Clinical and Experimental Obstetrics & Gynecology

Clin. Exp. Obstet. Gynecol. **2026**; 53(3): 46000
https://doi.org/10.31083/CEOG46000

Original Research

Evaluation of Triglyceride-Glucose Index, Insulin Resistance, and Lipid Level in Turkish Women With Polycystic Ovary Syndrome

Neslihan Erkal[1,*], Yeliz Akpinar Mayir[1]

[1]Department of Obstetrics and Gynecology, Antalya Training and Research Hospital, 07100 Antalya, Turkey
*Correspondence: drnboz@yahoo.com (Neslihan Erkal)
Academic Editor: Michael H. Dahan
Submitted: 23 August 2025 Revised: 18 November 2025 Accepted: 28 November 2025 Published: 16 March 2026

Abstract

Background: This study aimed to elucidate the triglyceride to high-density lipoprotein cholesterol (TG/HDL-C), total cholesterol to high-density lipoprotein cholesterol (TC/HDL-C), low-density lipoprotein cholesterol to high density lipoprotein cholesterol (LDL-C/HDL-C), and triglyceride-glucose (TyG) indices in patients with polycystic ovary syndrome (PCOS). Moreover, we aimed to determine whether the TyG index and traditional lipid parameters could serve as indicators of insulin resistance (IR) in Turkish women. **Methods**: 68 patients diagnosed with PCOS who presented to the gynecology outpatient clinic of our hospital between January 2020 and June 2023 were examined retrospectively. Patients were diagnosed according to the 2003 Rotterdam criteria. Anthropometric measurements and laboratory parameters (glucose, total cholesterol, TG, HDL-C, LDL-C, glycated hemoglobin (HbA1-c), and homeostasis model assessment of insulin resistance (HOMA-IR)) were obtained from hospital records. **Results**: Receiver operating characteristic (ROC) curve analysis was performed to examine patients' differential effects on body mass index (BMI), TyG index, TG/HDL-C, TC/HDL-C, and LDL-C/HDL-C values. A HOMA-IR value of $\geq$2.5 was considered a reference during these calculations. The area under the curve (AUC) and limit values for the other parameters were as follows: the TyG index was 83.8% and $>$4.41, the TG/HDL-C ratio was 81.7% and $>$1.44, and the TC/HDL-C ratio was 62.2% and $>$3.29. BMI and TC/HDL-C demonstrated moderate discriminatory power (AUC 70%–80%), whereas TyG index and TG/HDL-C showed strong discriminatory power (AUC 80%–90%). LDL-C/HDL-C was not statistically significant in predicting IR. **Conclusion**: TyG index, TG/HDL-C ratio, and TC/HDL-C ratio may serve as useful indicators of IR in patients with PCOS.

Keywords: polycystic ovary syndrome; insulin resistance; triglyceride-glucose index

1. Introduction

Polycystic ovary syndrome (PCOS) is a multifactorial endocrine disorder frequently observed in women of reproductive age. It is typically defined by ovulatory disturbances, elevated androgen levels, and the presence of polycystic ovarian morphology (PCOM) detected via ultrasonography. The global prevalence of PCOS is estimated to be between 5% and 15%, and represents one of the leading causes of female infertility [1]. Although PCOS may develop in women with a normal body mass index (BMI), affecting about 50–70% of them, its occurrence is even more common in individuals with obesity. Excess insulin and androgen secretion interfere with normal follicular maturation, giving rise to menstrual irregularities, anovulatory infertility, and the accumulation of immature ovarian follicles [2].

Despite ongoing research, the underlying mechanisms of PCOS remain not fully understood. However, a substantial body of evidence implicates insulin resistance (IR) as a key factor in its development. IR is also closely linked with metabolic abnormalities, such as type 2 diabetes mellitus (T2DM), dyslipidemia, nonalcoholic fatty liver disease, and cardiovascular disorders. Strategies aimed at improving insulin sensitivity have shown beneficial effects on the clinical and metabolic manifestations of PCOS. Thus, evaluating IR in women with PCOS is essential for early detection and management of associated comorbidities [3]. Glucose metabolism disorders have been reported in 44–85% of PCOS patients. This wide range of incidence rates reflects differences in PCOS phenotypes and the ethnic backgrounds of study populations [4]. Overall, women diagnosed with PCOS have an approximately 4-fold increased risk of developing T2DM after matching for age and BMI [5]. Systematic reviews also indicate that the prevalence of impaired glucose tolerance and T2DM is greater in PCOS patients, independent of obesity, which can be observed at earlier ages. However, documenting IR in clinical settings is not always easy [6].

