Razi Med J. 2026;2(2):380-383
https://doi.org/10.69667/rmj.26232
Razi Medical Journal
https://razi.edu.ly/rmj/index.php/hm

Original article

Association Between Triglyceride/Glucose Index and Established Insulin Resistance Indices in a Libyan Cohort

Amani Tayeh[1]*, Mohamed Ahmida[2]

[1] *Department of Biomedical Science, Libyan Academy-Aljabal Al-akther Branch, Al-Bayda, Libya.*
[2] *Department of Nutrition, Faculty of Public Health, Benghazi University, Benghazi, Libya.*
***Corresponding Email**. amaniosama8074@gmail.com*

Abstract
Insulin resistance (IR) is a major metabolic abnormality associated with obesity, dyslipidemia, and increased cardiometabolic risk. The triglyceride–glucose (TyG) index has been proposed as a simple surrogate marker for insulin resistance; however, its clinical utility remains under investigation. This study aimed to evaluate the TyG index and its association with fasting blood glucose (FBG), fasting insulin, and the Homeostasis Model Assessment of Insulin Resistance (HOMA-IR). In addition, its diagnostic performance for detecting insulin resistance was assessed. A cross-sectional study was conducted on 108 participants. Anthropometric and biochemical data were collected, including FBG, fasting insulin, and triglycerides. The TyG index and HOMA-IR were calculated using standard equations. Insulin resistance was defined as HOMA-IR > 2.5. Correlation analysis was performed using Pearson's or Spearman's methods according to data distribution. Receiver operating characteristic (ROC) curve analysis was used to evaluate the diagnostic ability of the TyG index. The TyG index showed significant positive correlations with FBG, fasting insulin, and HOMA-IR. ROC curve analysis demonstrated fair discriminatory performance for detecting insulin resistance, with an area under the curve (AUC) of 0.722 (95% confidence interval: 0.625–0.818, $p < 0.001$). The TyG index demonstrated a significant association with established markers of insulin resistance and showed fair diagnostic performance. It may serve as a simple and practical surrogate marker for insulin resistance in clinical and epidemiological settings.
Keywords. *Homeostasis Model Assessment of Insulin Resistance, Insulin Resistance, Triglyceride–Glucose Index.*

***Received**: 04/04/26*
***Accepted**: 02/06/26*
***Published**: 09/06/26*

Introduction

Insulin resistance (IR) is a major metabolic abnormality associated with obesity, dyslipidemia, type 2 diabetes mellitus (DM), and increased cardiometabolic risk [Ref]. Early identification of IR is clinically important for reducing the risk of future metabolic and cardiovascular complications [1]. Although the hyperinsulinemic–euglycemic clamp technique remains the gold standard for assessing insulin sensitivity, its complexity and limited applicability in routine clinical practice have encouraged the use of simpler surrogate markers [2]. In addition, commonly used indices such as the Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) require insulin measurements, which may not always be readily available in many healthcare settings [3].

The triglyceride/glucose (TyG) index has recently emerged as a simple, inexpensive, and reliable surrogate marker for insulin resistance and is calculated from fasting triglyceride (TG) and fasting glucose levels (FBG). The TyG index has demonstrated good correlation with insulin resistance and HOMA-IR in different populations [3]. Because of its low cost and accessibility, the TyG index has gained increasing attention in both clinical and epidemiological research, particularly in resource-limited settings where insulin assays may be expensive or unavailable. The present study aimed to evaluate the TyG index among the study participants and to assess its association with insulin resistance–related parameters, including fasting blood glucose, fasting insulin, and HOMA-IR. In addition, the diagnostic performance of the TyG index for the detection of insulin resistance was evaluated. We hypothesized that the TyG index would be significantly associated with HOMA-IR and could serve as a simple surrogate marker for insulin resistance in the studied cohort.

Methods

Study design and participants

This cross-sectional study included a total of 108 participants aged between 12 and 25 years. Participants were selected randomly from the local community (universities, schools, malls) during the period from March to May 2025, in Al-

Razi Med J. 2026;2(2):380-383
https://doi.org/10.69667/rmj.26232
Razi Medical Journal
https://razi.edu.ly/rmj/index.php/hm

Bayda/Libya. Individuals with acute or chronic illness were excluded from the study. Written informed consent was obtained from participants or their legal guardians prior to enrollment. The study protocol was approved by the ethical committee of the Libyan Academy for Postgraduate Studies, Al-Jabal Al-Akhdar branch (Approval No. 004.H.25.9).

