DOI: https://doi.org/10.30525/2256-0742/2023-9-3-222-227

BIOLOGICAL AND SOCIAL ASPECTS OF HUMAN HEALTH AS DETERMINANTS OF ECONOMIC DEVELOPMENT

Liliia Yukhymenko[1]

Abstract. *The purpose* of the study was to analyse the relationship between a person's mental performance, work efficiency and psychophysiological functions (PF) of the body. It is proved that taking into account the biological foundations of a person should be an essential condition for life and health, as well as for the development of a modern democratic country. The use of a typological approach based on psychophysiological criteria optimises professional orientation and provides recommendations on the possibility of mastering certain professions without harming health. This approach contributes to the efficient allocation of human capital, the use of periodic health monitoring, and the prediction of production volumes and quality, as well as its competitiveness. *Methodology*. The study was aimed at identifying the level of mental performance and efficiency of information processing on a computer in representatives of three groups of employees who differed in strength (mental performance, MP), mobility of nervous processes (MNP), balance (BNP) of nervous processes, speed of sensorimotor reactivity, indicators of situational anxiety (SA), cardiovascular system, and activation processes of the brain. *Results*. The study found that the examined employees of an office company (77 women and men aged 18-23 years) who had the highest level of MP and work efficiency were characterised by higher heart rate spectral power (HR), SA, and BNP. It is from individuals of this psychophysiological type that one should expect maximum mastery of the profession, relevant competencies associated with the speed of reaction, a minimum of erroneous actions, promotion of income, production volumes and rates, and a low level of injuries. The group of employees with low levels of PF was characterised by low levels of MP and efficiency, but at the same time high levels of SA, demonstrating a high risk of chronic fatigue and general neuroticism. Subjects with an average level of sensorimotor reactivity, spectral power indices of HR, SA and BNP showed a high level of RP and work efficiency, but relatively low reserve capabilities of the body. *Practical implications*. Taking into account that the respondents with the highest spectral power indicators of HR, SA, and BNP showed the highest level of MP and efficiency of work performed, it is this category that should be targeted first of all by the main business strategies of the country's development related to economic growth, development of marketing trajectories, and building innovative and exclusive production models. At the same time, it is necessary to systematically introduce various health-saving programmes to enable timely restoration of human physical and psychophysiological potential. Subjects with low characteristics of the psycho-emotional and neurovegetative spheres demonstrated lower MP and work efficiency. Predictably, they are associated with lower ratings of competitiveness and income in a professional field with a high rhythm of tasks, tension and time pressure, but are able to demonstrate sufficient labour potential in other professions. *Value/originality*. The obtained actual data of the selected groups of employees make it possible to assess the MP, the effectiveness of the work performed by them and can be used as reliable biological markers of economic fluctuations in society. On the other hand, it should be borne in mind that high performance and labour efficiency largely depend on the PFs involved in the state of human health. Thus, timely preservation and maintenance of the population's health at the proper level, combined with the applied typological psychophysiological approach to vocational guidance and individualisation of work regimes, lays a solid foundation for the economic growth of a democratic country.

Key words: health, psychophysiological functions, mental performance, efficiency of work, economic development of the country.

JEL Classification: A12, A14, I15, O15, Z13

[1] Bohdan Khmelnytsky National University of Cherkasy, Ukraine *(corresponding author)*
E-mail: liyukhimenko@ukr.net
ORCID: https://orcid.org/0000-0002-4455-6233
ResearcherID: IAP-2902-2023

1. Introduction

It is well known that high labour efficiency of employees is one of the main factors of the country's development. At the same time, the highest social value of the state is human life and health. In Ukraine, the health of the population and the improvement of its quality of life are constitutionally protected. At present, in the context of the full-scale war that continues as a result of Russia's unprovoked aggression against Ukraine, the issue of improving human performance is particularly acute. This is due to a rapidly increasing mortality rate, uncontrolled migration, rising morbidity rates, production curtailment, rising unemployment, and public finance instability, among other things. At the same time, the fall in gross domestic product cannot be explained solely by military factors (Bohdan Danilishyn, 2023). This situation requires new approaches to regulating the economy and finding more efficient methods to support its further development and post-war recovery.

