

The condition of the pituitary-adrenal axis in first-year students from various regions of Kyrgyzstan

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Abstract: *The study investigates the condition of the pituitary-adrenal axis in first-year students from different regions of Kyrgyzstan. The participants included first-year students from Naryn State University (NSU), natives of the Naryn region (elevation of 2020 m above sea level), and students from Kyrgyz-Russian Slavic University (KRSU), natives of the Chui region (lowland, 760 m above sea level). The research focused on analyzing cortisol and adrenocorticotrophic hormone (ACTH) levels in the blood. The findings revealed a significant increase in cortisol levels among first-year students permanently residing in lowland conditions after their first exam session, and this elevated level persisted for an extended period. Similar trends were observed in the ACTH levels of first-year students from lowland regions.*

Key words: *students, highland, cortisol, adrenocorticotrophic hormone, stress.*

Introduction. The population of Kyrgyzstan, a country known for its high-altitude regions, resides at various altitudes. Researchers are particularly interested in high-altitude inhabitants, whose metabolic indicators show numerous changes recognized as adaptive. Approximately 32% of the population of high-altitude regions of Kyrgyzstan comprises youth aged 14-28 years. This part of the population represents the country's reproductive potential, which requires special attention (1). It is well-known that entering university entails significant stress, which has a negative impact on the young organisms of students; the changes occurring in the body lead to various functional shifts and negative consequences pertaining to the internal organs and systems of organs of the youth. Such changes aimed at facilitating rapid adaptation to changing conditions (5,6). One of the leading roles in this regard is attributed to the endocrine system. Among the key endocrine components, activation of the pituitary-

adrenal axis is highlighted in this response, through which the body must respond to challenges when encountering stressors (7,8). One of the leading roles is attributed to the endocrine system. Among the main endocrine components in this response, activation of the pituitary-adrenal axis is highlighted, through which the body must respond to challenges when faced with stressors (7,8). Studies on hormones of the pituitary-adrenal system—cortisol and ACTH (adrenocorticotrophic hormone), which participate in ensuring rapid adaptation to changing environmental conditions, have not been conducted in first-year university students in Kyrgyzstan. However, it has been previously established that this cohort shows a tendency towards decreased concentrations of major thyroid hormones and activation of pituitary thyrotropic function. It has also been found that this social group experiences changes in fat and carbohydrate metabolism, indicators of red blood cells, and hemostasis (2,3,4). Therefore, the study is relevant and timely.

Objectives: To forecast the students' health condition and develop comprehensive measures to improve it, it is crucial to assess the condition of the pituitary-adrenal axis in first-year students from various regions of Kyrgyzstan.

Methods: The first-year students were divided into two groups. The first group (71 individuals) included 30 males and 41 females, students of *Naryn State University (NSU)*, natives of Naryn Region (2020 meters above sea level). The second group comprised 142 students of *Kyrgyz-Russian Slavic University (KRSU)*, natives of Chui Region (lowlands, 760 meters above sea level), among whom were 65 males and 77 females. All individuals had their blood serum ACTH levels measured in pg/ml using the electrochemiluminescence immunoassay method and cortisol levels in nmol/L using the competitive solid-phase chemiluminescent enzyme immunoassay method on the *Cobas 8000 analyzer, Roche Diagnostics, Switzerland*. The research was conducted at the time of enrollment period (4 weeks after admission), before the first end-of-term exams, and at the end of the first year of study (4 weeks after the first session). Data analysis was performed using *SPSS 15.0 software*. In accordance with the principles of *the 2008 Declaration of Helsinki*, written informed consent was obtained from all study participants.

Results: The conducted comparative analysis of the secretory function of the pituitary-adrenal axis in first-year students of Group 1 differs from that of Group 2 representatives. At the time of enrollment period, cortisol levels in females from Group 1 were significantly lower (p -value <0.05) than those in females from Group 2 by 1.4 times (Table 1).

Table 1. Levels of cortisol and ACTH in first-year female students residing in various climatogeographic zones of Kyrgyzstan.

