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PHYSICAL ACTIVITY OF NAVAL SPECIALISTS AS A FACTOR OF PRESERVING THEIR JOB PERFORMANCE

Pavel A. Soshkin, Vasiliy G. Belov, Dmitriy S. Zabrodsryi, Anton V. Naumov, Alexandr G. Anohin
State Scientific Research Test Institute of the military medicine of the Russian Ministry of Defense, St. Petersburg, Russia

The purpose of the study was to assess the physical activity of naval specialists during a cruise. Physical performance of the personnel and its dependence on the regularity of the exercise program were evaluated. In total, 80 ship crew members aged 20 to 40 years were surveyed during a two-month cruise with a different physical exercise programs: not engaged in physical training, engaged in physical training by a specially developed program under the guidance of a surgeon, and doing it independently. The study has revealed that during a cruise, naval specialists without physical training show multidirectional dynamics of their physical performance with increasing in the middle of the cruise, and returning to the initial state by the end of the cruise. Naval specialists with regular independent exercise have a positive dynamics of their physical performance, which significantly increases both in the middle and at the end of the cruise. Downward trend in the level of physical performance is observed among persons engaged in physical training independently and irregularly at the end of the cruise.
The study has established that the use of a specially developed training program for physical activity allows us not only to preserve, but also improve the physical performance of naval specialists in the conditions of a cruise.
Key words: marine medicine, the Navy, naval specialists, physical activity, physical performance. .

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Introduction. Due to a number of specific elements of combat training, personnel selection, climatic, geographical and environmental specifics of ship-based points and combat patrol areas in the World Ocean, the Navy has a special place in the structure of the Armed Forces.
At present, within the framework of the program for advanced development of the Armed Forces of the Russian Federation, it is carried out the building of a series of small tonnage ships (such as small rocket ships) staffed with the personnel performing specific tasks under hypodynamia and hypokinesia. At the same time, the problem of optimal physical load is one of the priorities for the crews of such ships performing tasks in the conditions of high emotional and physical stress.

Successful achievement of training objectives by naval specialists, especially by seafarers, is closely connected with the solution of a number of biomedical problems, among which the optimization of the physical activity of the personnel is the primary one.
Taking into account the tasks solved by naval servicemen, there is the potential of their contact with radioactive substances and toxic technical fluids, as well as being in the zone of increased non-ionizing and ionizing radiation, excessive noise load, and under effect of other physical factors [1, pp. 105–111; 2, pp. 58–65; 3, p. 35].
Development of military equipment and use of atomic energy on ships of the Navy allowed to design and put into service the modern ships with certain specificities of manning and fulfilment of tasks as intended for war duty far from the borders of Russia [1, pp. 105–111; 2, pp. 58–65].
Higher fitness standards in officers, warrant officers and sailors who serve on modern ships are required, as their professional activity is connected with the effects of ionizing and electromagnetic radiation, as well as other adverse factors of habitability. In addition, the adverse climatic and geographical features of the locations of the Navy ships have an impact on the functional state of this contingent [2, pp. 58–65; 3, p. 35; 4, pp. 15–26].

In the long-term sea campaign, seafarers are affected by a complex of factors defined by the term “captive environment onboard”, which places higher demands on the human body than coastal conditions do. Human bodies have no well-developed adaptive mechanisms to these factors [2, pp. 58–65; 3, p. 35; 4, pp. 15-26; 5, pp. 55–58]. This complex of factors includes hypokinesia, sensory-psychological deprivation, vibration and noise, sudden change in climatic conditions, constant change in biorhythms, prolonged isolation of a limited team, geomagnetic disturbances, electromagnetic radiation of a wide range of frequencies, the presence of harmful substances in the indoor air, the change in the gas composition of inhaled air [2, pp. 58–65; 3, p. 35; 6, pp. 144-149].

Relatively small size of closed hermetic service premises and monotonous operator work of naval specialists make it necessary to pay serious consideration to development of the hypokinetic syndrome, which is one of the key developments of adverse changes in their bodies that can lead to a significant performance degradation. The studies carried out in the Navy [2, pp. 58–65; 3, p. 35; 6, pp. 144–149] have proved that prolonged, continuous exposure of autonomous navigation factors impairs functional status and physical performance of seafarers and adversely affects the efficiency of the crew-ship system. High levels of neuropsychic and physical loads on the background of hypokinesia as well as the adverse effect of habitability factors lead to the health disorders in seafarers with primary manifestation of cardiovascular diseases, diseases of the nervous system and the gastrointestinal tract, and metabolic disorder [2, pp. 58–65; 3, p. 35; 4, pp. 15–26].

