

PAPER • OPEN ACCESS

## Factor model of foreign students' adaptation to the climate and geographic conditions of Volgograd region

To cite this article: G A Sevriukova *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **315** 042037

View the [article online](#) for updates and enhancements.

## Factor model of foreign students' adaptation to the climate and geographic conditions of Volgograd region

G A Sevriukova<sup>1,2</sup>, I B Isoupov<sup>2</sup>, L A Tovmasian<sup>2</sup>, N V German<sup>2</sup> and M A Golovanova<sup>2</sup>

<sup>1</sup>Volgograd State Technical University, pr. V.I. Lenina 28, Volgograd, 400005, Russia

<sup>2</sup>Volgograd State University, University Avenue, 100, Volgograd, 400062, Russia

E-mail: sevrykova2012@yandex.ru

**Abstract.** The article deals with the body adaptation of foreign students from warm countries to the sharply continental climate of the Volgograd region. By adapting to the new climatic and geographical conditions of study and living, there are changes in the physiological function of the life-supporting systems. On the basis of a differentiated approach to the assessment of the adaptive state of functional systems, it is possible to identify groups with "poor adaptation of functional systems", with "stress of functional systems by adaptation" and with "satisfactory adaptation of functional systems". The factor structure of adaptation has been determined, including: the hormonal factor, the oxygen transport cascade factor, the vegetative supply factor, the respiratory homeostasis factor, the acid-base and gas composition factor. Imbalance and inadequacy in the activity of life-supporting systems, strengthening the central contour of cardiac activity regulation, changes in peripheral blood, hormonal status are criteria for an unfavorable course of adaptation processes in the body. Functional adaptation of the body of foreign students is influenced by the factors of a new climatic and geographic environment and educational activities features.

### 1. Introduction

It is known that the response of a body to the disturbing effects of environmental factors is due to the mobilization and expenditure of functional reserves [1-4]. Adaptation of the body of foreign students to the conditions of studying in a foreign environment should be considered from the perspective of a general biological concept of stress and adaptation [6, 7]. At the same time, the effectiveness of academic adaptation of foreign students, on the one hand, is determined by the basic level of knowledge in general education subjects, and on the other hand, by the initial level of functioning of life-supporting systems in the changed climatic and geographical conditions of residence in a new region.

The Volgograd region is characterized by a sharply continental climate (sharp interseasonal temperature changes, severe winters and dry summers) and anthropogenic altered environmental conditions due to the presence of the developed industrial sector. Therefore, the problem of adaptation of foreign students coming from a hot climate with a long warm period to the arid conditions of southern Russia is actual. Foreign students are at risk, as in the conditions of the Volgograd region there is a high probability of acquiring natural and environmental diseases [5].



## **2. Features of foreign students' body adaptation in the changed climatic and geographical conditions of the Volgograd region**

The research has involved foreign students from South and South-West Asia, the Middle East and Africa. The orientation and strategy of adaptive changes of foreign students' body were evaluated on the basis of an individual approach, which allowed to avoid averaging the obtained data and to determine the important patterns of response of some individuals differing in physiological or psycho physiological indicators.

A differentiated approach to the assessment of the adaptive state of functional systems allowed to distribute the contingent of foreign students into three main groups: a group with "poor adaptation of functional systems", a group with "stress of functional systems" and one group with "satisfactory adaptation of functional systems". At the same time, in the second group, the multidirectional shifts in the functioning of life-supporting systems were observed: "stress of functional systems" with the expected transition to a satisfactory adaptation; "stress of functional systems" with the expected transition to unsatisfactory adaptation.

According to our research, by the end of the school year, the predominance of students with "stress of functional systems" with the expected transition to unsatisfactory adaptation compared to the beginning of the school year was observed. At the same time, 48% of these students showed sympathicotonic type of autonomic regulation of heart rate. This indicates poor adaptive reactions and physiological "overprice" of academic adaptation. The exhaustion of the regulatory and adaptive body capabilities of foreign students by the school year end is an unfavorable expected mark of adaptive changes.

