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CORRELATION BETWEEN BODY MASS INDEX AND HOMA INDEX IN BARIATRIC PATIENTS

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Abstract

Background and aims: *Overweight and obese individuals are prone to an insulin resistance status assessed in the present study by the HOMA index ("Homeostasis model assessment"). This prospective study assessed the body mass index (BMI) and the insulin resistance status (HOMA index) in obese patients after bariatric surgery (gastric sleeve, gastric by-pass).* ***Material and Methods:*** *The study included 48 patients who were assessed before the bariatric surgery and at 6 months thereafter. The assessment included the body mass index (BMI) and the HOMA index before meal.* ***Results:*** *There was a significant positive correlation between BMI and HOMA index, mostly between weight loss and improvement in insulin resistance status (rho = 0.308, p = 0.0335).* ***Conclusions:*** *BMI decreases significantly after bariatric surgery, which correlates positively with an improvement in insulin resistance status.*

key words: *obesity, bariatric surgery, body mass index (BMI), HOMA index.*

Background and aims

Obesity is a multiple factor polygenic disease characterized by a mixed disorder of metabolic processes of the organism with a change in its energy balance. The excess of adipose tissue gradually causes alterations in the metabolism regulation process, consequently with the occurrence of various comorbidities. The American Association of Clinical Endocrinology and the American College of Endocrinology has proposed a new name for obesity in 2016, namely Adiposity-Based Chronic Disease. This name does not replace the term of "obesity", but it helps the doctor, regardless of specialty, to focus more upon the physiopathological implications of overweight [1] Excessive body weight increases the risk of insulin resistance status and chronic conditions such as type 2 diabetes, dyslipidemic syndrome, high blood pressure, ischemic disease or obstructive sleep apnea syndrome [2].

Currently, the weight of a person is most frequently evaluated by body mass index (BMI). [3] This index is a statistical measure based on the weight and height of a person, ie the ratio of G and h^2 (kg /m^2), where G represents the weight (measured in kilograms) and h – the height (in

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meters). Although several versions of obesity classification are accepted, the most commonly used is the one proposed by the World Health Organization (WHO) which evaluates the BMI, as follows; Underweight: BMI <18.5 kg/m^2, low risk of comorbidities associated with obesity; Normal weight: IMC = 18.5-24.9 kg/m^2; Overweight: IMC = 25-29.9 kg/m^2, mildly increased comorbidity risk associated with obesity; Obesity Class I: BMI = 30-34.9 kg/m^2, moderately increased comorbidity risk; Obesity Class II: BMI = 35-39.9 kg/m^2, increased comorbidity risk; Obesity Class III or morbid obesity: BMI> 40 kg/m^2, very high comorbidity risk. A BMI between 40 and 50 kg/m^2 defines morbid obesity and a BMI of over 50 kg/m^2 - the super obese category of individuals. The cut-off threshold of each class of obesity varies according to ethnicity.

HOMA index

The main method for assessing insulin resistance is called "euglycemic clamp" which establishes a certain amount of ingested glucose after which the basal level of blood sugar remains constant meanwhile the blood insulin maintains at a constantly increased level. Depending on the insulin sensitivity status, the amount of ingested glucose will show variations from one individual to another [4]. However, the method is accessible only in specialized centers, being laborious and time-consuming, therefore simpler alternative methods have been proposed over time, including the HOMA index [5]. Matthews et al. describe in 1985 the HOMA index ("Homeostasis model assessment") based on the assumption that insulin blood levels and blood sugar levels before meal with or without normal glucose tolerance are set at a specific level of their own organism. Therefore, under basal conditions, the relationship between glucose and insulin serum levels reflects the balance between liver glucose synthesis and insulin secretion of β pancreatic cells, maintained through a feed-back loop established between the liver and β cells. Both insulin resistance and the insufficiency of insulin secretion response have an equivalent impact on hepatic glucose synthesis, which is why high blood sugar levels can be assumed to be the result of the association between the functional deficiency of pancreatic β cells and insulin resistance.

