Al-Farouk journal of sciences
Volume (2), Issue (5) (Nov, 2026)
ISSN: 3135-2359

مجلة الفاروق للعلوم
المجلد (2) العدد 5 نوفمبر 2026
عدد خاص بالمؤتمر العلمي الرابع للعلوم والتقنية
28-29 نوفمبر 2026 مصراتة – ليبيا
إدارة المعاهد العليا – وزارة التعليم التقني

Optimal Cut-off Value and Diagnostic Agreement of the Triglyceride-Glucose (TyG) Index Compared with HOMA-IR for Identifying Insulin Resistance: A Cross-Sectional Study

Siraj sobhi hamad [1*], Eman Mohamad elalawani[2]

[1] Department of lab medicine, Faculty Higher Institute of Sciences and Technology,Misurata, Libya

[2] nutrition therapy, medical Misurata center, , Misurata, libya

Sirajshahen99@gmail.com

Received: 29/7/2026 Revised: 20/8/2026 Accepted: 28/8/2026 Publication: 28/11/2026

Abstract:

The study aimed to evaluate the accuracy of the TyG index compared to the HOMA-IR index for assessing insulin resistance in patients visiting the therapeutic nutrition clinic at Misurata Medical Center. The study involved 100 cases, all females aged between 20 and 50 years. The study concluded that there is a statistically significant correlation between the TyG index and HOMA-IR at a significance level of p = 0.002 and R = 0.445. The study also determined the cut-off value for the TyG index at 4.795, at which a patient is diagnosed with insulin resistance. Furthermore, the study highlighted the importance of this test due to its availability and low cost compared to other tests..

Keywords: insulin resistance; diabetes; triglyceride; fast blood sugar

Introduction

Because insulin resistance (IR) is becoming so common everywhere, which serves as the primary pathophysiological precursor to type 2 diabetes mellitus (T2DM) , represents one of the most widespread metabolic disorders (1), insulin resistance is defined as impaired cellular responsiveness to insulin—the key hormone regulating systemic glucose homeostasis (2 ,3).

reports international health organizations indicate a substantial rise in global insulin resistance rates, currently exceeding 26% among the adult population in world (4). This trend significantly elevates the risk of T2DM, a leading cause of global mortality that exhibits a persistent annual incidence growth rate of 3.73 per 100,000 individuals (18).

Given that IR constitutes the clinical hallmark of T2DM, optimizing early, accessible screening modalities remains imperative. In 1985, the Homeostatic Model Assessment of Insulin Resistance (HOMA–IR) was established using fasting plasma glucose and fasting insulin concentrations, effectively reflecting the high level of insulin (hyperinsulinemic) and high level of glucose characteristic of insulinresistance (5,6,7)

However, the routine clinical application of HOMA–IR is frequently constrained by the financial cost , also its limited availability of fasting insulin immunoassays, leading to reduced compliance in early population screening. To address these limitations, the Triglyceride–Glucose index (TyG) was introduced in 2008 as a cost–effective surrogate derived from routine, widely accessible fasting lipid and glucose parameters (8).

Subsequent evidence has validated the diagnostic sensitivity of the TyG index for detecting IR and metabolic syndrome (9). As a composite biomarker integrating glucolipotoxicity, it offers operational simplicity and diagnostic accuracy suitable for large–scale epidemiological application (10).Furthermore, studies revealed to index functions as an independent biological marker. It helps predict early spikes in blood sugar following a tolerance test. Notably, it exhibits superior diagnostic utility compared to fasting plasma glucose alone and conventional HOMA–IR in identifying normoglycemic individuals at high risk for T2DM (11).

