Association of Triglyceride-Glucose Index and Its Derived Parameters with Metabolic Syndrome in Indonesian Police Officers: A Cross-Sectional Study

Yusuf Aji Samudera Nurrobi[a], Chabib Fachry Albab[a], Ken Christian Kawilarang[a], Meity Ardiana[a,b]

[a] *Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia*
[b] *Department of Cardiology and Vascular Medicine, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia*

ARTICLE INFO

Article history:
Submitted: 18. 8. 2025
Accepted: 1. 9. 2025
Available online: 12. 5. 2026

Klíčová slova:
Inzulinová rezistence
Metabolický syndrom
Poměr TyG
Pracovní lékařství

SOUHRN

Kontext: Poměr triglyceridy-glukóza (TyG) a jeho odvozené parametry TyG-BMI, TyG-WC a TyG-WHtR byl u řady populací uváděn do spojitosti s metabolickým syndromem (MetS); je známo, že se jedná o zástupné inzulinové rezistence. Těsnost této spojitosti se však může mezi různými rasami a skupinami povolání lišit.
Cíl: Posoudit vztah mezi metabolickým syndromem a indexem triglyceridy-glukóza a přidruženými parametry u indonéských policistů.
Metody: V popisované průřezové studii bylo vyšetřeno 3 600 zaměstnanců indonéské policie ve věku 33 až 70 let (3 201 mužů a 399 žen). Index TyG a od něj odvozené parametry byly vypočítávány s použitím antropometrických údajů a nalačno odebíraných krevních vzorků. Pro definování přítomnosti MetS byla použita harmonizovaná kritéria (≥ 3 z 5 složek). Pro výpočet korelací a zjišťování rozlišovacích schopností byly použity plocha pod křivkou operační charakteristiky přijímače (receiver operating characteristic, ROC) a logistická regrese.
Výsledky: U žen byly nalezeny vyšší hodnoty TyG-WHtR, zatímco u mužů byly naměřeny vyšší průměrné hodnoty TyG, TyG-BMI a TyG-WC. V multivariačních modelech nebyly zjištěny žádné statisticky významné korelace mezi některým z indexů a MetS ($p > 0{,}05$). Nedostatečné diskriminační schopnosti byly nalezeny při analýze ROC parametrů TyG (AUC = 0,512), TyG-BMI (0,505), TyG-WC (0,518) a TyG-WHtR (0,519).
Závěr: V popisované průřezové studii s indonéskými policisty se poměr TyG a jeho varianty u MetS statisticky významně nelišily, což ukazuje, že indexy založené na poměru TyG nemusejí být u této konkrétní skupiny zaměstnanců užitečné. Uvedené výsledky podtrhují nutnost validace sledovaných parametrů pro specifické populace a hodnocení alternativních markerů rizika.

Keywords:
Insulin resistance
Metabolic syndrome
Occupational health
TyG index

ABSTRACT

Background: The triglyceride-glucose (TyG) index and its derivatives, TyG-BMI, TyG-WC, and TyG-WHtR, have been linked to metabolic syndrome (MetS) in a number of populations and are known to be surrogate markers for insulin resistance. Their association value, however, can change among various racial and vocational groups.
Objective: To assess the relationship between metabolic syndrome and the triglyceride-glucose index and its related characteristics in Indonesian police officers.
Methods: 3,600 Indonesian police personnel between the ages of 33 and 70 were evaluated in this cross-sectional study (3,201 men and 399 women). The TyG index and its derivatives were computed using anthropometric data and fasting blood samples. The harmonized criteria (≥3 of 5 components) were used to define MetS. To ascertain correlations and discriminative capacities, investigations using receiver operating characteristic (ROC) curves and logistic regression were performed.
Results: Females had greater TyG-WHtR, while males had higher mean values for TyG, TyG-BMI, and TyG-WC. In multivariable models, there were no significant correlations between any of the indices and MetS ($p > 0.05$). Poor discriminative capacities were found by ROC analysis for TyG (AUC = 0.512), TyG-BMI (0.505), TyG-WC (0.518), and TyG-WHtR (0.519).
Conclusion: The TyG score and its variants did not significantly correlate with MetS in this cross-sectional study of Indonesian police officers, indicating that TyG-based indices may not be very useful in this particular occupational group. These results underline the necessity for population-specific validation and the evaluation of alternative risk markers.

