ASSESSMENT OF ADAPTATION POTENTIAL OF FOREIGN STUDENTS STUDYING IN LOW- AND MIDLANDS CONDITIONS

©*Satarkulova A.,* ORCID: 0000-0002-9879-1802, *International Higher School of Medicine, Bishkek, Kyrgyzstan, asat79@mail.ru*
©*Tiuliuliueva A.,* ORCID: 0000-0003-0721-248X, *International Higher School of Medicine, Bishkek, Kyrgyzstan, aizada_tiu@mail.ru*
©*Keneshova K.,* ORCID: 0009-0005-8323-0235, *International Higher School of Medicine, Bishkek, Kyrgyzstan, kanykeisadyrbekovna@gmail.com*

ОЦЕНКА АДАПТАЦИОННОГО ПОТЕНЦИАЛА ИНОСТРАННЫХ СТУДЕНТОВ, ОБУЧАЮЩИХСЯ В УСЛОВИЯХ НИЗКОГОРЬЯ И СРЕДНЕГОРЬЯ

©*Сатаркулова А. М.,* ORCID: 0000-0002-9879-1802, *Международная высшая школа медицины, г. Бишкек, Кыргызстан, asat79@mai.ru*
©*Тюлюлюева А. К.,* ORCID: 0000-0003-0721-248X, *Международная высшая школа медицины, г. Бишкек, Кыргызстан, aizada_tiu@mail.ru*
©*Кенешова К. С.,* ORCID: 0009-0005-8323-0235, *Международная высшая школа медицины, г. Бишкек, Кыргызстан, kanykeisadyrbekovna@gmail.com*

Abstract. Assessment of the adaptive potential of students studying in low- and midlands conditions is a very important task, since it allows students to timely identify pathological conditions that precede the development of the disease. The goal of this study is to assess the adaptive capabilities of foreign students studying in low- and midlands conditions. The 260 first-course male students aged 19.55±1.31 years from India were examined. The study was conducted in low mountains (760 m ASL) and middle mountains (1650 m ASL). The index of functional changes (IFCh), as calculated by R. M. Baevsky, took into account factors such as age, height, body weight, heart rate, and blood pressure. A comparative analysis of the indicators of the index of functional changes (IFCh) of foreign students studying in lowlands and midlands revealed significant differences in systolic blood pressure (SBP). In the low mountains group, the value of IFCh was higher than in the middle mountains group. The majority of students (77% in the lowlands and 86% in the midlands) demonstrated a satisfactory level of adaptation. However, a small percentage of students in both the lowlands (6%) and midlands (1%) showed unsatisfactory adaptation. Therefore, the educational environment in the midlands was found to be more favorable for the adaptation of Indian students.

Аннотация. Оценка адаптационного потенциала студентов, обучающихся в условиях низкогорья и среднегорья, является весьма важной задачей, поскольку позволяет своевременно выявлять у студентов патологические состояния, предшествующие развитию болезни. Исследовано 260 юношей первого курса в возрасте 19,55±1,31 лет из Индии. Обследование осуществлялось в условиях низкогорья (760 м н. у. м.) и среднегорья (1650 м н. у. м.). Вычислялся индекс функциональных изменений (ИФИ) по Р. М. Баевскому с учетом возраста, длины и массы тела, частоты сердечных сокращений и артериального давления. Сравнительный анализ показателей индекса функциональных изменений (ИФИ) у иностранных студентов, обучающихся в условиях низкогорья и среднегорья, выявил достоверные различия по данным систолического артериального давления (САД). В то же

время у юношей в низкогорье величина ИФИ была выше, чем в группе среднегорцев. Для большинства обследованных студентов (77% в низкогорье и 86% в среднегорье) характерно состояние удовлетворительной адаптации, в то же время у части лиц в низкогорье (6%) и в среднегорье (1%) выявлено состояние неудовлетворительной адаптации. Следовательно, условия образовательной среды в среднегорье оказались более благоприятны для адаптации индийских студентов.

Keywords: foreign students, adaptation potential, functional state, lowlands, midlands.

Ключевые слова: иностранные студенты, адаптационный потенциал, функциональное состояние, низкогорье, среднегорье.