The hyperinsulinemic-euglycemic clamp (HEC) method is considered the gold standard for evaluating IR. Nonetheless, its use in routine settings is limited due to the procedure's complexity, high-cost, and requirement for specialized equipment and expertise. As alternatives, indices such as the homeostasis model assessment of insulin resistance (HOMA-IR), the quantitative insulin sensitivity check index (QUICKI), and the fasting glucose-to-insulin ratio (FG–IR) have garnered attention in recent studies. However, these surrogate measures also present

limitations, including variability in insulin assay methods, lack of universal standardization, and relatively high costs [7]. Consequently, identifying a simpler, reliable, and more economical marker for assessing IR would be highly beneficial for everyday clinical applications. In clinical practice, HOMA-IR is the most commonly used method for assessing IR. However, the triglyceride-glucose (TyG) index has been proposed as a reliable surrogate marker for IR [8]. In insulin-resistant conditions, the removal of triglyceride (TG)-rich lipoproteins from the bloodstream becomes impaired, leading to elevated TG levels. Traditional lipid ratios—including total cholesterol to high-density lipoprotein cholesterol (TC/HDL-C), TG to high-density lipoprotein cholesterol (TG/HDL-C), and low-density lipoprotein cholesterol to HDL-C (LDL-C/HDL-C)—have been shown to correlate with IR, as measured by HOMA-IR, in women with PCOS. Moreover, the TC/HDL-C ratio has been identified as a potential indicator for both IR and cardiovascular disease risk [4]. The TyG index has emerged as a simple, cost-effective, and reliable surrogate marker of IR, which is a key pathophysiological mechanism underlying a broad spectrum of metabolic and cardiovascular disorders. Given that the TyG index is derived from routine biochemical parameters—fasting TGs and fasting plasma glucose—it offers a practical alternative to insulin-based indices and demonstrates a strong correlation with the HEC. Moreover, it has been shown to predict the onset of T2DM, assess poor glycemic control and diabetes-related complications, and reflect pancreatic β-cell dysfunction. Beyond glucose metabolism, the TyG index has also been widely applied for evaluating metabolic syndrome (MS) and cardiometabolic risk in various populations worldwide. Accumulating evidence further supports its significant association with vascular dysfunction, cardiovascular events, and all-cause mortality, suggesting that the TyG index may serve as an early and integrative indicator for cardiometabolic health and disease risk [5]. However, the predictive power and threshold values of these indices are substantially influenced by population-specific characteristics such as ethnicity, genetic variations, dietary habits, degree of urbanization, and the prevalence of obesity. The variation in population-specific TyG thresholds (e.g., 9.72 in China and 8.51 in the United Kingdom) indicates that metabolic sensitivities unique to each population should be carefully considered. Therefore, to enhance the clinical validity and applicability of the TyG index and lipid ratios, population-specific validation study in multiethnic cohorts incorporating genetic predispositions (e.g., APOA5 variants) and cultural determinants (e.g., dietary patterns and lifestyle behaviors) are warranted [9].

It is well established that low-glycemic index diets, compared with high-glycemic index diets, enhance the lipid profile by improving glucose regulation, as evidenced by reductions in HOMA-IR and fasting insulin levels, and by decreasing total TC, LDL-C, and TG levels [10]. In addition, hypoglycemic agents, antiplatelet drugs, lipid-lowering agents, and antihypertensive medications have been shown to affect the TyG index and lipid ratios [11].

The relationship between lipid ratios and IR may vary across ethnicities [8], and data on Turkish women with PCOS remain limited. This study aims to evaluate the potential utility of TG/HDL-C, TC/HDL-C, LDL-C/HDL-C, and TyG indices in identifying IR (measured by HOMA-IR). The objective is to determine whether the TyG index and traditional lipid ratios could serve as practical alternatives for assessing IR in primary care settings lacking access to HOMA testing.

2. Materials and Methods

In this retrospective study, data from 68 women diagnosed with PCOS who attended the Obstetrics and Gynecology Clinic of Antalya Training and Research Hospital (Turkey) between January 2020 and June 2023 were analyzed. The diagnosis of PCOS was established based on the 2003 Rotterdam criteria. To confirm the diagnosis, other potential causes of hyperandrogenism and ovulatory dysfunction, such as Cushing's syndrome, thyroid disorders, 21-hydroxylase deficiency, androgen-secreting tumors, congenital adrenal hyperplasia, and hyperprolactinemia, were ruled out. Hirsutism was evaluated using the Modified Ferriman–Gallwey (mFG) scoring method, while acne severity was determined using the Global Acne Grading System (GAGS).

All study procedures complied with institutional and national ethical guidelines, as well as the principles outlined in the Declaration of Helsinki (1975, revised in 2008). Ethical approval was obtained from the institutional review board under protocol number 2023–168. As this was a retrospective study, the requirement for informed consent was waived.

