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Triglyceride-glucose index and triglyceride-to-high-density lipoprotein cholesterol ratio in predicting severity of acute pancreatitis: a cross-sectional clinical study

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Abstract

Background The aim of this study is to investigate the correlation of triglyceride-glucose (TyG) index and triglyceride-to-high-density lipoprotein cholesterol (TG/HDL-C) ratio with acute pancreatitis (AP), and to compare the predictive value of the two indexes for severe AP (SAP).

Methods This study was a clinical cross-sectional study. Spearman's correlation, logistic regression analysis and receiver operating characteristic (ROC) curves were used to investigate the relationship between the TyG index and TG/HDL-C ratio with SAP.

Results Of the 311 enrolled AP patients, the mean age was 62.59 ± 9.03 years, and 131 (42.12%) were male. A total of 34 (10.93%) patients met the diagnostic criteria for SAP. The results of Spearman's correlation showed that TyG index (Spearman rho = 0.262; $p < 0.001$), TG/HDL-C ratio (Spearman rho = 0.206; $p < 0.001$) were associated with SAP. Logistic regression analysis showed that TyG index was independently and positively correlated with SAP [odds ratio (OR), 4.311; 95% confidence interval (CI), 1.222–15.208; $p = 0.023$]. However, this association was not further confirmed on TG/HDL-C ratio (OR, 2.530; 95% CI, 0.883–7.251; $p = 0.084$). According to the ROC curve analysis, the area under the curve (AUC) for TyG index was 0.712 ($p < 0.001$), and the AUC for TG/HDL-C ratio was 0.691 ($p < 0.001$).

Conclusions TyG index and TG/HDL-C ratio have different diagnostic values in AP patients. And the TyG index may be a more useful auxiliary tool for predicting SAP.

Keywords Acute pancreatitis, TyG index, TG/HDL-C ratio, Insulin resistance

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Background

Acute pancreatitis (AP) is a common inflammatory disease of the digestive system worldwide [1, 2]. Although AP is primarily a self-limited disease, approximately 15% of AP cases progress to more severe disease [3]. Patients with severe AP (SAP) suffer from persistent organ failure and infected pancreatic necrosis [4, 5]. And the mortality rate of SAP can be as high as 30%, posing a great threat to the safety of patients' lives and property [6, 7]. However, the value of AP-related predictors is currently limited. Therefore, early detection and reasonable assessment of SAP are of great significance for adjusting the treatment regimen and reduce the occurrence of complications.

Insulin resistance (IR) is associated with a variety of metabolic disorders [8]. Hyperglycemia and hypertriglyceridemia are the two most common metabolic disorders in AP, both of which can increase the risk of AP infection [9–11]. Studies have shown that IR is an important mechanisms in the pathogenesis of AP, and can affect the prognosis and severity of AP [12, 13]. Currently, the gold standard for evaluating IR is hyperinsulinemic-euglycemic clamp technique, which is difficult to apply in large-scale cohort studies [14]. As a novel marker reflecting IR, TyG index and triglyceride to high-density lipoprotein cholesterol (TG/HDL-C) ratio have the advantage of simplicity and ease of availability [15–17]. TyG index has been shown to be associated with the development of metabolic syndrome and adverse outcomes of cardiovascular and cerebrovascular events [18, 19]. As another important indicator of dyslipidemia, high TG/HDL-C ratio is associated with increased risk of cardiovascular diseases, metabolic syndrome and other diseases [20, 21]. However, there are few studies on the relationship between TyG index and TG/HDL-C ratio with AP, and further studies are needed.

Given the close relationship between IR and AP, it is reasonable to infer that TyG index and TG/HDL-C ratio are also closely related to AP. Therefore, the aim of this study was to investigate the association of TyG index and TG/HDL-C ratio with AP. The early predictive ability of the two indicators for SAP was compared to provide a basis for the early evaluation of SAP.

Methods

Study design and participants

This study was a single-center, clinical cross-sectional study. The clinical data of 311 patients with AP in our hospital from January 2020 to March 2024 were collected. Inclusion criteria: (1) age ≥ 18 years old; (2) AP was diagnosed by doctors; Exclusion criteria: (1) complicated with other infectious diseases; (2) severe basic heart, lung, or renal insufficiency; severe immunosuppression or hematological diseases; (3) acute onset of chronic pancreatitis or idiopathic pancreatitis; (4) concurrent malignant or benign tumors; (5) patients with severe cognitive impairment or mental illness; (6) pregnancy or lactation; And (7) lack of complete data.

