Body mass index and parameters of dyslipidemia, carbohydrate metabolism, leptin and insulin in the ethnic population of Kazakhs

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Abstract. Obesity as a multifactorial disease is associated with hyperinsulinemia and insulin resistance, which lead to the development of atherogenic dyslipidemia. The increasing importance in understanding the mechanisms of obesity development is associated with an in-depth study of the functions of leptin produced by adipocytes.

Keywords: obesity, Kazakh population, carbohydrate metabolism, leptin, dyslipidemia.

Introduction

The problem of obesity in the modern world is becoming more and more urgent and begins to pose a social threat to people's lives. This problem is relevant regardless of social and professional affiliation, area of residence, age and gender. According to the WHO, in 2016 1.9 billion of the world's adult population was overweight, 600 million people were obese. It is predicted that 50% of the world's population will suffer from excess weight by 2025. In Kazakhstan, more than half of the population is overweight, and 23.5% of Kazakhstanis are completely obese. The improvement of diagnostic methods to a personalized approach is gaining relevance.

Of particular interest is the analysis of the relationship between body mass index and indicators of insulin, leptin, dyslipidemia. This step is a necessary level of scientific and practical significance in the study of the nature of obesity, which is important for practical health care.

At the same time, the issue of studying obesity taking into account ethnic characteristics has not been sufficiently studied, especially among Asians. The ethnicity of the patient is an important link

at the present stage of developing a personalized approach to the treatment and prevention of diseases.

Purpose of the study

Study of the relationship between body mass index (BMI) and indicators of lipid profile, carbohydrate metabolism, leptin, insulin levels in blood serum in the Kazakh population.

Materials and methods

The study was carried out as part of the research work WKSMU named after Marat Ospanov, MRNTI 76.03.39,76.29.37. in accordance with the Declaration of Helsinki of the World Medical Association "Ethical principles of scientific and medical research with human participation" The study was approved by the Local Ethics Committee of the WKSMU named after Marat Ospanov № 17 dated 04.09.2019. The recruitment of patients was carried out by the method of random sampling, taking into account the age and sex composition of the population in public places, on the territory of Aktobe (Western Kazakhstan). Written informed consent was obtained from each participant to conduct the survey. Inclusion criteria: ethnicity - Kazakhs, including grandparents, taking into account three generations; age 18 and over; the patient's ability to participate in the study. Exclusion criteria: a history of endocrine diseases (diabetes mellitus, thyroid and adrenal gland diseases), chronic decompensated diseases of internal organs, pregnancy, lactation. Anthropometric studies included the measurement of height, weight, waist circumference (WC) and hips circumference (HC) of the subject. According to the parameters of height and body weight, the body mass index (BMI) was calculated using the formula: weight (kg)/height in m^2. BMI was assessed according to the WHO classification of overweight and obesity: norm 18.5 - 24.9 kg/m^2; excess weight - 25-29.9 kg/m^2; obesity of the 1st degree - 30-34.9 kg/m^2; obesity of the 2nd degree - 35-39.9 kg/m^2; obesity degree 3 - 40 kg/m^2 or more WC measurements were carried out using a tape measure from a point in the middle between the costal edge and the iliac crest along the mid-axillary line, the results were evaluated in centimeters (cm). Hip circumference (cm) was measured at the widest point around the greater trochanter.

The sample consisted of 159 patients, which was divided into 3 groups according to BMI, which were randomized among themselves by age and gender. Venous blood sampling was performed in the morning on an empty stomach. The leptin content was determined by enzyme-linked immunosorbent assay in blood serum (ng/ml). Lipid status includes determination of total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL), triglycerides (TG). TC was determined by the enzymatic (CHOD-PAP) method (mmol/l). LDL was calculated using the Friedwald formula (using TC, HDL and TG values) (mmol/l). In determining HDL, a homogeneous enzymatic colorimetric test (mmol/l) was used. When assessing the lipid profile data, we were guided by the NCEP/ATPIII Experts'

Recommendations: For hypercholesterolemia, a TC level of ≥ 5.2 mmol/l was taken, a TG level of ≥ 1.7 mmol/l was referred to as hypertriglyceridemia. The atherogenic coefficient (AC) was calculated using the following formula: AC = (TC - HDL): HDL. Fasting glucose and insulin concentrations were determined using a reagent kit. Insulin resistance index (IR HOMA) - was calculated using the formula: IR HOMA = fasting glucose × fasting insulin/22.5.