Recent findings by Porchia et al. (2026) further confirm that demographic-specific TyG thresholds facilitate early IR detection, thereby contributing to reduced diabetes-related mortality (12)

In addition to cardiometabolic risk stratification and heart failure prognosis (13), the TyG index shows strong independent associations with non-alcoholic fatty liver disease (NAFLD), and advanced hepatic fibrosis in patients with obesity. Combining the TyG index with gamma-glutamyl transferase (GGT) yields robust non-invasive diagnostic performance AUC= 0.79), offering a practical clinical tool to evaluate the necessity of liver biopsy (14).

Accordingly, this study was designed to establish the optimal diagnostic cut-off value for the TyG index and evaluate its concordance with HOMA-IR in identifying insulin resistance, providing a rapid, non-invasive screening tool for early metabolic assessment.

Study Objectives

To evaluate the diagnostic accuracy of the TyG index relative to HOMA-IR and determine the optimal population-specific cut-off value for identifying insulin resistance in a local clinical setting.

Study Design

This cross-sectional analytical study was conducted among patients attending the Therapeutic Nutrition Clinic at Misrata Medical Center. The study enrolled 100 adult patients aged between 20 and 50 years. Following a strict 12-hour overnight fast, venous blood samples (10 mL) were collected for laboratory analyses, including fasting lipid profile, fasting blood sugar (FBS), and fasting serum insulin, alongside complete anthropometric and demographic evaluations.

Exclusion Criteria

To ensure diagnostic precision and eliminate potential confounding influences on lipid and insulin dynamics, participants meeting any of the following criteria were excluded:

- Current pharmacological treatment with lipid-lowering agents (e.g., fibrates or statins).
- Use of antidiabetic medications or insulin secretagogues.
- Confirmed diagnosis of Type 1 Diabetes Mellitus.
- Adherence to ketogenic or restrictive dietary regimens.
- Pregnancy or lactation.
- Failure to comply with the required 12-hour fasting protocol.

Tools and Mathematical Formulas

Biochemical data were processed and metabolic indices calculated according to standard validated formulas:

Sample Collection & Serum Preparation

Venous blood samples were collected in anticoagulant-free tubes and allowed to clot at room temperature. Serum was separated by centrifugation at 3,000 rpm for 5 minutes, after which 500 µL serum aliquots were harvested and processed for biochemical and endocrine analyses.

Biochemical & Lipid Profile Assays

Fasting blood sugar (FBS) and serum lipid parameters—including Triglycerides, High-Density Lipoprotein (HDL), and Low-Density Lipoprotein (LDL)—were quantified using an automated clinical chemistry analyzer (Cobas Integra 400 Plus; Roche Diagnostics, Germany) based on enzyme and substrate absorbance photometry.

Serum Insulin & HOMA-IR Calculation

Fasting serum insulin concentration was determined via electrochemiluminescence immunoassay (ECLIA) using an automated analyzer (Cobas e411; Roche Diagnostics, Germany).

1. Triglyceride-Glucose (TyG) Index:

Calculated using the natural logarithm (\ln) of the product of fasting triglycerides and fasting glucose divided by two (8):

$$TyG\ \ Index\ In = Fasting\ Triglycerides\ mg\backslash dl \times Fasting\ Glucose\ \ mg\backslash dl\ /\ 2]$$

2.Homeostatic Model Assessment of Insulin Resistance (HOMA-IR):

Calculated using fasting serum insulin and fasting glucose concentrations (7):

$$\{\text{HOMA}-IR\} = Fasting\ Insulin\ (mg\backslash dl) \times Fasting\ Glucose/\ 405\}$$

Statistical Analysis

Data processing and analysis will be performed using IBM SPSS Statistics (Version 26.0). Normality of data distribution will be assessed using the Kolmogorov–Smirnov test. Correlations between parameters will be evaluated using Pearson or Spearman correlation coefficients, as appropriate. Receiver Operating Characteristic (ROC) curve analysis will be conducted, and the Area Under the Curve (AUC) calculated to determine the optimal TyG index cut-off value maximizing diagnostic sensitivity and specificity.

