Diagnostic Value of the Triglyceride-Glucose Index in Predicting Metabolic Syndrome in Women with Polycystic Ovary Syndrome

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ABSTRACT

Background: Polycystic ovary syndrome (PCOS) is associated with a high risk of metabolic syndrome (MetS), increasing cardiovascular complications. The Triglyceride-Glucose (TyG) index is a simple marker of insulin resistance, but its utility in predicting MetS in Vietnamese PCOS patients is underexplored. **Methods:** A cross-sectional study was conducted on 105 women diagnosed with PCOS (Rotterdam criteria) at Da Nang Hospital of Women and Children from September 2019 to June 2020. Clinical parameters, lipid profiles, glucose, and TyG index (calculated as ln[Triglycerides × Glucose/2]) were assessed. MetS was diagnosed following the IDF 2006 criteria. Data were analyzed using SPSS 20.0 and MedCalc 12.5, with $p < 0.05$ considered significant. **Results:** Mean TyG index was 8.98 ± 0.61. TyG was higher in women ≥35 years (9.16 ± 0.58 vs. 8.84 ± 0.61, $p = 0.043$), those with hypertension (9.41 ± 0.36 vs. 8.77 ± 0.59, $p < 0.05$), and those with MetS (9.73 ± 0.59 vs. 9.29 ± 0.47, $p < 0.05$). TyG predicted MetS with an AUC of 0.772, sensitivity of 83.3%, specificity of 64%, and cut-off >8.895, outperforming individual MetS components. Conclusion: The TyG index is a valuable, cost-effective tool for predicting MetS in Vietnamese women with PCOS, supporting early screening and intervention to reduce cardiovascular risk.

Keywords: Triglyceride-Glucose Index, Metabolic Syndrome, Polycystic Ovary Syndrome, Insulin Resistance, Cardiovascular Risk

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a prevalent endocrine disorder affecting 6–20% of reproductive-aged women, characterized by hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology [1]. PCOS is closely linked to insulin resistance (IR), a key driver of metabolic syndrome (MetS), which encompasses central obesity, hypertension, dyslipidemia, and impaired glucose tolerance [2]. A meta-analysis by Lim et al. (2019) reported that women with PCOS have a 2–4-fold higher risk of MetS compared to healthy controls, increasing the likelihood of cardiovascular disease (CVD) and type 2 diabetes mellitus (T2DM) [3]. In Vietnam, MetS prevalence in PCOS women ranges from 20–40%, underscoring the need for early screening to mitigate long-term complications [4].

The Triglyceride-Glucose (TyG) index, calculated as ln[Triglycerides (mg/dL) × Fasting Glucose (mg/dL)/2], is a simple, cost-effective marker of IR, reflecting the interplay between lipid and glucose metabolism [5]. Unlike traditional IR measures like the Homeostatic Model

Assessment of Insulin Resistance (HOMA-IR), TyG requires only routine biochemical tests, making it feasible in resource-limited settings [6]. Studies, such as Zhang et al. (2023), have demonstrated TyG's utility in predicting MetS in PCOS patients, with higher TyG values correlating with increased IR and cardiovascular risk [7]. Yang et al. (2023) further reported TyG's superior predictive performance over individual MetS components in Chinese PCOS cohorts [8].

In Vietnam, MetS screening in PCOS patients relies on complex International Diabetes Federation (IDF) criteria, requiring multiple laboratory tests (e.g., waist circumference, HDL-C, triglycerides, glucose), which are costly and less accessible in regional hospitals [9]. The TyG index offers a promising alternative for early MetS detection, but its application in Vietnamese PCOS patients remains underexplored. This study aims to: (1) determine the TyG index in women with PCOS, and (2) evaluate its predictive value for MetS in this population at Da Nang Obstetrics and Pediatrics Hospital.

MATERIALS AND METHOD

Study Design

A cross-sectional descriptive study was conducted on women with PCOS at Da Nang Obstetrics and Pediatrics Hospital from September 1, 2019, to June 30, 2020.

Participants

The study included 105 women aged 18 – 45 years diagnosed with PCOS per Rotterdam criteria (2003) [10].

Inclusion criteria: Confirmed PCOS diagnosis based on at least two of three criteria (oligo-/anovulation, clinical/biochemical hyperandrogenism, polycystic ovaries on ultrasound).

