# ANALYSIS OF THE TRIGLYCERIDE-GLUCOSE (TYG) INDEX IN RELATION TO THE HOMEOSTATIC MODEL ASSESSMENT (HOMA-IR) IN CARDIAC BYPASS PATIENTS WITH METABOLIC RISK FACTORS

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**Abstract:** Insulin resistance (IR) plays a central role in the development of both diabetes and cardiovascular diseases. The Triglyceride-Glucose (TyG) index has emerged as a promising alternative to the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) for determining insulin sensitivity.
The primary aim of this study was to evaluate the predictive value of the TyG index compared to HOMA-IR in cardiac surgery patients presenting with metabolic risk factors.
Between February and October 2025, 170 cardiac bypass surgeries were performed on patients with metabolic risk factors at the Zan Mitrev Clinic. Preoperative fasting insulin, blood glucose, and triglyceride levels were determined for all patients. These values were used to calculate the insulin resistance indices: the Triglyceride-Glucose (TyG) index and the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR). The values of these indices were compared with the postoperative course and surgical outcomes.
The mean TyG index value among the patients was 9.07, while the mean HOMA-IR value was 3.23. The analysis of the postoperative outcomes demonstrated that HOMA-IR is a more robust and superior predictor of postoperative complications compared to the TyG index. Patients with a HOMA-IR score above 2.5 exhibited the highest atrial fibrillation frequency (n=41) and neurological deficits (n=16). The TyG index showed relatively uniform and low predictive power across all groups; this was further confirmed by linear regression ($R^2$=0.180), suggesting that 82% of its variability is independent of insulin resistance. Furthermore, ROC analysis indicated that the TyG index and HOMA-IR measure significantly different metabolic risk aspects.
The HOMA-IR index is clinically superior in predicting the early postoperative course in cardiac surgery patients. The low efficacy of the TyG index is likely a consequence of widespread statin therapy among these patients. Statins may mask the true metabolic risk by artificially lowering triglyceride levels, thus making HOMA-IR a more reliable diagnostic choice for perioperative assessment.
**Keywords:** insulin resistance, HOMA-IR index, TyG index, cardiac bypass patients, metabolic risk factors

## 1. INTRODUCTION

Cardiovascular diseases (CVD) represent the leading cause of morbidity and mortality worldwide, posing significant public health challenges and a substantial economic burden for patients [1]. Therefore, identifying individuals with early exposure to CVD risk is of paramount clinical importance for improving risk stratification and therapeutic management [2].
In practice, clinicians can assess insulin resistance (IR) using markers such as the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), a reliable method utilized in both research and routine practice [3]. Recently, simpler and more universally applicable surrogate markers for IR have gained increasing attention. Among these, the Triglyceride-Glucose (TyG) index has emerged as a promising alternative [4].
The TyG index has also been shown to effectively predict adverse clinical outcomes, including coronary artery disease (CAD), heart failure, ischemic stroke, atherosclerosis, non-alcoholic fatty oily liver disease (NAFLD), and hypertension [5]. Insulin resistance, as determined by the TyG index, is associated with adverse outcomes in patients with cardiovascular diseases and following various cardiac surgical procedures. In addition, a 10-year follow-up study demonstrated that patients with IR have an approximately 1.5 times bigger of adverse cardiovascular events following coronary artery bypass graft (CABG) surgery than patients without IR [6].
This study primarily aims at evaluating the predictive value of the TyG index in comparison to HOMA-IR in cardiac surgery patients presenting with metabolic risk factors.

## 2. MATERIALS AND METHODS

This study is a prospective, observational analysis of insulin resistance indices (TyG and HOMA-IR) in patients with metabolic risk factors who underwent surgical myocardial revascularization (aortocoronary bypass). The study included patients with metabolic risk factors, who had surgeries at the "Zan Mitrev" Clinic during the period from February to October 2025.

Preoperative laboratory assessment included: complete blood count (CBC), biochemical parameters, fasting insulinemia, glycated hemoglobin (HbA1c), and lipid profile (total cholesterol, HDL, LDL, and triglycerides). These values were used to calculate the insulin resistance indices: the Triglyceride-Glucose (TyG) index and the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR). The values of these indices were compared with the postoperative course and the cardiac surgical intervention outcomes.