Anthropometric measurements

Anthropometric measurements were obtained from all participants in the fasting state by trained personnel using standardized procedures. Body weight was measured to the nearest 0.1 kg using a digital electronic scale (InBody 770, InBody Co., Ltd., Seoul, South Korea), while height was measured to the nearest 0.1 cm using a digital stadiometer (BSM series, InBody Co., Ltd., Seoul, South Korea) with participants wearing light clothing and no shoes. BMI was calculated using the standard formula: weight (kg)/height (m^2).

Biochemical analysis

Venous blood samples were collected from all participants after an overnight fast of 8–12 hours under standardized conditions. Blood samples were centrifuged, and serum was separated for biochemical analysis. FBG and TG levels were measured using standard enzymatic colorimetric methods [4,5] at Al-Borj Laboratory, Al-Bayda, Libya. Serum insulin levels were determined using commercially available immunoassay kits according to the manufacturer's instructions [6]. Homeostasis model assessment of insulin resistance (HOMA-IR) was calculated using the standard formula: HOMA-IR = fasting insulin (μIU/mL) × fasting glucose (mg/dl) / 405. HOMA-IR above 2.5 indicates IR [7]. Triglyceride/glucose (TyG) index was calculated using the standard formula: TyG = In [TG (mg/dl) × FBG (mg/dl) / 2] [8].

Statistical analysis

All data were coded and analyzed using the Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). The normality of data distribution was assessed using the Shapiro–Wilk test. Continuous variables were presented as mean ± standard deviation (SD) for normally distributed data or as median with interquartile range (IQR) for non-normally distributed variables. Pearson's or Spearman's rank correlation analysis was used to assess the associations between variables according to the data distribution. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the diagnostic performance of the TyG index for insulin resistance. A p-value of less than 0.05 was considered statistically significant.

Results

(Table 1) presents the baseline demographic, anthropometric, and metabolic characteristics of the study population, including glucose homeostasis and insulin resistance–related parameters. Of the total participants, 57 (52.8%) were classified as having IR based on HOMA-IR > 2.5, while 51 (47.2%) were non-IR.

Table 1. Baseline characteristics of the study population

Variable	Total cohort (n = 108)
Age, years	14.5 ± 5
Sex (male/female)	53/55
Weight, kg	54.3 ± 24
Height, cm	154 ± 19
BMI, kg/m^2	23.5 (14 -45)
FBG, mg/dl	94.5 ± 7.2
Insulin, μIU/ml	11.6 (2.6-32.0)
TG, mg/dl	79 (36-236)
HOMA-IR	2.7 (0.5-9.07)
TyG index	8.24 ± 0.44

Data are presented as mean ± SD or median (IQR), depending on the distribution; n, number of participants; BMI, body mass index; FBG, fasting blood glucose; TG, triglyceride; HOMA-IR, homeostasis model assessment of insulin resistance; TyG, triglyceride/glucose.

Razi Med J. 2026;2(2):380-383
https://doi.org/10.69667/rmj.26232
Razi Medical Journal
https://razi.edu.ly/rmj/index.php/hm

Correlation analysis, as shown in (Table 2), revealed a significant positive association between FBG, fasting insulin, HOMA-IR, and the TyG index (Fig. 1).

Table 2. Correlation between the triglyceride/glucose (TyG) index and insulin resistance surrogate markers

r (p-value)	HOMA-IR	TyG index	FBG	Insulin
HOMA-IR		0.46 (<0.001)	0.509 (<0.001)	0.992 (<0.001)
TyG index	0.460 (<0.001)		0.388 (<0.001)	0.445 (<0.001)
FBG	0.509 (<0.001)	0.388 (<0.001)		
Insulin	0.992 (<0.001)	0.445 (<0.001)	0.444 (<0.001)	

FBG, fasting blood glucose; HOMA-IR, homeostasis model assessment of insulin resistance; TyG, triglyceride/glucose. Bold p-value indicates statistical significance at P < 0.05

