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## BIOMEDICAL INDICATORS STUDY IN TERMS OF THE MODERN TYPE OF TECHNOGENESIS

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### Abstract.

Despite the high socio-economic, defense and medical importance, the problem of health development in men of military age and in military servicemen in general has not been sufficiently developed both theoretically and practically [1].

One of the objectives of the current military reform is to ensure medical assistance for military servicemen. The problem of health, the factors affecting the health and quality of life still remain insufficiently studied [2].

The problems of male health and its forming factors are to be developed as a coherent system of social attitudes and traditions of modernity, biomedical, economic, organizational and managerial aspects [3].

This study has applied a set of research methods: biological, chemical, biochemical, clinical, sociological, socio-hygienic, immunofluorescent, cytological, statistical, medical and demographic, and clinical methods.

Objective of the research is to study the systemically important medicobiological indicators of military technogenesis in order to develop the risk management mechanisms.

All subjects were divided into two main groups: control group and experimental group. Control group (C) includes: C1 - civils, and C2 - private soldiers. Experimental group (E) includes: E1 - acting military servicemen, E2 - retired military servicemen. Military servicemen were divided by age, length of service and the type of troops. Age-specific cohort was divided into 6 groups: 18-29, 30-39, 40-49, 50-59, 60-69, and over 70 years old.

Gradation according to length of service was as follows: less than 2 years, 3-9 years, 10-19 years, 20-29 years, and 30-39 years.

During sociological studies, an attention was given to the production block (occupation, the presence of harmful factors, experience, etc.), medical and biological block (age, presence of chronic diseases, complaints) and social block (presence of harmful habits, diet, lifestyle). Each question and grading of answers had their own diagnostic feature and informational value. The coefficients were evaluated in points. Subject to the score level, four groups of cancer risk were formed: Group 1 (no risk), Group 2 (low risk), Group 3 (medium risk), Group 4 (high risk).

The estimation of the immunological status of military servicemen was based on the indicators of humoral and cellular immune system. Analysis of survey and interview results made it possible to determine a significant excess in medium cancer risk in the experimental group as compared with control (42.5% vs. 14.6%). High cancer risk group is characteristic of retired military servicemen (actual retired) - 69.4%. It was determined that the gradation of the immunological states "not changed", "slightly suppressed immune system", "sharply suppressed immune system", "depressed immune system" allowed ranking the immunological status subject to the contingent, the age and length of service. A significantly high immunosuppression value is observed in military servicemen in the age group of 50-59 years old and with length of service of 15-19 years. According to data analysis of the conducted studies, the significance level of differences in the control and the experimental groups, according to immunologist's report, is ( $P \leq 0.005$ )  $P=0.001$ ,  $\chi^2=0.1662$ . The comparative analysis also revealed that the group c1kc2e1e2 has statistically significant differences in standard values and values below standard ( $\rho=0.368$ ). The constructed model of the discriminant function with the resulting index "Immunologist's report" with the characteristics of  $P < 0.001$  and a match of observed and calculated cases of one of the groups - 88.2%, ensures development of management mechanisms for the stabilization and improvement of qualitative and quantitative characteristics of the immune status.

**Keywords:** Technogenesis, biomedical indicators, cancer risk, immune system, statistical data processing.

## **Introduction**

Optimization of medical services is a relevant scientific problem. It can be solved with the development of an optimization technology through the preliminary diagnosis [4,5]. A large share of defects in the provision of medical services at pre-hospital stage is the organization defects (61.1%), and inattention (51.5%). The assessment of the successful medical service in the military unit includes the identification of a circle of 17 simple and 8 complex vectors, their importance coefficients (their sum is equal to one) and levels (10 points - high level, 20 - medium level, 30 - low level), which gives the opportunity to choose the best of the worst [6].

An occupation associated with life-threatening is classified as hazardous. Military servicemen, who are engaged in the fighting, play a special role. Therefore, preventing stress for the benefit of physical and mental health is one of the major problems [7,8,9].

Based on these facts, we can say, that the adaptation of military servicemen due to threat to life requires using the comprehensive approaches of psychological solutions. The main factors of stress disorders were psychological disorders [10,11].

In order to maintain a high level of health in military servicemen and reduced morbidity, the modernization of the military health care is required [12,13].