Address: Meity Ardiana, Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia,
e-mail: meityardiana@fk.unair.ac.id
DOI: 10.33678/cor.2025.092

Please cite this article as: Nurrobi YAS, Albab CF, Kawilarang KC, Ardiana M. Association of Triglyceride-Glucose Index and Its Derived Parameters with Metabolic Syndrome in Indonesian Police Officers: A Cross-Sectional Study. Cor Vasa 2026;68:150–156.

Background

The term “metabolic syndrome” (MetS) refers to a collection of associated cardiometabolic disorders that raise the risk of type 2 diabetes and cardiovascular disease, including central obesity, atherogenic dyslipidemia, hypertension, and hyperglycemia.[1]

It has become a global pandemic, affecting roughly 20–25% of adults.[2] Rapid urbanization and lifestyle changes have contributed to a high burden of MetS in Southeast Asia. According to harmonized criteria, which include an ethnicity-specific definition of central obesity (waist circumference ≥90 cm for Asian males or ≥80 cm for Asian women), a person is typically diagnosed with MetS if they display at least three of the five risk factors.[4] This syndrome is of particular public health concern in occupational groups like police officers, who frequently face high stress, shift work, and suboptimal diets. For example, a nationwide survey in Indonesia reported a prevalence of about 21.7%, and other studies have found even higher rates in specific subgroups. The need for targeted prevention in these populations is highlighted by previous studies showing that the prevalence of MetS is disproportionately high among law enforcement personnel, such as approximately 29.5% of Indian police officers (compared to 18.3% of the general population) and approximately 39% of Thai police officers.[4,5] Indonesian police officers have been identified as a high-risk occupational group for MetS due to lifestyle and occupational factors. Bhayangkara Hospital in Denpasar showed a 68.7% prevalence of metabolic syndrome, while Makassar reported a 41.7% prevalence.[32,33] These findings are greater than the projected 21.66% prevalence of metabolic syndrome among Indonesian adults.[34]

Insulin resistance (IR), as a major factor underlying the metabolic abnormalities of MetS, is well accepted. Decreased insulin sensitivity in critical tissues results in compensatory hyperinsulinemia, which raises blood pressure, triglycerides, HDL cholesterol, and blood glucose levels.[6] Even though insulin resistance (IR) is a key factor in the pathogenesis of MetS, IR can be challenging to measure directly in epidemiological or clinical contexts. A more straightforward surrogate measure that calculates insulin resistance from fasting insulin and glucose levels is the Homeostasis Model Assessment of IR (HOMA-IR), which necessitates insulin assays that aren’t always easily accessible in real-world settings.[6] These restrictions have led to a search for more accessible and alternative IR indicators in order to better identify those who are at risk for MetS and its associated consequences. The gold standard for evaluating insulin sensitivity is the hyperinsulinemic-euglycemic clamp, but its resource-intensive and intrusive nature renders it unsuitable for everyday use.

The triglyceride-glucose index, or TyG index, is a potentially useful surrogate biomarker for insulin resistance.[8,9] According to validation studies, the TyG index is a reliable indicator of insulin resistance. A higher TyG index has also been associated with a higher risk of adverse outcomes; for example, individuals with higher TyG index values have a higher chance of developing type 2 diabetes over time, and the TyG index has been associated with the onset and prognosis of cardiovascular disease in a variety of populations.[6] To increase the predictive utility of this marker, several derivative indices that combine TyG with anthropometric measures of adiposity have been introduced. Notably, the TyG index was shown to correctly identify insulin-resistant individuals with ~96% sensitivity and 85% specificity when compared to the glucose clamp gold standard. These include TyG-WHtR (TyG index × waist-to-height ratio), TyG-WC (TyG index × waist circumference), and TyG-BMI (TyG index × body mass index).[10] The idea behind these composite indices is that adding an obesity metric could improve risk discrimination by better capturing the level of adiposity-related insulin resistance. This strategy is supported by new data, which indicate that TyG-based combination indices frequently have higher correlations with metabolic diseases than the TyG index by itself.[11]

Even though the TyG index and its derived parameters are becoming more and more supported, little is known about how well TyG and its related indices predict MetS in Southeast Asian populations, especially within high-risk professions.[3] Ethnic differences in body composition and metabolic risk profiles necessitate local validation of such surrogate markers, as findings from Western or East Asian cohorts may not directly generalize to Southeast Asia. This study was carried out to evaluate the association between the metabolic syndrome and the triglyceride-glucose index and its related parameters in Indonesian police officers.