Anthropometric measurements (weight, height), complaints (oligomenorrhea, hirsutism, alopecia, acne), laboratory parameters (glucose, TC, TG, HDL-C, LDL-C, follicle-stimulating hormone [FS]), luteinizing hormone [LH], thyroid-stimulating hormone [TSH], prolactin, estradiol, 17-OH progesterone, dehydroepiandrosterone sulfate [DHEA-SO_4], total testosterone, glycated hemoglobin [HbA1-c], and HOMA-IR) were obtained from hospital records. The Castelli Risk Indexes (CRI) I and II are simple ratios derived from an individual's lipid profile and are used as screening tools to identify increased cardiovascular risk. CRI-I is calculated as the ratio of TC to HDL-C, whereas CRI-II is based on the ratio of LDL-C to HDL-C [12]. The TG/HDL-C, TC/HDL-C, and TyG indices were calculated as follows:

- TyG index: Ln [fasting TGs (mg/dL) $\times$ fasting glucose (mg/dL)].
- TC/HDL-C: TC (mg/dL)/HDL-C (mg/dL) (CRI-I).
- TG/HDL-C: TG (mg/dL)/HDL-C (mg/dL).

- LDL-C/HDL-C: LDL-C (mg/dL)/HDL-C (mg/dL) (CRI-II).
- HOMA-IR: [Fasting glucose (mmol/L)] × [Fasting insulin (mIU/L)]/22.5.
- IR was defined as a HOMA-IR value ≥2.5 [13].

2.1 Inclusion Criteria

Patients aged 18–35 years who were diagnosed with PCOS and who applied to our hospital's gynecology clinic were included in the study. PCOS patients with and without IR were compared via the calculation of traditional lipid ratios (TC/HDL-C, TG /HDL-C, LDL-C/HDL-C, TyG indices).

2.2 Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics for MacOS, version 29.0 (IBM Corp., Armonk, NY, USA). Categorical variables were presented as frequencies and percentages, while continuous variables were summarized as mean ± standard deviation (SD), median, and interquartile range (IQR). The normality of continuous data was assessed using the Kolmogorov–Smirnov test and skewness–kurtosis values (acceptable range: ±2). Homogeneity of variances was evaluated using Levene's test. Between-group comparisons were conducted using the Independent Samples *t*-test for normally distributed variables with homogeneous variances, and the Mann-Whitney U test for non-normally distributed variables. For categorical data, appropriate chi-square tests were applied according to expected cell frequencies: the Pearson chi-square test was used when all expected counts exceeded 5; the Yates-corrected chi-square test was applied for 2 × 2 tables when less than 20% of cells had expected counts below 5 but above 1; and Fisher's Exact test with the Monte Carlo simulation method was used when any expected count was below 1 or more than 20% of cells had expected counts below 5.

A multivariable logistic regression analysis was performed to evaluate independent predictors associated with IR (HOMA-IR ≥2.5). Variables that were significant at $p < 0.05$ in univariate analyses or considered clinically relevant were included in the model. Multicollinearity was assessed using the variance inflation factor (VIF), and VIF values <5 were considered indicative of no collinearity. Logistic regression results were reported as coefficients (β), odds ratios (OR), and 95% confidence intervals (CI). To assess the change in predictive power for IR when BMI and the TG-glucose index were used together, a combined logistic regression model approach was employed. Predicted probabilities obtained from the multivariable model were recorded as "predicted probabilities" and used as test variables in receiver operating characteristic (ROC) analysis. In the ROC analysis, the area under the curve (AUC) values for BMI, the TG-glucose index, and the combined model were calculated and reported for comparative purposes. ROC analyses were conducted and ROC curves plotted for parameters thought to have discriminative value for HOMA-IR ≥2.5. A p-value < 0.05 was considered statistically significant for all analyses.

3. Results

A total of 68 patients diagnosed with PCOS were included in this retrospective analysis. The individuals were divided into two groups: PCOS patients with (n = 37) and without (n = 31) IR. Women with IR had significantly greater body weights [78 (60.0–88.0) kg versus 62 (56.0–66.0) kg; $p < 0.001$] and BMIs [29.4 (24.1–35.5) kg/m^2 versus 23.1 (21.4–25.2) kg/m^2; $p < 0.001$]. The prevalence of acne was also higher in the IR group (37.8%, n = 14 versus 12.9%, n = 4; $p < 0.020$). While total testosterone levels were significantly higher in the insulin-resistant group (0.7 ± 0.2 µg/L versus 0.6 ± 0.2 µg/L; $p = 0.066$), no significant differences were observed in FSH, LH, estradiol, progesterone, or prolactin. Baseline demographic characteristics of the study population are presented in Table 1.

The glucose-related parameters included fasting blood glucose (FBG) (90.1 ± 11.5 mg/dL versus 82.3 ± 9.1 mg/dL; $p = 0.003$), HbA1-c [5.4 (5.3–5.5) versus 5.1 (5–5.3); $p < 0.001$], fasting insulin [17.4 (15.2–29.1) µIU/mL versus 6.3 (5.2–9.2) µIU/mL; $p < 0.001$] and HOMA-IR [3.7 (3.2–6.2) versus 1.4 (1.0–1.8); $p < 0.001$] were significantly greater in patients with IR.