Many studies by both domestic and foreign authors have been devoted to the problems of the country's development, personnel selection in connection with the peculiarities of biological and sociological components of human health, the use of international experience and the recognition of human health as an economic category (Tsiborovskyi, 2015; Marc Suhrcke et al, 2015; Nebava, 2018). It is noted that for economic science and economic practice, it is special that human health (physical and mental) is the basis for the ability of a person to work, to any professional activity, i.e., the availability of labour force (Dolot, 2016). It is emphasised that human health belongs to the system of factors of labour potential formation and, according to the European Commission, health makes a significant contribution to economic development through increased productivity, labour supply, skills and savings, which become a source of investment. At the same time, attention is drawn to the fact that at the present stage, the problem of physiological preservation and reproduction of the able-bodied population, which is the basis of labour potential, continues to worsen due to the poor health of the majority of the population of Ukraine (Antoniuk, 2020). This situation calls for further research into the causes of the decline in the health and labour potential of the working-age population. It remains a priority to increase them, improve human physiological capabilities, and search for ways that are not sufficiently understood today. The purpose of this study is to: to clarify the importance of the biological and social aspects of mental performance (MP) and the effectiveness of work performed by a person in the context of forming labour potential and democratic development of the country, to find ways to optimally use psychophysiological functions (PF) during work without harming his or her health. To achieve this goal, the methods of theoretical generalisation, typological psychophysiological instrumental research and statistical analysis were used. The following tasks follow from this goal: to establish how labour efficiency is related to the body's PF and human health; to identify how health status affects MP, work efficiency and human development depending on the psychophysiological type; to identify ways to eliminate the decline in labour efficiency and MP.

2. Psychophysiological Functions of the Body as Important Components of Health

In a broad sense, according to the latest views of physiologists and psychologists, the main PFs include: sensorimotor reactivity (sensory and motor), mnemonic capabilities (memory: perception, fixation of information, its reproduction and forgetting; attention), thinking, speech, intelligence, emotions. It should be emphasised that all of these functions, despite their heterogeneity and diversity, have in common that any of their mental components are always based on physiological processes. Moreover, none of the physiological processes is possible without the participation of the nervous system. Only the continuous connection of the nervous system with the environment and the continuous synthesis of receptor, central and effector circuits integrates the reflex (nervous) and mental activities of the organism, creating the possibility of human existence.

Consideration of the biological basis of human behaviour is impossible without an understanding of the properties of the main nervous processes: its mobility (MNP), strength (in the sense of MP) and balance (BNP). The degree of the limiting rate of differentiation of heterogeneous positive and inhibitory stimuli, memory performance, and attention are entirely dependent on the development of the MNP. The strength of the nervous system determines a person's MP in different conditions of life, physical activity, work efficiency, levels of professional achievement, neuropsychological stability, brain and heart activation. Regulatory mechanisms of the cardiovascular system and the brain do not manifest themselves equally in people with high, medium or low levels of MNP, MP and BNP (i.e., with different types of PF), which are genetically determined (Makarenko, 2006). These physiological properties have clear links with many psychological components of the personality and to a certain extent determine both the individual style of human behaviour and may be involved in psychosomatic disorders (Yukhymenko, 2023).

Thus, PFs play one of the leading roles in human health, which is the main condition for human life and its main value. Health, as defined by the World

Health Organisation, is a multidimensional concept and is understood as a state of complete physical, mental and social well-being and not merely the absence of infirmity or disease. This is what explains the ability of a person to exist optimally, to carry out various types of activities, and to engage in various social relations. The medical aspect of health includes the absence of diseases and painful symptoms, and the social aspect includes the ability to satisfy social, economic, cultural, and scientific activities. The mental aspect includes the fulfilment of one's own desires, stress resistance, and social interaction, while the purely biological aspect of health is related to the economic situation in the country in general and the state policy on the health of citizens (Svintsitskyi, 2013; Gigantesco, 2013). This article makes an attempt to consider the phenomenon of health in a comprehensive manner with an emphasis on its biological and social components – human physical functioning related to the provision of MP, efficiency of work performed and creation of the country's labour potential.

3. Research Methodology

At present, the importance of PFs in increasing the MP and efficiency of work performed, their optimal use during a person's work activity without harming his or her health remains insufficiently researched, especially in the context of wavy economic changes in the country. To achieve the goal, the subjects (77 employees of the Teleperformance office, men and women aged 18-23) were divided into three groups (high, medium and low) according to the level of nervous system strength (the level of MP was taken as the target). It was determined the characteristics of mobility (MNP), MP, BNP, sensorimotor reactivity, situational anxiety (SA), brain activity according to the electroencephalogram (EEG) and heart rate regulation (HR) during information processing on a computer. All examinations were conducted in accordance with the norms of bioethics and in compliance with the provisions of the Ministry of Health of Ukraine dated 13.03.2006, No. 66 and the Helsinki Declaration (1975, later editions 1996–2013).

