Problems of psychophysiological status of human capital in the cyclic conditions of Arctic

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Abstract. The problem of studying the psychophysiological status of labor resources, carrying out their professional activities in the complex cyclical conditions of the Arctic latitudes, is extremely important. The human research and his work activities are being actively developed in various areas of the medical, biological and psychological sciences. However, a systematic study of the psychophysiological status of human capital in the cyclical conditions of the Arctic, using its scientific terminology, has been identified individually. In this connection, it remains unclear whether the mechanism of integral adaptation to the conditions of the complex effect of stress factors of different nature, important for identifying the psycho-physiological status and psychological portrait of human capital in the special cyclical conditions of the Arctic. In the studied literature, we have not encountered a synergistic approach to the problems under study. It should be understood that human resources were not considered as a dissipative system and therefore we see in the results only the principle of determinism, but not the fractal one. The obtained information about the psychophysiological problems of human capital in the cyclical conditions of professional activity is necessary to create areas of medical and environmental monitoring of the Arctic.

1. Introduction

Countries that prioritize specializing in the extractive industries penetrate into hard-to-reach areas, attracting labor resources to difficult, often dangerous, working conditions. The development of such territories as arctic latitudes is not always thought out and expedient, since it entails a complex of problems: environmental, natural climax, medical and biological, psychological and others. An important, but insufficiently funded problem is the health of the workforce. Search and production of oil and gas deposits in the Arctic Russian latitudes requires health workers, including psychological. In such territories, rotational and expeditionary-rotational methods of labor activity are preferable. For the watch period, which is a short period of time, heterogeneous groups are formed with different levels: health, age, moral and value orientations, personal characteristics, education, professionalism, intelligence, and so on.

The analysis of literary sources showed that these questions are not given enough attention by Russian researchers. They are single, fragmented and require a deep, integrated approach. In this regard, we turned to various sources that highlight the problem of the psycho-physiological status of human capital, which carries out its work in the cyclical conditions of the Arctic.

The psychophysiological status determines the potential possibilities of the human body as a subject or personality in the conditions of mastering human activity, including professional one. Requirements for the psychophysiological status depend on the complexity of labor, and increase in terms of its danger to health. Since the development of the Arctic, at the state level is considered as a factor in the innovative development of the Russian economy, the labor force will be human capital.
Society creates its own rhythms, in which there is evolutionarily laid biological rhythms of man. As such, there are changes in the external environment (temperature, intensity or duration of light) and changes in the internal state and behavior, such as movement or immobility, wakefulness and sleep, hunger and food intake, magnetic fields, exercise, and so on. Social factors such as interpersonal relationships, physical activity, psycho-physiological and social. The relationship of the physiological and psychological characteristics of a person engaged in his work activity in the conditions of the Far North and the Arctic has not been sufficiently studied.

The purpose of this work is to analyze the literary sources in which there is information about the psycho-physiological problems of human capital in the cyclical conditions of professional activity necessary to create areas of medical and environmental monitoring of the Arctic.

2. Main part

Work in extreme conditions and situations makes special demands on human health not only in the medical aspect, but also in the psychological one (mental, psychological, social).

It is known that high latitudes are characterized by the activity of magnetic and solar storms, especially in transitional periods. From the point of view of the influence of solar and magnetic fields on the behavior of a person living or staying in the Arctic, are poorly understood, and are of undoubted interest.

Chronophysiological studies conducted under the guidance of Academic N.A. Aghajanian, in the conditions of the Arctic, showed that the temporary organization of the body in different environmental conditions has its own characteristics [1-3]. Synchronization of biorhythms in the subjects as a socially determined factor is of great adaptive importance, contributing to the survival of people in extreme situations [21]. In humans in the Far North due to changes in the circadian structure, intrasystem desynchronosis has been revealed [ibid.]. In trans-latitudinal movement, seasonal desynchronization is observed. When moving to the north, the amplitudes of external synchronizers cause flattening of biorhythms, the circadian organization is weakened, and the intersystem correlations are partially destroyed. Transmeridional flight - entails circadian desynchronization. It should be understood that workers of the rotational method carry out trans-latitudinal and trans-meridional flight for labor activity and start working in conditions of seasonal and circadian desynchronosis, which leads to disruption of the adaptation systems of the body.