Exclusion criteria: Pregnancy, use of insulin-sensitizing drugs (e.g., metformin) within 3 months, or other endocrine disorders (e.g., thyroid dysfunction, hyperprolactinemia).

Participants were consecutively enrolled.

Sample Size

The sample size was calculated using:

$$n = \frac{Z_{1-a/2}^2 \times p \times (1-p)}{d^2}$$

With: $(Z_{(1-\alpha/2)}^2 = 1.96)$ (95% confidence level), (p = 0.353) (MetS prevalence in PCOS from Weerakiet et al., 2007 [11]), (d = 0.1) (margin of error).

This yielded a minimum sample size of 88. A total of 105 participants were included to account for incomplete data.

Data Collection

Data were collected via medical records and clinical examinations:

Demographics: Age (< 35 vs. ≥ 35 years).

Anthropometric measures: Height, weight (BMI: < 23 vs. ≥ 23 kg/m²), waist circumference (WC, normal: < 80 cm; increased: ≥ 80 cm).

Clinical parameters: Blood pressure (hypertension: ≥ 130/85 mmHg).

Biochemical parameters: Fasting glucose, triglycerides (TG), total cholesterol, HDL-C, LDL-C (measured using standard enzymatic methods).

TyG index: Calculated as ln[Triglycerides (mg/dL) × Fasting Glucose (mg/dL)/2].

MetS diagnosis: Per IDF 2006 criteria, requiring WC ≥ 80 cm plus ≥ 2 of: TG ≥ 150 mg/dL (1.7 mmol/L), HDL-C < 50 mg/dL (1.3 mmol/L), blood pressure ≥ 130/85 mmHg, fasting glucose ≥ 100 mg/dL (5.6 mmol/L), or diagnosed T2DM [12].

Data were recorded anonymously using a standardized form.

Statistical Analysis

Data were analyzed using SPSS 20.0 and MedCalc 12.5. Descriptive statistics included means ± standard deviations (SD) and frequencies (%). Independent t-tests compared TyG across groups (age, BMI, hypertension, WC, MetS status). Receiver Operating Characteristic (ROC) analysis assessed TyG's predictive performance for MetS, reporting area under the curve (AUC), sensitivity, specificity, and optimal cut-off. Statistical significance was set at p-value < 0.05.

Ethical Issues

The study was approved by the Biomedical Ethics Committee of Da Nang University of Medical Technology and Pharmacy (No. 2019-12/BB-HĐĐĐ, August 2019) and Da Nang Obstetrics and Pediatrics Hospital. Informed consent was obtained from all participants, and data were anonymized per the Declaration of Helsinki.

RESULTS

Participant Characteristics

Of 105 women with PCOS, 82.9% (n=87) were <35 years (mean age: 28.9 ± 4.9 years). BMI was ≥23 kg/m² in 66.7% (n=70), hypertension was present in 19% (n=20), and increased WC (≥80 cm) in 39% (n=41) (Table 1).

Table 1. Demographic and Clinical Characteristics of Women with PCOS

Characteristic	No. (percentage)
Total	105 (100)
Age	
<35 years	87 (82.9)
≥35 years	18 (17.1)
Age (years) (Mean ± SD)	28.9 ± 4.9
BMI (kg/m²)	
<23	35 (33.3)
≥23	70 (66.7)
Blood Pressure	
Hypertension (≥130/85 mmHg)	20 (19.0)
Normal	85 (81.0)
Waist Circumference	
Normal (<80 cm)	64 (61.0)
Increased (≥80 cm)	41 (39.0)

Triglyceride-Glucose Index

Mean TyG index was 8.98 ± 0.61. TyG was significantly higher in women ≥ 35 years (9.16 ± 0.58 vs. 8.84 ± 0.61, p = 0.043), those with hypertension (9.41 ± 0.36 vs. 8.77 ± 0.59, p < 0.05), and those with MetS (9.73 ± 0.59 vs. 9.29 ± 0.47, p < 0.05). No significant differences were observed by BMI (p > 0.05) or WC (p > 0.05) (Table 2).