Currently, the internationalization of university activities has become a crucial strategy for many institutions. The export of higher education, particularly in the field of medicine, has resulted in a significant increase in the number of foreign students coming to study (http://www.uis.unesco.org). Kyrgyzstan, in particular, stands out in Central Asia for its ability to attract students from India and Pakistan. This not only brings economic advantages to the country, but also enhances the quality of education, cultural diversity, and prestige of both the universities and the nation.

However, the process of studying, especially in medical universities, can be mentally and psychologically demanding, leading to functional tension and a decrease in the body's adaptive capabilities. This can ultimately result in the development of psychosomatic diseases [1-3]. Foreign students, in particular, face additional challenges as they must adapt to a new educational and social environment, as well as different climatic and living conditions [4-7]. Therefore, it is crucial to assess the functional state of students, including foreign ones, as they are valuable intellectual and socio-economic resources for their communities [8].

In this regard, one effective method for assessing the body's adaptive capabilities is the calculation of the index of functional changes (IFCh) according to R. M. Baevsky. The goal of this study is to evaluate the adaptive capabilities of foreign students studying in low- and midlands conditions.

Material and research methods

The present study involved a cohort of 260 young men from India, aged 19.55±1.31 years, who were in their first year of study at the International Higher School of Medicine. All participants were in good health. The study was conducted in accordance with the principles outlined in the Helsinki Declaration and was approved by the Ethics Committee at the IHSM (Minutes of the Meeting no. 4 dated 09.11.2016). The study was carried out at two campuses, namely Bishkek – Central Campus (lowlands — 760 m ASL) and Cholpon-Ata – Issyk-Kul campus (midlands — 1650 m ASL). Prior to the study, informed consent was obtained from all participants.

The aim of the study was to investigate the functional state of the students' body during academic activity. This was achieved by calculating the index of functional changes by R. M. Baevsky (IFCh, points), which took into account age (A, years), height (H, cm), body weight (BW, kg), heart rate (HR, beats/min), and blood pressure (systolic (SBP) and diastolic (DBP), mm Hg).

The formula used was as follows: $IFCh=0.011\times HR+0.014\times SBP+0.008\times DBP+0.014\times A+0.009\times BW-0.009\times H-0.27$. The results of the IFCh values were used to evaluate and classify the adaptive potential (AP) and functional capabilities of the organism. Specifically, IFCh

values of ≤2.59 points indicated a state of satisfactory adaptation, while IFCh values in the range of 2.60–3.09 points indicated a state of tension of adaptation mechanisms. IFCh values in the range of 3.10–3.49 points indicated a state of unsatisfactory adaptation, while IFCh values ≥3.50 points indicated a state of failure of adaptation mechanisms [9].

The results of the study were subjected to statistical processing using the program SPSS 16 version for Windows. The results are presented in the form of median (Me), first (Q1) and third (Q3) quartiles (Me (Q1-Q3)). Quantitative data were compared using the Mann-Whitney criterion. The level of differences was considered statistically significant at p≤0.05.

Results and discussion

During the course of the study, the functional changes index (IFCh) developed by R. M. Baevsky was utilized to evaluate and categorize the adaptive potential of the examined students [10, 11]. A comparative analysis of the IFCh indicators in first-year male students studying in Bishkek (located in the lowlands) and Cholpon-Ata (situated in the midlands) did not yield any significant differences between the groups in terms of heart rate, body weight, height, and diastolic blood pressure (DBP) (Table 1).

Table 1

INDICATORS OF IFCh OF FOREIGN STUDENTS STUDYING IN
LOWLAND AND MIDLAND CONDITIONS

Parameters	Lowlands (n=133)	Midlands (n=127)	P
HR, b. p. m.	83 (77-90)	85 (76-94)	0.662
Body weight, kg	65 (54-75)	66 (58-72)	0.597
Height, cm	170 (165-177)	171 (166-178)	0.494
SBP, mm Hg	127 (115-135)	119 (112-128)	0.000*
DBP, mm Hg	78 (70-85)	79 (72-84)	0.501
IFCh, point	2.35 (2.16-2.56)	2.27 (2.11-2.48)	0.062

Notes: * — significance of differences at p<0.05

The data presented in Table 1 reveals notable distinctions solely in the systolic blood pressure (SBP) values. For instance, students residing in lowlands exhibited an SBP value of 127 mm Hg, whereas those in midlands had a value of 119 mm Hg However, all values remained within the normal range.

