

HYPODYNAMIA OF THE SPECIALISTS OF THE MILITARY SEA FLEET UNDER THE CONDITIONS OF A LONG SEA TRIP

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In order to study the effect of physical inactivity on the dynamics of the body composition of military seamen of surface ships (SS), the actual anthropometric and biophysical indicators of military seamen of a scientific research vessel under conditions of a long sea campaign were investigated. It was found that a motor activity significantly decreased in the campaign compared with the same at the point of permanent dislocation. The surveyed servicemen noted mostly sedentary lifestyle. By the end of the campaign, some of the personnel had leg lean mass reduced on average, by 0.23-0.44 and 0.22-0.4 kg, respectively, that may be considered as a mild muscle hypotrophy. The chemical composition and energy value of products provided for a long sea trip did not fully meet the requirements of medical and technical requirements for marine ration (norm No. 3). A sufficiently high-calorie diet and a prolonged positive energy balance, as well as physical inactivity with a decrease in energy consumption in a long sea trip, leads to an increase in body weight in seamen due to an increase in the fat component of the body composition. The current norm of food ration (marine ration, Diet N3) does not require to increase the energy value, but demands for greater variety of the ration composition and compensation for deficiencies of vitamins A, B₁, B₂, PP, β -carotene and some macroelements (potassium, magnesium and calcium) in food, for example, by intervention of modern vitamin-mineral complexes. In order to solve the problem of hypodynamia in Navy specialists in conditions of a long-term sea campaign, it is recommended to combine dietary by the Diet 3 (marine ration) with regular additional physical exertion. At the same time, the actual task is to develop and introduce in the daily practice of physical activities for military personnel in a long sea campaign. Medical specialist should control the level of physical activity of servicemen. **Key words:** marine medicine, physical inactivity, actual nutrition, physical activity, body fat mass, leg lean mass, level of training, long sea campaign.

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Materials and methods. The study of body composition indicators (BCI) was held with the participation of 40 military volunteers at the age from 22 to 45 years during pre- and post-sea campaign medical examination of the personnel of surface ship. Total duration of the campaign was 147 days. During the sea campaign, main life conditions for the personnel of surface ship stayed firm, prescribed eating, work and rest schedule were followed.

The dynamics of BCI was evaluated by analysis data of anthropometric measures. Body mass (BM), waist circumference (WC), body mass index (BMI), waist-to-hip ratio (WHR) were taken into account when calculating. Bioelectrical impedance analysis of the participant body was carried out in addition to estimate fat mass (FM), percentage fat mass (PFM), visceral fat area (VFA), lean mass (LM) of limbs and trunk, training level (TL) and others. The level of physical activity was assessed using the International Physical Activity Questionnaire (IPAQ) and TL. Biochemical blood analysis in volunteer participants was carried out in order to determine human indicators that characterize the protein, fat and carbohydrate metabolic condition as well as the content of vitamins and minerals. All indicators registered in the military personnel were adapted for mathematical and statistical analysis using nonparametric techniques (Mann–Whitney U test, Wilcoxon signed-rank test and Fisher test (angular transformation)).

Results and discussion. The results of the study show naturally determined trends of BCI in the military personnel during a long sea campaign. Results of the comparative analysis of BCI in the military personnel for the entire duration of the long sea campaign are given in Table 1.

Table 1

Characteristic of directivity and intensity of changes of BCI parameters in the SS military personnel during long-term campaign (Wilcoxon signed-rank test) [Statistical Package for Social Sciences (SPSS)]

Parameter	Descriptive statistics of parameter increments						p
	increasing measure			decreasing measure			
	n ⁺	Me ⁺ [x _{min} ; x _{max}]	ΣR ⁺	n ⁻	Me ⁻ [x _{min} ; x _{max}]	ΣR ⁻	
BM, kg	17	3.5 [0.4;9.8]	224.0	7	2.1 [1.7;6.9]	76.0	0.034*
WC, sm	17	3 [1;10]	212.0	4	1.5 [1;3]	19.0	0.001*
BMI, kg / m ²	17	1.1 [0.2;3.1]	223.0	7	0.7 [0.4;2.1]	77.0	0.037*
VFA, sm ²	22	16.8 [1.18;37.2]	278.0	2	17.1 [10.4;23.7]	22.0	3·10 ⁻⁴ *
FM, kg	21	2.8 [0.3;9.6]	262.0	3	2.9 [0.9;7.7]	38.0	0.001*
PFM, %	21	1.6 [0.3;4.0]	280.0	3	1.8 [0.5;4.3]	20.0	2x10 ⁻⁴ *
WHR, c.u.	23	0.04 [0.01;0.1]	294.0	1	0.03 [0.03;0.03]	6.0	4x10 ⁻⁵ *

Notes: n⁺, n⁻ – number of persons with increased/ decreased parameter; Me⁺, Me⁻ — increment median; [x_{min}; x_{max}] — increment range; ΣR⁺, ΣR⁻ — total increment rank; * — detected statistical significance of increment difference at accepted significance level α=0.05.