Application of the developed algorithms will facilitate the work with military medical information in terms of optimization of its accumulation, storage, and use for analysis [14,15].

Scientific novelty consists in that the criterion characterizing the biomedical risks in terms of the modern type of military technogenesis has been developed for the first time on the basis of an integrated approach. Investigations were carried out to assess the dynamics of biomedical parameters involving the whole period of professional activity of military servicemen, including the long-term exposure effects.

**Objective** of the research is to study the systemically important medicobiological indicators of military technogenesis in order to develop the risk management mechanisms.

## **Methods**

In accordance with the objective and the tasks of the study, a set of research methods, such as biological, chemical, biochemical, clinical, sociological, socio-hygienic, immunofluorescent, cytological, statistical, medical and demographic, and clinical methods, has been applied. The main methodological trend in the research program is a comprehensive approach. This gives an opportunity to consider the body of the military servicemen from the perspective of a comprehensive study of a multifaceted complex process being developing together with a variety of factors and its components [16,17]. To develop the scientific substantiation of biomedical indicators in terms of military technogenesis, the process of organizing military medical service has been studied. The programming of statistical and methodological foundations of the systemic study, has been performed. Data groups were divided into two main groups: control group and experimental group. Control group (C) includes: C1 - civilians, and C2 - private soldiers. Experimental group (E) includes: E1 - acting military servicemen, E2 - retired military servicemen.

Military servicemen were divided by age, length of service and the type of troops. Age-specific cohort was divided into 6 groups: 18-29, 30-39, 40-49, 50-59, 60-69, and over 70 years old.

Gradation according to length of service was as follows: less than 2 years, 3-9 years, 10-19 years, 20-29 years, and 30-39 years.

For this study, the integrated indicators of cellular and humoral immune system were used (assessment of indicators was conducted by conventional techniques) [18]. The material, which characterizes the level of health of the relevant group, was analyzed using biomedical indicators. All said material was appropriately processed using statistical computer programs "SPSS", "Statistica", according to the specific objectives of the study. Using this program, database was compiled, multiple tables were obtained, the individual charts were constructed based on the obtained results, the Pearson, Student, and Fisher tests were evaluated, and the correlation and discriminant analyses were conducted. One of the main methods of identification of factors, playing an etiological role in the development of the disease, was the questionnaire survey. This method allows for selection among the military servicemen for further in-depth study. To evaluate the analysis of the early development of cancer process, a screening method and a test system developed by the IARC (International Association for Cancer Research), France, were applied. The questionnaire included total 133 questions. When drawing up a questionnaire, an attention was given to the production block (occupation, the presence of harmful factors, experience, etc.), medical and biological block (age, presence of chronic diseases, complaints) and social block (presence of harmful habits, diet, lifestyle). Each question and grading of answers had their own diagnostic feature and informational value. The coefficients were evaluated in points. Subject to the score level, four groups of cancer risk were formed: Group 1 (no risk), Group 2 (low risk), Group 3 (medium risk), Group 4 (high risk).

Based on the discriminant analysis, a control model was constructed for the factors that form the state of immune system based on data of the humoral and cellular components.

## **Results**

During the first stage of the study the identification and evaluation of cancer risk factors was conducted using a questionnaire developed by the International Association for Cancer Research.

Data analysis of the distribution of exposure to harmful factors in the professional military activity showed that the body is more affected by contact with the chemical products, outdoor work, and work in highly dust conditions.

Analysis of survey and interview results made it possible to determine a significant excess in medium cancer risk in the experimental group as compared with control (42.5% vs. 14.6%). High cancer risk group is characteristic of retired military servicemen (actual retired) - 69.4%.

In the experimental group (e1e2), the comparative analysis revealed that values above standard ( $\rho=0.000$ ), standard ( $\rho=0,0005$ ), and below standard ( $\rho=0.000$ ) level of cancer risk present a statistically significant difference ( $\rho<0.05$ ).

The second stage of the study involved integral evaluation of cellular and humoral immune system.

According to the data obtained from comparing the control (c1c2) and experience groups (e1e2), values above standard ( $\rho=0.000$ ) level of B-lymphocyte present a statistically significant difference ( $\rho<0,05$ ). The comparative analysis also revealed that the standard values ( $\rho=0.183$ ) of the level of B-lymphocyte in the group c1c2 are statistically significant.