The foretaste described by the HOMA mathematic calculation model have at their basis data obtained from experimental studies on human and animals. HOMA1, the initial model, was calibrated to give a normal 100% pancreatic cell function and a normal insulin resistance of 1. Increased insulin resistance associates increased basal blood insulin level and suboptimal secretion of pancreatic β cells by increasing blood sugar levels. Considering this glucose-insulin interrelation, any pair of basal sugar and insulin blood levels can be used to quantify insulin resistance (HOMA1-IR) and pancreatic β cell function (β HOMA1-% B) using the following formula:

HOMA1-IR = (IB (μU / L) x GB (mmol / L)) / 22.5, where IB represents basal blood insulin levels before meal, and GB basal glycemia before meal. For basal blood glucose in mg/dL, the denominator is 405.

A very tight correlation (r = -0.820) was found between insulin sensitivity, estimated by the “euglycemic clamp” test, and the one estimated by HOMA index in a study of 115 male and female European individuals, young and elderly, obese and norm normal weight, diabetic and non-diabetic, with and without high blood pressure [5] and also in a study of 55 Japanese subjects with type 2 diabetes before and after diet and exercise (r = -0.613 and r = -0.734) [6].

Following some recent studies, the HOMA index is considered a lab test which has a predictive value in the cardiovascular risk [7] Furthermore, detection of insulin resistance in non-diabetic subjects through the HOMA index was associated with an increased risk of stroke [8].

The HOMA index is recommended to be determined in the following conditions: assessment of patients with BMI> 28 kg/m^2; suspicion of insulin resistance (metabolic syndrome, type 2 diabetes); polycystic ovary syndrome [8]. The method used in our study is by calculating the HOMA1 index according to the formula HOMA-IR = (insulin (μU / mL) x glycemia (mg / dL) / 405. For determination of serum insulin, the chemiluminescence detection method (CLIA) was used, and as for glycemia, the spectrophotometric method [9].

HOMA index reference values [10]:

– < 2: normal;
– 2: possible resistance to insulin;
– 2.5: increased probability of insulin resistance;
– 5: the mean value in diabetes.

Material and method

This clinical trial was conducted over a period of 1 year and 9 months, from January 2017 to September 2018, at the Laboratory Department of Bethany Medical Clinic Oradea over the patients operated at MedLife Genesys Hyperclinic Arad, Bariatric Surgery Department.

Study design and patients

The laboratory blood tests for the group of patients included in the study were performed in Oradea at Bethany Private Medical Center. The eligible patients for the study were the overweight and obese individuals evaluated in order to receive a bariatric treatment. The selection algorithm for the eligible patients is shown in Figure 1 flowchart.

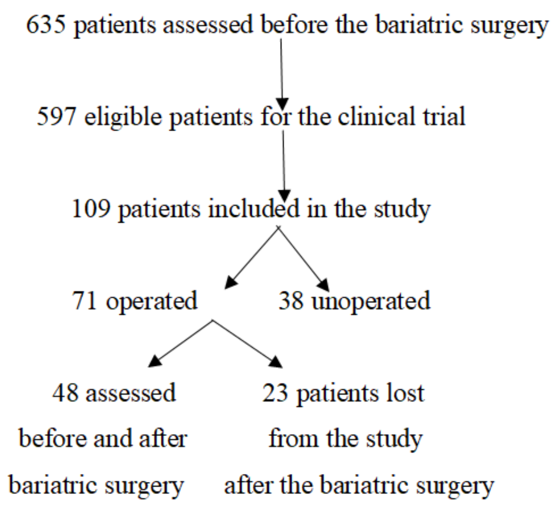

Figure 1. *The selection algorithm of eligible patients.*

Laboratory, anthropometric and clinical data collection

The patients enrolled in the study were assessed before the bariatric surgery and at 6 months thereafter. The evaluation included the following: weight, height, body mass index (BMI), abdominal circumference, family history of overweight/obesity, comorbidities, insulin, glucose and HOMA indexes before meal.

Statistical analysis

The categorical variables were described by absolute numbers and percentages in brackets, and for their comparison the chi-square test with or without Yates' correction was used. The continuous variables were checked using the Kolmogorow-Smirnoff test for normal or asymmetric distribution and according to the result of this test, they were described by median and 25-75 percentile in brackets, namely arithmetic mean and standard deviation in brackets. In terms of followed trend in time, comparison of mean values was performed using the Student pair test for normal distribution variables and the Wilcoxon test for those with asymmetric distribution. The study of the correlation between the variables was done using the Spearmann (rho) test. The statistical significance limit was 0.05.