As can be seen from the Table 1, BM in the group of the military men of the SS more often and more intensively changed in the direction of increase, as evidenced by the medians of absolute increments of 3.5 kg and 2.1 kg (p = 0.034), an increase in BM was detected in 71% (17 persons) of the examined. WC also changed in the direction of increase - the medians of absolute increments of 3.0 cm and 1.5 cm, (p = 0.001), an increase in WC was observed in 81% (17 persons) of the patients.

BMI, VFA and FM also increased more frequently and more intensively (p = 0.037, p = 3 × 10⁻⁴, p = 0.001, respectively).

The results of a comparative analysis of physical status parameters in the military personnel for the entire duration of a long sea campaign are given in Table 2.

Table 2

Characteristic of directivity and intensity of changes of physical status parameters in the SS military personnel during long-term campaign (Wilcoxon signed-rank test) [SPSS]

Parameter	Descriptive statistics of parameter increments						p
	increasing measure			decreasing measure			
	n ⁺	Me ⁺ [x _{min} ; x _{max}]	ΣR ⁺	n ⁻	Me ⁻ [x _{min} ; x _{max}]	ΣR ⁻	
TL, c.u.	5	5 [1;7]	54.0	16	3.5 [1;21]	177.0	0.032*
LM of right leg, kg	4	0.17 [0.1;0.22]	34.0	20	0.29 [0.03;0.66]	266.0	0.001*
LM of left leg, kg	6	0.1 [0;0.2]	37.0	19	0.3 [0.1;0.6]	288.0	0.001*

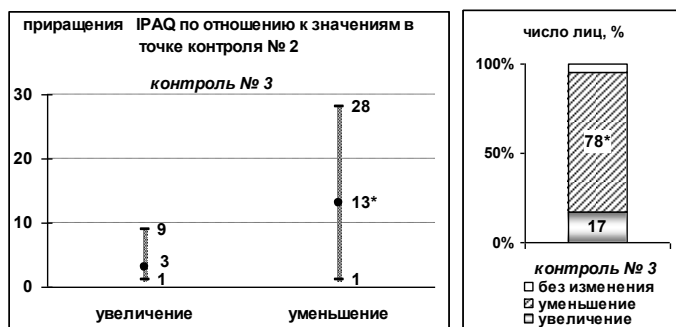
Notes: n⁺, n⁻ – number of persons with increased/decreased parameter; Me⁺, Me⁻ – increment median; [x_{min}; x_{max}] – increment range; ΣR⁺, ΣR⁻ – total increment rank; * – detected statistical significance of increment difference at accepted level of significance α=0.05.

The results of changes of LM of legs and TL are marked out in the Table 2. The parameters have significantly decreased (p=0.001, p=0.032, p=0.001).

Given data of changes in LM of legs comply with statistical significant changes in IPAQ parameter that changed more frequently and more intensively in the direction of decrease (look Figure):

- decreasing was matched in 78 % (18 persons) of the patients in comparison with its increasing in 17 % (4 persons, p=9·10⁻⁶);

- decreasing intensity exceeded the similar increasing measure (medians of absolute increments 13 and 3 correspondingly, $p=0.001$)



приращения IPAQ по отношению к значениям в точке контроля №2 - IPAQ increments in relation to values in the control point No. 2
 контроль №3 – control No. 3
 увеличение – increase
 уменьшение – decrease
 число лиц – number of persons
 без изменения – without change

Figure. Intensity and frequency of IPAQ in the RV military group during a long-term campaign

As indicated by the results of the study, the analyzed parameters of BCI and physical status in the SS military personnel have significantly decreased by the end of long-term sea campaign. The results of aggregation of parameters of physical activity in the SS military group are given in the Table 3.

Table 3

Aggregation of trends of parameters of BCI and physical activity in the SS military group during a long-term sea campaign

Parameter	Resulting trend	
	Trend	Range
BM, kg	Increasing	2.670–5.518
WC, sm	Increasing	2.800–5.000
BMI, kg / m ²	Increasing	0.895–1.843
WHR, c.u.	Increasing	0.042–0.064
VFA, sm ²	Increasing	12.965–22.662
FM, kg	Increasing	2.418–4.896
PFM, %	Increasing	3.267–5.372
TL, c.u.	Decreasing	2.370–8.000
LM of right leg, kg	Decreasing	0.230–0.440
LM of left leg, kg	Decreasing	0.220–0.400
IPAQ, points	Decreasing	8.500–16.940

As indicated by the results of the study given in Table 3, physical activity in the military personnel have significantly decreased by 8.5-16.9 points in the long-term sea campaign comparing with the same parameter on shore. The subjects marked prevalently sedentary life style. In this case, TL has decreased on average by 2.4-8.0 c.u.

