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NEUROSTEROID HORMONES AND PSYCHO-EMOTIONAL STATE OF INDIGENOUS MEN (YAKUTIA)

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A survey of 56 practically healthy men from among the indigenous inhabitants of Yakutia (yakuts-34, evenks-22) was carried out. The average age of men was 40.1±1.58 years. The purpose of this study was to assess the psycho-emotional state and the level of neurosteroid hormones in men of the indigenous population of the Republic of Sakha (Yakutia). The results of a psycho-emotional study of men showed that good psychological adaptation was noted in 64.3% (37), of which the «health» level was 28.6% (16) and optimal adaptation was 35.7% (20).

Non-pathological maladaptation was detected in 16.1% (9), and severe pathological maladaptation - in 19.6% (11) (pathological mental maladjustment - 8.9% (5) and probably a disease state - 10.7% (6)). Depression (D) was absent in 35.7% (20), mild depression was noted in 17.8% (10), moderate in 28.6% (16) and severe in 17.8% (10), severe depression not identified. An analysis of the degree of aggression showed that in 42.9% (24) of the surveyed, the aggression index (IA) was normal, in 53.6% (30) it was low and in 3.6% (2) it was high. An increase in the level of neurosteroid hormones in indigenous men is a protective reaction of the body in ensuring homeostasis and adaptation to the conditions of the North. The concentration of steroid hormones in men decreases with the deterioration of the psycho-emotional state.

Keywords: testosterone, cortisol, dehydroepiandrosterone sulfate, serotonin, depression, neuropsychological adaptation, Yakutia.

The process of adaptation and maintenance of homeostasis in residents living in extreme climatic conditions of the North, under the influence of man-made, socio-economic factors is accompanied by activation of metabolism (metabolism), changes in the endocrine and nervous systems [8; 7; 6]. Constant exposure to stress-limiting factors can lead to depletion of the body's reserve capabilities, disrupt homeostasis and provoke «oxidative stress», thereby increasing morbidity and mortality of the working-age population [13; 4, 1, 16]. Manifestations of stress reactions in residents of Northern latitudes in more than 60% of practically healthy people are expressed in psychoemotional and endocrine changes [5, 15]. There was an increase in psychoemotional tension by 19.4% and the level of the stress hormone cortisol by two times, compared with healthy residents of the middle latitudes [14]. A relatively frequent occurrence of anxiety-depressive states was noted in residents of Southern Yakutia (Neryungri) [12].

Hormones of the hypothalamic-pituitary-adrenal system regulate not only neuroendocrine function, but also affect behavior, thinking, sleep cycle regulation, memory, depression, anxiety and aggression [21]. Aggression is one of the most common ways to solve problems that arise in complex and difficult (frustrating) situations that cause mental tension. It is essential that aggressive actions used to overcome difficulties and relieve tension are not always adequate to the situation. Aggressive actions act as: 1) means of achieving some significant goal; 2) methods of mental discharge, replacement of satisfaction of blocked needs and switching activities; 3) satisfaction of the need for self-realization and self-affirmation.

Sex steroids are involved in the formation of cognitive functions, reduce the clinical manifestations of depression and other mental disorders. Understanding the effect of nonsteroidal hormones on the development and functioning of the central nervous system in different periods of men's lives is extremely rele-

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vant and can be used to correct various dishormonal disorders in men.

The purpose of this study was to assess the psychoemotional state and the level of steroid hormones in men of the indigenous inhabitants of the Republic of Sakha (Yakutia).

Material and methods of researc- During the field expeditions, in the spring (March), 56 practically healthy men from among the indigenous inhabitants of Yakutia (yakuts-34, evenks-22) (Megino-Kangalassky, Vilyuysky and Ust-Maysky districts) were examined. The average age of men was 40.1±1.58 years. Blood sampling was carried out from the ulnar vein in the morning from 8 to 11, on an empty stomach, in a state of muscular rest.

Determination of the concentration of cortisol, testosterone, dehydroepiandrosterone sulfate (DHEA-S) was carried out in blood serum using sets «Alkor-Bio» (Russia), dehydroepiandrosterone (DHEA) from DBC (Canada), serotonin - LDN (Germany) by three-phase enzyme immunoassay on a «Uniplan» photometer (Russia) on the basis of the Laboratory of Immunology of the FSBSI «YSC CMP», Yakutsk.