Results

Descriptive analysis of the study samples (N = 100) showed that the mean age of the participants was 36.60 std deviation 11.49 years. The mean levels of fasting blood sugar (FBS) and triglycerides were 105.86 std deviation mg\dl 31.30 mg/dL and 159.61 mg\dl std deviation 29.98 mg/dL, respectively. The arithmetic mean of the HOMA-IR scale recorded 3.99 mg\dl std deviation 1.84, while the mean TyG index was approximately 4.84 mg\dl std deviation 0.15. Regarding lipid profile distributions, 63.38% of participants exhibited elevated triglyceride levels (> 150 mg/dL), and 77.46% presented with reduced HDL levels (< 50 mg/dL). Overall, the prevalence of insulin resistance in the total sample reached 67.6%.

Pearson correlation analysis indicated the presence of a positive, statistically significant correlation between the TyG index and the HOMA-IR scale ($r = 0.440$, $p < 0.001$).

To evaluate the discriminative and diagnostic ability of the TyG index in identifying insulin resistance compared to the HOMA-IR scale, Receiver Operating Characteristic (ROC Curve) analysis was used. The results showed that the area under the curve (AUC) reached 0.803 (95% CI : 0.702–0.904, $p < 0.001$), reflecting excellent diagnostic performance. Based on the highest value of Youden's index ($J = 0.471$), the optimal cut-off value for the TyG index was determined at 4.795, recording a sensitivity of 79.2% and a specificity of 67.9%.

Furthermore, the level of diagnostic agreement between the two indices at the cut-off point (4.795) was measured using Cohen's Kappa coefficient. The analysis showed a moderate and statistically significant diagnostic agreement ($\kappa = 0.412$, $p < 0.001$), with an overall diagnostic agreement rate of 75.0% (diagnostic agreement in 75 cases out of 100).

Discussion

The study conducted on 100 participants to evaluate the efficiency of the TyG index in assessing insulin resistance demonstrated high test efficiency and accurate discriminatory diagnostic ability for insulin resistance, which is clearly shown at an AUC = 0.803, with a significance value of $p < 0.001$. This recommends it as a highly sensitive alternative to the HOMA-IR index, which may be economically costly to perform. The study also showed a statistically significant positive correlation as another indicator of the accuracy of the TyG index and its moderate diagnostic agreement ($\kappa = 0.412$), with an overall accuracy of 75.0% at an optimal cut-off point of 4.795.

The diagnostic accuracy of the TyG index is attributed to its reliance on a highly important indicator in diagnosing diabetes, which is the fasting blood glucose test—the same test used in HOMA-IR. However, the TyG index is distinguished by its use of triglycerides, combining both to link glucose, insulin resistance, and lipid and glucose parameters, which may reflect insulin resistance at the hepatic level, fat accumulation on the liver, and increased lipid influx to it. The study clearly illustrates this link between both lipid and glucose tests, as approximately 63% of the study sample suffers from elevated triglycerides and low HDL levels, which was directly reflected in elevated insulin resistance, where 67.9% of the study sample suffers from insulin resistance. This confirms the reliability of the TyG index in evaluating insulin resistance due to its strong reliance on lipids along with glucose instead of insulin. Moreover, the elevated lipid indices and high insulin resistance markers in the sample validate this decision, making the TyG index a more skillful and reliable tool as a primary assessment instrument.

The strong diagnostic efficiency of the TyG index shown by our study (AUC= 0.803) aligns closely with recent literature that evaluated triglyceride- and glucose-based indices as accurate surrogates for insulin resistance. In this context, a study by Rhaiem et al. (2026) confirmed that TyG-based indices possess very high discriminatory accuracy {AUC} ranging from 85.1% to 86.7%) when evaluated against the reference standard HOMA-IR, reinforcing the reliability of depending on glucose

and triglycerides to identify metabolic disorders and insulin resistance across different clinical groups (15)

The strong diagnostic value of the TyG index observed in our study (AUC= 0.803) is reinforced by pooled evidence from major systematic reviews and specialized clinical studies. In this framework, the comprehensive meta-analysis conducted by Nabipoorashrafi et al. (2022) on a large sample of 49,325 participants confirmed that the TyG index possesses exceptional efficiency in detecting metabolic disorders, with a pooled sensitivity of 80%, a specificity of 81%, and an area under the curve (sROC AUC) of 0.87. This pooled diagnostic power aligns with our results, confirming that adopting this simple biochemical index provides high accuracy that clearly separates healthy cases from those with metabolic disorders (9).