Lipid-related parameters were significantly lower in the insulin-resistant patient group HDL-C [51 (43–56) mg/dL versus 56 (47–67) mg/dL; $p = 0.032$], whereas TG were significantly greater [112.0 (90–148) mg/dL versus 69.0 (52–100) mg/dL; $p < 0.001$]. There was no difference in LDL-C ($p = 0.798$) or TC ($p = 0.562$) levels.

The LDL-C/HDL-C ratio was not significantly different between the two groups ($p = 0.112$). However, all other calculations were significant. TC/HDL-C (3.5 ± 0.7 mg/dL versus 3.1 ± 0.7 mg/dL; $p = 0.010$), TG/HDL-C [2.4 (1.6–2.9) mg/dL versus 1.2 (0.9–1.7) mg/dL; $p < 0.001$], and the TyG index (4.6 ± 0.2 mg/dL versus 4.3 ± 0.2 mg/dL; $p < 0.001$) were higher in insulin-resistant women.

The results of the ROC analysis evaluating the discriminative performance of BMI and various lipid ratios in predicting IR in women with (HOMA-IR ≥2.5) and without (HOMA-IR <2.5) IR are presented in Table 2. According to the analysis, the TyG index demonstrated the highest predictive ability for IR ($p < 0.001$). A cutoff value of >4.41 for this parameter yielded a sensitivity of 83.8% and a specificity of 67.7%. Similarly, the TG/HDL-C ratio was found to have high discriminative power ($p < 0.001$). For BMI, a cutoff value of >26 predicted IR with 64.9% sensitivity and 87.1% specificity ($p < 0.001$). The TC/HDL-C ratio exhibited moderate discriminative performance ($p = 0.004$), whereas the LDL/HDL-C ratio did not reach statistical significance in terms of predictive ability ($p = 0.063$). Overall, these findings indicate that the TyG index and TG/HDL-C

Table 1. Demographic and clinical characteristics of the patients.

Variables	Toplam (N = 68)	No IR (n = 31)	IR (n = 37)	*p*-value
Age (years)	23 (21–25)	24 (22–26)	22 (21–24)	0.081
Education				0.165
-Middle school	1 (1.5)	0 (0.0)	1 (2.7)	
-High school	45 (66.2)	24 (77.4)	21 (56.8)	
-University	22 (32.4)	7 (22.6)	15 (40.5)	
Employment status				0.280
-Not working	53 (77.9)	26 (83.9)	27 (73.0)	
-Working	15 (22.1)	5 (16.1)	10 (27.0)	
Marital status				0.566
-Single	55 (80.9)	26 (83.9)	29 (78.4)	
-Married	13 (19.1)	5 (16.1)	8 (21.6)	
Amenorrhea (months)	2 (2–3)	2 (2–3)	2 (2–3)	0.516
Weight (kg)	65 (57.5–84.5)	62 (56.0–66.0)	78 (60.0–88.0)	0.001
Height (cm)	160.8 ± 5.9	161.9 ± 4.7	159.9 ± 6.8	0.153
BMI (kg/m^2)	25.2 (22.6–32.1)	23.1 (21.4–25.2)	29.4 (24.1–35.5)	<0.001
Hirsutism	50 (73.5)	23 (74.2)	27 (73.0)	0.910
Acne	18 (26.5)	4 (12.9)	14 (37.8)	0.020
Alopecia	2 (2.9)	0 (0.0)	2 (5.4)	0.496
Smoking	4 (5.9)	1 (3.2)	3 (8.1)	0.620
FSH (U/L)	5.9 ± 1.9	6.3 ± 1.8	5.7 ± 1.9	0.196
LH (U/L)	9.9 (6.4–13.4)	10.1 (6.5–13.8)	9.9 (6–13)	0.563
Estradiol (ng/L)	40 (33–57)	42 (34–54)	38 (33–60)	0.956
Total testosterone (µg/L)	0.7 ± 0.2	0.6 ± 0.2	0.7 ± 0.2	0.066
DHEA-SO_4 (µg/dL)	262.1 (207.8–340.3)	249.7 (164.8–304.5)	277.8 (226.8–360.3)	0.095
17-OH-progesteron	0.6 (0.4–1.2)	0.5 (0.4–0.9)	0.7 (0.5–1.6)	0.095
TSH (µIU/mL)	1.8 (1.3–2.4)	1.8 (1.3–2.1)	1.8 (1.2–2.8)	0.579
HbA1-c (%)	5.3 (5.1–5.5)	5.1 (5.0–5.3)	5.4 (5.3–5.5)	<0.001
Fasting insulin (IU/L)	12.7 (6.4–17.7)	6.3 (5.2–9.2)	17.4 (15.2–29.1)	<0.001
HOMA-IR	2.7 (1.4–3.9)	1.4 (1.0–1.8)	3.7 (3.2–6.2)	<0.001
Fasting glucose (mg/dL)	86.6 ± 11.1	82.3 ± 9.1	90.1 ± 11.5	0.003
HDL-C (mg/dL)	52 (46–60)	56 (47–67)	51 (43–56)	0.032
LDL-C (mg/dL)	100.3 ± 26.8	99.4 ± 27.9	101.1 ± 26.1	0.798
TG (mg/dL)	95.5 (65–135)	69.0 (52–100)	112.0 (90–148)	<0.001
TC (mg/dL)	174.4 ± 31.8	171.9 ± 32.9	176.4 ± 31.1	0.562
Prolactin (ng/mL)	15.1 (10.8–19.4)	16 (11.0–21.3)	13.3 (10.7–18.0)	0.449
TyG index	4.5 ± 0.2	4.3 ± 0.2	4.6 ± 0.2	<0.001
TG/HDL-C	1.6 (1.2–2.6)	1.2 (0.9–1.7)	2.4 (1.6–2.9)	<0.001
TC/HDL-C	3.3 ± 0.7	3.1 ± 0.7	3.5 ± 0.7	0.010
LDL-C/HDL-C	1.9 ± 0.6	1.8 ± 0.6	2.0 ± 0.6	0.112