The determination of MNP, MP, and BNP was performed using the Diahnost-1M computer device (Makarenko, 2006). Subjects were asked to differentiate between positive and inhibitory stimuli presented pseudo-randomly on a computer monitor in the form of 120 geometric shapes. The test had to be completed in the shortest possible time with the least number of false reactions. MP was assessed by the total number of stimuli processed during 5 minutes of work. The greater the number of stimuli that a person could process without error, the higher their level of MP. The measure of the MNP was the time spent on the test task: the faster the subject performed the task, the higher its level. The determination of BNP involved recording the accuracy of reactions to a triangle moving across the screen, which had to stop at a certain point. It was believed that the smaller the sum of motor reaction deviations (ms), the higher the BNP. Sensorimotor reactivity was assessed by the value of latent periods (ms) during the reaction of differentiation of two stimuli out of three – PB2-3. Specifically, the right hand had to press the button as quickly as possible when a square appeared on the screen, the left hand had to respond to circles, and the triangle had to be ignored. The shortest latency periods corresponded to better sensorimotor reactivity.

During the EEG recording with the NeuroCom encephalograph of XAI Medica (in resting conditions and during stimulus processing), the power of α (alpha, 8-13 Hz, 30-70 μV), β (beta, 14-35 Hz, 5-30 μV) and θ (theta, 4-7 Hz, 25-35 μV) rhythms in all leads was determined according to the international 10-20 system. The brain activation coefficient (BAC) was calculated as the ratio of the power of total β oscillations to the power of the α-band in the frontal and parietal cortex. Simultaneously, during the EEG recording, HR was recorded with the Cardiolab+ device. The obtained indicators were studied according to the spectral characteristics of the total spectrum power (TRms 2), spectrum power at very low frequencies (VLFms 2, less than 0.05 Hz), low (LFms 2, 0.05-0.15 Hz) and high (HFms 2, 0.15-0.4 Hz) frequencies to take into account the LF/HF ratio (units). The level of personal and situational anxiety (SA) was determined by the self-assessment method of C. Spielberger in the adaptation of Yu. L. Khanin (Ahaiev, 2016). Professional performance was assessed based on the results of 6 monthly reports (the number of positive and negative customer reviews, the number of certified professional courses completed, and the number of new work projects mastered). The results were processed using the methods of parametric statistics with the identification of significant differences in the data obtained by the Student's t-test and non-parametric statistics with the determination of the Wilcoxon-Mann-Whitney criteria using the Excel and STATISTICA for Windows software packages. The existence of a relationship between the studied indicators was tested by calculating the Spearman correlation coefficient (rs). Differences between the groups and the existence of a correlation were considered significant at $p \leq 0.05$. After dividing the respondents into three groups (with high, medium and low levels of MP), a scaling method was used to assess and compare all the PFs obtained during the survey. The absolute characteristics of the studied indicators and the values of their standard

Table 1

Differential scales for assessing the psychophysiological functions of subjects during the processing of stimuli on a computer

№	Indicators	Level of mental performance		
		High	Average	Low
	Points	10	6	2
1.	MNP, ms	≤54,0	60,0-64,9	≥70,0
2.	BNP, ms	≤14,6	21,6-29,9	≥38,0
3.	PB2-3, ms	≤360,0	409,6-479,5	≥570,6
4.	BAC, units	≥0,40	0,34,6-0,30,5	≤0,26
5.	LF/HF, units	≥3,5	2,4-2,0	≤1,6
6.	SA, units	≥46,0	41,0-36,5	≤31,9

deviation (σ) from the statistical mean were used as the basis for obtaining the corresponding relative quantitative values. According to the scaling, a high level of PF corresponded to 10 points, an average level of PF – 6 points, and a low level of PF – 2 points (Table 1).