Furthermore, our study revealed a cut-off value for the TyG index of 4.79, which aligns with a study published in Nature conducted on the Iraqi population by Hameed et al. (2022), This underscores the high efficiency and accuracy of the TyG index for predicting and diagnosing metabolic disorders in type 2 diabetic patients. The cut-off value reported in that study closely parallels our derived value, thereby demonstrating strong consistency between our results and broader Middle Eastern regional findings(16).

Furthermore, recently published medical literature highlights the deep pathophysiological dimensions of an elevated TyG index; a study by Chen & Wen (2022) demonstrated a strong inverse correlation between an elevated TyG index and impaired pancreatic beta-cell secretory capacity (beta-cell dysfunction) in both its early and late stages, establishing a cut-off value of 9.08 to screen for the risk of impaired insulin secretion. This value fully corresponds—when adjusting the logarithmic formula—with the cut-off value derived in our study (4.795), demonstrating that the TyG index is not limited to reflecting peripheral and hepatic insulin resistance measured via HOMA-IR, but extends to reflect the gradual deterioration in beta-cell function resulting from glucolipotoxicity (17)

Conclusion

The Triglyceride-Glucose (TyG) index proved to be a highly accurate, reliable, and cost-effective surrogate marker for evaluating insulin resistance (AUC = 0.803, $p < 0.001$) at an optimal cut-off value of 4.795. By combining fasting glucose and triglycerides, it successfully reflects both glucose dysregulation and hepatic insulin resistance without the high costs of insulin testing. These findings support the TyG index as a practical primary screening tool across Middle Eastern populations.

Recommendations

1. Adopt the TyG index in routine clinical practice for early detection of insulin resistance and metabolic dysfunction.
2. Utilize the TyG index (4.795) as a primary, low-cost surrogate for HOMA-IR, particularly in resource-limited settings.
3. Use elevated TyG values to trigger further assessments for hepatic steatosis, metabolic syndrome, and early \beta-cell dysfunction.
4. Conduct larger multi-center longitudinal studies to validate population-specific cut-off thresholds across diverse patient groups

Reference

1) Chandrasekaran, P., & Weiskirchen, R. (2024). Cellular and molecular mechanisms of insulin resistance. Current Tissue Microenvironment Reports, 5(3), 79–90
2) Accili, D., Deng, Z., & Liu, Q. (2025). Insulin resistance in type 2 diabetes mellitus. Nature Reviews Endocrinology, 21(7), 413–426.
3) Szablewski, L. (2024). Changes in cells associated with insulin resistance. International Journal of Molecular Sciences, 25(4), Article 2397.
4) Ballena-Caicedo, J., Zuzunaga-Montoya, F. E., Loayza-Castro, J. A., Bustamante-Rodríguez, J. C., Vásquez Romero, L. E. M., Tapia-Limonchi, R., & Vera-Ponce, V. J. (2025). Global prevalence of insulin resistance in the adult population: A systematic review and meta-analysis. Frontiers in Endocrinology, 16, Article 1646258.
5) Fazio, S., & Carlomagno, G. (2026). Insulin resistance with associated hyperinsulinemia as a risk factor for the development and worsening of HFpEF. Frontiers in Cardiovascular Medicine, 13, Article 1719492.