IR, insulin resistance; BMI, body mass index; FSH, follicle-stimulating hormone; LH, luteinizing hormone; DHEA-SO_4, dehydroepiandrosterone sulfate; TSH, Thyroid-stimulating hormone; HbA1-c, glycated hemoglobin; TC, total cholesterol; TG, triglycerides; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; TyG, triglyceride-glucose; HOMA-IR, homeostasis model assessment of insulin resistance.

Categorical variables are presented as n (%), normally distributed continuous variables as mean ± SD, and non-normally distributed continuous variables as median (IQR).

ratio possess higher discriminative value for identifying IR, as defined by HOMA-IR, compared to BMI and other lipid ratios.

The AUC indicates the statistical significance of the discrimination ability of the diagnostic test. Since the diagnostic test evaluated in our study revealed that the patients' HOMA-IR value was ≥2.5, the BMI and TC/HDL-C ratio were moderate (70%–80%), and the TyG index and TG/HDL-C (80%–90%) ratio were strong. LDL-C/HDL-C measurement was not statistically significant (Fig. 1).

Table 2. ROC analysis results for BMI and lipid ratios according to HOMA-IR (≥2.5 and <2.5) groups.

Risk factors	AUC (95% CI)	Cutoff	*p*-value	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
BMI	0.772 (0.658–0.886)	>26.00	<0.001	64.9	87.1	85.7	67.5
TyG index	0.838 (0.746–0.931)	>4.41	<0.001	83.8	67.7	75.6	77.8
TG/HDL-C	0.817 (0.715–0.919)	>1.44	<0.001	81.1	71.0	76.9	75.9
TC/HDL-C	0.705 (0.577–0.833)	>3.29	0.004	62.2	80.6	79.3	64.1
LDL-C/HDL-C	0.632 (0.496–0.767)	>1.91	0.063	56.8	74.2	72.4	59.0

AUC, area under curve; CI, confidence interval; PPV, positive predictive value; NPV, negative predictive value.

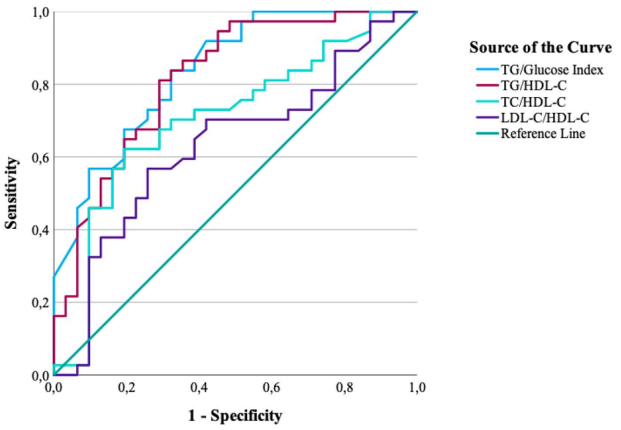

Fig. 1. ROC curves of BMI and lipid ratios for predicting IR (HOMA-IR ≥2.5). ROC, receiver operating characteristic.

