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Examination Stress and Salivary Cortisol Levels in Kazakh and Indian Medical Students

Anastasia Kononets
Nazarbayev University

Gulmira Zharmakhanova
West Kazakhstan Marat Ospanov Medical University

Victoria Kononets
West Kazakhstan Marat Ospanov Medical University

Abstract: Stress is an important component of modern life and has become a serious problem for the health of the population as a whole. Studying at a medical university is accompanied by significant psycho-emotional stress among students. Medical students experience acute stress during exams. One of the markers of stress is cortisol. **Objectives:** to evaluate the level of cortisol in Indian medical students and Kazakhstan medical students during the examination stress. **Methods:** The study involved 134 medical students aged from 18 to 23 years, of which 81 were men, 53 women, studying in the 1st, 2nd and 3rd years of the West Kazakhstan Medical University named after Marat Ospanov. Among them are 67 students from India (46 men and 21 women) and 67 students from Kazakhstan (35 men and 32 women). Groups for the study were formed by random sampling. Free cortisol concentrations in saliva were measured in a diagnostic laboratory using the standard kit "Cortisol Saliva ELISA" of the company "DBC". **Results:** No significant differences were found in the level of saliva cortisol under conditions outside exam stress (Cortisol 1) and saliva cortisol under exam stress conditions (Cortisol 2) between a group of Indian and Kazakhstan students without regard to year of study. The level of free saliva cortisol under conditions outside exam stress is significantly higher in the general group of women compared to the general group of men. Increased salivary cortisol levels under examination stress were observed in all groups and examined. **Conclusion:** Identification of a contingent of students with high levels of cortisol (i.e., more susceptible to stress) will allow us to develop and recommend a set of measures that will help reduce cortisol levels and neutralize its pathogenic effect on the functioning of the main systems of the body.

Keywords: Exam stress, Students, Cortisol, Saliva, ELISA

Introduction

Stress is an important component of modern life. This has become a serious problem for the health. The transition from school to university education is a process that induces significant mental and emotional stress (McEwen, 2007; Conley et al., 2015; Inostroza et al., 2024). The transition from school to university education is a process that requires significant mental and emotional stress. Exam stress is a special form of emotional stress. The process of studying at the university can be considered as chronic stress, the severity of which depends on a number of factors (including social factors - living conditions, material status, family situation, as well as individual characteristics). Education at a medical university is accompanied by significant psycho-emotional stress among students (Al-Ayadhi, 2005; Daya & Hearn, 2018; Wang et al., 2024).

Students of the medical university experience acute stress during the exams, which adversely affects their performance, and can also lead to the development of pathological conditions (Daya & Hearn, 2018; Kulsoom & Afsar, 2015; Fawzy & Hamed, 2017).

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Depression leads to increase in the secretion of ACTH and activation of the hypothalamic pituitary adrenal axis (HPA), which increases the level of cortisol. Activation of HPA is an adaptive mechanism that allows the human body to maintain physiological stability in response to signals of general stress (Schulkin, 2011; An et al., 2016; Basilicata et al., 2023).

The change in forms and places of training is usually accompanied by the development of stress (Parent et al., 2019). It is known that the change of place of residence, and long journeys over long distances are stress factors and are accompanied by an increase in cortisol concentration in saliva (Stevens et al., 2018). Foreign students who come from a region with different climatic and geographic characteristics experience additional stress factors in comparison with students studying in their home country.

The aim of this study was to evaluate the level of cortisol in Indian and Kazakh medical students during the examination stress. To solve the aim, we staged the following tasks:

1. To identify differences in cortisol levels between groups of students from Kazakhstan and India in normal and exam-stress conditions.
2. To compare cortisol levels among first-, second-, and third-year students under normal conditions and during exam stress.
3. To explore the relationship between cortisol levels and gender.

Method

Study Participants

The study involved 134 medical students from the age of 18 to 23 years (81 men, average age 19.84 ± 1.65 years); 53 women (average age 19.68 ± 1.53 years old) enrolled in 1, 2, and 3 courses at the West Kazakhstan Medical University, among them 67 Indian students (46 men and 21 women) and 67 Kazakh students (35 men and 32 women). Groups for the study were formed by random sampling. According to the results of the conclusions of the doctors, all the subjects at the time of the examination did not have acute diseases and chronic neurological, psychiatric and somatic pathology. Exclusion criteria were also smoking, the use of psychoactive substances and drugs, pregnancy.