Results

Distribution by gender

Of the 109 patients enrolled in the study, 83 (76.1%) were female and 26 (23.9%) male (p <0.0001, chi-square test).

If we only consider the patients who came for the postoperative assessment to follow the evolution of study parameters, the ratio becomes even more unequal: out of a total of 48 patients, 41 (85.4%) were women and only 7 (14.6 %) were men (p <0.0001, chi-square test).

By comparing these data with the gender distribution in the group that didn't show up at the postoperative assessment, we obtain the following data:

Table 1.

Gender	Lost group (n=61)	Enrolled group (n=48)
Female nr. (%)	42 (68,9)	41 (85,4)
Male nr. (%)	19 (31,1)	7 (14,6)

There is a higher ratio in women among controls, but the difference does not reach the statistical significance threshold (p = 0.0738, Yates correction).

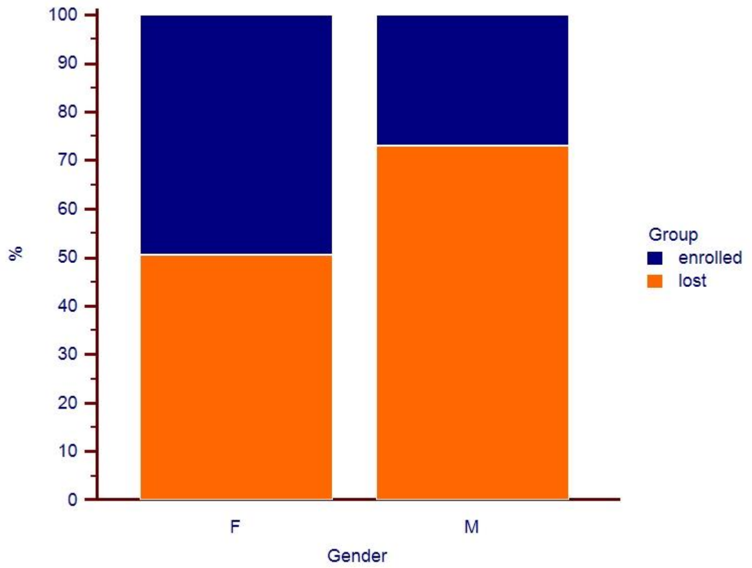

Figure 2. *Distribution of the lost group and the enrolled group by gender (percentage%). M = male, F = female*

BMI and comparative pre- and postoperative mean abdominal circumference

By comparing the body mass index before and after bariatric surgery reflects the effectiveness of this treatment in weight loss. Thus, the BMI mean value before surgery was 41.9 (± 8.6) and after surgery 30.5 (± 5.6), meaning a statistically significant decrease (p <0,0001, student test for dependent groups).

The decrease in abdominal circumference reflects the same thing. These data are shown in Figure 3 and the following table:

Table 2.

	Before surgery (n=48)	After surgery (n=48)	Statistic significance (p)
BMI (kg/m^2) – mean value (DS)	41,9 (±8,6)	30,5 (±5,6)	p<0,0001
Abdominal circumference (cm) – mean value (cm)	123,5 (±18,8)	96,5 (±15,4)	p<0,0001

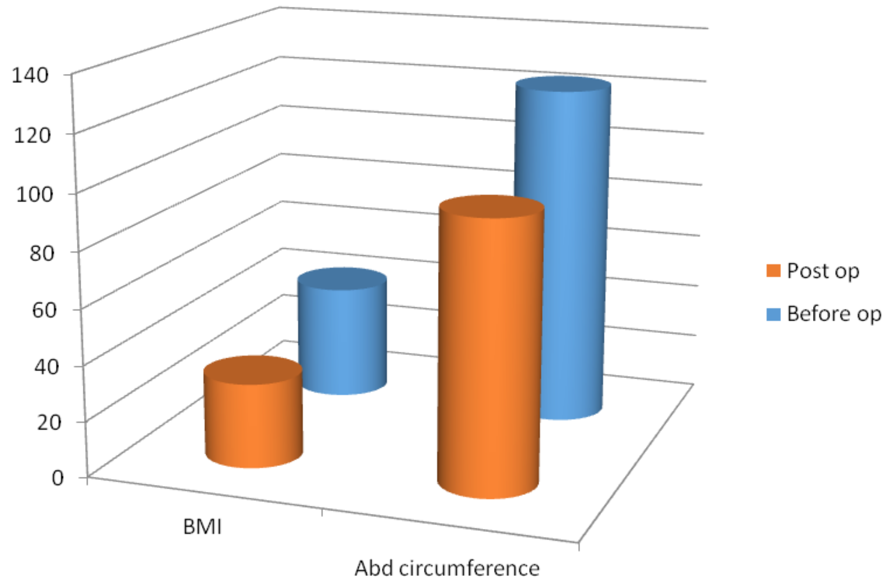

Figure 3. *The trend in BMI (IMC) and abdominal circumference after bariatric surgery (mean values)*