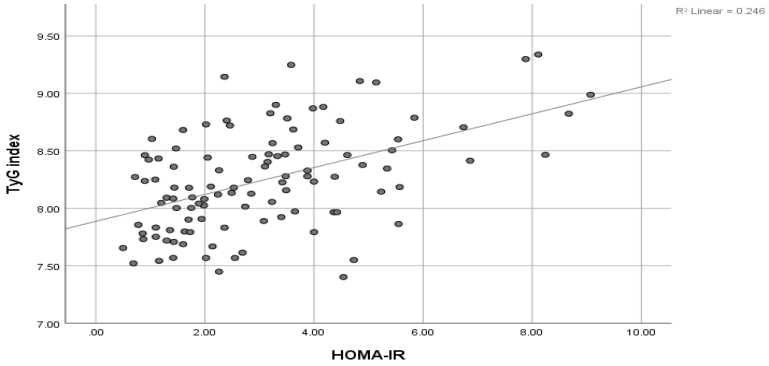

Fig 1. Correlation between HOMA-IR and triglyceride–glucose (TyG) index among the study participants

ROC curve analysis demonstrated that the TyG index had a fair and statistically significant ability to predict insulin resistance (Fig 2), with an area under the curve (AUC) of 0.722, a standard error (SE) of 0.049, and a 95% confidence interval (CI) of 0.625–0.818 (p < 0.001)

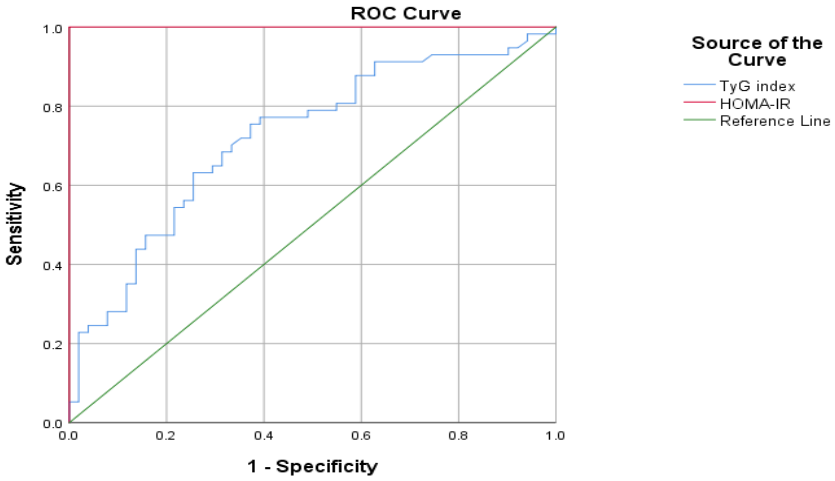

Fig 2. Receiver Operating Characteristic (ROC) curve analysis of Triglyceride-Glucose (TyG) index (blue line) and HOMA-IR (red line) for the detection of insulin resistance

Discussion

In the present study, insulin resistance was defined using HOMA-IR values > 2.5. The findings demonstrated significant positive correlations between the triglyceride–glucose (TyG) index and FBG, fasting insulin, and HOMA-IR. These results support the close association between the TyG index and established markers of insulin resistance. The TyG index is derived from fasting triglyceride and fasting blood glucose measurements, which are metabolic parameters closely associated with insulin sensitivity and glucose homeostasis [2]. Previous studies have similarly reported significant associations between the TyG index and HOMA-IR, supporting its utility as a surrogate marker for insulin

resistance in different populations [9, 10]. The observed correlations in the current study are consistent with these findings and further support the metabolic relevance of the TyG index.

ROC curve analysis demonstrated that the TyG index had a fair discriminatory ability for detecting insulin resistance, with an AUC of 0.722. Similar findings have been reported in previous studies, where the TyG index showed moderate to good diagnostic performance for identifying insulin resistance [11,12]. These findings suggest that the TyG index may be useful as a practical screening tool for metabolic dysfunction in clinical and epidemiological settings. An important advantage of the TyG index is its simplicity and accessibility, as it can be calculated using routine laboratory parameters without the need for insulin assays [10]. Compared with insulin-based indices, the TyG index may therefore represent a more practical approach for the assessment of insulin resistance, particularly in settings with limited laboratory resources.