Some authors believe that weak magnetic storms, having a 27-day cyclicality, can be attributed to the number of «pulse sensors» of biorhythms, and sporadically occurring storms - responses to solar flares («interference») that desynchronize functional systems [10]. During electromagnetic disturbances, when the rhythm-forming organization of the external environment is destroyed, violations of biological rhythms are observed [7; 26; 31].

Researchers have noted the presence of statistically significant correlations between geomagnetic disturbances and various characteristics of biological objects, including the human body at various levels of its organization [27]. It is established that the geomagnetic factor, along with the solar one, is a temporary sensor responsible for circadian rhythms, the failures of which lead to desynchronization of endogenous rhythms [ibid.].

Due to the peculiarities of the geographical position of the population of the northern territories, exacerbations of non-communicable diseases and psychopathology are observed [35].

It was revealed that shift work affects social relationships, psychological disadaptation and the development of somatic pathology, however, remain the subject of scientific debate [19]. For example, statistics indicate an increased incidence of the cardiovascular, nervous system, dysfunction of the organs of the gastrointestinal tract in people working in a shift mode [14].

Shift work reduces labor productivity especially at night and in the middle of the day (from 13.00 to 16.00 hours), the quality of sleep changes and drowsiness increases, the peak of which falls at 05.00 in the morning [5]. Intervals between shifts, with a sliding graph, cause an accumulation of fatigue and a slow recovery of psychological and physiological functions in people of different sex and age [24].
The psychological status of people working on the night shift suffers quite seriously - attention decreases, decision-making time increases, exogenous stimuli are perceived inadequately, which increases the level of industrial conflicts and increases the likelihood of local and global man-made accidents [8; 9; 29].

Psychological distress resulting from industrial activity negatively affects interpersonal relations with close relatives and children [11; 17; 30; 9; 29; 34]. It can be argued that workers of interchangeable and sliding graphs experience not only physiological stress, but also mental stress, which ultimately leads to problems of social adaptation.

Various studies have discussed options for shift work: 12-hour shifts with the correct alternation [39], 16-hour shifts; 24-hour shifts with the correct alternation; aperiodic [22]. Among researchers there is an active discussion of the ideal shift work [38]. It has been established that long-term shift work negatively affects biological rhythms and leads to desynchronosis, as a result of which, persistent social, psychological and physiological disadaptation sets in [16; 18; 28; 33]. The researchers are actively discussing the ideal shift work [38].

The problem of psycho-rhythms is not sufficiently studied. The question of the relationship between psychological and physiological parameters in the management of human behavior remains open.

Social rhythms can be timers of human behavior. Our correlation analysis of the acrophase of the indices of the frequency components of the heart rate variability spectrum (HRV) with the psychological indices of self-actualization of men and women under the extreme conditions of labor activity revealed a significant positive relationship. For example, in men in extreme situations during the daytime period, there is a positive relationship between the acrophase of the frequency components of fast waves (HF) and slow (VLF) with orientation in time and cognitive needs. In women, these same waves - with the need for support, the acceptance of aggression, which can be called psychological time behavioral reporters in the state of wakefulness. Also, according to the circadian rhythms of the spectral analysis of the heart rate, it has been revealed that in men and women in extreme situations, the spectrum activity shift depends on the awakening time and joint group activity, affecting the heart rate synchronization, the individual rhythm in the waking state will obey the social group influence [7]. This aspect is insufficiently studied in the chronobiological studies of workers to ensure social and psychological security in the development of high latitudes.

Studies of sleep / wakefulness impairment are of particular psychophysiological importance [40]. Separate consideration is given to the problem of the influence of psycho-traumatic events on circadian rhythms, which may appear in the structure of acute or chronic stress. It should be emphasized that both negative and positive changes in a person's life can act as traumatic events [20]. All of these social factors can have a pathogenic effect on biological rhythms and lead to the development of mental and psychosomatic disorders, in case of a lack of adaptive resources.