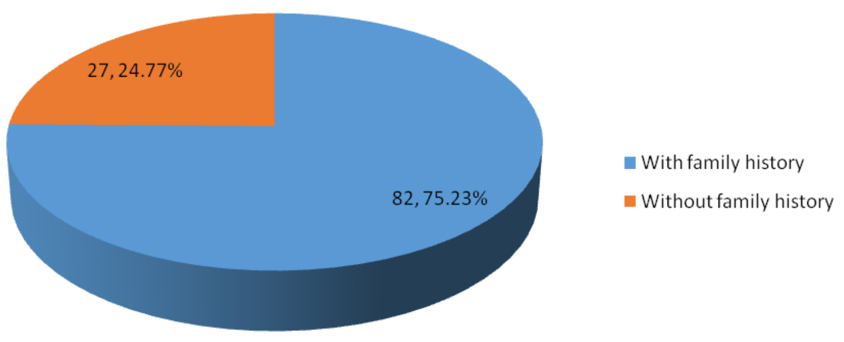

Figure 4. Incidence of obese relatives in the preoperative group

The incidence of obesity relatives in the preoperative group

Over 75% of the patients enrolled in the study had obese relatives. The difference is statistically significant: p <0.0001, chi-square test (Figure 4).

HOMA 1 and HOMA 2 pre- and postoperative indexes

The geometrical mean values for the two pre- and postoperative risk scores are shown in the following table:

Table 3.

Index	Preoperative (n=48)	Postoperative (n=48)	Statistic significance (p)
HOMA 1 – Geometrical mean value (IC 95%)	4,3 (3,2-5,6)	1,2 (1,0-1,5)	<0,0001
HOMA 2 – geometrical mean value (IC95%)	2,3 (1,8-3,0)	0,76 (0,65-0,85)	<0,0001

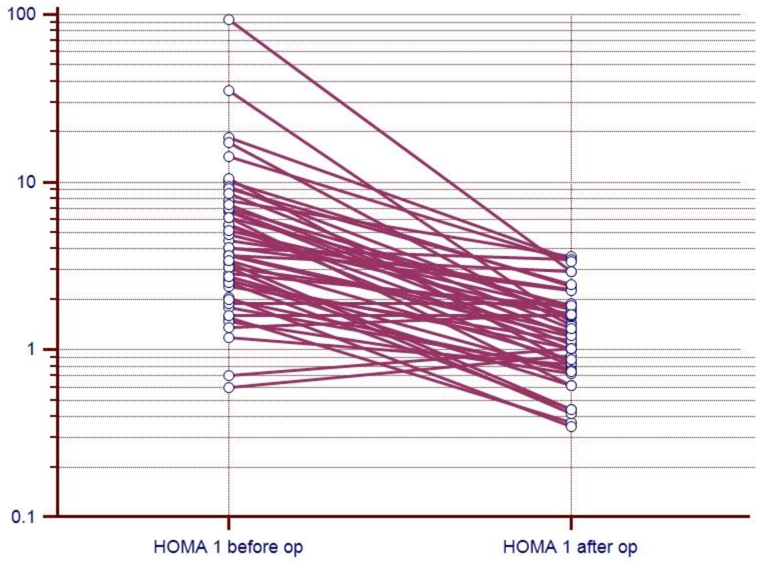

Figure 5. *The trend in HOMA 1 index values. (before and after bariatric surgery)*