Table 2. TyG Index by Participant Characteristics

Characteristic	TyG (Mean ± SD)	p-value
Overall	8.98 ± 0.61	

Age		
<35 years	8.84 ± 0.61	0.043
≥35 years	9.16 ± 0.58	
BMI (kg/m²)		
<23	8.96 ± 0.59	ns
≥23	8.86 ± 0.62	
Blood Pressure		
Hypertension	9.41 ± 0.36	<0.05
Normal	8.77 ± 0.59	
Waist encircle		
Normal	8.81 ± 0.62	ns
Increased	9.03 ± 0.57	
MetS Status		
With MetS	9.73 ± 0.59	<0.05
Without MetS	9.29 ± 0.47	

ns: not significant

Predictive Value of TyG for MetS

ROC analysis showed TyG's predictive value for MetS with an AUC of 0.772 (95% CI: 0.678–0.866), sensitivity of 83.3%, specificity of 64%, and optimal cut-off > 8.895. TyG outperformed individual MetS components (e.g., glucose, WC, HDL-C) in predicting MetS (Figure 1).
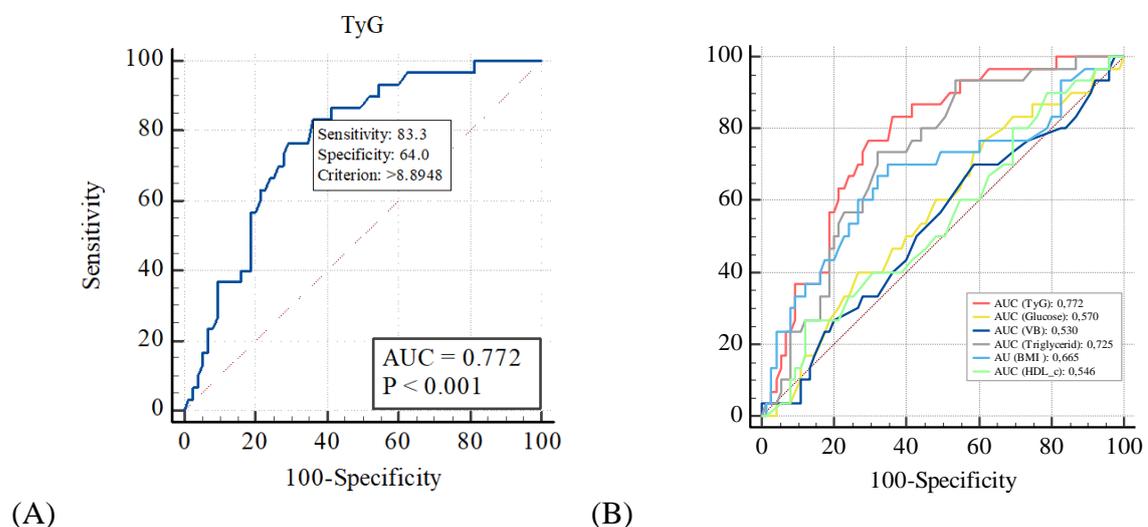

(A)   (B)

***Figure 1.** ROC Curve for TyG in Predicting MetS in Women with PCOS.*
(A) The ROC curve demonstrates TyG's ability to predict MetS (AUC = 0.772, cut-off >8.895, sensitivity 83.3%, specificity 64%).
(B) Comparison of the value of TyG index and single MetS parameters in predicting MetS in women with PCOS.

DISCUSSION

This study found a mean TyG index of 8.98 ± 0.61 in Vietnamese women with PCOS, with higher values in those ≥ 35 years, with hypertension, or with MetS. TyG demonstrated good predictive performance for MetS (AUC = 0.772, cut-off > 8.895),

outperforming individual MetS components. These findings highlight TyG's potential as a simple, cost-effective screening tool for MetS in PCOS patients in resource-limited settings like Vietnam.

TyG Index and PCOS

The mean TyG of 8.98 ± 0.61 aligns with international studies, such as Yang et al. (2023) (8.60 ± 0.60) and Kwon et al. (2023) (8.12 ± 0.61), confirming elevated TyG in PCOS due to IR-driven dyslipidemia and hyperglycemia [8,13]. Higher TyG in PCOS compared to non-PCOS populations, as reported by Zhang et al. (2023), reflects the syndrome's metabolic burden, even in younger women (mean age: 28.9 years) [7]. IR, a central feature of PCOS, impairs lipoprotein lipase activity, increasing TG, while reducing glucose uptake in muscle and liver, elevating fasting glucose [14]. These metabolic derangements, captured by TyG, underscore its relevance in PCOS.