6) Lee, C. H., Shih, A. Z. L., Woo, Y. C., Fong, C. H. Y., Leung, O. Y., Janus, E., & Lam, K. S. L. (2016). Optimal cut-offs of homeostasis model assessment of insulin resistance (HOMA-IR) to identify dysglycemia and type 2 diabetes mellitus: A 15-year prospective study in Chinese. PLoS ONE, 11(9), Article e0163424.
7) Matthews, D. R., Hosker, J. P., Rudenski, A. S., Naylor, B. A., Treacher, D. F., & Turner, R. (1985). Homeostasis model assessment: Insulin resistance and \beta-cell function from fasting plasma glucose and insulin concentrations in man. Diabetologia, 28(7), 412–419.
8) Simental-Mendía, L. E., Rodríguez-Morán, M., & Guerrero-Romero, F. (2008). The product of fasting glucose and triglycerides as surrogate for identifying insulin resistance in apparently healthy subjects. Metabolic Syndrome and Related Disorders, 6(4), 299–304.
9) Nabipoorashrafi, S. A., Seyedi, S. A., Rabizadeh, S., Ebrahimi, M., Ranjbar, S. A., Reyhan, S. K., Meybodi, A. P., Nakhjavani, M., & Esteghamati, A. (2022). The accuracy of triglyceride-glucose (TyG) index for the screening of metabolic syndrome in adults: A systematic review and meta-analysis. Nutrition, Metabolism and Cardiovascular Diseases, 32(12), 2677–2688.
10) Sun, Y., Ji, H., Sun, W., An, X., & Lian, F. (2025). Triglyceride glucose (TyG) index: A promising biomarker for diagnosis and treatment of different diseases. European Journal of Internal Medicine, 131, 3–14.
11) Mustakin, M. D., & PK, S. (2026). Triglyceride—Glucose (TyG) index as a screening tool in community settings for early detection of type 2 diabetes risk: A systematic review. TyG Index Community Diabetes Screen, 37, 149–158.
12) Porchia, L. M., Gonzalez-Mejia, M. E., & López-Bayghen, E. (2026). Demographic-specific TyG and TyG-BMI thresholds improve insulin resistance and mortality risk. Academia Medicine and Health, 3(2)
13) Cai, Y., Yang, M., Ma, S., Zhang, J., Huang, B., & Yu, B. (2025). A meta-analysis of the prognostic value of the TyG index in heart failure. Frontiers in Endocrinology, 16, Article 1463647.
14) Rivière, B., Jaussent, A., Macioce, V., Faure, S., Builles, N., Lefebvre, P., & COMET study group. (2022). The triglycerides and glucose (TyG) index: A new marker associated with nonalcoholic steatohepatitis (NASH) in obese patients. Diabetes & Metabolism, 48(4), Article 101345.
15) Ben Rahim, T., Owczarek, A. J., Wójtowicz, M., Ciura, D., Madej, P., Chudek, J., & Olszanecka-Glinianowicz, M. (2025). The cut-off for triglyceride-glucose index (TyG) discriminating the insulin resistance based on the SHBG level and HOMA-IR values in white women with polycystic ovary syndrome. Life, 15(5), Article 691.
16) Hameed, E. K., Al-Ameri, L. T., Hasan, H. S., & Abdulqahar, Z. H. (2022). The cut-off values of triglycerides-glucose index for metabolic syndrome associated with type 2 diabetes mellitus. Baghdad Science Journal, 19(2), 0307–0314.
17) Chen, Z., & Wen, J. (2022). Elevated triglyceride-glucose (TyG) index predicts impaired islet β-cell function: A hospital-based cross-sectional study. Frontiers in Endocrinology, 13, Article 973655.
18) Balooch Hasankhani, M., Mirzaei, H., & Karamoozian, A. (2023). Global trend analysis of diabetes mellitus incidence, mortality, and mortality-to-incidence ratio from 1990 to 2019. Scientific Reports, 13(1), Article 21908