LM of right and left legs has decreased on average by 0.23–0.44 and 0.22–0.4 kg respectively. Thereby, changes in LM of upper limbs had not significant differences. In the opinion of K. Fearon and co-authors [2, p. 1–3], such data detect myopenia as mild muscle atrophy under a decrease in muscle mass of a healthy 30-year-old man, which was observed by the end of a long sea campaign for some of the SS personnel.

Medical specialists should exercise medical control over the level of physical activity of the military personnel. In this case, developing and introducing practice complexes of physical exercises for military personnel into everyday in a long sea campaign is relevant objective.

During the analysis of the actual nutrition of the SS personnel, it was found that the composition and energy

value of the products obtained for a long sea voyage did not fully meet the requirements of medical and technical requirements for marine ration (Diet N3) [3, p. 110-123].

Excessive high-calorie nutrition and a long-lasting positive energy balance, as well as a decrease in physical activity, lead to an increase in BM in seamen during a long sea voyage. The main reasons that spur the chain of subsequent changes are a decrease in transport requests for delivery and elimination of metabolic products from the body with concurrent reducing afferent stimulation of the central nervous system, including the areas regulating the function of the cardiovascular system by the flow of muscles, tendons and joints [4, p. 61; 5, pp. 44-45]. The most effective way to reduce MT is a carbohydrate-restricting diet. Since carbohydrates are broken down much more quickly and easier than fats, they are the ones that satisfy the body's need for energy [6, pp. 165–168].

Conclusion. Hypodynamia with a simultaneous decrease in energy consumption in a long sea voyage disrupts leads to metabolic disorder and increase the fat content of body composition.

It has been established that in the conditions of a long-term sea voyage, there is no need to increase the energy content of the current norm of food ration (Diet N3, marine ration), but it is necessary to diversify the composition of ration and compensate the diet for deficiency of vitamins A, B1, B2, PP, β - carotene and some trace elements (K, Mg and Ca) in food, for example, by introducing modern vitamin-mineral complexes into the diet.

Increase in physical activity through the implementation of additional physical exercises is a means of preventing the development of malnutrition of the musculoskeletal system and decline in the level of training in whole. The combination of low-carb diet with regular physical exercises is the most favorable for maintaining BM and muscle strength.

References

1. Kutelev G.M., Zaitsev A.G. *Obraz zhizni i stereotipy povedeniya, okazyvayushchie vliyanie na zdorov'e voennosluzhashchih VMF v sovremennykh usloviyah* [Lifestyle and behavioural stereotypes as determinants of health in the Navy military in modern conditions] // *Morskaya medicina* [Marine medicine]. 2016. Vol. 2, No 3. pp. 61–69 (In Russ.).
2. Fearon K., Evans W., Anker S. Myopenia — a new universal term for muscle wasting // *J. Cachexia Sarcopenia Muscle*. 2011. Vol. 2 (1). Pp. 1–3.
3. Burmistrov G.P., Lopatin S.A., Makarov P.P. *Normirovanie kak konceptual'naya osnova sovershenstvovaniya pitaniya voennosluzhashchih* [Rationing as a conceptual basis for improving of the diet in the military] // Saint Petersburg: *Izdatel'stvo Servis-Ehkspress*, [Publ. Servis-Ehkspress, 2000, pp. 110–123 (In Russ.)].
4. Kovalenko E.A., Gurovskij N.N. *Gipokineziya* [Hypokinesia]. Moscow: *Izdatel'stvo Medicina* [Publ. Medicine, 1980, pp. 61–68 (In Russ.)].
5. Hankevich Yu.R., Kal'manov A.S., Pisarev A.A., Bloshchinskij I.A., Val'skij A.V. *Funkcional'noe sostoyanie organizma podvodnikov posle neprodolzhitel'nogo morskogo pohoda* // *Voen.-med. zhurn.* [Functional state of the body of undersea boatmen after short-duration marine journey // Military medical journal, 2015, Vol. 336, No. 10, pp. 44–47 (In Russ.)].
6. Andriyanov A.I., Smetanin A.L., Konovalova A.I., Krivcov A.V., Kravchenko E.V., Kirichenko N.N., Ivchenko E.V., Sorokoletova E.F. *Fiziologo-gigienicheskaya harakteristika organizatsii pitaniya i vodosnabzheniya otdalennogo voinskogo garnizona v Arktike*. *Vest. Ros. voen.-med. akad.* [Physiological and hygienic assessment of food and water supply management of distant military post in the Arctic // Vestnik of Russian military medical Academy, 2015, No. 4 (52), pp. 165–168. (In Russ.)].

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