Statistical data processing. Comparisons of the two groups in terms of numerical indicators were carried out on the basis of the nonparametric Mann-Whitney test. Comparisons of three or more groups on numerical scales were carried out using the nonparametric Kruskal-Wallace method. To describe the quantitative scales, the mean and standard deviation in the form of "M ± S" were used. The statistical significance of different values for binary and nominal indicators was determined using the Pearson Chi-square test in the case of independent samples. Correlation analysis was carried out on the basis of Spearman's nonparametric rank correlation. The level of statistical significance was fixed at the error probability level of 0.05. Statistical data processing was performed using Statistica 10 and SAS JMP 11 software packages.

Results. Table 1 shows the results of statistical analysis comparing the quantitative indicators of the subjects in the three groups according to BMI.

Table 1. Clinical and laboratory characteristics (mean ± standard deviation).

Indicator	Body mass index (BMI) classification			P level (df=2)
	Normal body weight	Excessive body weight	Obesity	
Anthropometry				
Age, years	28.5 ± 8.0	44.2 ± 11.0	40.6 ± 12.8	0.0006
Height, cm	164.6 ± 7.7	165.8 ± 7.8	165.8 ± 9.7	0.8699
Weight, kg	56.7 ± 8.9	75.3 ± 7.3	102.1 ± 17.8	<0.0001
Waist, cm	72.3 ± 6.9	88.4 ± 7.6	106.6 ± 11.4	<0.0001
Hip, cm	92.9 ± 3.3	102.1 ± 4.1	119.4 ± 11.9	<0.0001
Waist/hip index	0.8 ± 0.1	0.9 ± 0.1	0.9 ± 0.1	<0.0001
Waist/height index	0.4 ± 0.0	0.5 ± 0.0	0.6 ± 0.1	<0.0001
Body mass index	20.9 ± 1.8	27.3 ± 1.4	37.2 ± 5.6	<0.0001
Lipid profile				
Cholesterol	4.2 ± 0.7	4.8 ± 0.8	4.9 ± 0.9	0.0392
HDL	1.6 ± 0.3	1.3 ± 0.3	1.2 ± 0.3	0.0003
LDL	2.6 ± 0.8	3.4 ± 0.8	3.3 ± 0.8	0.0227
Triglycerides	0.7 ± 0.3	1.1 ± 0.4	2.0 ± 1.4	<0.0001
Atherogenic index	1.8 ± 0.8	2.9 ± 1.0	3.4 ± 1.1	<0.0001
Hormones				
Leptin	10.6 ± 7.5	18.0 ± 20.5	30.5 ± 24.9	0.0010
Insulin	7.8 ± 5.2	14.2 ± 7.8	23.9 ± 17.1	<0.0001

In the lipid profile, all indicators are statistically significantly different between the three compared groups. The most significant differences were found in HDL in persons with BMI for the norm in relation to BMI with obesity (on average, 0.4; P = 0.0003); atherogenic index in obese individuals in relation to the group with normal BMI (on average by 1.6; P <0.0001); triglycerides

with BMI of the obese group in relation to the group with BMI for the norm (on average by 1.3; P <0.0001).

The level of hormones (insulin, leptin) was statistically significantly different between the three compared groups. The most significant differences were found for the leptin index in obese patients relative to those with normal body weight (on average, 19.9; P = 0.0010); ninsulin concentration in the obese group in relation to the group with normal body weight (on average by 16.1; P <0.0001).

