



Diagnostic significance of the HOMA-IR index in patients with obesity

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Abstract. Obesity is one of the leading medical and social problems of our time, accompanied by an increased risk of developing metabolic and cardiovascular diseases. One of the key pathophysiological mechanisms of metabolic disorders in obesity is insulin resistance, the timely detection of which is of great importance for early diagnosis and prevention of complications. The HOMA-IR index is an accessible calculated indicator that is widely used to assess tissue sensitivity to insulin. The aim of the study was to conduct a comparative analysis of the HOMA-IR index and carbohydrate metabolism indicators in patients with diabetes mellitus and in patients with diabetes mellitus combined with obesity, compared with practically healthy individuals. A statistically significant increase in the HOMA-IR index was established in patients with diabetes mellitus compared with practically healthy individuals, and the most pronounced changes were observed in patients with a combination of diabetes mellitus and obesity. A similar trend was established regarding carbohydrate metabolism indicators. Further study of HOMA-IR in patients with obesity and diabetes mellitus may contribute to improving the early diagnosis of insulin resistance, assessment of metabolic risk, and optimization of individualized preventive and therapeutic measures.

Keywords: obesity; insulin resistance; glucose; risk; insulin; metabolic disorders.

Introduction

Obesity is a chronic multifactorial disease characterized by excessive accumulation of adipose tissue in the body and accompanied by significant metabolic disturbances. In the modern world, the prevalence of obesity is steadily increasing, making it one of the leading public health problems. The importance of this pathology is determined not only by aesthetic aspects, but primarily by the high risk of developing severe complications such as type 2 diabetes mellitus,

atherosclerosis, ischemic heart disease, and arterial hypertension [1, 2].

A key pathophysiological mechanism that links obesity with the above conditions is insulin resistance-reduced sensitivity of peripheral tissues to insulin. This leads to compensatory hyperinsulinemia, which at early stages may maintain normal glycemia, but over time exhausts pancreatic β -cells and contributes to the development of disorders of carbohydrate metabolism [3].

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The HOMA-IR (Homeostasis Model Assessment of Insulin Resistance) index is one of the most widely used and informative methods for assessing insulin resistance in clinical practice and research studies. Insulin resistance is considered a key pathogenetic mechanism in the development of obesity, metabolic syndrome, type 2 diabetes mellitus, and cardiovascular diseases. Under current conditions, with the increasing prevalence of obesity, the problem of early detection of metabolic disturbances has become especially relevant [4].

The HOMA-IR index is based on measuring fasting glucose and insulin levels and allows evaluating the degree of tissue sensitivity to insulin. Advantages of this method include simplicity of performance, availability, and high information value, which makes it convenient for screening studies and for assessing the risk of endocrine and metabolic disorders.

An increase in the HOMA-IR value indicates a decrease in insulin sensitivity of peripheral tissues and is associated with the progression of disturbances in carbohydrate and lipid metabolism. It has been established that insulin resistance is an important factor in the development of obesity complications, including arterial hypertension, atherosclerosis, and type 2 diabetes mellitus [5, 6].

Thus, determining the HOMA-IR index has important diagnostic and prognostic significance in patients with obesity, allowing timely detection of metabolic changes and implementation of prevention strategies for severe complications.

In clinical practice, early detection of insulin resistance is of crucial importance, as it enables timely initiation of preventive and therapeutic interventions. One of the most common indirect methods for evaluating it is the HOMA-IR index (Homeostasis Model Assessment of Insulin Resistance), which is based on measuring fasting glucose and insulin levels. The simplicity of calculation and sufficient informativeness have made this index widely used both in scientific studies and in routine clinical practice [7, 8].

HOMA-IR allows a quantitative assessment of the degree of insulin resistance and identification of patients with elevated metabolic risk even before the appearance of clinical manifestations of type 2 diabetes.

This is especially relevant for individuals with obesity, in whom significant disorders of insulin metabolism may already exist even when glucose levels remain relatively stable [9].

Therefore, studying the diagnostic value of the HOMA-IR index in patients with obesity is an important direction of modern endocrinology, contributing to early diagnosis of metabolic disorders, assessment of the risk of developing type 2 diabetes mellitus, and development of effective preventive strategies [10].

The aim of the study: to conduct a comparative analysis of the level of the HOMA-IR index and glucose in patients with obesity and without obesity.

Materials and Methods

Sixty patients who underwent outpatient treatment were examined. Specifically, 20 were practically healthy (control group), 20 were patients with diabetes mellitus (Group 1), and the remaining 20 were patients with diabetes mellitus in combination with obesity (Group 2). The mean age of patients was (50 ± 3) years.