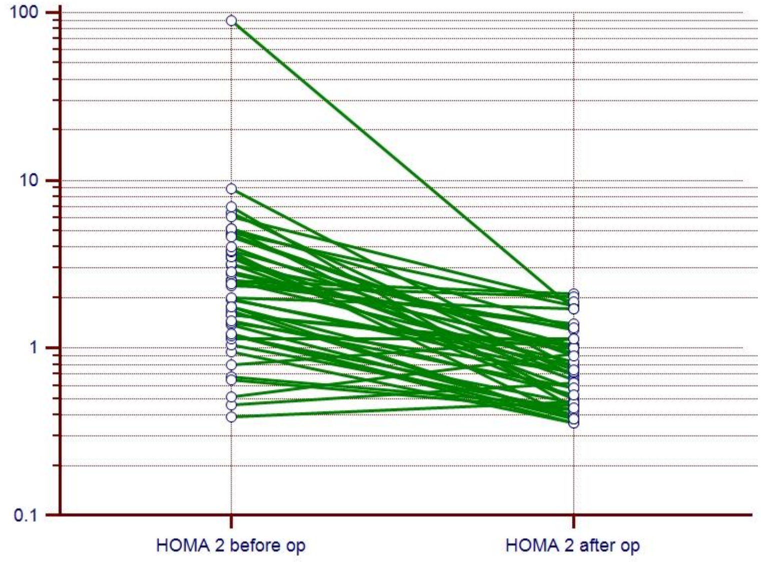

Figure 6. *The trend in HOMA 2 index values. (before and after bariatric surgery).*

After studying the results shown in this table the decrease of HOMA values after bariatric surgery becomes obvious. The graphic representation in Figure 5 and Figure 6 further emphasizes these differences:

The link between BMI and HOMA 1 index

There is a significant positive correlation between the decrease of the BMI and the decrease of the HOMA 1 index. This trend can also be noticed in the Figure 7 chart, which has each case distributed on X-axis and Y-axis depending on the changes of these two variables:

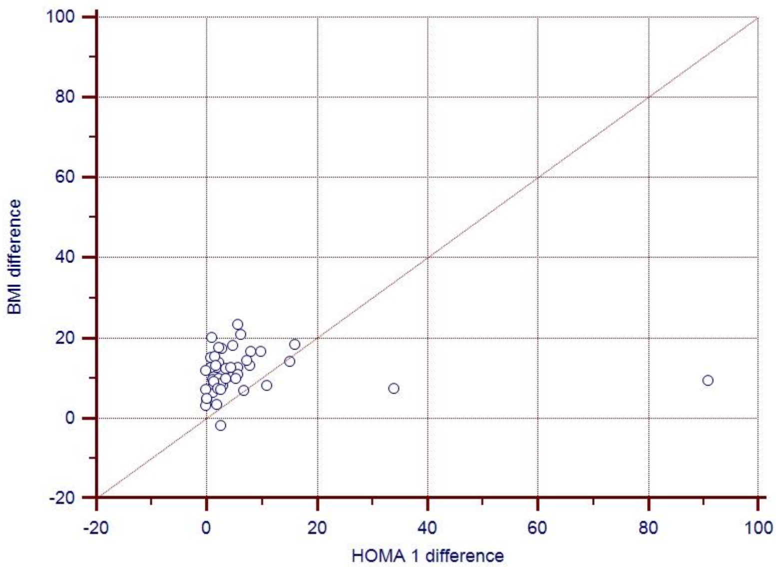

Figure 7. *Case distribution based on the decreasing BMI and postoperative HOMA 1 index.*

Discussion

There are contradictory results regarding the correlation between insulin resistance expressed by the HOMA1 index and BMI (body mass index) among morbid obese patients: some have demonstrated a linear relationship, others have failed to emphasize a positive correlation before the surgery [11]. Other contradictory results arose when attempting to demonstrate a positive correlation between the decreased HOMA1 index (and also in the improvement in insulin sensitivity) and the weight loss after bariatric surgery [12,13]. Our results confirm the positive correlation of insulin resistance, both preoperative with BMI as absolute values, and the close correlation between the decrease in the HOMA1 index and the decrease in body weight following bariatric surgery in the study group.

Conclusions

The Body Mass Index (BMI) is effectively and consistently reduced after bariatric surgery, a treatment option that favors women. Also, the insulin resistance status is improved by this surgical method. Based on this study, the results recorded a significant positive correlation between the weight loss assessed by BMI and the improvement in insulin resistance status, which was a decrease in the HOMA index.

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Duality of interest – no conflicts of interest.

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