

World ocean flight around the North Pole: Effects to pilots' psychophysiological state

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Abstract— In order to determine the main human body psychophysiological parameters, assisting to implementation of work during the flight in the Arctic region, there were carried out the assessment of some pilots' psychological parameters before and after round-the-world oceanic flight around the North Pole on the Arctic Ocean. The data show the development of fatigue and general psycho-emotional stress after long term Arctic flight, which indicate some adaptability decrease, but are not critical to limit the professional duties performance after rest. The study indicates the pilots' organism high adaptive capacity under the work extreme loads in the Arctic region.

Keywords— *psychophysiology, Arctic region, pilots, adaptation*

I. INTRODUCTION

The existing system of professional risks is developed for working conditions at the enterprises of Central Russia mainly. The intensive development of the Arctic territories necessitates the increasing use of work related to the complex of climatic, industrial, social, medical, information and psychological new risks, and requires the of technologies of medical selection, adaptation and rehabilitation of workers in the Russian Federation Arctic region improvement. A high-intensity professional load, significantly exceeding the standards for normal working conditions, often accompanies work in the Arctic. This creates the prerequisites for somatic disorders and the development of a wide range of neuropsychiatric and psychosomatic disorders.

Meanwhile the complex of above-mentioned factors: desynchronization, a high degree of neuro-emotional, physical loads, in case of long-term flights in the Arctic region can lead to health disorders risk increase. Mental health stability and reliability can play the special role in this case, as it will ensure not only human health preservation, but also keep work stability.

Particularly noteworthy are the issues of workers of dangerous (extreme) professions psycho-physiological disorders risk assessment, including for work in Arctic. Flight work is a typical variant of extreme work. There is a limited number of studies aimed at assessing the impact of flight conditions in the Northern region [1-3, etc.]. There are the data that psychophysiological adaptation in pilots (navigators) to Far North conditions occurs with greater

psycho-emotional stress than persons of other specialties [1]. Thus, the study of pilots and navigators organism functional state during the adaptation to the Far North shows significant violation of memory, attention processes, including a decrease in the volume and distribution of attention [2]. In the study of professional burnout risk in the air force flight crew (156 people, age 21-50 years), there was a clear identification of burnout syndrome. The flight crew showed emotional tone decrease in 65.3 % of cases, depersonalization – a decrease in self-esteem in 52.5 % cases, and reduction of professional achievements in 60.2 % cases [3].

Successful activity in extreme situations largely depends on self-regulation possibility, the main purpose of which is the harmonization of relations with the outside world and with oneself. This goal achieved by involuntary and arbitrary self-regulation mechanisms activating [4]. Psychophysical self-regulation is a set of techniques and methods of the person' psychophysiological state self-correction, leading to of mental and somatic functions optimization. Thus, the issues of psycho-physiological adaptation to flight work in the Far North are of high are very important.

However, none of the previous studies has not addressed the issues of combined effects on pilot's physiological and psychological parameters complex effects of many hours flights in the far North with the change of time zones and a high degree of physical loads and psycho-emotional stress.

The goal of this work was to determine the of pilot's main psychophysiological parameters, contributing to work implementation in the conditions of flight in the Arctic region, performed in the framework of the Arctic round-the-world expedition "North Your" on domestic amphibious aircraft: two LA-8 and one "Borey".

II. MATERIAL AND METHODS

Pilots (6 men, 39 to 69 age) performed a round-the-world oceanic flight around the North Pole in the Arctic Ocean psychophysiological state assessment were carried out immediately before departure from the home airport and after return. The flight lasted 6 weeks and took place at altitudes up to 3000 m. During the flights, about 50 flights were made, extreme situations including.

Pilot's psychophysiological status assessment were carried out by Universal psycho-diagnostic complex UPDK-

MK development JSC "NEUROCOM", Moscow, using computer psycho-diagnostic techniques for the following parameters:

- Readiness for psychological testing and functional state dynamic control - functional state express test;
- Health, activity, mood – a questionnaire used to determine the of health situational level, activity and mood;
- Complex motor reaction, estimated in terms of complex visual-motor reaction time and errors number;
- Risk taker that allows to predict the likelihood of risky actions in the performance of professional activities;
- Attention span and the workability efficiency, which allows to determine the dynamics of mental fatigue and sustainability of the health indicators of attention;
- The sense of time assessment, allowing to remember the "reference" time interval of the color signal;
- Emotional stability to assess the person's ability of work in the presence of interference and negative emotional factors;
- Proof-reading test used to assess the attention concentration and stability;
- The level of subjective control intended for the diagnosis of internality – externality.