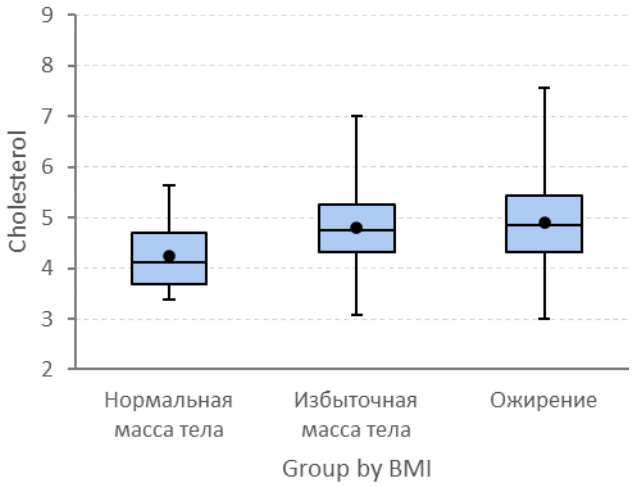

Figure 1: Statistical scores for each BMI value for cholesterol score

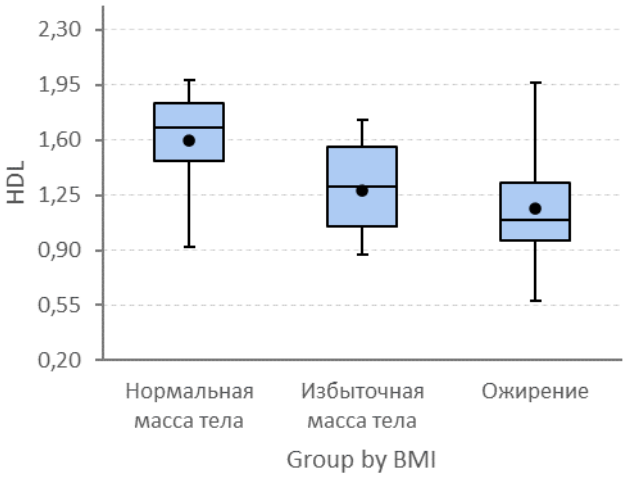

Figure 2.Statistical indicators for each value of BMI for HDL index.

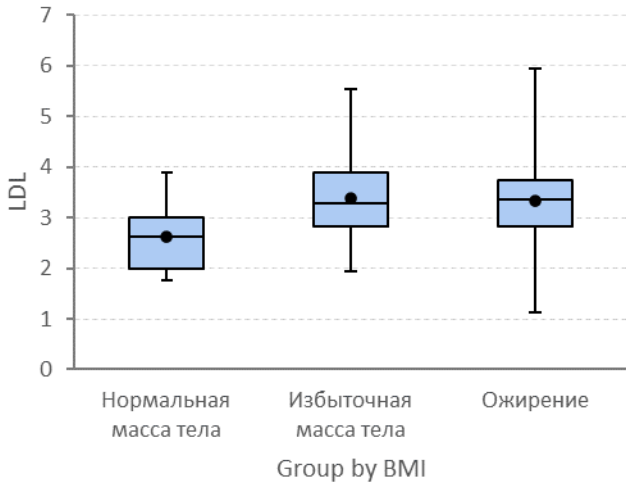

Figure 3. Statistical indicators for each BMI value for LDL score.

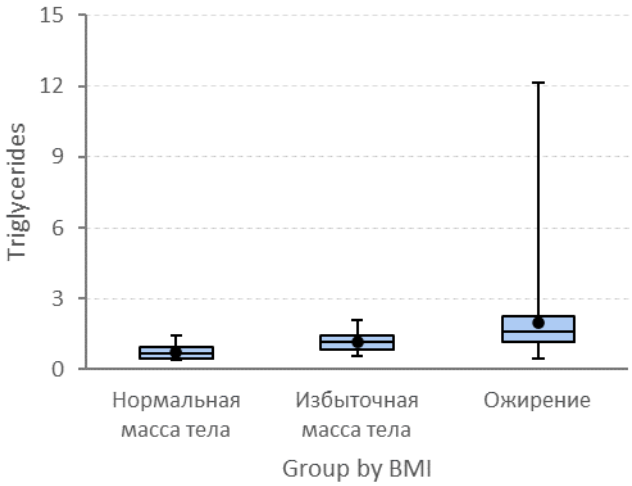

Figure 4. Statistical indicators for each BMI value for Triglycerides.