3. Conclusion

Thus, the analysis of literary sources showed that research on a person’s labor activity is being actively developed in various fields of biomedical and psychological sciences. However, systemic chronobiological studies using its scientific terminology have been identified individually. In this regard, it remains unclear the mechanism of integral adaptation to the conditions of the complex impact of stress factors of different nature, on the example of high latitudes, important for identifying the psychological status and psychological portrait of human capital in the cyclical conditions of the Arctic. According to S.M. Chibisov, the most intriguing mystery of biorhythmology, is the question why rhythms that coordinate the vital activity of organisms with a “chronometer” accurate to fractions of a second (astronomical day) themselves have a systematic “error” up to several hours:

- the researcher assumes that it is this “error” that makes it possible to coordinate the biorhythms of various functions among themselves. The emergence of a kind of "tremor" biorhythms allows you to adjust the system to a wide range of constantly occurring changes in the external environment (including rhythmic changes).
the human body is a subtle evolutionarily formed keeper of rhythmic processes, the violation of which has a destructive effect on the human body and is reflected in its behavioral actions. It should be understood that human resources were not considered as a dissipative system and therefore we see in the results only the principle of determinism, but not the fractal one. Perhaps desynchronosis is an adaptive space in which the human body finds individual opportunities to adapt to the complex of cyclical rhythms acting on it.

An analysis of literary sources has shown that the development of the Arctic is relevant for the Russian economy, but the health of the workforce, professional longevity is of paramount importance, requires the socio-economic satisfaction of their basic needs. The obtained information about the psychophysiological problems of human capital in the cyclical conditions of professional activity is necessary to create areas of medical and environmental monitoring of the Arctic.