Psychophysiological parameters assessment were carried out personified and in the group. Statistical data processing were performed using a nonparametric-paired test.

III. RESULTS AND DISCUSSION

The assessment of pilot's readiness for psychological testing and functional state dynamic control show that 3 parameters out of 5 evaluated before and after the flight did not have significant differences. However, after the flight, the number of missed signals increased (from 2.17 to 3.2) as well as the total number of errors (from 2.67 to 3.80), objectively indicating a decrease in concentration, possibly as a result of general fatigue after a long physical and neuro-emotional stress.

Pilots psychophysiological state assessment according to health, activity, mood parameters before and after the flight indicates the following. Before the Arctic flight, the pilots noted high values of all questionnaire parameters - health (5.65 points), activity (5.33 points), mood (5.72 points). After the flight, you can see a statistically significant decrease in the values of health and activity parameters (see Fig.1) with a significant increase up to the maximum limits of the mood indicator - up to 5.9 points. Perhaps this may be due to the satisfaction of the pilots achieved the results of difficult flight. The decrease in the values of well-being to 5.03 and activity to 5.1 after the flight makes it possible to associate these changes with a subjective decrease in the level of functional state of psychophysiological functions as a result of fatigue after a high level of psychoemotional loads during a long and stressful flight.

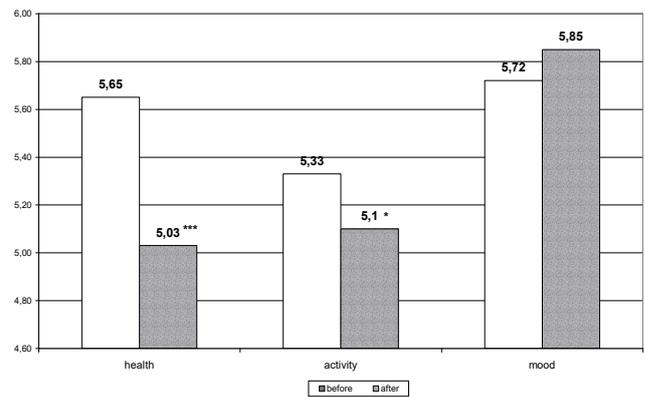


Fig.1. Health, activity, and mood assessment before and after round the world flight: * $p \leq 0.005$ *** $p \leq 0.0001$.

The analysis of pilots' risk taker assessment indicates statistically significant decrease of this parameter values after the flight (from 6.67 to 4.8 points in average, $p \leq 0.001$). As it known, the tendency to risk is stable, but secondary characteristic of the individual, because due to the presence of human other features - the desire to search for new sensations, anxiety, perseverance, extroversion, neuroticism, uncritical, emotional lability. Risk taker significant decrease after the flight may be related to triggered reflexive processes in the pilots in problem situations during the flight, which led to a reassessment of their value system and cognitive models, and perhaps this was the result of fatigue as result of prolonged neuro-emotional and physical loads and overloads.

Emotional stability parameters assessment before and after the flight indicates the stability deterioration after the flight for most indicators (see Fig.2). The number of errors statistically significantly increased, indicators N1-N2 difference show unstable emotional state at the end of long flight. As it known, emotional stability provides the individual ability to maintain a certain focus of actions in stressful situation with the help of self-regulation and self-control and thus contributes to professional success. It reduces the negative impact of strong stress factors, contributes to the manifestation of readiness to act in load situation. A person is able to carry out the necessary activities successfully in difficult emotional conditions due to the emotional stability.