The psychological examination was conducted using the validated Bass-Darkey questionnaire (for aggression research), the Beck depression scale and the neuropsychic Adaptation Test (NAT) (for categorical assessment of mental health). The study was approved by the decision of the Local ethics committee at the FSBSI «YSC CMP» and was carried out in accordance with the ethical standards of the Helsinki Declaration (2000), after receiving the informed consent of the participants to use the materials in scientific generalizations.

Statistical processing of the results was carried out using the package of applied statistical programs SPSS Statistics 26. To identify the relationship between the studied indicators, the method of correlation analysis of data with the calculation of coefficients and Spearman rank correlation was used. The reliability of the differences was determined by ANOVA for independent groups. The critical value of the level of statistical significance of differences (p) was assumed to be 5%.

Results and discussion. The results of a psychoemotional study of men showed that 64.3% (37) had good psychological adaptation, of which 28.6% (16) had the level of «health» and 35.7% (20) had optimal adaptation. Non-pathological maladaptation was detected in 16.1% (9), and pronounced pathological maladaptation - in 19.6% (11) (pathological mental maladaptation - 8.9% (5) and probably a painful condition - 10.7% (6). Depression (D) was absent in 35.7% (20), mild depression was noted in 17.8% (10), moderate in 28.6% (16) and pronounced in 17.8% (10), severe depression was not detected.

According to the results of the study, Alekseeva Z.N. et al. (2018) in men of rural residents of Yakutia, the severity of depression and neuropsychiatric maladaptation is less pronounced than in women, while the severity of depression among men was 17.4% (moderate - 12.9%, pronounced - 3.8% and severe - 0.8%), and the NAT of the «painful state» was 28.8% [10].

The analysis of the degree of aggression showed that in 42.9% (24) of the surveyed, the aggression index (AI) is normal, in 53.6% (30) it is low and in 3.6% (2) it is high. The predominance of individuals with a low level of aggression requires further study. According to the definition of the methodology itself, the norm of aggression is an average indicator, and deviation from the norm to a low or high level is considered as destructive changes. A low level of aggression can be regarded as the suppression of aggression, which is more often regarded as a predictor of psychosomatization [3].

Correlation analysis showed that the level of NAT had a direct relationship with the level of depression (0.376; p=0.004) and AI (0.383; p=0.04), the main stress hormone - cortisol had an inverse correlation with indicators of psychoemotional state: with a degree of NAT (-0.326; p=0.018), with depression (-0.329; p=0.013) and with AI (-324; p=0.015).

The average level of cortisol in men was 566.21±21 (nmol/L), while an increased level of cortisol was noted in 25% of respondents, which is comparable to the data of studies of northerners, who had an increase in cortisol compared with healthy residents of the middle latitudes [14].

In groups with high psychological maladaptation (Table 1), with a higher level of depression (Table 2) and aggression (Table 3) a lower cortisol content was noted in comparison with groups with normal and low levels of psychological indicators (Tables 1, 2), which may be one of the disadaptation signs.

According to literature data, in two groups with unidirectional hormonal, psychoemotional manifestations of the severity of northern stress, practically healthy newcomers with an increased level of psychoemotional stress and a low concentration of cortisol showed more pronounced functional disorders of the cardiovascular system, gastrointestinal tract and painful meteoreaction [14]. When exposed to physical or psychological stressors, the brain sends a signal to the adrenal glands, and cortisol is released. Under the influence of which concentration of attention improves, blood circulation and glucose synthesis increases — this helps the body to release