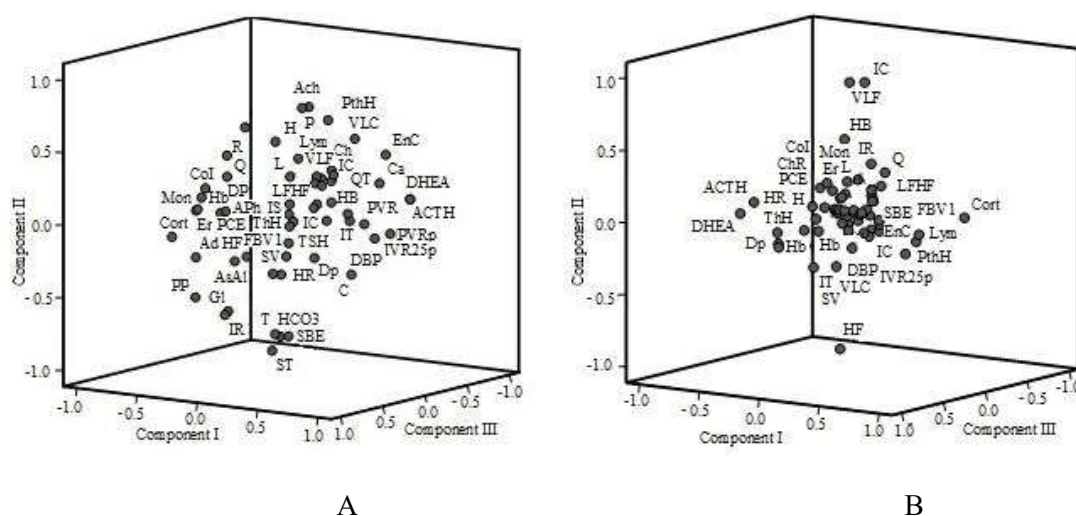
The analysis of intra-and inter-system probabilistic connections of physiological functions of life-supporting systems (cardiovascular system, respiratory system, blood circulation, blood, hormonal status) allowed to state the stress of regulatory mechanisms in groups of foreign students with "poor adaptation of functional systems" and with "stress of functional system". The observed relation and the correlations in the intersystem groups of functional systems indicate the reduction in degrees and, consequently, plasticity of the homeostatic support of body functions. Foreign students with "satisfactory adaptation of functional systems" had a sufficient level of functional reserves of the body. Therefore, they have in the process of academic adaptation to the changed climatic and geographic no homeostatic dysfunction was observed, but only some shifts were registered in the physiological parameters of life-supporting systems within the physiological norm, but only recorded the shift of physiological parameters of life-supporting systems within the physiological norm.

## **3. Mechanisms and factor structure of body adaptation of foreign students in the changed climatic and geographical conditions of the Volgograd region**

Individual adaptation of the organism to the changed environmental conditions depends on the ratio of the ergo-and trophotropic systems [2, 4, 8]. Integration of body functions and adequacy of regulatory mechanisms provide a positive (satisfactory) outcome of adaptive reactions [1, 2]. The results of the factor analysis of physiological variables of body activity in the changed environmental conditions, including educational ones, allowed to establish the sequence of regulatory-adaptive mechanisms activating which provide (satisfactory) or not provide (poor) adaptation.

The observed "similarity" of reactions characterizing the compensatory mechanisms activation for maintaining homeostasis and ensuring adaptation processes allowed building a factor structure of adaptation. Factor structure of adaptation is represented by the following components: No. 1 is the hormonal factor, No. 2 is the oxygen transport cascade factor, No. 3 is the vegetative supply factor, No. 4 is the respiratory homeostasis factor, No. 5 is the acid-base and the gas composition factor.

According to our research, "poor adaptation of functional systems" was observed in the imbalance of inadequately overestimated number of indicators of the general functional state, providing the final adaptation result. It is established that in the state of poor adaptation, the variables included in the formation of the determining factors are not sufficiently synchronized and belong to different functional systems, the so-called "uncertain factors" (figure 1).



**Figure 1.** Relationship between marker variables at different levels of adaptation  
A – favorable adaptation, B – unfavorable adaptation

Inadequately increased involvement of hormonal components, in particular, adrenal medulla hormones (catecholamine) in the regulation of adaptive processes, is accompanied by an increase in the tone of the sympathetic system, which is reflected in the established increase in the number of foreign students with a predominance of sympathetic-tonic type of vegetative regulation by the end of the school year.