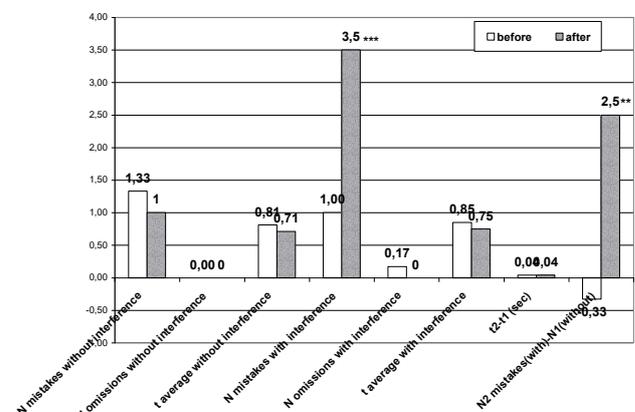


Fig.2. Pilot's emotional stability parameters before and after before and after round the world flight: ** $p \leq 0.001$ *** $p \leq 0.0001$.

These data are confirmed by the results of complex sensorimotor reactions assessment and characteristics of attention stability.

The pattern of pilot's complex sensorimotor reactions changes after the flight (the errors and missed stimuli number statistically significant increase) (Fig. 3), reflects the central nervous system functional state decrease apparently also due to chronic load and overloads and general fatigue developing as result, thus acting as a predictor of reduced reliability.

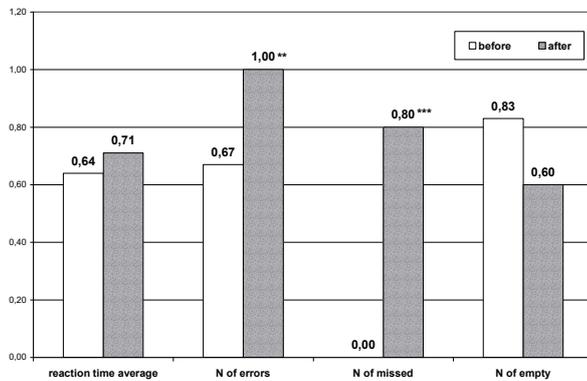


Fig.3. Pilot's complex sensorimotor reaction parameters before and after before and after round the world flight: ** $p \leq 0.001$ *** $p \leq 0.0001$.

Similarly, the assessment of pilot's attention stability before and after the Arctic flight indicates its deterioration, which is manifested in increase of errors number from 2.5 to 3.75 ($p \leq 0.001$) as well as signal gaps increase from zero to 0.5 ($p \leq 0.0001$). Attention stability potential decrease indicates the natural fatigue and shifts in the system of adaptability of pilots after the flight.

The assessment of remember the color signal burning "reference" time interval ability before and after the flight revealed an almost twofold increase in the time interval of memorization after the flight (from 2.33 to 5.75 s), which is clearly explained by both a decrease in concentration after long flight finish, and general fatigue associated with prolonged stress. At the same time, there were no significant differences in both re- and underestimation of the time interval. These data almost fully confirm the conclusion about reducing the adaptability of pilots.

There were no significant differences in the average values of proofreading test parameters. Before the flight, its average time was 239.3 ± 21.1 s, and after the flight – 232.0 ± 19.6 s with the absence of significant differences of recognizable number of letters (33.5 and 35.0) and statistically unreliable increase of errors number (6.67 and 10.75).

Similarly, there were no significant changes in pilot's level subjective control after the flight, which indicates a high level of training and readiness to maintain a stable ratio of internality – externality level even after a long loads and

overloads, including flights with a change of time zones and cooling environment.

IV. CONCLUSION

The data of study show the development in pilots fatigue and general psycho-emotional stress after long multi-day Arctic flight, which indicate some adaptability decrease, but are not critical to limit the performance of professional work ability after rest. At the same time, there were no significant dependencies of changes on the age of the pilots (taking into account the high level of training and extensive experience of work in extreme conditions). These results are generally correlate with published data of the same group cardiovascular system assessment before and after the flight. There were founded the changes in the functional state of regulatory systems in the absence of these systems individual parameters changes in the [5] against the background of stress index and minimum duration of inter-systolic intervals decrease.

Thus, workability of activity subject is determined, on the one hand, its phenotypic properties, on the other — the conditions and specific requirements of activity. Obtained data allow us to emphasize the importance of individual psychological characteristics and functional state relationship to maintain balance in the system of professional activity of pilots.

In General, the study shows the pilots' organism high adaptive capacity under the work extreme loads in the Arctic region.

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