Methods

Considering a number of difficulties associated with the determination of serum cortisol — invasiveness, soreness, stressful conditions of the blood sampling procedure, preference was given to the method of analysis of salivary cortisol. Saliva was used as a material for the study on the determination of cortisol concentration (indicator "free cortisol of saliva" (ng/ml). Saliva samples were collected in Eppendorf-type tubes from chemically inert material. Sampling for cortisol was performed twice - one month before the exam (Cortisol 1 indicator) and during the exam (Cortisol 2 indicator). The time of the survey was from 9 to 10 a.m. The survey was performed on an empty stomach. Eating, drinking, chewing gum and brushing teeth 3 hour before sampling were excluded. Saliva samples were frozen and stored at -25°C until analysis. Determination of the concentration of free cortisol in saliva was performed in the diagnostic laboratory using the standard set "Cortisol Saliva ELISA" of the company "DBC".

Statistical Analysis

Statistical processing of the results was carried out using descriptive statistics methods. While analyzing intergroup differences for independent samples, we used the non-parametric Mann-Whitney test (U-test), the Wilcoxon test, the Kruskal-Wallis test implemented in the program Statistica 10.0.

Results and Discussion

The data in Table 1 indicate an absence of significant differences between groups of Indian and Kazakh students (without gender and year of study) in the level of saliva cortisol under normal conditions and examination stress conditions.

Table 1. Salivary free cortisol levels in Kazakh and Indian students

| Indicators | Indian students (n = 67) | Kazakh students (n = 67) | p |
|--|-----------------------------|-----------------------------|------|
| Cortisol 1 (one month before the exam), ng / ml | 59.36±25.09 | 61.99±23.76 | 0.59 |
| Cortisol 2 (during the exam), ng / ml | 71.48±21.62 | 74.29±20.96 | 0.29 |

The level of free salivary cortisol under normal conditions outside exam stress (Cortisol 1) was significantly higher in the general group of women (Figure 1), in the general group of second-year students (Figure 2), and also in a group of Indian first-year students in comparison with a group of Kazakhstan's first-year students (Table 2).

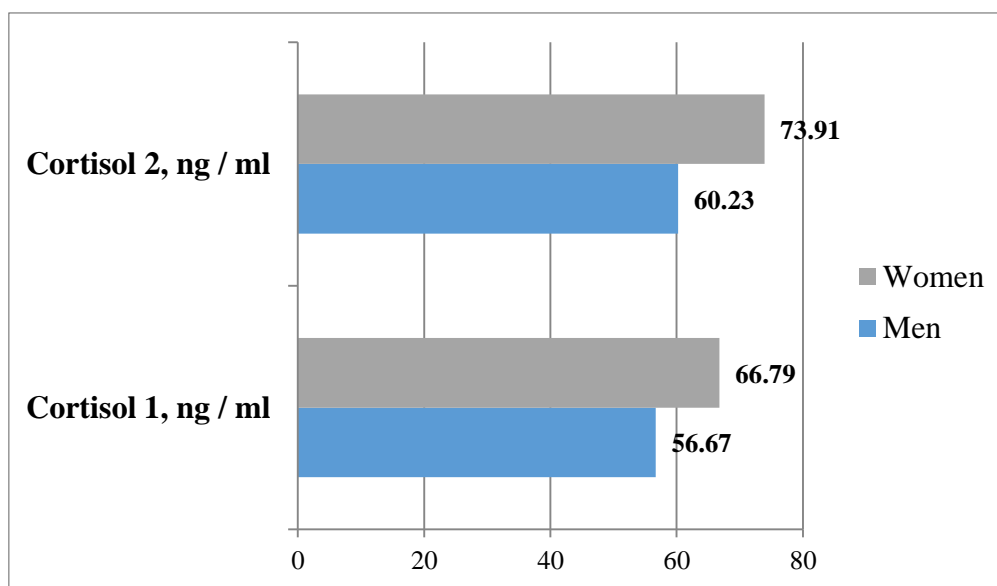


Figure 1. The level of free salivary cortisol in groups of male and female students