At the same time, the predominance of anaerobic metabolism over aerobic leads to the accumulation of glycolysis products and overfatigue, decreased performance, depletion of physiological reserves, impaired body defenses, sleep disorders in this cohort. Prolonged isolation from the usual mode of life, as well as age peculiarities of the crew determine the priority of optimizing the functional state by optimizing the motor mode [2, pp. 58–65; 3, p. 35].

During long-term campaigns, an adverse effect of hypokinesia on a physical performance that changes under the influence of environmental conditions to a greater extent than the muscle strength, moreover, detraining of the back muscles is more pronounced compared to the muscles of the lower limbs, which is associated with limitation of dynamic and static load [2, pp. 58–65; 6, pp. 144–149; 7, pp. 171-177].

Thus, sensory deprivation, relative social isolation, and hypokinesia are risk factors for the deterioration of health status in naval specialists, and, at that, the optimal physical load for this contingent is the key prevention factor, which determined the relevance of the present study.

Study objective: to assess physical activity in naval specialists during the campaign.

Study tasks: to assess physical performance in naval specialists during the campaign and reveal the dependence of physical performance on regularity of execution of training program.

Materials and methods. 80 members of ship crew aged 20 to 40 participated in two-month (8 weeks) campaign. Recreation activities based on physical trainings were held during the campaign. The crew was allocated to three groups: the 1st group enrolled 23 seamen who was not engaged in physical activities in campaign; the 2nd group enrolled 27 seamen who was engaged in physical activities by a specially developed program under the guidance of a surgeon (2 subgroups were picked out in this group: IIA — 16 seafarers who was engaged in physical activities by the program regularly and IIB — 11 seafarers who was engaged in physical activities by the program irregularly); the III group consisted of 30 seafarers who was engaged in physical activities independently (2 subgroups were picked out in this group: IIIA — 18 seafarers with regular physical activities and IIIB — 12 seafarers with irregular physical activities).

The survey during the campaign was divided into 3 periods: the 1st – control period (the 1st week) with the objective to detect the initial level of physical training; the 2nd – training period (from the 2nd to the 7th week) and the 3rd – final period (the 8th week of the campaign).

Training program envisaged use of basic and selective exercises. Basic exercises included cycling, stationary rower workout, walking on the deck of the ship. Selective exercises included training exercises with and without apparatus (dumbbells, expanders etc.) which promote strength and speed skills in subjects. Strength exercises (external resistance exercises and weight training exercises) were used primarily for maintaining all-round fitness of seafarers whose professional activities were not associated with muscular tension.

Round robin exercises were carried out with using some exercise machines in definite order (with and without apparatus as it was marked above).

The program was compiled taking into account such body physiological mechanisms as body warm-up and restoration.

All trainings had an introducing part, during which preparations were made for the perception of a greater load; the main part, which solved the main task of the training – building up general endurance; and the final part, aimed at body functional recovery.
Testing on a bicycle ergometer with performance of stepwise increasing load was used as a method for assessing physical performance.
The study used the apparatus of the mathematical-statistical analysis, including the calculation of variance factors of values (arithmetic mean value, standard deviation, F-value, standard error of the mean, 95% confidence interval of true value); comparison of correlations by calculating Student's t-test, non-parametric methods (Wilcoxon – Mann – Whitney test, sign test) of statistics. The calculations were carried out using the standard computer software package (the STATISTICA 6.0 application packages and the Microsoft Excel 2010 spreadsheet software).

Results and discussion. Analysis of a physical performance in the crew members who were not engaged in physical activities (group I) has shown that mean value of PWC_{170} on this group was 92W in the beginning of the campaign (Table). The parameter increased by 9% ($p<0.05$) by the 2nd day and decreased to the initial value with a trend of significance of differences comparing with the 2nd study.