The investigation further disclosed that the IFCh value was 2.35 points in a group of students in low mountains, whereas in a group of young men in middle mountains, the value was 2.27 points. Based on the functional state scale [12], this implies that 77% of subjects in lowlands are in a state of satisfactory adaptation, 17% experience strain in adaptation mechanisms, and 6% are in an unsatisfactory adaptation state. In midlands, 86% of young men exhibit a satisfactory adaptation state, 13% experience tension in adaptation mechanisms, and 1% display signs of unsatisfactory adaptation (Figure).

Based on the obtained results and the classification of body conditions and its interpretation [9, 10], it can be concluded that the majority of foreign students are in a state of physiological normality. Their body's adaptive capabilities are maintained at an adequate level, and homeostasis is maintained with minimal stress on regulatory systems. However, a portion of students in low mountains (17%) and middle mountains (13%) experience strain on their adaptation mechanisms and are in a prenosological state.
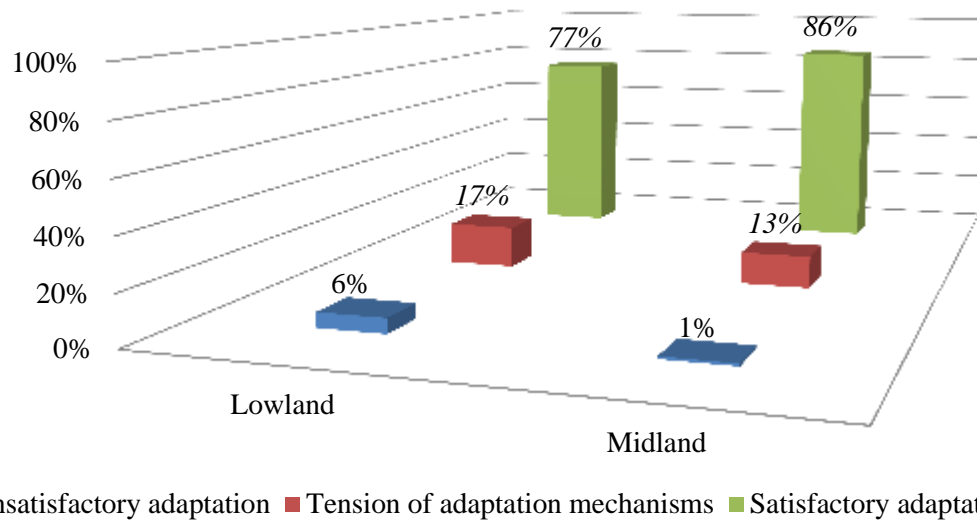
Figure. Percentage distribution according to the index of functional changes and the scale of functional states by R. M. Baevsky

Table 2 presents a comparative analysis of the IFCh indicators of foreign students who have satisfactory adaptation and those who experience stress on their adaptation mechanisms.

Table 2

INDICATORS OF IFCh OF FOREIGN STUDENTS WITH SATISFACTORY ADAPTATION AND WITH TENSION OF ADAPTATION MECHANISMS

Parameters	Satisfactory adaptation (n=211)	Tension of adaptation mechanisms (n=40)	Unsatisfactory adaptation (n=9)	P
HR, b. p. m.	82 (76-89)	90 (80-100)	95 (82-115)	0.000*
Body weight, kg	64 (56-72)	72 (63-80)	80 (71-103)	0.000*
Height, cm	171 (166-177)	170 (165-179)	165 (163-183)	0.875
SBP, mm Hg	119 (110-128)	140 (130-145)	154 (145-170)	0.000*
DBP, mm Hg	76 (70-80)	89 (81-95)	88 (85-95)	0.000*
IFCh, point	2.25 (2.10-2.40)	2.71 (2.65-2.81)	3.17 (3.14-3.36)	0.000*

Notes: * — significance of differences at p<0.05

Based on the data presented in Table 2, it is evident that students experiencing tension in their adaptation mechanisms exhibit significantly elevated levels of heart rate (90 beats/min), body weight (72 kg), SBP (140 mm Hg), DBP (89 mm Hg), and IFCH (2.71 points), which exceed the upper limits of the norm. In individuals with unsatisfactory adaptation (6% in low mountains and 1% in middle mountains), there were significantly increased values of SBP (154 mm Hg), DBP (88 mm Hg), and the index of functional changes (3.17 points), surpassing the normative range. These findings suggest a pronounced stress on the functional state and a decrease in the adaptive capabilities of the students' bodies. It is believed that such changes in regulatory systems have a negative impact on physiological processes, alter compensatory and adaptive reactions, and in cases of excessive intellectual and psycho-emotional loads, can lead to disruption of adaptation mechanisms [10].