During the statistical analysis, the experimental group showed the following values of B-lymphocyte by Pearson test:  $a=54.11$ , the degree of freedom  $n'=6$ ,  $\chi^2=0.000$ . According to Cramer test, the value is  $CC=0.695$ , a high correlation degree. During the statistical analysis, the control group showed the following values of B-lymphocyte by Pearson test:  $a=7.793$ , the degree of freedom  $n'=6$ ,  $\chi^2=0.02$ . According to Cramer test, the value is  $CC=0.291$ , a low correlation degree. According to data analysis of the conducted studies, the significance level of differences in the control and the experimental groups, according to distribution of circulating immune complexes, is ( $P\leq 0.005$ )  $P=0.0004$ ,  $\chi^2=0.1983$ . The comparative analysis also revealed that the group c1kc2e1e2 has statistically insignificant standard values ( $\rho=0.043$ ) of the NBT-test.

During the statistical analysis, both control and experimental groups showed the following values of B-lymphocyte by Pearson test:  $a=54.11$ , the degree of freedom  $n'=6$ ,  $\chi^2=0.000$ . According to Cramer test, the value is  $CC=0.695$ , a high correlation degree. During the third stage of the study, a discriminant function model with a resulting indicator "Immunologist's report" for the acting military servicemen was constructed.

To construct a model "Immunologist's report" for the acting military servicemen, the model included the codes of levels of cellular and humoral immune indicators.

The power of influence of factors by the value of standardized coefficients (max. value =  $\pm 1$ ), located in descending order, is as follows: NBT-induced (0.912, inverse effect), circulating immune complexes - CIC (0.397, direct effect), T-lymphocytes (0.358, direct effect), neutrophils (0.322, direct effect), NBT-spontaneous (0.268, inverse effect), IgM (0.259, direct effect), leukocytes (0.180, direct effect), B-lymphocytes (0.111, direct effect).

The resulting figure (Immunologist's report for the acting military servicemen) has 3 gradations - normal immune system - 1; suppressed -2; depressed -3.

The constructed model is as follows:  $DF = -4.0 + 0.4 \times (\text{leukocytes code}) + 0.03 \times (\text{neutrophils}) + 0.1 \times (\text{T-lymphocytes}) + 0.02 \times (\text{B-lymphocytes}) - 0.08 \times (\text{NBT-spontaneous}) - 0.07 \times (\text{NBT-induced}) + 0.03 \times (\text{CIC}) + 0.5 \times (\text{IgM})$ .

For this model  $P < 0.001$ , the coincidence of the observed and calculated cases of affiliation with one of the groups is 88.2%. The calculated centroid values in relation to the immunologist's report for the acting military servicemen are expressed as follows: for group 1 - 6.533; group 2 - 0.976; group 3 - 0.577.

An example of practical application of the developed model: insert in the equation the specific values of the indicators included in the formula:

$$DF = -4.0 + 0.4 \times 1 + 0.03 \times 55 + 0.1 \times 73 + 0.02 \times 29 - 0.08 \times 7 - 0.07 \times 91 + 0.03 \times 59 + 0.5 \times 0.1 = 0.82$$

As a result – the military serviceman can be attributed to group 2.

The developed control mechanism for this phenomenon can be exemplified by the recommendations for the transition from the immune state of group 2 to group 1 - CIC increase by 56%.

Thus, using this model makes it possible to predict an individual's state of immune system, develop a scheme of management decisions for the stabilization and improvement of the immune status.

## **Summary**

- Analysis of survey and interview results made it possible to determine a significant excess in medium cancer risk in the experimental group as compared with control (42.5% vs. 14.6%). High cancer risk group is characteristic of retired military servicemen (actual retired) - 69.4%.

- The gradation of the immunological states “not changed”, “slightly suppressed immune system”, “sharply suppressed immune system”, “depressed immune system” allowed ranking the immunological status subject to the contingent, the age and length of service. A significantly high immunosuppression value is observed in military servicemen in the age group of 50-59 years old and with length of service of 15-19 years.

- According to data analysis of the conducted studies, the significance level of differences in the control and the experimental groups, according to immunologist's report, is ( $R \leq 0.005$ )  $P = 0.001$ ,  $\chi^2 = 0.1662$ . The comparative analysis also revealed that the group c1kc2e1e2 has statistically significant differences in standard values and values below standard ( $p = 0.368$ ).