Methods

Study design and population

A total of 3,600 Indonesian police officers (3,201 males and 399 females) from various cities and areas in the province of East Java participated in this cross-sectional survey. As part of a regular medical examination program for police officers on active duty, participants were gathered. Included were those officers between the ages of 33 and 70 who had completed the required yearly health examination. Notably, in order to capture the entire range of metabolic health status in this cohort, we did not exclude people who already had diabetes or cardiovascular disease. This strategy made sure that the study sample included people with known metabolic abnormalities and represented real-world circumstances. All participants gave written informed consent in accordance with ethical guidelines, and the study methodology was approved by the institutional ethics committee.

Data collection

Clinical and anthropometric data were collected by skilled medical workers in accordance with established protocols.[12] Participants were assessed for height and weight using stadiometers and calibrated scales while wearing light clothing and no shoes. Their weight (kg) was divided by their height squared (m^2) to calculate their body mass index (BMI). The participant’s waist circumference (WC) was measured at the midpoint between the iliac crest and the lowest rib while they were standing upright and breathing properly. Using these measures, the waist-to-height ratio (WHtR) was computed by dividing the height (in centimetres) by the waist circumference (in centimetres). A regular sphygmomanometer (or an automated blood pressure device) was used to take the patients' resting blood pressure on the right arm after they had been sitting still for at least five minutes. The systolic blood pressure (SBP) and diastolic blood pressure (DBP) of each subject were recorded.

Venipuncture was used to obtain fasting blood samples following an 8–10 hour overnight fast. Standard enzymatic assays were used at accredited local clinical laboratories to evaluate important biochemical markers, such as low-density lipoprotein (LDL) cholesterol, triglycerides, and fasting plasma glucose.

Index calculations

We looked at three related composite indices and the triglyceride-glucose (TyG) index as indicators of insulin resistance and metabolic risk. The TyG index, which is based on fasting triglyceride and glucose values, is a simple and reasonably priced method of identifying insulin resistance. It has been effective in determining who is at a higher risk of developing metabolic syndrome.[13] For each participant, we calculated the TyG index and its derivatives using the following formulas:

The TyG index: ln [fasting glucose (mg/dL) × fasting triglycerides (mg/dL) / 2]. According to Simental-Mendía et al.'s original description, this is the natural logarithm of the product of the triglyceride and glucose values divided by 2.[14]

TyG-BMI: TyG index × BMI (kg/m^2), which is the result of multiplying the body mass index by the TyG index.[14]

TyG-WC: TyG index × waist circumference (cm), which is the result of multiplying the waist circumference by the TyG index.[14]

TyG-WHtR: TyG index × waist-to-height ratio, which is the product of the waist/height ratio and the TyG index.[15]

Definition of outcome (metabolic syndrome)

A collection of conditions known as the "metabolic syndrome" increase the risk of cardiovascular diseases linked to atherosclerosis, such as peripheral artery disease, insulin resistance, heart attacks, strokes, and type 2 diabetes. Abdominal obesity, poor insulin function, elevated blood pressure, and unhealthy cholesterol levels are among the interconnected metabolic disorders that define it. If a participant had three or more of the following five requirements, they were categorized as having MetS (**Table 1**).[16]

These cutoff values are in line with globally recognized definitions of metabolic syndrome (MetS), modified to account for Asian-specific criteria.[17] If a person satisfied at least three of the previously listed requirements, they were considered to have metabolic syndrome.[12] Trained medical professionals verified the presence of MetS components, and participants receiving treatment for diabetes or hypertension were counted as meeting the glucose or blood pressure criteria, respectively. Waist circumference cutoff values vary by ethnicity and sex listed in **Table 2**.[34]

Statistical analysis

Descriptive analyses for men and women were conducted independently. Continuous variables are represented by the mean ± standard deviation (SD). Sex-based differences were assessed using the Mann–Whitney U test for continuous variables, and two-tailed p-values <0.05 were deemed statistically significant. All analyses were conducted using IBM SPSS Statistics (Version 29.0, Armonk, NY, USA). This study did not include subgroups or stratified analysis.