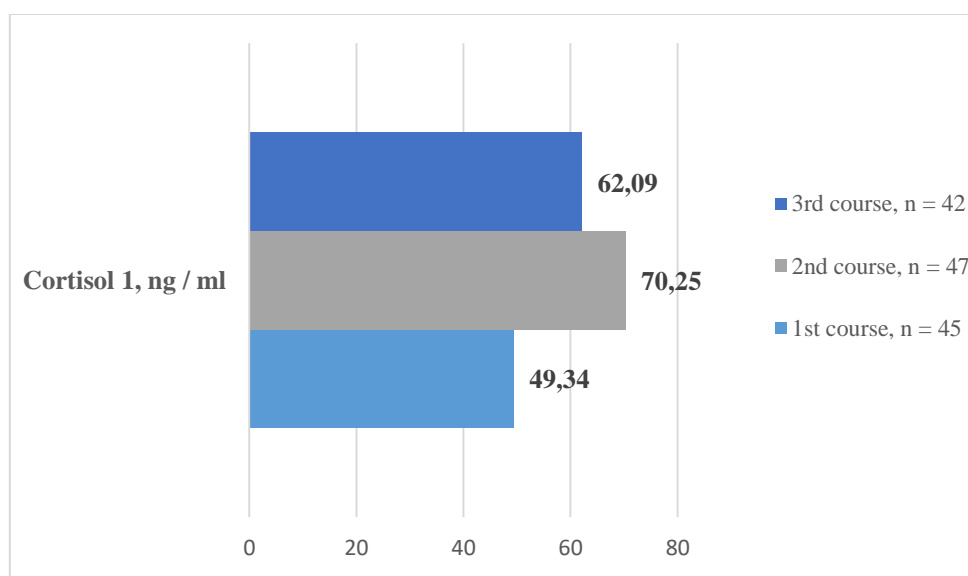


Figure 2. The level of free salivary cortisol in groups of students 1-3 courses

Attention is drawn to the significantly lower level of Cortisol 1 in Kazakhstan first-year students in comparison with Indian first-year students (Table 2).

Table 2. The level of free salivary cortisol in groups of Kazakhstan and Indian students of 1-3 courses

| Indicators | Indian students | | | Kazakh students | | |
|---|------------------------------------|---------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| | 1 st course (n = 24) | 2 nd course (n = 23) | 3 rd course (n = 20) | 1 st course (n = 21) | 2 nd course (n = 24) | 3 rd course (n = 22) |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Cortisol 1 (one month before the exam), ng / ml | 58.65 ±27.27 | 65.70 ±20.61 | 52,90 ±26.48 | 38.70 ±18.29 | 74.62 ±16.18 | 70.45 ±19.22 |
| | p 1-4 = 0,006** | | p 3-6 = 0,023* | p 4-5 = 0,000*** | p 4-6 = 0,000*** | |
| Cortisol 2 (during the exam), ng / ml | 70.34 ±23.01 | 67.82 ±21.15 | 77.07 ±20.35 | 67.08 ±24.48 | 81.80 ±14.93 | 72.98 ±21.15 |
| | p 2-5 = 0,0041** | | | | | |

Note: p - statistically significant differences between groups (* p <0.05; ** p <0.01; *** p <0.001;)

A significant increase in the level of salivary cortisol under exam stress (Cortisol 2) was observed in all groups of subjects, with the exception of a group of second-year students (Figure 3).

