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THE LEVEL OF ENDOGENOUS INTOXICATION IN OVERWEIGHT INDIVIDUALS

According to the data obtained, there is an increase in the levels of low and medium molecular weight substances and oligopeptides in plasma, erythrocytes, and urine, depending on body weight. In obese individuals, there was a significant increase in the concentrations of low and medium molecular weight substances and oligopeptides compared to those with normal body weight in all biological samples studied, indicating endogenous intoxication in the body of obese individuals.

Keywords: low and medium molecular weight substances, oligopeptides, obesity, overweight, endogenous intoxication.

Introduction. At present, the problem of obesity is urgent both worldwide and in Russia [5]. Modern man is exposed to several factors leading to obesity (abundance and caloric content of food, hypodynamia, psycho-emotional-stresses, bad habits, and ecology).

Obesity leads to serious complications in human health. People suffering from obesity are more prone to the development of cancer [6, 13], cardiovascular [9], autoimmune diseases [11]. Obesity is a risk factor for severe outcomes in COVID-19 disease [8]. In addition, obesity is the cause of leading a person to disability and death [5].

Obesity is a complex, multifactorial disease, the development of which, along with genetic predisposition, is greatly influenced by external factors that lead to metabolic disorders in the human body. Disturbance of metabolic processes leads to endogenous intoxication (EI) development. According to many authors, EI is a nonspecific process in diseases of different etiology, pathogenesis, and severity [1]. In patients with chronic EI, there is often a shift in homeostasis, leading to decreased body resistance [10, 12].

In connection with those mentioned above, detection EI in risk groups for correction of this condition is an urgent task. In scientific and clinical studies, the determination of low and medium molecular weight substances (LMMWSs) as markers of EI is widespread.

There have been no studies on the level of LMMWSs as markers of EI in overweight and obese residents of Yakutia.

Materials and methods. The present work was carried out in the Yakut Science Centre of Complex Medical Problems under the research work: "Regional characteristics of biochemical and immunological parameters in the indigenous and native population of the Republic of Sakha (Yakutia) in norm and pathology". The material was collected during medical and biological expeditions during the health examination of the population of Yakutia in the spring period from 2015 to 2019. It was mandatory to obtain informed consent of the respondents for the study (according to the protocol of the Ethical Committee of Yakut Science Centre of Complex Medical Problems №49 dated 25.03.2018).

Fifty people aged 31 to 50 years were examined. The body mass index (BMI) = m (kg) / h^2 (m), where m-body weight, h-height, was calculated for each individual. According to the BMI, the examined persons were divided into three groups: the first group included 15 people with normal body weight (BMI from 18 to 24.9), the second group included 20 people with overweight (BMI from 25 to 29.9) and the third group included 15 obese people (BMI from 30 and above). The study material was blood from the ulnar vein on an empty stomach.

The content of LMMWSs estimated the level of EI according to the method of M.Y. Malakhova [7]. The determination of oligopeptides (OPs) was evaluated using the Lowry protein assay. In plasma, blood erythrocytes, and urine we calculated the coefficients of the complex assessment of endotoxemia: K1 - ratio of LMMWSs concentration in plasma to LMMWSs concentration in erythrocytes; K2 - ratio of LMMWSs concentration in urine to the sum of LMMWSs concentrations in blood plasma and erythrocytes; K3 - ratio of oligopeptide (OPs) concentration in urine to the sum of OPs concentrations in blood plasma and erythrocytes.

Biochemical parameters were studied in serum. The concentrations of cholesterol, triglycerides, high-density lipoproteins, glucose, alanine aminotransferase and aspartate aminotransferase were determined on an automatic biochemical analyzer Chem Well 2902.

The obtained data was performed using IBM SPSS Statistics 19 program. In this article, quantitative indicators are presented in the format Mean ± SD, where Mean is the arithmetic mean, and SD is the error of the arithmetic mean.

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Table 1

LMMWSs and OPs content in plasma, urine and erythrocytes

BMI	LMMWSs in plasma (CU)	LMMWSs in erythrocytes (CU)	LMMWSs in urine (CU)	OPs in plasma (g/L)	OPs in erythrocytes (g/L)	OPs in urine (g/L)
Normal body weight	16,714±0,039	26,180±0,086	23,928±0,017	0,060±0,009	0,094±0,002	0,621±0,001
Overweight	17,875±0,096	29,344±0,081	26,971±0,053	0,071±0,002	0,105±0,007	0,733±0,009
Obesity	20,213±0,069*	31,105±0,076*	30,260±0,015*	0,083±0,005*	0,110±0,006*	0,854±0,009*

Note: * - level of statistical significance $p<0.05$, CU – conventional units.