The association between each TyG-based metric (TyG, TyG-BMI, TyG-WC, and TyG-WHtR) and the presence of MetS was assessed using multiple linear regression analysis. We conducted a comprehensive statistical study in order to evaluate the predictive power of TyG-based markers for metabolic syndrome (MetS). The significance of each predictor was first assessed using t-tests, and the model as a whole was evaluated using F-tests. The model fit was evaluated using the coefficient of determination (R2). To examine the connection between MetS and each TyG-derived index (TyG, TyG-BMI, TyG-WC, and TyG-WHtR), we performed univariate logistic regression analysis. For each unit increase in each index, we calculated odds ratios (OR) with 95% confidence intervals (CI) for MetS. The diagnostic performance of these indicators was further evaluated using receiver operating characteristic (ROC) curve analysis. Each index's area under the

Table 1 – The NCEP ATP III criteria for metabolic syndrome

Component	Definition
Abdominal obesity	Waist circumference ≥90 cm (men) or ≥80 cm (women)
Hypertriglyceridemia	Fasting triglycerides ≥150 mg/dL
Low HDL cholesterol	HDL-C <40 mg/dL (men) or <50 mg/dL (women)
Elevated blood pressure	SBP ≥130 mmHg or DBP ≥85 mmHg, or currently using antihypertensive medication
Hyperglycemia	Fasting plasma glucose ≥100 mg/dL or use of antidiabetic medication

Table 2 – Ethnic specific waist circumference thresholds (cm)

Ethnic group	Male (cm)	Female (cm)
Europids	Male ≥94 cm	Female ≥80 cm
South Asians	Male ≥90 cm	Female ≥80 cm
Chinese	Male ≥90 cm	Female ≥80 cm
Japanese	Male ≥85 cm	Female ≥90 cm
Easter Mediterranean and Middle East	Use European data until more specific data available	

Table 3 – Participant characteristics

Parameter	Male (n = 3201)	Female (n = 399)	*p-value*
Age (years)	51.51 ± 11.01	51.02 ± 10.72	0.414
Weight (kg)	79.28 ± 11.91	70.03 ± 11.69	<0.001
Height (cm)	169.63 ± 27.15	159.10 ± 6.37	<0.001
BMI (kg/m²)	27.56 ± 4.32	27.48 ± 5.71	0.183
Waist circumference (cm)	89.92 ± 10.40	90.46 ± 10.64	0.650
Waist-to-height ratio	0.532 ± 0.065	0.570 ± 0.075	<0.001
Systolic BP (mmHg)	125.84 ± 17.62	120.21 ± 18.69	<0.001
Diastolic BP (mmHg)	82.35 ± 12.90	78.95 ± 11.08	<0.001
Fasting glucose (mg/dL)	105.06 ± 49.25	98.42 ± 42.47	<0.001
Triglycerides (mg/dL)	179.52 ± 123.49	137.97 ± 91.14	<0.001
LDL cholesterol (mg/dL)	127.77 ± 27.39	128.04 ± 27.27	0.886
TyG Index	9.04 ± 0.93	8.65 ± 0.63	<0.001
TyG-BMI	249.45 ± 48.21	238.42 ± 55.71	<0.001
TyG-WC	812.69 ± 121.84	782.35 ± 106.29	<0.001
TyG-WHtR	4.81 ± 0.74	4.93 ± 0.72	<0.001

BMI – body mass index; BP – blood pressure; TyG – triglyceride-glucose; WC – waist circumference; WHtR – waist-to-height ratio.
Values are presented as mean ± standard deviation.

ROC curve (AUC) and its corresponding 95% confidence intervals (CIs) were computed. Perfect discrimination is shown by an AUC of 1.0, whilst no discriminative capacity beyond chance is implied by an AUC of 0.5. Finally, we performed a statistical evaluation of the AUC values among indices to identify which index, if any, demonstrated superior predictive accuracy for MetS detection. We were able to completely evaluate each TyG-based index's diagnostic accuracy and association strength with MetS because to this multifaceted analytical technique.

Results

Participant characteristics

A total of 3,600 Indonesian police officers were analyzed, consisting of 3,201 males (88.9%) and 399 females (11.1%). The mean age was comparable between sexes (males: 51.51 ± 11.01 years; females: 51.02 ± 10.72 years, $p = 0.414$). Male participants were significantly heavier (79.28 ± 11.91 kg vs. 70.03 ± 11.69 kg, $p < 0.001$) and taller (169.63 ± 27.15 cm vs. 159.10 ± 6.37 cm, $p < 0.001$) than female participants. BMI did not significantly differ between sexes (27.56 ± 4.32 kg/m² males vs. 27.48 ± 5.71 kg/m² females, $p = 0.183$). Waist circumference was similar between males (89.92 ± 10.40 cm) and females (90.46 ± 10.64 cm, $p = 0.650$), but females had a substantially greater waist-to-height ratio (0.570 ± 0.075) than males (0.532 ± 0.065, $p < 0.001$).