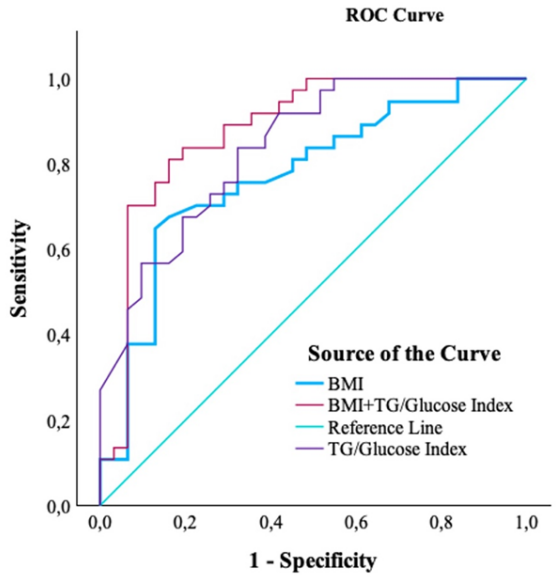

Fig. 2. Combined ROC curve (BMI + TyG index) compared with BMI and TyG index alone for predicting IR.

To evaluate the additional diagnostic value of the TyG index over BMI, a combined logistic regression model, including BMI and TyG index values, was constructed, and the predicted probabilities of the model were subjected to ROC analysis. The combined model demonstrated the highest discriminative ability [AUC = 0.880, 95% CI: 0.792–0.968], performing significantly better than the model including BMI alone [AUC = 0.772, 95% CI: 0.658–0.886] and the model using the TyG index alone [AUC = 0.838, 95% CI:0.746–0.931]. These results indicate that the TyG index provides additional and BMI-independent diagnostic value in identifying IR in women with PCOS (Fig. 2).

Table 3. Multivariate logistic regression analysis for predictors of IR.

Variable	β	OR*	95% CI	*p*-value
BMI (per 1 kg/m^2)	0.147	1.16	1.02–1.32	0.025
TyG index (per 0.1-unit increase)	0.657	1.93	1.34–2.77	<0.001

*OR values were calculated after rescaling TG-glucose index by multiplying by 10 so that odds ratios represent the effect per 0.1-unit increase.
OR, odds ratio.

A multivariable logistic regression analysis was performed to evaluate independent predictors associated with IR (HOMA-IR ≥2.5). Both BMI and the TyG index were included in this model. The analysis showed that each 1 kg/m^2 increase in BMI was significantly associated with IR (OR = 1.16; $p = 0.025$). Even after adjusting for BMI, the TyG index remained an independent predictor of IR, with each 0.1-unit increase in the TyG index approximately doubled the likelihood of IR (OR = 1.93; $p < 0.001$). These findings indicate that the TyG index provides additional diagnostic value in predicting IR in women with PCOS, independent of obesity (Table 3).

4. Discussion

In recent years, the TyG index has emerged as a practical, inexpensive, and reliable indicator of IR. Owing to its simplicity and accessibility, it has attracted attention as a promising biomarker that may be useful in predicting several metabolic and systemic disorders. Furthermore, the TyG index has been associated with conditions such as diabetes mellitus, cardiovascular events, fatty liver disease, metabolic lung disorders, and gastric cancers, and it is anticipated to gain broader use in routine practice, particularly in primary healthcare settings [14–16].

Yang *et al.* (2023) [17] reported that the TyG index was strongly and independently associated with *MS* in women with PCOS. PCOS creates a facilitating environment for additional comorbidities, and according to Yang *et al.* [17], the TyG index is independently associated with risk factors, including hypertension, obesity, central obesity, hyperglycemia, and dyslipidemia. On the contrary, in women without PCOS, the TyG index is independently associated with only obesity and hyperglycemia. Moreover, Yang *et al.* [17] reported that a higher TyG index led to an increased incidence of MS in patients with PCOS.

In a study conducted in Brazil, Vasques *et al*. (2011) [18] demonstrated that the TyG index was slightly more effective than HOMA-IR in detecting IR. Similarly, Zheng *et al*. (2022) [19] found that higher TyG index levels were correlated with IR—evaluated through HOMA-IR, QUICKI, and FG-IR—among Chinese women diagnosed with PCOS. Their findings indicated that both the TyG index and TyG-BMI outperformed conventional lipid parameters and ratios in predicting IR, suggesting their potential use as diagnostic markers in this population [19]. Moreover, when compared with lipid ratios such as TG/HDL-C, the TyG index showed a higher AUC in studies involving Iranian women [20].

In our research, the AUC values of BMI and the TC/HDL-C ratio were moderate, whereas those of the TyG index and TG/HDL-C ratio demonstrated stronger predictive capacity for IR. Consistent with our observations, Kheirollahi *et al*. (2020) [20] also observed in Iranian women with PCOS that TG/HDL-C was significantly correlated with IR, and could serve as a useful alternate marker. Similarly, we observed that women with PCOS and IR exhibited elevated values of the TyG index, TG/HDL-C, and TC/HDL-C ratios.