The investigated risk factors included arterial hypertension, hyperlipidemia, impaired glucose tolerance, type 2 diabetes mellitus, and obesity.

**Statistical Analysis**

Data were entered into the Hospital Information System (HIS) and processed using Microsoft Excel for Windows 11 and IBM SPSS Statistics v.26. Quantitative variables were analyzed by calculating the mean and standard deviation. Student's t-test was used to compare the mean values between the two indices. A Receiver Operating Characteristic (ROC) curve analysis was performed to evaluate and compare the indices' diagnostic performance. For all statistical tests, results were considered statistically significant if the p-value was less than 0.05 ($p < 0.05$).

## 3. RESULTS

Data were processed for a total of 170 patients who met the study inclusion criteria between February and October 2025.

Tables 1 and 2 directly compare the ability of the TyG and HOMA-IR indices to predict early postoperative complications, specifically atrial fibrillation and cerebrovascular incidents. Regarding the TyG index, complications were entirely concentrated in the group with TyG > 6.0. In contrast, for HOMA-IR, the majority of events occurred at index values above 2.0

Table 1 demonstrates that as the HOMA-IR index values increase, there is a corresponding shift in clinical outcomes. With respect to the length of hospital stay, patients with higher HOMA-IR levels (above 2.0) tend to require longer hospitalization, with the highest index group (above 2.5) showing a median stay of 6 days. A clear correlation was observed with atrial fibrillation; specifically, in the group with HOMA-IR scores exceeding 2.5, where a total of 41 patients developed this condition. Likewise, neurological complications followed a similar trend, with the highest incidence (16 patients) occurring in the group with the highest HOMA-IR values.

***Table 1. Association of the HOMA index with early postoperative complications***

| HOMA Index | Hospital Stay - Mean (±SD) / Median (IQR)* | Atrial Fibrillation | Neurological Complications |
|---|---|---|---|
| HOMA ≤ 1,0 (n=8) | 7,75 (±2,12) | 2 | 2 |
| HOMA 1,0-1,9 (n=24) | 7,78 (±2,63) | 9 | 2 |
| HOMA 2,0-2,5 (n=10) | 9,1 (±4,15) | 5 | 2 |
| HOMA ≥ 2,5 (n=106) | 6,00 (5,00–8,00) | 41 | 16 |

Source:

Table 2 shows more consistent (uniform) results for the TyG index compared to the HOMA-IR index. Irrespective of the TyG index value, both the length of hospital stay, as well as the number of complications remain relatively similar across the four groups. This may suggest that the HOMA-IR index is a more sensitive and critical marker for predicting early postoperative complications than the TyG index itself.

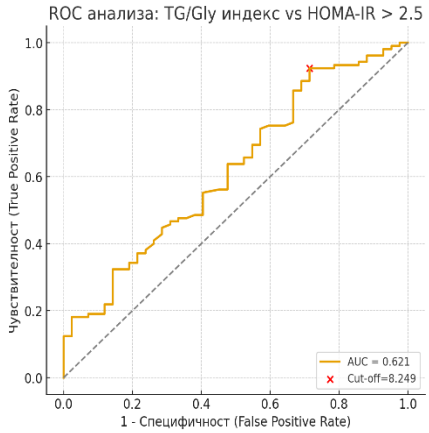
***Table 2. Association of the TyG Index with Early Postoperative Complications***

| TyG Index | Hospital Stay | Atrial Fibrillation | Neurological Complications |
|---|---|---|---|
| < 8.4 (n=43) | 7,24 | 4,6 | 14 |
| 8.5-8.8 (n=43) | 6,63 | 5,68 | 18 |
| 8.9- 9.5 (n=43) | 7,7 | 5,15 | 15 |
| >9.6 (n=40) | 7,29 | 4,59 | 15 |

Source:

The ROC analysis was performed to evaluate the diagnostic accuracy of the TyG index as a predictor of clinically significant insulin resistance, defined by the HOMA-IR threshold. An AUC value of 0.621 suggests a poor to moderate discriminatory power of the TyG index in predicting a state of HOMA-IR > 2.5. The result of 0.621 confirms the previously observed low correlation ($R^2$ = 0.180), indicating that the TyG index and HOMA-IR measure significantly different aspects of metabolic risk.