References

[1] Agadzhanyan N Petrova P 1996 Man in the conditions of the North M KRUK 208 (in Russian)
[2] Agadzhanyan N Gorshkov M 1981 Chronobiology and chronopathology (Moscow: Sciencep) 16-17 (in Russian)
[3] Agadzhanyan N and Ermakova N 1997 Ecological portrait of a man in the North M KRUK 208 (in Russian)
[4] Aganov D et al 2014 The elemental status of servicemen serving in the extreme conditions of the North of the Russian Federation Medical, biological and socio-psychological problems of safety in emergency situations 4 60–65 (in Russian)
[5] Akerstedt T 1998 Shift work and disturbed sleep/wakefulness Sleep Medicine Reviews 2 117–128
[6] Baker A et al 2003 The impact of roster changes on absenteeism and incident frequency in an Australian coal Occupational and Environmental Medicine 60 43–49
[7] Bashkireva A et al 2018 The problem of modeling human behavior in the system of human factor prevention Agadjanian readings. Materials of the II All-Russian Scientific and Practical Conference M RUDN 49-51 (in Russian)
[8] Becker H 1999 Alcohol withdrawal: neuroadaptation and sensitization CNS Spectrums 4 38–65
[9] Borisov V and Pochukaeva O 2016 Relationships between development factors of the Arctic Zone of the Russian Federation Studies on Russian Economic Development 27 (2) 159-165
[10] Breus T et al 2002 Chronostruktura heart biorhythms and environmental factors. Peoples’ Friendship University of Russia, Polygraph Service Publishing House Moscow 232 (in Russian)
[11] Brough P O’Driscoll M 2000 Construction and validation of a multidimensional measure of time-based work-family conflict Journal of Vocational Behaviour 56 249–276
[12] Bühr E et al 2010 Temperature as a universal resetting cue for mammalian circadian oscillators Science 330 379–85
[13] Carlson D et al 2000 Construction and validation of a multidimensional measure of time-based work-family conflict Journal of Vocational Behaviour 56 249–276
[14] Costa G 2003 Shiftwork and occupational medicine: An overview Occupational Medicine. 53 (2) 83–88
[15] Danel T and Touitou Y 2004 Chronobiology of alcohol: from chronokinetics to alcohol-related alterations of circadian system Chronobiol Int. 21 (6) P 923–935
[16] Earle J 2001 Managing the social cost of shiftwork on the employee’s family and social environment Paper presented at the Best Practice Rostering and Shiftwork Conference Sydney
[17] Eby L et al 2005 Work and family research in IO/OB: Content analysis and review of the literature (1980- 2002) Journal of Vocational Behavior 66 124–197
[18] Gibbs M et al 2002 Adaptation of the circadian rhythm of 6-sulphatoxymelatonin to a shift schedule of 7 nights followed by 7 days in offshore oil rig workers Neuroscience Letters 325 91–94
[19] Harrington J 2001 Health effects of shift work and extended hours of work Journal of Occupational and Environmental Medicine 58 68–72
[20] Holmes T and Rahe R 1965 The social readjustment rating scale Psychosomatic Res 7 (11) 213–218
[21] Human ecology in a changing world.2008 Edited by RAS and RAMS VA Chereshneva Qty. authors (Ekaterinburg: Ural Branch of RAS) 580 (in Russian)
[22] Iskra-Golec I et al 1996 Health, well-being and burnout of ICU nurses on 12 and 8 hour shifts Work and Stress 10 251–256
[23] Jackson S et al 1985 Family life disruptions: Effects of job-induced and emotional interference. Academy of Management Journal 28 (3) 574–586
[24] Johnson S 2005 Life events in bipolar disorder: Towards more specific models. Clin Psychol Rev 25 27–1008
[25] Johnson S and Miller I 1997 Negative life events and time to recovery from episodes of bipolar disorder Abnormal Psychology 106 (57) 449
[26] Khabarova O and Rudenchik E 2004 Fundamentals of a new medium-term forecast method for magnetic storms Mat. Int. of the seminar “Biological effects of solar activity”, Pushchino-on-Oka 10-11 (in Russian)
[27] Komarov F et al 2018 Environmental factors as a possible cause of desynchronosis Chronobiology and chronomedicine ed. C M Chibisova, S I Rapoport, M L Blagonravov (Moscow: PFUR) 80-10 (in Russian)
[28] Kundi M et al 1995 Attitudes of nurses towards 8-h and 12-h shift systems Work and Stress 9 134–139
[29] Leksin V and Profiryev B 2017 Socio-economic priorities for the sustainable development of Russian arctic macro-region Economy of Region 4 985-1004 doi: 10.17059/2017-4-2
[30] Loudoun R and Bohle P 1997 Work/non-work conflict and health in shiftwork: Relationship with marital status and social support International Journal of Occupational and Environmental Health. 3 Suppl. 2 71–77
[31] Mezun Y 1998 Adaptation and Health in the Far North Available from: http://www.arctic.org.ru/1998/1_10_98.htm [Accessed 20th May 2019]
[32] Monk T et al 1991 The Social Rhythm Metric (SRM): Measuring daily social rhythms over 12 weeks. Psychiat Res. 36 195–207.
[33] Pisarski A et al 2006 Extending a model of shiftwork tolerance Chronobiology International 23 (6) 1363–1377
[34] Presser H and Cain V 2001 Shiftwork among dual earner couples with children Science 219 876–879
[35] Ragozin O et al 2018 Geoclimatic factors and chronopathology of the northern region Chronobiology and chronomedicine ed. C Chibisova, S Rapoport, M Blagonravov. Moscow PFUR 134-166 (in Russian)
[36] Raistrick D 2000 Management of alcohol detoxification Advances in Psychiatric Treatment. 6 348–355
[37] Rodrigues V et al 2003 Shiftwork at a modern offshore drilling rig Journal of Human Ergology 30 (1/2) 167–172
[38] Rosa R 1995 Extended workshifts and excessive fatigue Journal of Sleep Research. 4 Suppl. 2 51–56
[39] Rudenko D and Skripnuk D 2016 Environmental Kuznets curve The case of arctic Russian regions International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management SGEM 3 209-216
[40] Verbitsky E 2009 Feedbacks in the regulation of sleep and its disorders Neurocybernetics problems 1 86-88