According to the developed differential scales, the subjects with high levels of PF were classified as those who had, respectively, lower time characteristics of MNP and BNP (about 54.0 – 59.9 s and 14.6 – 21.4), and those with low gradations of these properties – higher quantitative values: 65,0 – 71,0 s. Also, in subjects with high levels of MP, the majority of quantitative values of PB2-3 were in the range of 249.4 – 211.5 ms and less, respectively, and in representatives with lower gradations, such time characteristics were in the larger range of 411.3 – 525.1 and more.

It is also noteworthy that subjects with high levels of MP also had the highest SA, BAC, LF/HF scores and the lowest number of deviations in response to a moving object. Such results indicate that subjects with higher grades of MP have a greater tension of brain processes and activation of HR regulation mechanisms. In addition, they were characterised by a higher SA. The overall assessment of the above PFs of the subjects with a high level of MP and efficiency of work performed indicated their greatest development and corresponded to the limits of 8-10 points.

4. Findings

The general conclusion about the mental performance and efficiency of the work performed by the subjects was made by the integral index, which was calculated by the sum of points scored by each of them personally for all the studied PFs during the processing of stimuli (Figure 1).

Accordingly, the integral PF index of the respondents ranged from 55 to 16 points. It turned out that among the subjects, 7% (5 people) had low values of the integral index, ≤ 17 points, 26% (≥ 45 points) had high integral indices, and 67% of the subjects received an integral index that was in the range of 22-36 points,

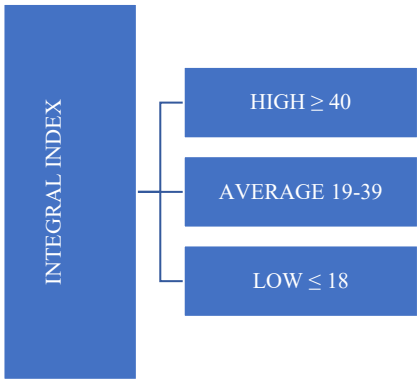

Figure 1. Integral index of mental performance and work efficiency

the largest number of which was 52 people. Comparison of the values of the integral index of work capacity and efficiency with the assessment of professional performance revealed that most employees had average performance indicators, 37% had high and 11% had low levels of performance. A correlation analysis was conducted to find out the links between the indicators of professional success and the studied PFs (Figure 2).

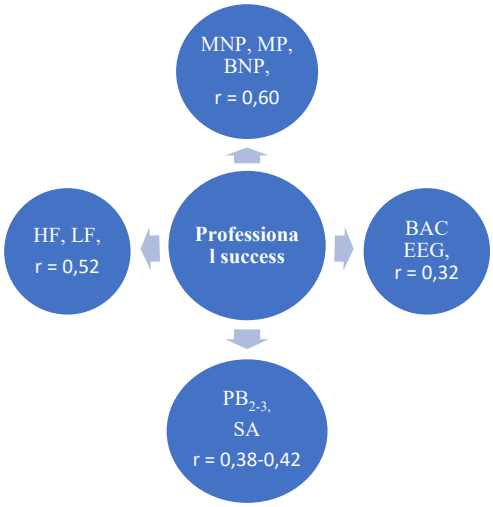

Figure 2. Correlations between professional success and psychophysiological functions (only significant relationships, p ≤ 0.05)

The obtained correlations indicate that a high level of professional performance requires a higher level of PF development. Such employees demonstrated the highest levels of MNP, MP, work efficiency, brain and heart activation. On the other hand, it can be stated that the level of development of a person's PF is a prognostic criterion of professional success. In addition, the obtained correlations indicate the need to take into account the indicators of PT, SA, HR and brain activity as objective markers of the "price" of mental activity.

5. Conclusions

The results of the study of PF, professional performance and the correlation analysis conducted between their indicators became the physiological basis for the development of some recommendations for individualising the work process. Three professional groups were identified among the subjects. The first group, according to the author, includes employees with high sensorimotor skills and the ability to make decisions with maximum accuracy. At the same time, when planning work tasks, it is necessary to take into account the likelihood of the risk of neurovascular pathology (Voronkov, 2017) and recommend that employees adhere to reasonable limits of computer work, diversify their personal life with fitness, aerobics, cultural, musical, creative or other social programmes. The second group of employees may include those with an average level of performance and efficiency. The recommendations include both mental and physical requirements. Their observance will be useful in preventing the rapid depletion of PF reserves, the emergence of psychosomatic symptoms and promoting professional success. The third group of employees should be formed from individuals who are relatively slow to perform work and have low professional performance. It should be noted that a low level of physiological foundation is not able to create an appropriate basis for the rapid performance of tasks and requires more time for recovery. In some cases, there may be a high probability of a mismatch between certain deficits in physiological functions and professional requirements, which may lead to chronic fatigue and the development of general neuroticism (Antoniuk, 2020; Moskalenko, 2019). Sometimes it may be appropriate for this category of employees to consider other areas of professional activity. Recommendations for increasing the psychophysiological potential and optimising the MP of people in this group may include expanding the range of various incentives, modernising existing models of professional relationships, individualising the work process, and training in personal self-control and education.