Table 1

The content of neurosteroid hormones in men with different levels of NAT

Indicators	NAT level				
	1 n=16	2 n=20	3 n=9	4 n=5	5 n=6
Cortisol, 150-660 (nmol/L)	607.07±31.57	617.24±39.04	509.39±51.29	460.94±43.63 p_{2-4}=0.047	459.28±71.4 p_{1-5}=0.049; p_{2-5}=0.031
Testosterone, 12.1-38. (nmol/L)	22.21±1.37	25.32±1.64	20.91±2.61	21.48±2.61	23.47±3.40
Serotonin 40-400 (ng/ml)	321.72±20.41	336.21±23.56	315.91±36.72	293.50±37.10	314.56±36.45
DHEA, 3-11(mcg/ml)	5.72±0.75	6.50±0.66	6.54±1.27	4.21±0.64	6.87±2.66
DHEA-S, 1.0-4.2 (mcg/ml)	2.81±0.38	3.39±0.38	3.75±0.64	2.25±0.49	1.92±0.36 p_{2-5}=0.053 p_{3-5}=0.035
T/C, u.e	0.037±0.002	0.044±0.004	0.045±0.007	0.046±0.003	0.054±0.008
DHEA/C, u.e	0.96±0.14	1.24±0.24	1.49±0.43	0.94±0.16	0.32±0.40 p_{1-5}=0.049
DHEA-S/C, u.e	0.46±0.52	0.63±0.11	0.77±0.13	0.48±0.13	0.46±0.09

Note: 1-health; 2-optimal adaptation; 3- non-pathological mental maladaptation; 4-pathological mental maladaptation; 5-probable painful condition.

additional energy in order to overcome stress more effectively.

The testosterone level in all groups varied within the reference values, and had no significance from the level of NAT and depression (Tables 1, 2). Its significant dependence was revealed on the level of aggression, in the group with a low aggression index, a higher testosterone content was noted by 20.27% ($p<0.05$), in comparison with the group with a normal aggression index, (Table 3). Correlation analysis showed an inverse relationship of testosterone levels with the aggression index (-0.349; p=0.008) and a direct relationship with the cortisol level (0.421; p=0.004), DHEA (0.361; p=0.006) and the T/C index (0.396; p=0.003).

Studies by scientists from the Netherlands and South Africa have shown that aggression (in its everyday manifestation) has a connection not only with testosterone, but also with cortisol, as well as serotonin — a substance that nerve cells use to exchange signals. These studies suggested that testosterone increases aggressiveness mainly when there is little cortisol or receptors responsible for interacting with serotonin, and serotonin receptors partially prevent impulsive aggression, outbursts of rage. [24]. Thus, a strong positive correlation between testosterone and aggression was found in male offenders with low cortisol levels. In male offenders with high cortisol levels, the relationship between testosterone and aggression was not observed [17]. In addition, recent studies have revealed a similar relationship between testosterone, cortisol and aggressive behavior in clinical groups of children with behavioral disorder and adults with psychopathy, as well as in healthy people [19].

Recently, it has been suggested that a low level of serotonin combined with a high ratio of the T/K index contributes, in particular, to an impulsive subtype of aggression [25; 23].

The average level of serotonin in all groups varied within the normal range and did not differ depending on the indicators of the psycho-emotional state (Table 1.2), however, in the group with an increased level of aggression it tended to decrease (Table 3). Serotonin is the most important neurotransmitter involved in the regulation of cognitive, behavioral and other mental functions in humans, the neurobiological profile of low cortisol and high testosterone levels, together with low serotonin levels, predisposes to impulsive aggression.

The average level of DHEA hormone having an anabolic effect was 6.12 ± 0.46 (pg / ml) and, depending on the indicators of psychoemotional state, did not differ, which is consistent with the literature data. The level of DHEA in patients with hysterical symptoms did not differ from the indicators of healthy individuals [9]. In the work of Nakhodkin S.S. et al. (2018), the dependence of hormone levels on smoking and the type of character was revealed: in smoking young yakut men, the level of cortisol increases, and the level of DHEA tends to decrease, the dependence of the content of DHEA in the blood serum of smoking men on extroversion indicators is also shown (r=0.47; p=0.02). [2]. DHEA is a natural anti-glucocorticoid hormone that opposes the key stress hormone cortisol [21]. For adequate protection of the body from stress, DHEA, which is characterized by a protective effect against the central ner-