The TyG index has recently gained recognition as a useful marker in patients with PCOS as well as those with T2DM. Serving as a composite indicator derived from FPG and TG levels, it has been identified as a strong predictor for both prediabetes and T2DM. In a Korean population with T2DM, the TyG index demonstrated superior performance compared with HOMA-IR in assessing IR [21]. Similarly, a study involving 3307 Colombian participants indicated that the TyG index was more effective than BMI, waist circumference (WC), and the visceral adiposity index (VAI) in identifying individuals at risk for prediabetes [22]. In addition, a cohort study by Wen *et al*. (2020) [23] that followed 4543 Chinese adults without baseline diabetes or prediabetes found that the TyG index showed a higher AUC for predicting prediabetes and isolated impaired glucose tolerance (IGT) compared with FPG, WC, and BMI.

Limitations

This study has three main limitations. First, it was a retrospective study based on existing medical records, which may have been subject to potential data incompleteness or reporting bias. Second, the study was conducted at a single tertiary center, which may limit the generalizability of the findings. Third, the sample size was relatively small, which may limit the statistical power of the study.

5. Conclusions

The TyG index, TG/HDL-C ratio, and TC/HDL-C ratio may be utilized to identify IR in patients with PCOS. Lipid ratios appear to be more informative than lipid parameters alone. These findings suggest that lipid ratios could support the detection of IR in PCOS patients at primary healthcare facilities where HOMA testing is not accessible.

Abbreviations

AUC, area under the curve; BMI, body mass index; CVD, cardiovascular disease; FG–IR, fasting glucose insulin ratio; FBG, fasting blood glucose; FSH, Follicle-stimulating hormone; HDL-C, high-density lipoprotein cholesterol; HOMA-IR, homeostasis model assessment for insulin resistance; IR, insulin resistance; LDL-C, low-density lipoprotein cholesterol; LH, Luteinizing hormone; MS, metabolic syndrome; PCOM, polycystic ovarian morphology; PCOS, polycystic ovary syndrome; QUICK, quantitative insulin sensitivity control index; ROC, Receiver Operating Characteristics; SPSS, Statistics Package for the Social Sciences; T2DM, type 2 diabetes mellitus; TC, total cholesterol; TG, triglycerides; TyG, triglyceride glucose index; VAI, visceral adiposity index.

Availability of Data and Materials

The datasets analyzed in the present study are available from the corresponding author upon reasonable request.

Author Contributions

NE and YAM have designed the study. NE has collected the data, performed statistical analysis NE and YAM prepared and reviewed the manuscript. Both authors contributed to editorial changes in the manuscript. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Ethics approval was granted by the Ethics Committee of Antalya Training and Research Hospital (Protocol No. 2023–168), and as this was a retrospective study, the requirement for informed consent was waived. The study was conducted in accordance with the guidelines of the Declaration of Helsinki.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

References

[1] Teede HJ, Tay CT, Laven JJE, Dokras A, Moran LJ, Piltonen TT, *et al*. Recommendations From the 2023 International Evidence-based Guideline for the Assessment and Management of Polycystic Ovary Syndrome. The Journal of Clinical Endocrinology and Metabolism. 2023; 108: 2447–2469. https://doi.org/10.1210/clinem/dgad463.

[2] Shrivastava S, Conigliaro RL. Polycystic Ovarian Syndrome. The Medical Clinics of North America. 2023; 107: 227–234. https://doi.org/10.1016/j.mcna.2022.10.004.

[3] Lemaitre M, Christin-Maitre S, Kerlan V. Polycystic ovary syndrome and adipose tissue. Annales D'endocrinologie. 2023; 84: 308–315. https://doi.org/10.1016/j.ando.2022.11.004.

[4] Herman R, Sikonja J, Jensterle M, Janez A, Dolzan V. Insulin Metabolism in Polycystic Ovary Syndrome: Secretion, Signaling, and Clearance. International Journal of Molecular Sciences. 2023; 24: 3140. https://doi.org/10.3390/ijms24043140.

[5] Kurniawan LB. Triglyceride-Glucose Index As A Biomarker Of Insulin Resistance, Diabetes Mellitus, Metabolic Syndrome, And Cardiovascular Disease: A Review. EJIFCC. 2024; 35: 44–51.

[6] Chiaffarino F, Cipriani S, Dalmartello M, Ricci E, Esposito G, Fedele F, *et al*. Prevalence of polycystic ovary syndrome in European countries and USA: A systematic review and meta-analysis. European Journal of Obstetrics, Gynecology, and Reproductive Biology. 2022; 279: 159–170. https://doi.org/10.1016/j.ejogrb.2022.10.020.

[7] Zhao H, Zhang J, Cheng X, Nie X, He B. Insulin resistance in polycystic ovary syndrome across various tissues: an updated review of pathogenesis, evaluation, and treatment. Journal of Ovarian Research. 2023; 16: 9. https://doi.org/10.1186/s13048-022-01091-0.

[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. Nutrition, Metabolism, and Cardiovascular Diseases: NMCD. 2022; 32: 596–604. https://doi.org/10.1016/j.numecd.2021.11.017.