Regarding blood pressure parameters, the systolic blood pressure (SBP: 125.84 ± 17.62 mmHg vs. 120.21 ± 18.69 mmHg, $p < 0.001$) and diastolic blood pressure (DBP: 82.35 ± 12.90 mmHg vs. 78.95 ± 11.08 mmHg, $p < 0.001$) of males were substantially higher than those of females. Males also showed significantly higher triglycerides (179.52 ± 123.49 mg/dL vs. 137.97 ± 91.14 mg/dL, $p < 0.001$) and fasting glucose (105.06 ± 49.25 mg/dL vs. 98.42 ± 42.47 mg/dL, $p < 0.001$). Male and female LDL cholesterol values were similar (127.77 ± 27.39 mg/dL vs. 128.04 ± 27.27 mg/dL, $p = 0.886$).

Males had significantly higher levels of all TyG-based indices, with the exception of TyG-WHtR: TyG Index (9.04 ± 0.93 vs. 8.65 ± 0.63, p <0.001), TyG-BMI (249.45 ± 48.21 vs. 238.42 ± 55.71, p <0.001), and TyG-WC (812.69 ± 121.84 vs. 782.35 ± 106.29, p <0.001). Conversely, TyG-WHtR was significantly higher among females (4.93 ± 0.72) compared to males (4.81 ± 0.74, p <0.001). **Table 3** provides a summary of the detailed descriptive characteristics.

Association of TyG indices

In multiple logistic regression analyses using the combined dataset, none of the TyG indices showed a significant association with metabolic syndrome (MetS). Specifically, the TyG index ($p = 0.605$), TyG-BMI ($p = 0.412$), TyG-WC ($p = 0.737$), and TyG-WHtR ($p = 0.964$) each demonstrated non-significant associations with MetS. The combined regression model incorporating all four indices also indicated no significant predictive capability (F = 0.611, $p = 0.655$) and explained only a minimal fraction of the variance ($R^2 = 0.001$).

ROC curve analysis

The poor discriminative power of the investigated indices was validated by the examination of ROC curves for MetS prediction.

The TyG index (AUC = 0.512, $p = 0.216$), TyG-BMI (AUC = 0.505, $p = 0.597$), TyG-WC (AUC = 0.518, $p = 0.059$), and TyG-WHtR (AUC = 0.519, $p = 0.053$) all showed low practical associative utility. None of these indices significantly exceeded the baseline discriminatory capability of 0.50,

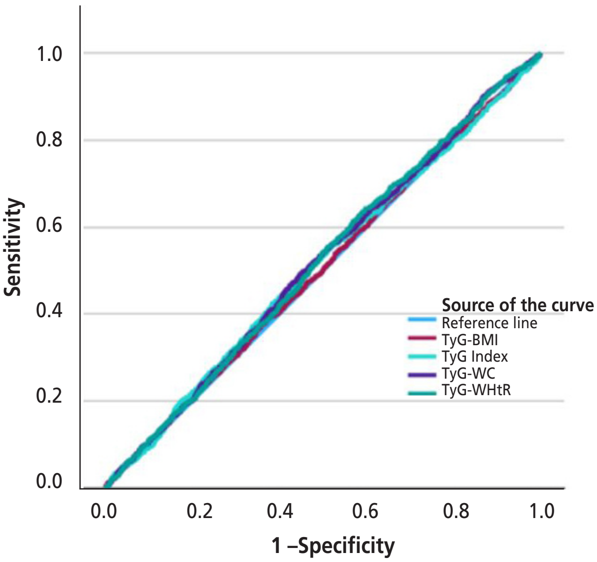

Fig. 1 – ROC curves for TyG-derived indices

Table 4 – ROC curve analysis for predicting metabolic syndrome

Variable	AUC	95% confidence interval	*p-value*
TyG index	0.512	0.493–0.531	0.216
TyG-BMI	0.505	0.486–0.524	0.597
TyG-WC	0.518	0.499–0.537	0.059
TyG-WHtR	0.519	0.500–0.537	0.053

AUC – area under the ROC curve; BMI – body mass index; TyG – triglyceride-glucose; WC – waist circumference; WHtR – waist-to-height ratio.

confirming their limited usefulness in identifying MetS within this population. The ROC results are detailed in **Figure 1** and **Table 4**.