Table 2

The content of neurosteroid hormones in men with different levels of depression

Indicators	The level of depression			
	1 n=20	2 n=10	3 n=16	4 n=11
Cortisol, 150-660 (nmol/L)	657.39±31.92	527.34±49.91 p_{1-2}=0.028	484.37±30.30 p_{1-3}=0.001	553.64±58.53
Testosterone, 12.1-38.3(nmol/L)	23.23±1.44	24.57±2.24	22.57±1.83	22.69±2.11
Serotonin 40-400 (ng/ml)	314.87±27.39	329.77±14.49	338.05±23.55	306.65±20.97
DHEA, 3-11(mcg/ml)	5.45±0.56	7.97±1.12 p_{1-2}=0.065	6.02±1.17	5.77±.83
DHEA-S, 1.0-4.2 (mcg/ml)	3.14±0.41	3.17±0.49	2.48±0.34	3.5±0.53
T/C, u.e	0.035±0.001	0.049±0.006 p_{1-2}=0.043	0.047±0.009 p_{1-3}=0.045	0.048±0.008 p_{1-4}=0.066
DHEA/C, u.e	0.80±0.05	1.68±0.36 p_{1-2}=0.018	1.20±0.68	1.42±0.48
DHEA-S/C, u.e	0.48±0.05	0.66±0.13	0.53±0.06	0.76±0.02 p_{1-4}=0.065

Note: 1-absent; 2-mild; 3-moderate; 4-pronounced.

Table 3

The content of neurosteroid hormones in men with different levels of aggression

Indicators	Aggression Index		
	1 n =24	2 n=30	3 n=2
Cortisol, 150-660 (nmol/L)	613.41±27.33	518.21±32.39 p_{1-2}=0.029	443±147.88
Testosterone, 12.1-38.3(nmol/L)	25.41±1.15	20.26±1.31 p_{1-2}=0.004	24.86±1.95
Serotonin 40-400 (ng/ml)	326.57±18.21	326.97±17.27	213.09±55.35
DHEA, 3-11(mcg/ml)	6.10±0.56	6.26±0.84	4.88±2.01
DHEA-S, 1.0-4.2 (mcg/ml)	3.11±0.26	2.825±0.36	4.06±2.28
T/C, u.e	0.043±0.003	0.042±0.003	0.066±0.027 p_{1-3}=0.088; p_{2-3}=0.063
DHEA/C, u.e	1.09±0.15	1.30±0.22	1.09±0.09
DHEA-S/C, u.e	0.53±0.48	0.60±0.11	0.85±0.23

Note: 1-low; 2-normal; 3-high

vous system, should always prevail over cortisol [18, 20]. According to some studies, a low level of DHEA in the blood is one of the causes of insufficient stress resistance, increasing depression with age in adolescents and the elderly, increased suicide rates, and a decrease in the level of circulating DHEA and a decrease in the cortisol–DHEA ratio are associated with accelerated aging, depression, memory disorders, chronic fatigue syndrome, Alzheimer's disease. [18, 20].

In men of indigenous nationality, the average concentration of DHEA-S was equal to 3.02±0.21 (mcg/ml). The level of DHEA-S tended to decrease depending on the deterioration of the NAT. Changes in the concentration of DHEA-S were detected only depending on the level of NAT, in the group of people with a likely painful condition, the content of DHEA-S was reduced by 20%, compared with the «health» group and by 33.6% with optimal adaptation (Table 1). The DHEA-S content positively correlated with the DHEA level (0.427; p=0.001) and the DHEA/C index (0.313; p=0.019). DHEA-S has a weak androgenic effect, but in the process of its metabolism, testosterone and DHEA are formed in peripheral tissues.

Stressful situations lead to a violation of the central nervous system, according to most authors, they lead to a decrease in DHEA and DHEA-S. DHEA, unlike DHEA-S, can be metabolized in the brain, and affect mental processes.

The testosterone/cortisol index (T/C) had a direct relationship with NAT and depression (0.334; p=0.012 and 0.307; p=0.021), which indicates the activation of adaptive processes in the body of people with stress of a psychoemotional state. The ratio of DHEA to cortisol, which characterizes the anabolic-catabolic balance, is used as a marker of stress resistance in patients with mental disorders [9]. The DHEA/C index and DHEA-S/C had an inverse relationship with cortisol and a direct relationship with the level of DHEA and DHEA-S, respectively.

Thus, 35.7% of the surveyed indigenous men (yakuts, evenks) of the Republic of Sakha (Yakutia) have a stress of the psycho-emotional state according to the level of NAT. 46.4% of men were found to have depressive states. Low level of aggression is found in 53.6% (30), high in 3.6%. An increase in the level of neurosteroid hormones in indigenous men is a protective reaction of the body in ensuring homeostasis and adaptation to the conditions of the North. The concentration of steroid hormones in men decreases with the deterioration of the psycho-emotional state.

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