The HOMA-IR index was calculated using the following formula:

$$\text{HOMA-IR} = (\text{fasting glucose, mmol/L} \times \text{fasting insulin, } \mu\text{IU/mL}) / 22.5.$$

The obtained index allows assessing the degree of insulin resistance. In most studies, values of HOMA-IR above 2.5–2.7 are considered evidence of decreased tissue sensitivity to insulin; however, reference ranges may differ depending on age, sex, and characteristics of the studied population.

The HOMA-IR method is an available, non-invasive, and informative way to detect metabolic disturbances at an early stage in patients with obesity.

Statistical processing of the obtained results was performed using methods of mathematical statistics with the STATISTICA 8.0 software package (StatSoft, USA).

The results are presented as the mean value and standard deviation. Differences were considered statistically significant at $p < 0.05$.

Results

When analyzing the obtained laboratory blood test results, significant differences in the indicators of different groups were revealed (Table).

Table. Indicators of the HOMA-IR index and glucose in the patients of the studied groups

Study Groups		
Control group (n=20)	Group 1 (n=20)	Group 2 (n=20)
HOMA-IR Index		
25,4±0,35	26,3±0,44*	40,1±0,46*#
Glucose mmol/L		
4,1±0,11	6,8±0,54*	7,5±0,25*#

Notes: 1. * – significance of differences compared to the control group ($p < 0.05$);

2. # – significance of differences compared to Group 1 ($p < 0.05$).

Comparative analysis of the HOMA-IR index showed a significant increase in the studied groups compared to the control group. In particular, in patients of Group 1, the HOMA-IR index was 3.5 % higher than in the control group (26.3 ± 0.44 vs. 25.4 ± 0.35 ; $p < 0.05$). In patients of Group 2, this indicator exceeded the control group values by 57.9 % (40.1 ± 0.46 vs. 25.4 ± 0.35 ; $p < 0.05$) and was 52.5 % higher compared to Group 1 ($p < 0.05$) (Fig. 1).

Analysis of blood glucose levels also confirmed significant metabolic disturbances in the patients of the studied groups. Thus, in Group 1, glucose levels were 65.9 % higher than in the control group (6.8 ± 0.54 mmol/L vs. 4.1 ± 0.11 mmol/L; $p < 0.05$). In patients of Group 2, glucose concentration exceeded the control group values by 82.9 % (7.5 ± 0.25 mmol/L vs. 4.1 ± 0.11

mmol/L; $p < 0.05$) and was 10.3 % higher than in Group 1 ($p < 0.05$) (Fig. 2).

The obtained results indicate a pronounced increase in insulin resistance and carbohydrate metabolism disorders in patients with obesity, especially in the presence of concomitant metabolic changes.

Discussion

Analysis of the relationship between HOMA-IR index and blood glucose levels revealed a pronounced positive correlation. As the HOMA-IR index increased, there was a proportional rise in glucose concentration, indicating a close association between the degree of insulin resistance and carbohydrate metabolism disorders.

The obtained data allow us to suggest that the intensification of insulin resistance is accompanied

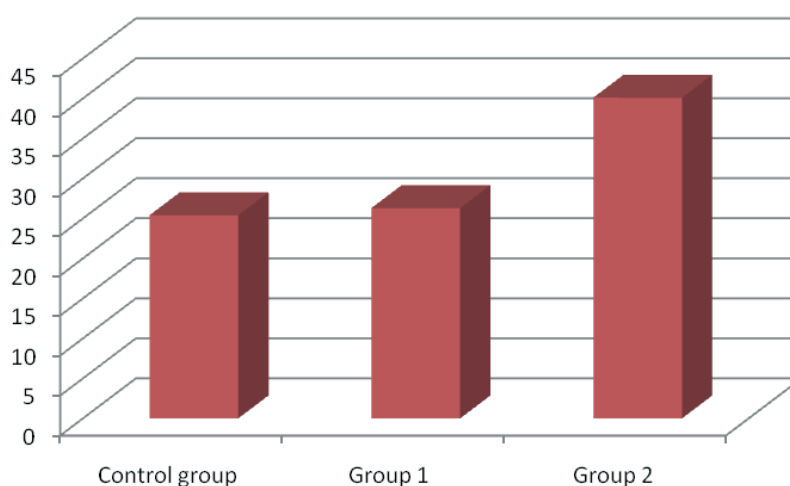


Fig. 1. Changes in the HOMA-IR index level in the blood of the studied groups.