***Figure 1. ROC Curve Analysis of TyG Index vs. HOMA-IR > 2.5***




| Parameter | Value |
|---|---|
| AUC (Area Under the Curve) | 0.621 |
| Optimal Cut-off (Youden Index) | 8.249 |
| Sensitivity | 0.924 (92.4%) |
| Specificity | 0.286 (28.6%) |
| IR Criterion | HOMA-IR > 2.5 |

Source:

## 4. DISCUSSION

Although contemporary literature highlights the TyG index as a superior index due to its accessibility, our results demonstrate that the preoperative HOMA-IR value possesses greater predictive power for early postoperative complications, particularly atrial fibrillation and neurological complications. This aligns with the findings of Mende et al. [7], who identified that high HOMA-IR is a significant factor in the occurrence of postoperative arrhythmias. This suggests that direct insulin resistance and hyperinsulinemia are more closely linked to the pathophysiological response to surgical stress than the lipid-glycemic status measured via the TyG index.

In our study, atrial fibrillation was most pronounced at high HOMA-IR values. This can be explained by the fact that the most of the participants received statin therapy, which affects lipid status and masks the true metabolic risk via the TyG index. In contrast, HOMA-IR directly reflects preoperative hyperinsulinemia and insulin resistance, which are critical for the myocardium inflammatory and electrophysiological response after surgery.

With respect to neurological complications, our results indicate a significantly higher number of events in patients with higher HOMA-IR values (above 2.5), while the TyG index did not show clear discriminatory power. The increased incidence of neurological complications in patients with high HOMA-IR in our study confirms the thesis of Kersten et al. [8]. Their study demonstrates that insulin resistance causes increased central nervous system sensitivity to ischemic injuries during perioperative stress.

The analysis of hospital stay shows that the TyG index does not offer a clear predictive power for the duration of recovery. Conversely, the variability in hospital stay is more significant in patients with higher HOMA-IR,

indicating that preoperative insulin status is a more critical factor for postoperative stability than the lipid-glycemic balance, modified by statin therapy.

Our results suggest that, in a surgical context, the direct measurement of insulin resistance is a more reliable marker. This difference from contemporary literature can largely be attributed to the use of statin therapy in our patients. It is known that statins effectively reduce triglyceride values, thereby directly lowering the TyG index and potentially masking the true metabolic risk, as noted by Ying et al. [9]. On the other hand, statins do not have the same effect on insulin resistance at the cellular level, making HOMA-IR a "more honest" indicator of the body's capacity to handle operative stress.

Furthermore, the low correlation $R^2 = 0.180$ in our study proves that 80% of the variability in the TyG index is independent of HOMA-IR, supporting the argument that the TyG index directly reflects atherogenic dyslipidemia—a key driver of endothelial dysfunction and a prothrombotic state. [10]

The literature supports the superiority of HOMA-IR in predicting outcomes among our subjects. Henley et al. [11] demonstrate that this index is an essential indicator of increased risk for cardiovascular events, independent of other metabolic risk factors. [12]

## 5. STUDY LIMITATIONS

Primarily, the lack of data regarding changes in the TyG and HOMA-IR indices following bypass surgery precludes the examination of their differential improvement rate. Such an analysis would be beneficial for a comprehensive understanding of the pathophysiological response of both indices to surgical intervention. Consequently, our study focuses exclusively on the predictive power of the preoperative values of these two indices. Additionally, a significant limitation is the preoperative management of lipid status with statin therapy, which directly reduces triglyceride levels. As a result, the TyG index may yield a falsely low value, potentially masking the underlying metabolic risk.

## 6. CONCLUSION

Based on the results obtained, we conclude that the preoperative HOMA-IR index serves as a superior biomarker for predicting atrial fibrillation and neurological complications in cardiac surgery patients compared to the TyG index. The impact of previously prescribed statin therapy in these patients reduces the predictive value of triglyceride-based indices, highlighting the necessity for direct monitoring of insulin resistance during preoperative preparation.

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