Combining the variables of factor No. 1 with the variables of factor No. 3 and No. 4, reflecting the functioning of visceral service systems (blood circulation, respiration) indicates a decrease in the relative independence in the functioning of the endocrine system, cardio respiratory system and vegetative support of the heart. Inadequate overestimated activity of hormonal components, in particular, hormones of adrenal medulla (catecholamine) in the regulation of adaptive processes, accompanied by an increase in the sympathetic system tone, which is reflected in increased number of foreign students with a predominance of sympathicotonic type of autonomic regulation by the end of the school year.

The content of oxygen and carbon dioxide in the atmospheric air, as well as the atmospheric pressure are not constant. These changes may cause the changes in the ratio of oxygen and carbon dioxide in the body [2, 8]. Therefore, the function of external respiration is provided by the synchronized activity of the parameters of the oxygen transport cascade (factor No. 2: the amount of hemoglobin in the blood, the number of erythrocytes, color index), respiratory homeostasis (factor No. 4: the vital capacity of the lungs, the volume of forced inhalation, peak volumetric speed, instantaneous volumetric capacity), acid-base and gas composition (factor No. 5: the concentration of hydrogen ions, the concentration of bicarbonate ion, deficiency of bases).

The important thing in the process of adaptation of the body of foreign students to the changed climatic and geographical living conditions is to maintain optimal values of the respiratory system parameters. It was found that on the background of a decrease in hemoglobin content in one erythrocyte in the blood of foreign students there is an increase in the number of erythrocytes. This fact can be considered as an adaptive response of the body in order to maintain the proper level of total hemoglobin in the blood.

#### 4. Conclusion

In the process of adaptation of the body of foreign students to the new climatic and geographical conditions of study and living, the physiological functions of life-supporting systems change. There are different strategies (“satisfactory or poor adaptation of functional systems”) and the orientation of the adaptation processes (“stress of functional systems in the process of adapting” with the expected

orientation to satisfactory or poor adaptation). Imbalance and inadequacy in the activity of life-supporting systems (respiratory system, blood circulation), strengthening of the central contour of cardiac activity regulation (predominant activity of the sympathetic nervous system), changes in peripheral blood parameters, hormonal status are criteria for an unfavorable adaptation processes in the body.

### Acknowledgement

The research is executed with financial support of Russian Foundation for Basic Research (project № 18-013-00795).

### References

- [1] Aghajanyan N A and Makarova N I 2014 The ethnic dimension of adaptation physiology and disease of the population *Human Ecology* **3** 3-13
- [2] Aghajanyan N A, Batotsyrenova T E and Semenov Yu N 2009 *Ecological, physiological and ethnic features of human adaptation to different environmental conditions* (Vladimir State University)
- [3] Veremchuk L V, Kiku P F and Simonova I N 2012 The influence of ecological and hygienic features of the environment on the immune and metabolic blood parameters of the population with respiratory diseases *Siberian Medical Journal* **111(4)** 126-30
- [4] Garkavi L Kh, Tolmachev G N and Mikhailov N Yu 2007 Adaptive reactions and reactivity levels as effective diagnostic indicators of prenosological states *Bulletin of the Southern Scientific Center of Russian Academy of Science* **3(1)** 61-6
- [5] Sevryukova G A, Isoufov I B, Tovmasyan L A, Bocharova I A and Kartoushina Yu N 2019 Adaptation of Foreign Students to Sharply Continental Climate of the Volgograd Region *IOP Conference Series: Earth and Environmental Science* **224(8)**
- [6] Sevryukova G A, Nastinova G E, Tovmasyan L A and Sevryukova P L 2018 The functional state of systemic hemodynamics of Russian and foreign students on the background of orthostatic tests *Proceedings of Saratov University New Series. Chemistry. Biology. Ecology* **18(4)** 407-11
- [7] Troubina M A, Skorik Ya V, Semova E L and Zeitlin B 2016 Research of the adaptation process of nonresident students to higher education *Scientific notes of the Russian state hydrometeorological University* **44** 245-54
- [8] Blaejczyk K and Krawczyk B 1991 The influence of climatic conditions on the heat balance of the human body *International Journal of Biometeorology* **35** 103-6