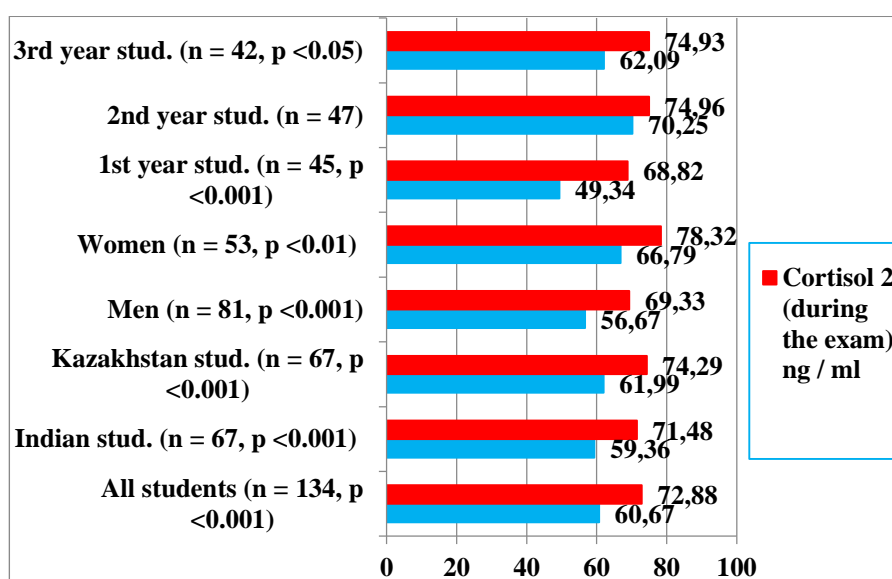


Figure 3. The level of cortisol outside exam stress and during exam stress in different groups of students

Analysis of data taking into account gender indicates a significantly higher rise in Cortisol 2 in the total group of women compared to the group of men (Figure 1). A higher level of cortisol in the group of women compared with the group of men, obviously, may be associated with the influence of sex hormones. These data are consistent with research data reporting a higher concentration of cortisol in groups of women compared with men (Welker et al., 2014; Labad et al., 2015). Given the differences between the group of women and men in terms of Cortisol 1, the increase in Cortisol 2 in the group of women compared to the group of men is quite natural.

The high level of Cortisol 1 among Indian first-year students in comparison with Kazakh first-year students is noteworthy. However, the level of Cortisol 1 in Indian first-year students did not significantly differ from the corresponding indicator in Indian students of the 2nd and 3rd courses, while the level of Cortisol 1 in Kazakh first-year students was significantly lower than this indicator of Kazakhstan students of the 2nd and 3rd courses.

It should be noted that the collection of samples under non-stress conditions was carried out during the 1st semester, before the first examination session. Undoubtedly, the examination session is a period of time during which students are exposed to a significant number of stress factors. First-year students had no experience in the examination session, which may explain their low Cortisol 1 in comparison with groups of students of 2nd and

3rd courses. Significantly high Cortisol 1 in Indian first-year students in comparison with a group of Kazakh first-year students can probably be explained by the influence of a combination of social and physical factors acting on them in a relatively unfamiliar environment. Education at a medical university is traditionally considered one of the most difficult, so it is only natural that the examination session provokes the formation of acute stress, which is manifested by an increase in Cortisol 2 in all groups of students surveyed.

Conclusion

No significant differences were found in Cortisol 1 and Cortisol 2 between a group of Indian and Kazakh students irrespective of year and gender. The level of Cortisol 1 and Cortisol 2 is significantly higher in the general group of women compared to the general group of men. The level of Cortisol 1 is significantly lower in the general group of first-year students, as well as in the group of Kazakhstan's first-year students in comparison with the group of Indian first-year students. Increased salivary cortisol levels under examination stress Cortisol 2 were observed in all groups.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in EPHELS Journal belongs to the authors.

Acknowledgements or Notes

* This article was presented as an oral presentation at the International Conference on Medical and Health Sciences (www.icmehes.net) held in Antalya/Turkey on November 14-17, 2024.

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Author Information

Anastasia Kononets

Nazarbayev University
Ave. Kabanbay Batyr 53, Astana 010000, Kazakhstan
Contact e-mail: anastassiya.kononets@nu.edu.kz

Gulmira Zharmakhanova

West Kazakhstan Marat Ospanov Medical University
Maresyev Street 68, Aktobe 030019, Kazakhstan

Victoria Kononets

West Kazakhstan Marat Ospanov Medical University
Maresyev Street 68, Aktobe 030019, Kazakhstan

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