The normality of the distribution of quantitative data was checked using the Kolmogorov-Smirnov test. As a result, the data in all the studied samples for the studied indicators differed from the normal distribution. In this regard, the Mann-Whitney U test was chosen to compare the studied groups. The significance level for accepting the null hypothesis was accepted at $p<0.05$.

Results and discussion. The spectrogram of erythrocytes, when analyzing the mean values of the supernatant after precipitation of erythrocyte mass with trichloroacetic acid, had the form of a hyperbola with maximum extinction at a wavelength of 258 nm, which is mainly due to the presence of LMMWSs containing nucleotides. The level of LMMWSs in erythrocytes of blood of obese individuals was significantly higher by 1.2 times compared to individuals with normal body weight.

The spectrogram of blood plasma had the form of an ascending curve with absorption maximum at 282 nm. The content of LMMWSs in blood plasma of obese individuals was significantly higher by 1.2 times.

The urine spectrogram had absorption maxima in the ranges of 238 and 270 nm, corresponding to the presence of urea, uric acid, and creatinine. In obese individuals, the concentration of LMMWSs in urine was significantly 1.3 times higher ($p<0.05$) (Table 1).

Determination of OPs allowed us to assess the proteolytic process activity in blood quantitatively. A significant increase of OPs values in plasma, erythrocytes, and urine was observed in obese individuals 1.3 times; 1.2 times; 1.4 times, respectively, compared to those with normal body weight.

In obesity, there is a metabolic disorder, which leads to the accumulation of toxic substances of endogenous and exogenous nature in the body, as evidenced by the accumulation of LMMWSs and OPs in blood and urine. The accumulation of LMMWSs and OPs in biological samples of obese patients is evidence of EI in the body. In EI, many studies cite the relationship between the increase in the concentration of LMMWSs and the deterioration of the patient's general condition. For example, Margity et al. (2021) found that maximum concentrations of LMMWSs and OPs were observed in severe and minimum concentrations in mild varicella. The levels of LMMWSs and OPs in patients with complications were higher than in patients without complications [3]. Prokofieva et al (2022) showed that the volume of ischemic myocardium, affects the severity of endogenous intoxication in patients with myocardial infarction [4]. The danger of chronic course of EI in obese patients is associated with decreased body resistance and the possibility of developing many serious diseases (cardiovascular, oncological, and autoimmune diseases). In our study, there is a direct correlation between the increase in BMI and the content of LMMWSs ($r=0.74$; $p=0.01$).

In obesity, the biochemical parameters of the blood changes towards an increase in blood glucose due to a decrease in tissue resistance to insulin. In obesity, the pancreas intensively synthesizes insulin, while the same gland compensatory secretes glucagon. Glucagon damages the nephron tubule. As a result, the kidney's barrier function is reduced, and proteins are intensively excreted with urine [2], as evidenced by our calculated coefficient of endotoxemia - K3 tending to increase with increasing body weight. This coefficient characterizes the process of kidney elimination of OPs (Table 2).

Obesity-induced hypertrophy of adipose tissue leads to activation of lipolysis and an increase in blood levels of triglycerides, free fatty acids, and cholesterol, from which low and intermediate density lipoproteins are formed in the liver. Our results confirm this (Table 3).

Table 2

EI coefficients

EI coefficients	Normal body weight	Overweight	Obesity
K1	0.634±0.084	0.601±0.040	0.649±0.059
K2	0.691±0.019	0.665±0.087	0.667±0.027
K3	4.137±0.036	4.296±0.049	4.475±0.015*

Table 3

Blood biochemical parameters

Biochemical parameters	Normal body weight	Overweight	Obesity
Cholesterol	5.324±0.120	5.721±0.254	5.833±0.096*
Triglycerides	0.765±0.026	0.915±0.042*	1.427±0.033*
Low-density lipoproteins	0.356±0.097	0.414±0.016	0.656±0.012*
Glucose	4.750±0.031	5.156±0.081	5.281±0.074
Alanine aminotransferase	14.236±0.112	18.238±0.994	21.002±0.295*
Aspartate aminotransferase	22.761±0.301	22.310±0.135	25.332±0.514

Thus, in obese individuals, compared to those with normal body weight, there are significantly high values of biochemical parameters of cholesterol, triglycerides, low-density lipoproteins, alanine aminotransferase activity in the blood, which is evidence of metabolic disorders. Comparison of LMMWSs and OPs in all studied biological samples (erythrocytes, plasma, urine) in obese individuals compared to those with normal body weight showed significantly high values of these indicators, which is evidence of EI in obese individuals. Correction of EI in the body of obese individuals may prevent the development of serious diseases such as type 2 diabetes mellitus, cardiovascular, oncological, and autoimmune diseases.

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