Table

Real time parameters of physical working capacity in seafarers during the campaign according to the test PWC_{120} (W), x±Sx

Group	Number of subjects, abs.	Campaign periods		
		1	2	3
I	23	92±5	100±5	91.6±4
IIA	16	110±9	126±10	125±11
IIB	11	113±9	119±10	118±10
II	27	114±5	126±6	123±7
IIIA	18	114±7	128±7	135±6
IIIB	12	110±8	114±10	104±9
III	30	113±5	124±5	120±6
Total	80	105±3	115.1±3	111.7±3

In the beginning of the campaign, PWC_{170} was on average 110W in the crew members who were engaged in physical activities (PA) regularly by a special training program (group IIA), the parameter has dramatically increased by 14.5% ($p<0.01$) by the 2nd study and remained unchanged by the 3rd study. The values were 126 and 125W, respectively. Compared to above-described group, the average values of PWC_{170} during the whole campaign remained practically unchanged (uncertain difference) and were 113W (the 1st study), 119W (the 2nd study) and 118W at the end of the campaign.
In the beginning of the campaign, PWC_{170} was 114W in the crew members who were engaged in physical activities (PA) regularly independently (group IIIA) was 114W, the parameter has increased by 12% ($p<0.01$) by the 2nd study and increased by 18% from the initial level ($p<0.01$), reaching 135W.
The results of PWC_{170} test in the crew members who were engaged in physical activities (PA) irregularly independently (group IIIB) showed practically unchanged physical working capacity by the 2nd study and decreased – by the end of the campaign. So, values of PWC_{170} test were 110W in the 1st study, 114W – in the 2nd while by the end of the campaign, the value decreased by 104W a trend of significance of differences relative to the 1st and the 2nd studies.
Thus, a higher level of physical performance was revealed in the crew members with regular physical activities. It is worth pointing out that by dynamometry data, the results of the present study show impairing endurance of back muscles and thoracic girdle muscles in I and IIIB groups and in IIIA group - in a smaller degree which is due to reduction in static and dynamic loads on this set of muscles under hypodynamia. Back muscles and shoulder girdle muscles are used when rowing a rescue boat and swimming. Thus, deconditioning and impairing endurance of this set of muscles demands development of organizational scheduled activities as well as a consideration the equipping of the ships with rowing machines providing the fulfilment of exercises aimed at development of physical qualities (strength and endurance) which promotes tolerance of the body to adverse effects of military professional activities, increases mental stability and develops moral and volitional powers.

Conclusion. The results of the present study aimed at the assessment of physical activities in naval specialists during the campaign allowed to arrive at the following conclusions.

1. Regular physical activities promote positive dynamics in parameters of physical performance in naval specialists during the campaign.
2. Impairing endurance and deconditioning of back muscles and thoracic girdle muscles due to hypodynamia are more evident in persons who are not engaged in physical activities and doing it irregularly.
3. Rowing machines promote the development of physical qualities (endurance and strength) which allows to exclude deconditioning of all muscles and may be recommended for training during the campaign.

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Contact: *Soshkin Pavel Aleksandrovich, soshkin-med@mail.ru*

Authors credentials:

Soshkin Pavel Aleksandrovich – Lieutenant Colonel of Medical Service, Candidate of Medical Sciences, Chief of the Department of the Federal State Budget Institution “State Scientific Research Testing Institute of

Military Medicine" of the Russian Ministry of Defense; 195043, Saint Petersburg, Lesoparkovaya str., 4; e-mail: soshkin-med@mail.ru;
Belov Vasily Georgievich — MD, Professor, Senior Scientific Researcher of the Federal State Budget Institution "State Scientific Research Testing Institute of Military Medicine" of the Russian Ministry of Defense; 195043, Saint Petersburg, Lesoparkovaya str., 4; e-mail: BelV1@yandex.ru;
Zabrodsky Dmitry Sergeevich — Lieutenant Colonel of Medical Service, Deputy Chief of the Department of the Federal State Budget Institution "State Scientific Research Testing Institute of Military Medicine" of the Russian Ministry of Defense; 195043, Saint Petersburg, Lesoparkovaya str., 4; e-mail: diz-06@mail.ru;
Naumov Anton Vladimirovich — Major of Medical Service, Deputy Chief of the Department of the Federal State Budget Institution "State Scientific Research Testing Institute of Military Medicine" of the Russian Ministry of Defense; 195043, Saint Petersburg, Lesoparkovaya str., 4; e-mail: soshkin-med@mail.ru;
Anokhin Alexander Gennadyevich — Lieutenant Colonel of Medical Service, Candidate of Medical Sciences, Chief of the Department of the Federal State Budget Institution "State Scientific Research Testing Institute of Military Medicine" of the Russian Ministry of Defense; 195043, Saint Petersburg, Lesoparkovaya str., 4; e-mail: soshkin-med@mail.ru.