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ASSESSMENT OF METABOLIC RISK FACTORS IN OBESE CHILDREN

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Abstract.

Obesity represents a severe health threat to children and adolescents, acting as a primary risk factor for conditions such as hyperlipidemia, insulin resistance, hypertension, and impaired glucose tolerance. To better understand the formation of cardiometabolic phenotypes and associated risks, a study was conducted involving 246 children aged 7 to 18 years. The participants were divided into a main group of 156 overweight and obese children and a control group of 90 normal-weight children based on their body mass index standard deviation (BMI Z-score). Biochemical analyses revealed significant pathological changes in the lipid and carbohydrate metabolism of the overweight and obese group. Specifically, elevated levels of triglycerides and total cholesterol were observed in 25% and 34.62% of these children, respectively, while protective high-density lipoproteins (HDL) decreased in 23.94% of the patients. Furthermore, 12.18% of the main group exhibited pathologically high basal blood glucose levels, and a significantly higher HOMA-IR index confirmed the early development of insulin resistance. The study also established a direct positive correlation between lipid profile disruptions and anthropometric indicators like BMI, overall body weight, and waist circumference. Ultimately, 71.8% of the examined overweight and obese children were found to possess at least one cardiovascular disease risk factor, classifying them within the "metabolically unhealthy obesity" phenotype. These findings highlight that early detection of such metabolic changes in overweight children is crucial for predicting the individual risk of future cardiometabolic complications and implementing timely medical interventions.

Keywords: *obesity, children, metabolic risk factors, lipid metabolism, carbohydrate metabolism, insulin resistance, HOMA-IR, body mass index.*

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Introduction

Obesity is a problem that poses a serious threat to the health of children and adolescents, and is the main and earliest risk factor for morbidity and mortality among adults. The direct impact of obesity on health is manifested in conditions such as hyperlipidemia, insulin resistance, hypertension, and impaired glucose tolerance [1,3,6]. Despite the publication of numerous scientific studies, the patterns of cardiometabolic phenotype formation and their associated risk factors in obese children and adolescents are still insufficiently studied. This situation prevents the full identification of patients with high metabolic risk [2,4]. Therefore, an in-depth study of lipid and carbohydrate metabolism indicators in overweight children, as well as individual forecasting of the risk of complications, is one of the most important directions of modern pediatrics [5].

Aim of the study To evaluate changes in carbohydrate and lipid metabolism in overweight and obese children, determine the level of insulin resistance, and study their pathological relationship with anthropometric indicators.

Materials and Methods

A total of 246 children aged 7-18 years were examined within the framework of the study. Patients were divided into groups based on WHO criteria according to the standard deviation of body mass index (BMI Z-score/SDS). The main group included 156 children with overweight (Z-score $>+1$) and obesity (Z-score $>+2$), and the control group included 90 children with normal weight. The degree of puberty in adolescents was assessed according to the Tanner scale. Biochemical testing methods were used to assess metabolic changes; serum triglycerides (TG), high-density lipoproteins (HDL), low-density lipoproteins (LDL), total cholesterol (TC), as well as basal blood glucose and insulin levels were examined, and insulin resistance was calculated using the HOMA-IR index. In addition, the amounts of total protein and uric acid were analyzed. The obtained data were statistically processed using SPSS 23.0 software, applying Student's t-test as well as Pearson and Spearman correlation analyses.

Results and Discussion

The obtained results showed that TG levels significantly increased in 25% of children in the main group (4.44% in the control group; $p<0.01$) and total cholesterol levels in 34.62% (8.89% in the control group; $p<0.001$). At the same time, a decrease in the level of HDL, which acts as an antiatherogenic defense, was observed in 23.94%

of overweight and obese children ($p<0.001$). Carbohydrate metabolism analyses showed that basal blood glucose levels were pathologically high in 12.18% of the main group, while the HOMA-IR index was significantly higher in obese children compared to the control group, confirming the early formation of insulin resistance. Furthermore, the mean uric acid level in the main group was $314.26\pm 62.37 \mu\text{mol/L}$, which was found to be higher than in normal-weight children ($p<0.05$).

Correlation analyses revealed that in boys, TG levels positively correlated with body mass index ($r=0.35$), obesity degree (Z-score) ($r=0.39$), and body weight, whereas in girls, it positively correlated with waist circumference ($r=0.24$). In girls, the total cholesterol level showed a positive correlation with body weight ($r=0.33$), waist circumference ($r=0.30$), and BMI ($r=0.25$). Overall, it was confirmed that 71.8% of the examined overweight and obese children had at least one cardiovascular disease risk factor, and they were classified into the "metabolically unhealthy obesity" phenotype.

Conclusion

Significant pathological changes in lipid and carbohydrate metabolism are observed in overweight and obese children, with a notable increase in blood glucose, HOMA-IR index, triglycerides, and total cholesterol levels. These conditions sharply increase the risk of early development of cardiometabolic diseases and metabolic syndrome.

The increase in BMI (Z-score) and waist circumference is directly associated with cardiometabolic risk, and early detection of metabolic phenotypes in children allows for individual forecasting of the risk of future complications and the determination of timely intervention measures.

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