Several limitations should be considered when interpreting the findings of the present study. First, the cross-sectional design limits the ability to establish causal relationships. Second, insulin resistance was assessed using HOMA-IR rather than the hyperinsulinemic-euglycemic clamp technique, which remains the reference standard for insulin sensitivity assessment [13]. In addition, the relatively modest sample size may limit the generalizability of the findings. Nevertheless, the study provides additional evidence supporting the potential utility of the TyG index as a simple surrogate marker for insulin resistance.

Conclusion

The TyG index appears to be a useful and practical surrogate marker for insulin resistance. It may provide a simple alternative tool for identifying insulin resistance in clinical and epidemiological settings, particularly where insulin-based measurements are not readily available.

Conflict of interest. Nil

References

1. Petersen MC, Shulman GI. Mechanisms of insulin action and insulin resistance. Physiol Rev. 2018;98(4):2133-2223. doi: 10.1152/physrev.00063.2017.
2. Yoon JS, Lee HJ, Jeong HR, Shim YS, Kang MJ, Hwang IT. Triglyceride glucose index is superior biomarker for predicting type 2 diabetes mellitus in children and adolescents. Endocr J. 2022;69(5):559-565. doi: 10.1507/endocrj.EJ21-0560.
3. Tahapary DL, Pratisthita LB, Fitri NA, Marcella C, Wafa S, Kurniawan F, et al. Challenges in the diagnosis of insulin resistance: Focusing on the role of HOMA-IR and triglyceride/glucose index. Diabetes Metab Syndr. 2022;16(8):102581. doi: 10.1016/j.dsx.2022.102581.
4. Tietz NW. Clinical guide to laboratory tests. 3rd ed. Philadelphia (PA): W.B. Saunders; 1995. p. 1096.
5. Siedel J, Schmuck R, Staepels J, Town MH. Long term stable, liquid ready-to-use monoreagent for the enzymatic assay of serum or plasma triglycerides (GPO-PAP method). Clin Chem. 1993;39:1127.
6. Chevenne D, Letailleur A, Trivin F, Porquet D. Effect of hemolysis on the concentration of insulin in serum determined by RIA and IRMA. Clin Chem. 1998;44(2):354-356. doi: 10.1093/clinchem/44.2.354.
7. Khalili D, Khayamzadeh M, Kohansal K, Ahanchi NS, Hasheminia M, Hadaegh F, et al. Are HOMA-IR and HOMA-B good predictors for diabetes and pre-diabetes subtypes? BMC Endocr Disord. 2023;23(1):39. doi: 10.1186/s12902-023-01291-9.
8. Son DH, Lee HS, Lee YJ, Lee JH, Han JH. Comparison of triglyceride-glucose index and HOMA-IR for predicting prevalence and incidence of metabolic syndrome. Nutr Metab Cardiovasc Dis. 2022;32(3):596-604. doi: 10.1016/j.numecd.2021.11.017.
9. Er EL, Wu S, Chou HH, Hsu LA, Teng MS, Sun YC, et al. Triglyceride glucose-body mass index is a simple and clinically useful surrogate marker for insulin resistance in nondiabetic individuals. PLoS One. 2016;11(3):e0149731. doi: 10.1371/journal.pone.0149731.
10. Khan SH, Sobia F, Niazi NK, Manzoor SM, Fazal N, Ahmad F. Metabolic clustering of risk factors: evaluation of triglyceride-glucose index for evaluation of insulin resistance. Diabetol Metab Syndr. 2018;10:74. doi: 10.1186/s13098-018-0376-8.
11. Sánchez-García A, Rodríguez-Gutiérrez R, Mancillas-Adame L, González-Nava V, González-Colmenero AD, Solis RC, et al. Diagnostic accuracy of the triglyceride and glucose index for insulin resistance: A systematic review. Int J Endocrinol. 2020;2020:4678526. doi: 10.1155/2020/4678526.
12. Han L, Lee HK, Shin SR. Diagnostic performance of insulin resistance indices for identifying metabolic dysfunction-associated fatty liver disease. Metab Syndr Relat Disord. 2024;22(5):402-409. doi: 10.1089/met.2023.0276.
13. da Silva C, Zambon MP, Vasques ACJ, Camilo DF, de Góes Monteiro Antonio MAÂR, Geloneze B. The threshold value for identifying insulin resistance (HOMA-IR) in an admixed adolescent population: A hyperglycemic clamp validated study. Arch Endocrinol Metab. 2023;67(1):119-125. doi: 10.20945/2359-3997000000533.