Hormones	Group 1 (NSU, N=41)			Group 2 (KRSU, N=77)		
	University enrollment	Before the examination period	After the examination period	University enrollment	Before the examination period	After the examination period
Cortisol (nmol/L)	256,54 [#] ±5,23	391,45*±3,61	312,14±29,24	378,19*±5,19	465,22 [#] ±3,14	387,21 [∞] ±4,03
ACTH (pg/ml)	12,25±6,71	10,37±4,26,17	14,55±7,36	19,43±6,58	16,82±6,59	13,51±9,54

* p -value $<0,05$ – comparison within groups

[#] p -value $<0,05$ – comparison between groups

[∞] p -value $<0,1$ – when comparing within a group before and after the end-of-term exams

Prior to the examination period, the average cortisol level among representatives of Group 1 increased by 1.5 times, whereas among those of Group 2, it rose by 1.2 times compared to admission levels, and was 1.4 times higher than in cohort 1, reaching 465 ± 24.84 nmol/L (p -value <0.05). Interestingly, despite a decrease in cortisol levels among female students from low-altitude regions after the examination period, it remained 1.2 times higher than at the time of enrollment period. In Group 2, no significant or substantial difference in cortisol concentration was observed, although there was a 1.2-fold decrease from 465.22 ± 3.14 to 387.21 ± 4.03 at the end of the first examination period (p -value <0.1). Adrenocorticotrophic hormone (ACTH) levels in female students from Group 1 decreased insignificantly before the examination period to 10.37 ± 4.26 pg/mL, increasing by 1.2 times after the examination period compared

to enrollment period levels. In Group 2, hormonal physiology patterns were disrupted, with a 1.2-fold decrease in ACTH from 19.43 ± 6.58 , then a subsequent 1.3-fold decrease in ACTH levels among female students from low-altitude regions compared to the previous measurement.

A similar pattern was observed among male students, where cortisol and ACTH levels were more stable among representatives of Group 1, i.e., individuals residing in high-altitude conditions (Table 2).

Table 2. Levels of cortisol and ACTH in first-year male students residing in various climatogeographic zones of Kyrgyzstan.

Hormones	Group 1 (NSU, N=38)			Group 2 (KRSU, N=68)		
	University enrollment	Before the examination period	After the examination period	University enrollment	Before the examination period	After the examination period
ACTH (pg/ml)	22,63±4,25	18,08±7,42	31,17±6,15	34,19±3,27	62,32±7,48	60,28±9,19
Cortisol (nmol/L)	320,41±31,27	446,29±22,32	403±19,54	309,56±23,39	587±36,44	486,51±36,72

Analysis of mean cortisol levels in the blood serum of first-year male students from highland and lowland cohorts upon enrollment period shows a 1.4-fold increase in hormone content in Group 2 compared to Group 1, approaching the upper limits of normal. A sharp increase in serum cortisol concentration by 1.9 times is noted in Group 2 males before the first examination period, from 309.56 ± 23.39 nmol/L to 587 ± 36.44 nmol/L. After the first examination period, cortisol levels in this group decrease but remain 1.6 times higher than at enrollment period. The situation with ACTH is similar to that observed in females and indicates hormonal imbalance in Group 2 males.

The conducted analysis suggests the possibility of primary disturbances in endocrine function, characterized by an imbalance in the secretory capacity of the body in response to exam stress. It is likely that the variability in ACTH and cortisol secretion

can be associated with the constitutional characteristics of young men or with changes in the hypothalamus, which activate the sympathetic nervous system and several groups of endocrine organs, the functional connections of which are usually represented in the form of axes – thyrotropic, somatotropic, sympathoadrenal-medullary.

Conclusion: The obtained data indicate the necessity of a personalized and more in-depth approach to assessing hormonal status indicators in university students located in different climatogeographic regions, early diagnosis (including the use of laboratory methods) of health disorders in students, and the development of educational programs aimed at improving the health of student youth and promoting a healthy lifestyle.

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