling voice (M = 3.71; SD = 2.31) cause a more moderate stress effect among the respondents. The results therefore clearly indicate that the emotional intensity of public communication – especially verbal aggression and offensive tone – is a prominent source of psychological stress for the on-call staff. The medium effect size ($\eta^2 = 0.048$) revealed by the analysis of variance confirms that this factor influences the mental strain of work to a non-negligible extent.

Results of a study on the relationship between work environment, psychological strain and incoming calls on stress

The relationships between the general stress level measured with the Cooper workplace stress scale and the factors examined in this hypothesis were explored using Pearson correlation.

Table 1: Correlation indices and test statistics of the relationship between work environment, psychological strain, and incoming calls and stress

Question	N	r	p
Does the IT software you use at work cause you stress?	347	0.158	0.003
Work environment, workstation			
I have all the computer technology requirements to do my job	347	−0.137	0.011
The computer monitor I work on is placed at the right distance	347	−0.165	0.002
The computer monitor is height-adjustable	347	0.040	0.456
I can use the computer comfortably (e.g. there is a wrist rest, typing on the keyboard is comfortable)	347	0.014	0.798
The desk is height-adjustable, so I can work standing up	347	0.163	0.002
The chair I sit in is comfortable, adjustable in height and angle	347	−0.042	0.434
The chair has lumbar support	347	−0.005	0.926
The lighting in the workplace is adequate	347	−0.056	0.299
The temperature in the workplace is appropriate	347	−0.056	0.297
I find my work environment comfortable	347	−0.079	0.141

Question	N	r	p
How does it affect you if your incoming calls are characterised by the following?			
The person asking for help cannot explain their problem	347	0.345	< 0.001
The informant talks back and forth	347	0.349	< 0.001
Crying, sobbing sound	347	0.298	< 0.001
The informant is upset	347	0.329	< 0.001
Rapid, forceful speech	347	0.322	< 0.001
The whistleblower communicates aggressively	347	0.319	< 0.001
The informant speaks badly	347	0.314	< 0.001
Swears during communication	347	0.286	< 0.001
Child's voice	347	0.334	< 0.001
A very trembling voice	347	0.344	< 0.001
How typical is the psychological strain of your job on a 10-point scale?	347	0.297	<0.001
How common is it for you to get stressed out by incoming calls?	347	0.384	< 0.001

Source: compiled by the authors

The results showed that stress from software use was moderately but significantly associated with higher overall stress scores ($r = 0.158$; $p = 0.003$), suggesting that managing digital systems itself may contribute to increased psychological strain.

Some of the ergonomic features of the work environment also showed a significant but weak relationship with stress levels. The lack of appropriate IT conditions ($r = -0.137$; $p = 0.011$) and inadequate monitor distance ($r = -0.165$; $p = 0.002$) were associated with lower ergonomic comfort and higher stress levels, while the presence of a height-adjustable desk paradoxically showed a positive relationship ($r = 0.163$; $p = 0.002$), which is probably due to the typical equipment and responsibilities of managerial or higher positions.

The correlations between the emotional characteristics of incoming calls and stress were significant for all factors examined ($p < 0.001$), with values between $r = 0.286–0.349$. I identified the strongest relationship with the caller talking back and forth ($r = 0.349$), the voice shaking strongly ($r = 0.344$) and the unclear, agitated communication ($r = 0.329$), which shows that communication uncertainty and emotional disturbance represent the greatest psychological burden for the on-call staff.

Subjective assessment of psychological strain ($r = 0.297$; $p < 0.001$) and self-reported stress due to calls ($r = 0.384$; $p < 0.001$) were also strongly correlated with Cooper stress scores, confirming that the main source of workload is the management of continuous, emotionally stressful communication situations.

Summary

Overall, the results partially confirmed the hypothesis that the working environment of the emergency response staff is basically satisfactory from an ergonomic point of view, but

the main source of psychological stress is the calls from the public. The physical conditions of the working environment – for example, the appropriate technical equipment ($M = 3.34$; $p < 0.001$) and the monitor placement ($M = 3.56$; $p < 0.001$) – were generally positively assessed, but several ergonomic factors, such as the adjustable desk ($M = 1.67$; $p < 0.001$), the lack of lumbar support ($M = 2.26$; $p < 0.001$) or the uncomfortable work chair ($M = 2.84$; $p = 0.036$), were statistically significantly below the expected average. This suggests that deficiencies in physical ergonomics may contribute to work fatigue and long-term psychophysiological strain.

The examination of psychological stress sources confirmed that the emotional intensity of communication situations represents a significant burden for the staff members. The repeated measures analysis of variance showed a significant difference between the different call types ($F[4.94; 1707.75] = 17.60$; $p < 0.001$; $\eta^2 = 0.048$), and the greatest burden was caused by aggressive, abusive and incoherent reports ($M = 4.57$; $M = 4.57$; $M = 4.03$). Verbal aggression and negative emotional charge therefore appear as prominent stress catalysts during service provision.

Correlation analyses using the Cooper workplace stress index further nuanced the picture: higher stress levels were moderately associated with stress experienced during software use ($r = 0.158$; $p = 0.003$) and with work environment deficiencies such as inadequate computer equipment ($r = -0.137$; $p = 0.011$) or monitor placement ($r = -0.165$; $p = 0.002$). However, the strongest correlations were found between the emotional characteristics of incoming calls and stress ($r = 0.286–0.349$; $p < 0.001$), especially in the case of agitated, shaky or aggressive communication.

Overall, the results suggest that although technical deficiencies in the work environment also contribute to stress, the most significant psychological stress factors are the emotional intensity, unpredictability and verbal aggression of public calls, which are closely related to the overall level of workplace stress. The results of the research clearly demonstrate that there is a dual challenge in the workload of dispatch services: physical ergonomics and psychological stress. Although the deficiencies in workstations (especially the adjustability of furniture and monitors) are a significant source of stress, the most significant factor is the emotional content of emergency calls. The paired sample t-test showed that the average levels of stress resulting from software use and calls are similar, but the verbal aggression and unpredictable emotional disturbance of callers are most closely related to the overall level of workplace stress.

Based on all this, the stress and ergonomic profile of the service under study is not a unique phenomenon. The results obtained are likely to correspond to the general stress factors of other dispatch services performing critical tasks (ambulance, fire, police). This pattern suggests that, in addition to technical and ergonomic developments, the most effective interventions should be sought in the targeted support of the emotional resilience and psychological coping strategies of the on-call staff, which may offer relevant, standardisable solutions for the entire sector.

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