[9] Mi W, Hao YH, Wan MG, Zhang JL, Huang HM, Song CZ, *et al*. Comparative study of triglyceride glucose index and coronary heart disease risk in middle aged and elderly Chinese and British populations. Scientific Reports. 2025; 15: 22637. https://doi.org/10.1038/s41598-025-08133-9.

[10] Kazemi M, Hadi A, Pierson RA, Lujan ME, Zello GA, Chilibeck PD. Effects of Dietary Glycemic Index and Glycemic Load on Cardiometabolic and Reproductive Profiles in Women with Polycystic Ovary Syndrome: A Systematic Review and Meta-analysis of Randomized Controlled Trials. Advances in Nutrition (Bethesda, Md.). 2021; 12: 161–178. https://doi.org/10.1093/advances/nmaa092.

[11] Zhang Y, Wang R, Fu X, Song H. Non-insulin-based insulin resistance indexes in predicting severity for coronary artery disease. Diabetology & Metabolic Syndrome. 2022; 14: 191. https://doi.org/10.1186/s13098-022-00967-x.

[12] Raaj I, Thalamati M, Gowda M N V, Rao A. The Role of the Atherogenic Index of Plasma and the Castelli Risk Index I and II in Cardiovascular Disease. Cureus. 2024; 16: e74644. https://doi.org/10.7759/cureus.74644.

[13] Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC. Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. Diabetologia. 1985; 28: 412–419. https://doi.org/10.1007/BF00280883.

[14] Park B, Lee HS, Lee YJ. Triglyceride glucose (TyG) index as a predictor of incident type 2 diabetes among nonobese adults: a 12-year longitudinal study of the Korean Genome and Epidemiology Study cohort. Translational Research: the Journal of Laboratory and Clinical Medicine. 2021; 228: 42–51. https://doi.org/10.1016/j.trsl.2020.08.003.

[15] Wu TD, Fawzy A, Brigham E, McCormack MC, Rosas I, Villareal DT, *et al*. Association of Triglyceride-Glucose Index and Lung Health: A Population-Based Study. Chest. 2021; 160: 1026–1034. https://doi.org/10.1016/j.chest.2021.03.056.

[16] Yang K, Liu W. Triglyceride and Glucose Index and Sex Differences in Relation to Major Adverse Cardiovascular Events in Hypertensive Patients Without Diabetes. Frontiers in Endocrinology. 2021; 12: 761397. https://doi.org/10.3389/fendo.2021.761397.

[17] Yang H, Chen Y, Liu C. Triglyceride-glucose index is associated with metabolic syndrome in women with polycystic ovary syndrome. Gynecological Endocrinology: the Official Journal of the International Society of Gynecological Endocrinology. 2023; 39: 2172154. https://doi.org/10.1080/09513590.2023.2172154.

[18] Vasques ACJ, Novaes FS, de Oliveira MDS, Souza JRM, Yamanaka A, Pareja JC, *et al*. TyG index performs better than HOMA in a Brazilian population: a hyperglycemic clamp validated study. Diabetes Research and Clinical Practice. 2011; 93: e98–e100. https://doi.org/10.1016/j.diabres.2011.05.030.

[19] Zheng Y, Yin G, Chen F, Lin L, Chen Y. Evaluation of Triglyceride Glucose Index and Homeostasis Model of Insulin Resistance in Patients with Polycystic Ovary Syndrome. International Journal of Women's Health. 2022; 14: 1821–1829. https://doi.org/10.2147/IJWH.S387942.

[20] Kheirollahi A, Teimouri M, Karimi M, Vatannejad A, Moradi N, Borumandnia N, *et al*. Evaluation of lipid ratios and triglyceride-glucose index as risk markers of insulin resistance in Iranian polycystic ovary syndrome women. Lipids in Health and Disease. 2020; 19: 235. https://doi.org/10.1186/s12944-020-01410-8.

[21] Lee SH, Kwon HS, Park YM, Ha HS, Jeong SH, Yang HK, *et al*. Predicting the development of diabetes using the product of triglycerides and glucose: the Chungju Metabolic Disease Cohort (CMC) study. PloS One. 2014; 9: e90430. https://doi.org/10.1371/journal.pone.0090430.

[22] Ramírez-Vélez R, Pérez-Sousa MÁ, González-Ruíz K, Cano-Gutierrez CA, Schmidt-RioValle J, Correa-Rodríguez M, *et al*. Obesity- and Lipid-Related Parameters in the Identification of Older Adults with a High Risk of Prediabetes According to the American Diabetes Association: An Analysis of the 2015 Health, Well-Being, and Aging Study. Nutrients. 2019; 11: 2654. https://doi.org/10.3390/nu11112654.

[23] Wen J, Wang A, Liu G, Wang M, Zuo Y, Li W, *et al*. Elevated triglyceride-glucose (TyG) index predicts incidence of Prediabetes: a prospective cohort study in China. Lipids in Health and Disease. 2020; 19: 226. https://doi.org/10.1186/s12944-020-01401-9.