Notes: 1. Significance of differences compared to the control group ($p < 0.05$);
2. Significance of differences compared to Group 1 ($p < 0.05$).

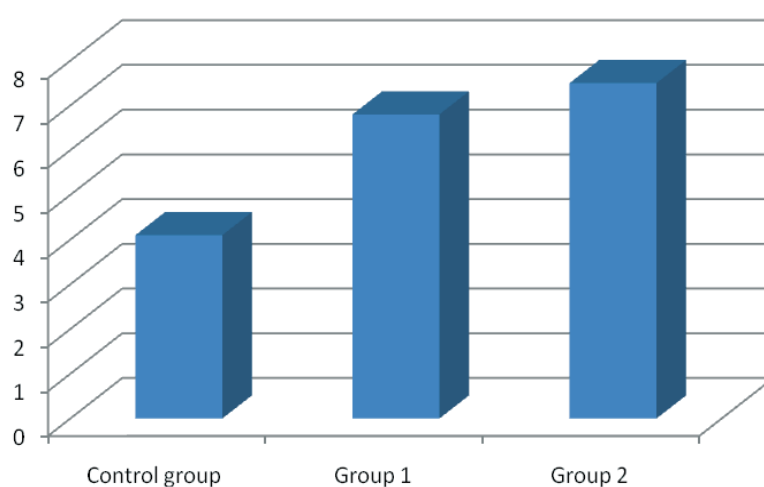


Fig. 2. Changes in blood glucose levels in the studied groups.

Notes: 1. Significance of differences compared to the control group ($p < 0.05$);
2. Significance of differences compared to Group 1 ($p < 0.05$).

by a progressive decrease in the efficiency of glucose utilization by tissues, clinically manifested as hyperglycemia. The strongest correlation was observed in patients of Group 2, which may indicate deeper metabolic disturbances in this cohort.

Thus, the HOMA-IR index can be considered not only as a separate diagnostic indicator of insulin resistance but also as a marker closely associated with glycemia levels, reflecting the overall degree of metabolic dysfunction in patients with obesity.

Conclusions

1. The results of the study indicate pronounced disturbances of carbohydrate metabolism and increased insulin resistance in patients with obesity. A significant increase in the HOMA-IR index and blood glucose levels was established in the studied groups compared to the control group. The most significant changes were observed in patients of patients with diabetes mellitus in combination with obesity, indicating progression of

metabolic disorders and reduced tissue sensitivity to insulin.

2. The increase in HOMA-IR values was accompanied by elevated blood glucose concentration, confirming a close relationship between insulin resistance and carbohydrate metabolism disorders. The data indicate high diagnostic informativeness of the HOMA-IR index in patients with obesity and the advisability of its use for early detection of metabolic changes and assessment of the risk of developing type 2 diabetes and other complications.

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Conflict of interest

The authors declare no conflict of interest.

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Діагностична значущість індексу НОМА-ІР у пацієнтів з ожирінням

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Анотація. Ожиріння є однією з провідних медико-соціальних проблем сучасності, що супроводжується підвищеним ризиком розвитку метаболічних та серцево-судинних захворювань. Одним із ключових патофізіологічних механізмів метаболічних порушень при ожирінні є інсулінорезистентність, своєчасне виявлення якої має важливе значення для ранньої діагностики та профілактики ускладнень. Індекс HOMA-IR є доступним розрахунковим показником, який широко використовується для оцінки чутливості тканин до інсуліну. Метою дослідження було провести порівняльний аналіз індексу HOMA-IR та показників вуглеводного обміну в пацієнтів із цукровим діабетом та у хворих на цукровий діабет, поєднаний з ожирінням, порівняно з практично здоровими особами. Встановлено статистично значуще підвищення індексу HOMA-IR у пацієнтів із цукровим діабетом, порівняно з практично здоровими особами, а найвираженіші зміни спостерігалися у хворих із поєднанням цукрового діабету та ожиріння. Аналогічна тенденція встановлена щодо показників вуглеводного обміну. Подальше вивчення HOMA-IR у пацієнтів з ожирінням та цукровим діабетом може сприяти вдосконаленню ранньої діагностики інсулінорезистентності, оцінці метаболічного ризику та оптимізації індивідуалізованих профілактичних і лікувальних заходів.

Ключові слова: ожиріння; інсулінорезистентність; глюкоза; ризик; інсулін; метаболічні порушення.