Conclusions

Hence, a significant proportion of the students surveyed (77% in the low mountains and 86% in the middle mountains) exhibit a state of satisfactory adaptation. These students possess sufficiently high adaptive capabilities of the body and demonstrate a high resistance to everyday learning activities. Conversely, a smaller portion of the students (17% in the low mountains and 13% in the middle mountains) display a correlation between their adaptive potential and a state of tension in their adaptive mechanisms. Although their functional capabilities are not diminished, their ability to handle academic workload is reduced. Additionally, a small percentage of individuals (6% in the lowlands and 1% in the midlands) exhibit a state of unsatisfactory adaptation, characterized by reduced functional capabilities and a predisposition to the development of pathological conditions.

In conclusion, the educational environment in the middle mountains proves to be more conducive to the adaptation of Indian students. This can be attributed not only to climatic factors (such as the mountain-sea climate of Issyk-Kul), but also social factors (such as the isolated location of the campus, the presence of Indian curators, and limited contact with the local population). Furthermore, academic factors, such as the involvement of Indian teachers in the educational process, contribute to the favorable conditions for adaptation.

References:

1. Agadzhanyan, N. A., Minnibaev, T. Sh., Severin, A. E., Ermakova, N. V., Kuznetsova, L. Yu., & Silaev, A. A. (2005). Izuchenie obraza zhizni, sostoyaniya zdorov'ya i uspevaemosti studentov pri intensifikatsii obrazovatel'nogo protsessa. *Gigiena i sanitariya,* (3), 50-54. (in Russian).

2. Shrinivasan, K., Vaz, M., & Sucharita, S. (2006). A study of stress and autonomic nervous function in first year undergraduate medical students. *Indian journal of physiology and pharmacology*, *50*(3), 257.

3. Kononets, I. E., Saidyldaeva, A. B., & Kalykeeva, A. A. (2018). Funktsional'noe sostoyanie vegetativnoi nervnoi sistemy u studentov I kursa meditsinskoi akademii i uchashchikhsya kolledzha Kyrgyzskogo gosudarstvennogo universiteta. *Siberian Journal of Life Sciences and Agriculture, 10*(2), 12-26. (in Russian). https://doi.org/10.12731/wsd-2018-2-12-26

4. Yoo, H. H., Yune, S. J., Im, S. J., Kam, B. S., & Lee, S. Y. (2021). Heart rate variability-measured stress and academic achievement in medical students. *Medical Principles and Practice*, *30*(2), 193-200. https://doi.org/10.1159/000513781

5. Thomas, B. L., & Viljoen, M. (2019). Heart rate variability and academic performance of first-year university students. *Neuropsychobiology*, *78*(4), 175-181. https://doi.org/10.1159/000500613

6. Semiletova, V. A., Dorokhov, E. V., & Abdurakhmonov, N. Sh. (2016). Osobennosti funktsional'nogo sostoyaniya i kardioritma otechestvennykh i inostrannykh studentov v razlichnye periody uchebnoi deyatel'nosti. *Vestnik novykh meditsinskikh tekhnologii, 23*(4), 155-160. (in Russian). https://doi.org/10.12737/23865

7. Maes, M., Van Der Planken, M., Van Gastel, A., Bruyland, K., Van Hunsel, F., Neels, H., ... & Scharpé, S. (1998). Influence of academic examination stress on hematological measurements in subjectively healthy volunteers. *Psychiatry research*, *80*(3), 201-212. https://doi.org/10.1016/S0165-1781(98)00059-6

8. Galeeva, A. V., & Kudryavtsev, M. D. (2015). Formirovanie polozhitel'nogo otnosheniya u studencheskoi molodezhi k zdorovomu obrazu zhizni v sovremennykh usloviyakh. In *Ekologo-*

fiziologicheskie problemy adaptatsii (pp. 34-35). (in Russian).