Discussion

Interpretation of key findings

With AUC values ranging from 0.505 to 0.519 and no significant relationships in multivariable models (p >0.05), the TyG index and its derivatives showed weak predictive connection for metabolic syndrome in Indonesian police officers, an unexpected conclusion of the current study. TyG indices generally show excellent discriminative ability for MetS, with AUC values consistently exceeding 0.80–0.87 in diverse populations.[18–20] This stands in stark contrast to the established literature. The discrepancy between our findings and the larger body of evidence calls for careful consideration of population-specific factors that may account for this anomaly.

Population-specific and occupational factors

The unique characteristics of this police officer cohort likely contributed to the poor performance of TyG indices. Police officers represent a specialized occupational group subject to chronic stress, irregular shift patterns, and frequent exposure to suboptimal dietary conditions during extended duties.[21] These occupational stressors can independently elevate blood pressure and alter lipid metabolism through pathways not directly captured by insulin resistance markers.[21] Consequently, many officers may develop MetS primarily through stress-induced hypertension and altered HDL cholesterol rather than through the insulin resistance pathway that TyG indices are designed to detect. Several pathways of IR could be from imbalanced lipid metabolism in PKB an MAPK signalling pathways and from T-cell polarization which increase several pro-inflammatory factors.[31]

The "healthy worker effect" may have further influenced our results by creating a homogenized risk profile.[21] Active-duty police officers undergo regular fitness assessments and health screenings, potentially filtering out individuals with extreme metabolic phenotypes. This selection bias could compress the range of TyG values and MetS severity, reducing the statistical power to detect meaningful associations between insulin resistance markers and metabolic outcomes. In contrast, similar study conducted in Thailand with 7,852 participants revealed that increased levels of the eight IR surrogate markers, a predictor of both hypertension and MetS, were associated with increased prevalence of both disorders among Thai police officers. The TyG-BMI index was the most effective surrogate for predicting hypertension, while the TyG-WC index was the most effective surrogate for predicting MetS.[28]

Age-related considerations

The mean age of approximately 51 years in our cohort represents a critical factor in interpreting these results. Meta-analyses demonstrate that TyG index performance varies significantly with age, showing stronger predictive value in younger populations.[22,23] In older adults, metabolic syndrome becomes increasingly prevalent and multifactorial, with age-related metabolic changes potentially diminishing the discriminative power of insulin resistance markers.[24] Cardiovascular and all-cause mortality were significantly correlated with the TyG index, with the correlation being highest among individuals aged under 65. In this age group, the TyG index had a non-linear connection with all-cause mortality, although cardiovascular mortality exhibited a positive correlation.[30] The importance of insulin resistance in the development of MetS may be obscured by the high incidence of hypertension and dyslipidemia in middle-aged populations, particularly when other risk factors are more common.

Sex-specific differences and methodological limitations

Our predominantly male cohort (89%) limited the ability to detect sex-specific patterns in TyG index performance. With women frequently exhibiting distinct thresholds and associations in comparison to men, emerging evidence points that the association between metabolic outcomes and TyG indices varies significantly by sex.[24–26] The small female subsample may have masked important sex-specific predictive association patterns that could inform targeted screening approaches. Several biological factors which may contribute in term of sex differences such as hormonal differences, androgens, visceral adiposity, and endothelial disfunction.[30]

The cross-sectional design represents a fundamental limitation in assessing the predictive utility of TyG indices because of its poor predictive association. Cross-sectional analyses may not capture the temporal relationship between insulin resistance and metabolic syndrome manifestation, even though longitudinal studies show that TyG can effectively predict incident MetS development.[23] The binary, threshold-based definition of MetS may also create artificial boundaries that obscure the continuous relationship between TyG indices and metabolic risk.

Clinical and research implications

These findings demonstrate how crucial population-specific validation is prior to the use of screening instruments in clinical settings. In a primary care context, the TyG index might be a helpful screening tool for determining normal-weight people who might be at higher risk of cardiometabolic disease.[29] TyG indices' failure in this cohort raises the possibility that complementary or alternative biomarkers may be required for metabolic risk assessment in comparable occupational populations.[27] Future studies should concentrate on creating composite risk scores that include age-adjusted thresholds, population-specific cut-off values, and occupational stressors.

Study limitations and future directions

This study has a number of limitations. First, this study did not evaluate the medical history, physical activity, or dietary practices that could have affected the outcome. Furthermore, because only 11% of participants were female, gender stratified analyses were not performed, which could have an impact on some possible risk variables and health disparities that could be included in this population-level analysis. Second, the cross-sectional nature of the current study precludes its applicability for investigating causality. In order to enhance the study's findings, we recommend that future research use longitudinal studies, evaluate dietary practices, physical activity, and medical history, and possibly incorporate inflammatory metrics like CRP.