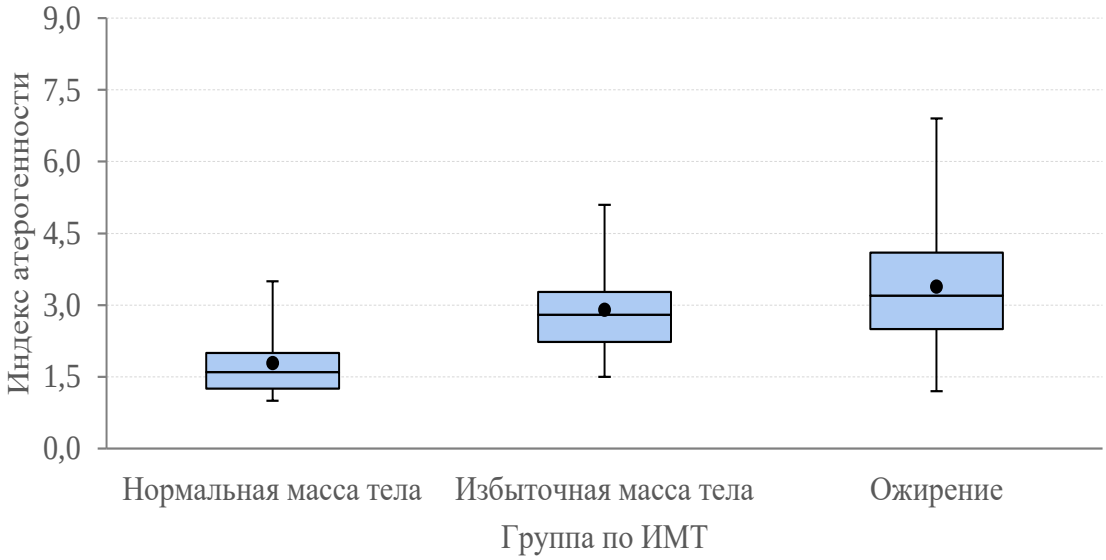

Figure 5. Statistical indicators for each BMI value for the atherogenic index.

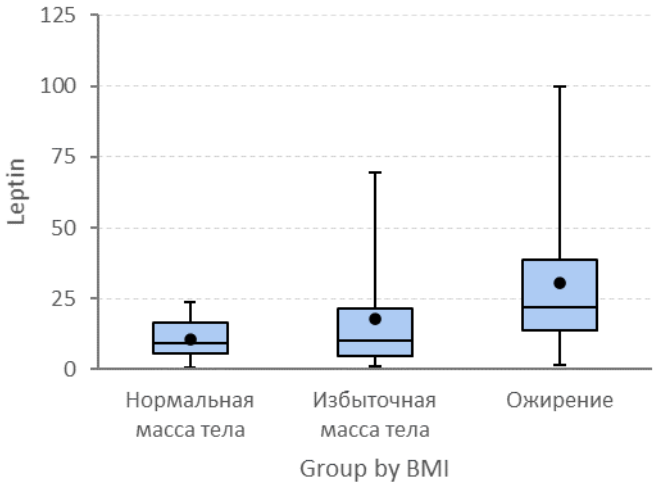

Figure 6. Statistical indicators of BMI for Leptin.

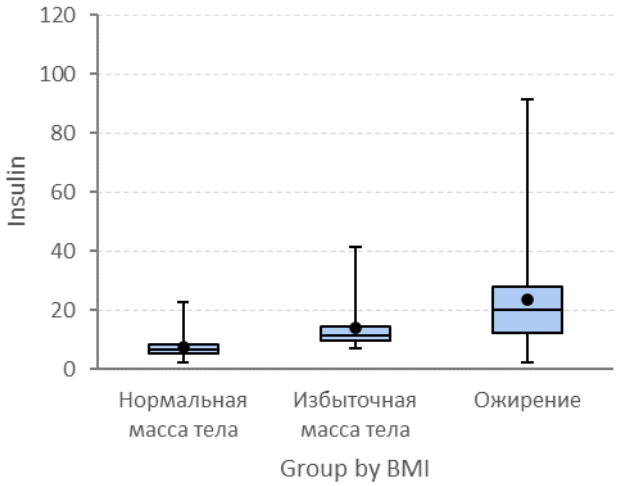

Figure 7. Statistical indicators of BMI indicators for Insulin

Table 2. Mean ± root-mean-square deviations of the carbohydrate spectrum according to BMI.