9. Baevskii, R. M., & Chernikova, A. G. (2014). Otsenka adaptatsionnogo riska v sisteme individual'nogo donozologicheskogo kontrolya. *Rossiiskii fiziologicheskii zhurnal im. IM Sechenova, 100*(10), 1180-1194. (in Russian).

10. Baevskii, P. M., & Berseneva, A. P. (1997). Otsenka adaptatsionnykh vozmozhnostei organizma i risk razvitiya zabolevanii. Moscow. (in Russian).

11. Matalygina, O. A. (2009). O diagnostike funktsional'nykh rezervov organizma. *Vestnik Severo-Zapadnogo gosudarstvennogo meditsinskogo universiteta im. II Mechnikova, 1*(2), 42-48. (in Russian).

12. Baranov, V. M., Baevskii, R. M., Berseneva, A. P., & Mikhailov, V. M. (2004). Otsenka adaptatsionnykh vozmozhnostei organizma i zadachi povysheniya effektivnosti zdravookhraneniya. *Ekologiya cheloveka,* (6), 25-29. (in Russian).

Список литературы:

1. Агаджанян Н. А., Миннибаев Т. Ш., Северин А. Е., Ермакова Н. В., Кузнецова Л. Ю., Силаев А. А. Изучение образа жизни, состояния здоровья и успеваемости студентов при интенсификации образовательного процесса // Гигиена и санитария. 2005. №3. С. 50-54. EDN: RYNRQH

2. Shrinivasan K., Vaz M., Sucharita S. A study of stress and autonomic nervous function in first year undergraduate medical students // Indian journal of physiology and pharmacology. 2006. V. 50. №3. P. 257.

3. Кононец И. Е., Сайдылдаева А. Б., Калыкеева А. А. Функциональное состояние вегетативной нервной системы у студентов I курса медицинской академии и учащихся колледжа Кыргызского государственного университета // Siberian Journal of Life Sciences and Agriculture. 2018. V. 10. №2. P. 12-26. EDN: VMISRI. https://doi.org/10.12731/wsd-2018-2-12-26

4. Yoo H. H., Yune S. J., Im S. J., Kam B. S., Lee S. Y. Heart rate variability-measured stress and academic achievement in medical students // Medical Principles and Practice. 2021. V. 30. №2. P. 193-200. https://doi.org/10.1159/000513781

5. Thomas B. L., Viljoen M. Heart rate variability and academic performance of first-year university students // Neuropsychobiology. 2019. V. 78. №4. P. 175-181. https://doi.org/10.1159/000500613

6. Семилетова В. А., Дорохов Е. В., Абдурахмонов Н. Ш. Особенности функционального состояния и кардиоритма отечественных и иностранных студентов в различные периоды учебной деятельности // Вестник новых медицинских технологий. 2016. Т. 23. №4. С. 155-160. EDN: XQQEYL. https://doi.org/10.12737/23865

7. Maes M., Van Der Planken M., Van Gastel A., Bruyland K., Van Hunsel F., Neels H., Scharpé S. Influence of academic examination stress on hematological measurements in subjectively healthy volunteers // Psychiatry research. 1998. V. 80. №3. P. 201-212. https://doi.org/10.1016/S0165-1781(98)00059-6

8. Галеева А. В., Кудрявцев М. Д. Формирование положительного отношения у студенческой молодежи к здоровому образу жизни в современных условиях // Эколого-физиологические проблемы адаптации. 2015. С. 34-35. EDN: WYKPNP

9. Баевский Р. М., Черникова А. Г. Оценка адаптационного риска в системе индивидуального донозологического контроля // Российский физиологический журнал им. ИМ Сеченова. 2014. Т. 100. №10. С. 1180-1194.

10. Баевский Р. М., Берсенева А. П. Оценка адаптационных возможностей организма и риск развития заболеваний. М.: Медицина, 1997. 236 с.

11. Маталыгина О. А. О диагностике функциональных резервов организма // Вестник Северо-Западного государственного медицинского университета им. ИИ Мечникова. 2009. Т. 1. №2. С. 42-48. EDN: NXRYVL

12. Баранов В. М., Баевский Р. М., Берсенева А. П., Михайлов В. М.Оценка адаптационных возможностей организма и задачи повышения эффективности здравоохранения // Экология человека. 2004. №6. С. 25-29. EDN: HRTLMX