Furthermore, measuring hsCRP levels helps refine cardiovascular disease (CVD) risk stratification, independent of baseline TyG index values, and vice versa. These findings highlight how crucial it is to evaluate the TyG index and hsCRP together in clinical practice for primary CVD prevention. While TyG-based indices serve as useful screening tools in various settings, their universal applicability should not be presumed. Thus, rigorous validation in specific populations is essential before widespread clinical adoption.[18]

Conclusion

In this cross-sectional study of Indonesian police officers, the TyG score and its derived parameters showed no significant associative ability to diagnose metabolic syndrome, with AUC values approximating chance (0.505–0.519). These findings contrast with prior international studies reporting strong associations between TyG indices and MetS, suggesting that their utility may be population-specific. Key factors such as occupational stressors (e.g., shift work, chronic stress), the cohort's male predominance, and unmeasured lifestyle confounders (e.g., diet, physical activity) may explain this divergence. Clinically, these results underscore that TyG-based markers – while valuable in other settings – require rigorous validation in specific subgroups before implementation. In order to better identify MetS drivers in high-risk occupational categories, future research should use longitudinal designs to evaluate causal correlations, incorporate more biomarkers (e.g., inflammatory markers like hsCRP), and include a wider demographic representation, especially among women. Until then, alternative screening strategies tailored to this population's unique risk profile should be explored.

References

1. Zhang Z, Pang Y, Shen J, et al. The new definition of metabolic syndrome including hyperuricemia improves its prognostic value: results from NHANES database. BMC Cardiovasc Disord 2025;25:93.
2. Moradkhani A, Mohammadzadeh P, Assadi S, et al. Prevalence of metabolic syndrome and its components in Iran: an updated meta-analysis. BMC Endocr Disord 2025;25:8.
3. Herningtyas EH, Ng TS. Prevalence and distribution of metabolic syndrome and its components among provinces and ethnic groups in Indonesia. BMC Public Health 2019;19:377.
4. Gurung M, Chotenimitkhun R, Ratanasumawong K, et al. Prevalence Of Metabolic Syndrome and Its Associated Factors Among Thai Police Officers – A Population-Based Study. Siriraj Med J 2023;75:208–217.
5. Bannigida DM, Neeravari VS, Nayak SB. Metabolic Syndrome and Cardiovascular Risk Factors in Police Officers. Indian Journal of Medical Biochemistry 2019;23:324–326.
6. Tao LC, Xu J, Wang T, et al. Triglyceride-glucose index as a marker in cardiovascular diseases: landscape and limitations. Cardiovasc Diabetol 2022;21:68.
7. Sasaki N, Ueno Y, Higashi Y. Indicators of insulin resistance in clinical practice. Hypertens Res 2024;47:978–980.
8. Sun Y, Ji H, Sun W, et al. Triglyceride glucose (TyG) index: A promising biomarker for diagnosis and treatment of different diseases. Eur J Intern Med 2025;131:3–14.
9. 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.
10. Lim J, Kim J, Koo SH, et al. Comparison of triglyceride glucose index, and related parameters to predict insulin resistance in Korean adults: An analysis of the 2007-2010 Korean National Health and Nutrition Examination Survey. PLoS One 2019;14:e0212963.
11. Miao Y, Wang Y, Wan Q. Association between TyG index with obesity indicators and coronary heart disease: a cohort study. Sci Rep 2025;15:8920.
12. Rahmawati ND, Andriani H, Wirawan F, et al. Body mass index as a dominant risk factor for metabolic syndrome among Indonesian adults: a 6-year prospective cohort study of non-communicable diseases. BMC Nutrition 2024;10:43.
13. Paramanathan T, Sandrasegarampillai B, Arasaratnam V, et al. The discriminative ability of the triglyceride-glucose index to identify metabolic syndrome among adults of the northern Sri Lankan population. BMC Endocr Disord 2024;24:101.
14. Kim AH, Son DH, Lee YJ. Modified triglyceride-glucose index indices are reliable markers for predicting risk of metabolic dysfunction-associated fatty liver disease: a cross-sectional study. Front Endocrinol 2024;14:1308265.