Indicator	**BMI group**			**P level (df=2)**
	Normal body weight	**Excessive body weight**	**Obesity**	
Carbohydrate spectrum				
Glucose	5.0 ± 0.7	5.5 ± 1.6	6.4 ± 3.1	0.0011
HOMA index	1.8 ± 1.6	3.5 ± 2.2	6.8 ± 6.2	<0.0001
Glycated hemoglobin	5.5 ± 0.4	6.1 ± 1.3	6.2 ± 1.6	0.0960

Based on table 2, figures 8.9, the most significant differences were found for fasting glycemic parameters in the obese group in relation to the group with normal body weight (on average by 1.4; P = 0.0011); HOMA index in the group with BMI more than 30 kg/m^2 in relation to the group with BMI less than 30 kg/m^2 (on average by 5.0; P <0.0001).

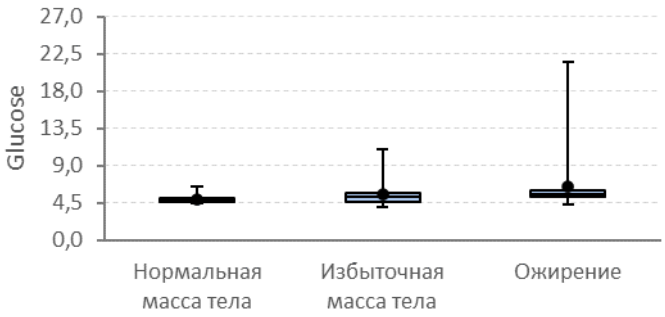

Figure 8. Statistical indicators of BMI for Glucose.

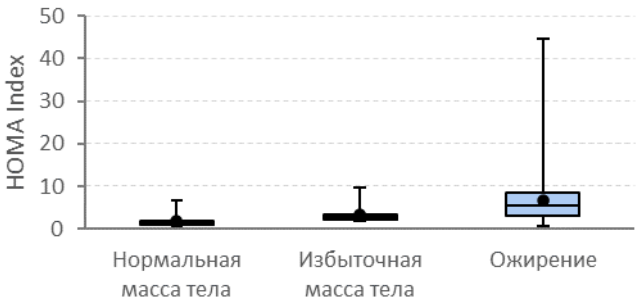

Figure 9. Statistical indicators of BMI for the HOMA index.

Conclusion. The study investigated the relationship of BMI with parameters of lipid and carbohydrate metabolism, including the hormones insulin and leptin in the Kazakh population. An increase in body mass index is associated with hormonal and metabolic risk factors. Adipose tissue is an endocrine organ that secretes a number of biologically active molecules - adipocytokines, including leptin. The imbalance between adipocytokines arising in obesity can lead to the occurrence of lipid and carbohydrate metabolism disorders, an increase in blood pressure and, consequently, to the formation of metabolic syndrome and its components. Adipose tissue is recognized as a source of pro-inflammatory cytokines, which, along with adipokines, contribute to the development of insulin resistance, the progression of obesity, and, finally, to inflammation of adipose tissue [Kulikov D.I. et al., 2013; Ouchi N. et al., 2011; Hirabara S.M. et al., 2012]. The results of the study show that assessing the relationship between leptin and insulin and understanding the possible mechanisms of action can be used in clinical practice to assess the metabolic status of an obese patient. As a biomarker of obesity, leptin reflects the activity of adipocytes and carries information about risk factors for the consequences of obesity and can be used to improve the efficiency of early diagnosis of obesity-associated diseases. In our prospective study, the identification of the relationship of pathogenetic factors of obesity in the Kazakh population showed that the content of leptin and insulin in serum correlates with BMI, the highest rates were observed with a BMI of more than 30 kg/m^2. Leptin relationships need further study as potential markers for improved clinical outcomes in obesity. The data obtained showed associations of BMI with parameters of carbohydrate and lipid metabolism, along with which the HOMA index as an indicator of insulin resistance are important pathogenetic links of obesity.