- The constructed model of the discriminant function with the resulting index "Immunologist's report" ensures development of management mechanisms for the stabilization and improvement of qualitative and quantitative characteristics of the immune status.

## **Discussion**

Military service is a high-risk zone. Adaptation of the military servicemen becomes a pressing issue. The number of persons involved in the conflict increases, which results in large losses, traumas and injuries. This is why the large number of people retire from their service for health reasons. Working in stressful situations leads to mental illnesses because of lack of psychological training. This study was conducted in three stages.

These results obtained emphasize the relevance of the study in terms of improving the health of military servicemen. In particular, it has been determined that the military service conditions contribute to the development of a high cancer risk and the suppression (inhibition) of the immune system. The management mechanisms for the stabilization and improvement of qualitative and quantitative characteristics of the immune status have been developed.

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## **References**

1. Fandeev V.A. Adapting the servicemen to the military conditions in regions with unfavorable climate / V.A. Fandeev, R.S. Rakhmanov et al.// - M.: Granitsa, 2000. - P. 56.
2. Aleksandrov O.A. The Comprehensive Health Program / O.A. Aleksandrov // - M.: Medicine, 1988. - 92 p.
3. Askalonov L.A. Policy and trends of health protection and promotion of peoples of Russia / L.A. Askalonov // Healthcare of the Russian Federation. - 1991. - No.4. - Pp. 1-6.
4. Bang K.M., Lockey J.E., Keye W. Reproductive hazards in the work place // Fam. Community Health. - 1983. - Vol.6, №1. - P. 44-56.
5. Donabedian A. Quality, cost and health: an integrative model // Med. Care. - 1982. - Vol. 20, № 10. - P. 975-992.
6. Feshbakh M. Environment and Public health of Russia Atlas / (M. Feshbakh) // - M.: PAIMS, 1995.-448 p.
7. Balter S.A. Puncture of malignant tumors under ultrasound control / S.A. Balter, N.G. Blokhin, A.V. Poltavskii // Pract. medicine. - 2007. - No.5. -P.19.
8. Belevitin A.B. Clinical examination of military servicemen with upper respiratory tract diseases / A.B. Belevitin // Military Medical Journal. -2010- V.331, No.1-1.- Pp. 4-7

9. Harris N.L., Jaffe E.S., Diebold J. et al. The World Health Organization Classification of neoplasms of the hematopoietic and lymphoid tissues: report of the clinical advisory committee meeting. // *The Hematology Journal*. – 2000. – Vol. 1. - P. 53-66
10. Belskikh A.N. Capabilities of the Military Medical Academy in the implementation of advanced research / A.N. Nelskikh // *Military Medical Journal*. -2013- V.334, No.6.- Pp. 4-7
11. DePinho R.A. Tiled age of cancer // *Nature*. - 2000. - Vol.408. - P. 248-254.
12. Berenbein B.A. Influence of environmental and occupational factors on the development of malignant tumors of the skin. // *The proliferative skin diseases*. / B.A. Berenbein, N.P. Malishevskaja // *Republican collection of scientific papers*. - M., 1991. - Pp. 4-8
13. Blagin A.A. The main trends of improvement of the medical support of the Air Force in modern conditions / A.A. Blagin, A.N. Grebeniuk, et al. // *Military Medical Journal*. -2014- V.335, No.2.- Pp. 42-45
14. Chissova V.I. Malignancies in Russia in 1980-1995 / V.I. Chissova, prof. V.V. Starinskogo, et al.// - M. 1995.- Pp. 158-164
15. Ivanov V.V. Relevant issues of the use of information technology in medical support / Korneenkov A.A., Bogomolov V.D., Borisov D.N., Rezvantsev M.V.// *Military Medical Journal*. -2013- V.334, No.6.- Pp. 8-13
16. Chabner B. Biological basis for Cancer treatment. // *Annals of Internal Medicine*. – 1993. - Vol. 118. - P. 633-637.
17. Webster L. Epidemiology of oral contraceptives and the risk of Breast cancer // *J. Reprod. Med*. -1986. -Vol.31. – P. 982-990.
18. Shubich M.G. Cytochemistry of neutrophils in normal conditions and in some diseases / M.G. Shubich // - Moscow, 2008. -45 p.