15. Raimi TH, Dele-Ojo BF, Dada SA, et al. Triglyceride-Glucose Index and Related Parameters Predicted Metabolic Syndrome in Nigerians. Metab Syndr Relat Disord 2021;19:76–82.
16. Swarup S, Ahmed I, Grigorova Y, et al. Metabolic Syndrome. StatPearls. Online. Treasure Island (FL): StatPearls Publishing; 2025 Jan. Available from: https://www.ncbi.nlm.nih.gov/books/NBK459248/. [cited 2026-05-12].
17. World Health Organization. Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation, Geneva, 8-11 December 2008. World Health Organization; 2011. Online. Available from: https://iris.who.int/handle/10665/44583. [cited 2025-04-30].
18. Nayak SS, Kuriyakose D, Polisetty LD, et al. Diagnostic and prognostic value of triglyceride glucose index: a comprehensive evaluation of meta-analysis. Cardiovasc Diabetol 2024;23:310.
19. Paramanathan T, Sandrasegarampillai B, Arasaratnam V, et al. The discriminative ability of the triglyceride-glucose index to identify metabolic syndrome among adults of the northern Sri Lankan population. BMC Endocr Disord 2024;24:101.
20. Wan H, Cao H, Ning P. Superiority of the triglyceride glucose index over the homeostasis model in predicting metabolic syndrome based on NHANES data analysis. Sci Rep 2024;14:15499.
21. Chen B, Peng XE. Association Between Serum Uric Acid to Creatinine Ratio and Metabolic-Associated Fatty Liver Disease in Southeast China (TyG-BMI as a Potential Mediator). DMSO 2024;17:4711–4720.
22. Yu Y, Wang J, Ding L, et al. Sex differences in the nonlinear association of triglyceride glucose index with all-cause and cardiovascular mortality in the general population. Diabetol Metab Syndr 2023;15:136.
23. Li X, Hao J, Han Q, et al. Triglyceride-glucose index prediction of stroke incidence risk in low-income Chinese population: a 10-year prospective cohort study. Front Endocrinol 2024;15:1444030.
24. Kim B, Kim G, Lee Y, et al. Triglyceride–Glucose Index as a Potential Indicator of Sarcopenic Obesity in Older People. Nutrients 2023;15:555.
25. Guo J, Yang J, Wang J, et al. Exploring Gender Differences in the Association Between TyG Index and COPD: A Cross-Sectional Study from NHANES 1999–2018. COPD 2024;19:2001–2010.
26. Lin W, Xu M, Zheng J, et al. Sex-specific differences in the association between triglyceride glucose index and carotid plaque in a cardiovascular high-risk population: a cross-sectional study based on a Chinese community-dwelling population. Front Cardiovasc Med 2024;11:1473171.
27. Gong S, Gan S, Zhang Y, et al. Gamma-glutamyl transferase to high-density lipoprotein cholesterol ratio is a more powerful marker than TyG index for predicting metabolic syndrome in patients with type 2 diabetes mellitus. Front Endocrinol 2023;14:1248614.
28. Rattanatham R, Tangpong J, Chatatikun M, et al. Assessment of eight insulin resistance surrogate indexes for predicting metabolic syndrome and hypertension in Thai law enforcement officers. Peer J. 2023;11:1–19.
29. Xu X, Bhagavathula AS, Zhang Y, et al. Sex Differences in the TyG Index and Cardiovascular Risk Factors in Metabolically Obese Normal Weight Phenotype. Int J Endocrinol 2022;2022:1139045.
30. Chen J, Wu K, Lin Y, et al. Association of triglyceride glucose index with all-cause and cardiovascular mortality in the general population. Cardiovasc Diabetol 2023;22:1–15.
31. Zhang H, Tu Z, Liu S, et al. Association of different insulin resistance surrogates with all-cause and cardiovascular mortality among the population with cardiometabolic multimorbidity. Cardiovasc Diabetol 2025;24:33.
32. Ibrahim IA, Syahrir S, Adha AS, et al. Faktor Risiko Kejadian Sindrom Metabolik pada Polisi di Kepolisian Resort Kota Besar (POLRESTABES) Makassar. Public Heal Sci J 2019;11:194–202.
33. Febyan, Wetarini K, Rendy, et al. A Clinical Profile of Metabolic Syndrome and Its Determinants among Police Officers in Bali. Eur J Med Heal Sci 2020;2:2–6.
34. Ross R, Neeland IJ, Yamashita S, et al. Waist circumference as a vital sign in clinical practice: a Consensus Statement from the IAS and ICCR Working Group on Visceral Obesity. Nat Rev Endocrinol 2020;16:177–189.