The significant association of TyG with age ≥ 35 years ($p = 0.043$) corroborates Kwon et al. (2023), who found a positive correlation between TyG and age in PCOS ($r = 0.61$) [13]. Aging exacerbates IR through reduced muscle mass, increased visceral fat, and hormonal shifts, amplifying TyG [15]. The lack of association with BMI ($p > 0.05$) or WC ($p > 0.05$) suggests TyG's utility in detecting metabolic risk across body types, as noted by Radic et al. (2025), who reported TyG's independence from obesity in PCOS [16]. This is critical in Vietnam, where lean PCOS phenotypes are common, yet metabolic risks persist [17].

TyG and MetS Prediction

TyG's AUC of 0.772 for MetS prediction is comparable to Yang et al. (2023) (AUC = 0.82, cut-off > 8.65) and Kheirollahi et al. (2020) (AUC = 0.78, cut-off > 8.7), affirming its robustness across Asian populations [8,18]. The cut-off > 8.895, with 83.3% sensitivity and 64% specificity, balances early detection with diagnostic accuracy, suitable for screening in high-risk groups like PCOS. TyG's superiority over single MetS components (e.g., glucose, HDL-C) aligns with Nayak et al. (2024), who highlighted TyG's integration of lipid and glucose metabolism as a stronger IR surrogate than isolated markers [19].

MetS in PCOS, driven by IR, hyperandrogenism, and visceral adiposity, increases CVD risk through endothelial dysfunction, arterial stiffness, and inflammation [20]. TyG's early elevation, even when glucose remains normal, as observed in our study, supports its role in detecting preclinical MetS, as proposed by Guerrero-Romero et al. (2010) [21]. In Vietnam, where MetS prevalence in PCOS is 20–40% [4], TyG's simplicity (requiring only TG and glucose) addresses barriers to comprehensive IDF-based screening, which demands multiple tests [22].

Clinical Implications

The 19% hypertension and 39% increased WC prevalence in our cohort, despite a young mean age, underscore PCOS's cardiovascular risk, consistent with Pham Thi Bich Ngoc (2020), who reported 63% dyslipidemia in Vietnamese PCOS patients [23]. TyG's association with hypertension ($p < 0.05$) and MetS ($p < 0.05$) suggests its utility in identifying high-risk patients for targeted interventions (e.g., lifestyle modification, metformin). In Vietnam's resource-constrained healthcare system, TyG-based screening could prioritize patients for further evaluation, reducing CVD burden, as advocated by Tran et al. (2021) [24].

Guidelines, such as those from the Androgen Excess and PCOS Society, recommend

MetS screening in PCOS [25]. Integrating TyG into routine practice could streamline this process, particularly in regional hospitals like Da Nang, where advanced IR tests (e.g., HOMA-IR) are unavailable. Training clinicians to interpret TyG, alongside blood pressure and WC, could enhance early detection, as demonstrated in community health programs in Vietnam [26].

The cross-sectional design limits causality inferences. The single-center setting and moderate sample size (n=105) may reduce generalizability, particularly for Vietnam's diverse PCOS phenotypes. Lack of HOMA-IR or hyperinsulinemic-euglycemic clamp data prevents direct IR comparison with TyG. The study did not assess longitudinal outcomes, such as CVD events, limiting prognostic insights. Future multi-center studies with larger cohorts, longitudinal follow-up, and additional IR markers are needed to validate TyG's cut-off and long-term predictive value.

CONCLUSION

To conclude, the TyG index (mean: 8.98 ± 0.61) is elevated in Vietnamese women with PCOS, particularly those ≥ 35 years, with hypertension, or with MetS. With an AUC of 0.772 and cut-off >8.895, TyG is a valuable, cost-effective tool for predicting MetS, outperforming individual MetS components. Its adoption in routine screening could enhance early detection and intervention, reducing cardiovascular risk in Vietnam's PCOS population.

Supplementary Materials
None.

Institutional Review Board Statement
The study adhered to the Declaration of Helsinki and was approved by the Ethics Committee of Da Nang University of Medical Technology and Pharmacy (No. 2019-12/BB-HĐĐĐ, August 20, 2019).

Informed Consent Statement
Informed consent was obtained from all participants.

Data Availability Statement
Data are available from the corresponding author upon reasonable request.

Conflicts of Interest
The authors declare no conflict of interest.

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