Thus, the results obtained in this paper indicate a link between PF and job performance. Employees with high levels of MP are distinguished by better professional performance. It seems that the applied typological approach, the developed differential scales for assessing the biological basis of human development, and the proposed integral PF index can improve the prognostication of professional success, and make the performance of work operations more "safe" for the employee's health.

This approach opens up new possibilities for individualising the workflow, expands the criteria base for assessing health and related economic progress, contributes to the country's stable development and can indirectly reduce threats to Ukraine's national security. Taking into account the biological and social aspects of employee health should have a positive impact on the competitiveness of the labour market, increase productivity and income, while maintaining health and increasing their own well-being needs.

References:

Ahaiev, N. A., Kokun, O. M., Pishko, I. O., Lozinska, N. S., Ostapchuk, V. V., & Tkachenko, V. V. (2016). Collection of methods for diagnosing negative mental states of military personnel: Methodological handbook. Kyiv: Research Centre for Humanitarian Problems of the Armed Forces of Ukraine, 234 p.

Antoniuk, V. P. (2020). Health in the system of factors of the formation of Ukraine's labor potential. *Herald of the Economic Sciences of Ukraine*, vol. 1(38), pp. 154–159. DOI: https://doi.org/10.37405/1729-7206.2020.1(38).154-159

Voronkov, L. H., & Solonovych A. S. (2017). Cognitive dysfunction in chronic heart failure: mechanisms, consequences, possibilities of correction. *Heart failure and comorbid conditions*, vol. 2, pp. 39–46.

Danilishyn, B. (2023). How to ensure economic growth in times of war. *Ekonomichna pravda*. Available at: https://www.epravda.com.ua/columns/2023/03/3/697664/

Dolot, V. D. (2016). Health as economic category factors affecting the level of health and health care. *Investments: practice and experience*, vol. 1, pp. 74–76. Available at: http://www.investplan.com.ua/pdf/1_2016/17.pdf

Makarenko, M. V. (2006). Bases of professional selection of military specialists and methods of studying individual psychophysiological differences between people. Kyiv: Research Centre for Humanitarian Problems of the Armed Forces of Ukraine, 395 p.

Moskalenko, V. (2019). Topical issues of health and healthcare in the third millennium. Available at: https://amnu.gov.ua/aktualni-problemy-zdorov-ya-ta-ohorony-zdorov-ya-u-iii-tysyacholitti/

Nebava, M. I., & Zaiukov, I. V. (2018). Human capital of health of the population of Vinnytsia region in the aspect of balanced development of the country. *Bulletin of Vinnytsia Polytechnical Institute*, 4, pp. 36–45.

Svintsitskyi, A. S. (2013). Public health as an important factor in state-building and national security. *The Praktitioner*, vol. 2, pp. 7–13. Available at: www.likar-praktik.kiev.ua

Tsiborovskyi, O. M. (2015). Public health and risk factors affecting its state as an object of management (literature review). *Ukraine. Nation's Health*, vol. 2(34), pp. 13–19.

Yukhymenko, L. I. (2023). Intersystemic connections of indicators of brain electrical activity and sensorimotor functions during information processing (typological aspect). Monograph. Cherkasy: Individual entrepreneur Hordiienko Ye.I., 150 p.

Gigantesco, A. (2013). Occupational stress and mental health. *Epidemiol. Prev.*, vol. 37(1), pp. 67–73.

Suhrcke, M., McKee, M., Stuckler, D., Sauto Arce, R., Tsolova, S., & Mortensen, J. (2006). The contribution of health to the economy in the European Union. *Public Health*, vol. 120(11), pp. 994–1001. DOI: https://doi.org/10.1016/j.puhe.2006.08.011

Received on: 10th of June, 2023
Accepted on: 19th of July, 2023
Published on: 25th of August, 2023