This study was approved by the Research Ethics Committee of Hangzhou Hospital of Traditional Chinese Medicine (batch number: 2021KY057). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Clinical data

By reviewing the inpatient electronic medical record system, the clinical data of the patients were collected, including baseline information such as gender, age, disease severity, and other baseline information. The relevant laboratory indicators, abdominal imaging indicators, comorbidities and related complications were also collected. All laboratory indicators were obtained by fasting peripheral venous blood sampling within 24 h after admission, including blood routine, C-reactive protein (CRP), blood calcium, fasting blood glucose, triglyceride, high-density lipoprotein, low-density lipoprotein, total cholesterol, uric acid, creatinine, etc. Abdominal imaging examination including ultrasound, computed tomography, magnetic resonance imaging, etc. The TyG index was calculated using the following formula: ln [fasting triglycerides (mg/dL)×fasting blood glucose (mg/dL) /2] [22]. The TG/HDL-C ratio was calculated using the formula TG (mg/dL) /HDL-C (mg/dL) [23].

Diagnostic criteria for AP and SAP

According to the revised Atlanta criteria, the diagnosis of AP can be made clinically when two or more of the following three features are present: (1) severe and persistent epigastric pain; (2) serum amylase or lipase exceeds three or more times the upper limit of normal; and (3) imaging findings on ultrasonography, computed tomography, or magnetic resonance imaging meet the characteristics of AP.

AP severity was categorized as mild, moderate to severe, and severe according to the revised Atlanta 2012 criteria. Mild AP: no organ failure and local or systemic complications; moderate to severe AP: transient organ failure resolved within 48 h with local or systemic complications; severe AP (SAP): associated with organ failure for more than 48 h. Complications associated with AP include systematic inflammatory reaction syndrome (SIRS), organ failure, acute peripancreatic effusion, acute accumulation of necrosis, pulmonary infection, liver injury, pleural effusion, and ascites [24, 25].

Statistical analyses

Normally distributed continuous variables are expressed as mean ± standard deviation and compared using Student's t-test or one-way analysis of variance (ANOVA).

Non-normally distributed continuous variables are expressed as median and quartile spacing, and the Mann-Whitney U test was used for comparison between groups. Categorical variables are expressed as counts and percentages and were compared using the chi-square test. Spearman's correlation was used to analyze the relationship between SAP and various clinical parameters. Univariate and adjusted multivariate logistic regression analyses were used to analyze the relationship between SAP and TyG index, TG/HDL-C ratio. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the diagnostic value of TyG index and TG/HDL-C ratio for SAP. Statistical analysis was performed using SPSS software (version 26.0, SPSS, Chicago, IL, USA). A p value of 0.05 was considered to be statistically significant. Furthermore, for figures, Prism version 9.0 (GraphPad Software, La Jolla California, USA) was used.

Results

General information

A total of 311 AP patients hospitalized in our hospital were included in this study, of whom 34 (10.93%) patients met the diagnostic criteria for SAP. Compared with patients in the non-SAP group, the average age of SAP was not significantly different (62.90 ± 8.90 years vs. 60.03 ± 9.85 years, $p = 0.080$), and the BMI was significantly higher (24.74 ± 3.65 kg/m^2 vs. 27.90 ± 4.56 kg/m^2; $p < 0.001$). Of these, CRP was significantly increased in the SAP group [25.79 (20.86–30.62) mg/L vs. 32.15 (25.81–76.13) mg/L, $p < 0.001$], and the number of deaths was significantly higher ($p < 0.001$). There were no statistically significant differences between the two groups in gender, tobacco use, alcohol consumption, albumin or other parameters (Table 1).

Association between TyG index and TG/HDL-C ratio with SAP

To further confirm our conclusions, we divided the TyG index and TG/HDL-C ratio into three groups according to tertiles. The prevalence of SAP increased with increasing TyG index and TG/HDL-C ratio (Fig. 1). Importantly, the SAP rate in the highest TyG tertile (T3: 8.53–10.36) was significantly higher than in the lowest tertile (T1:6.57–8.01) ($p < 0.001$).

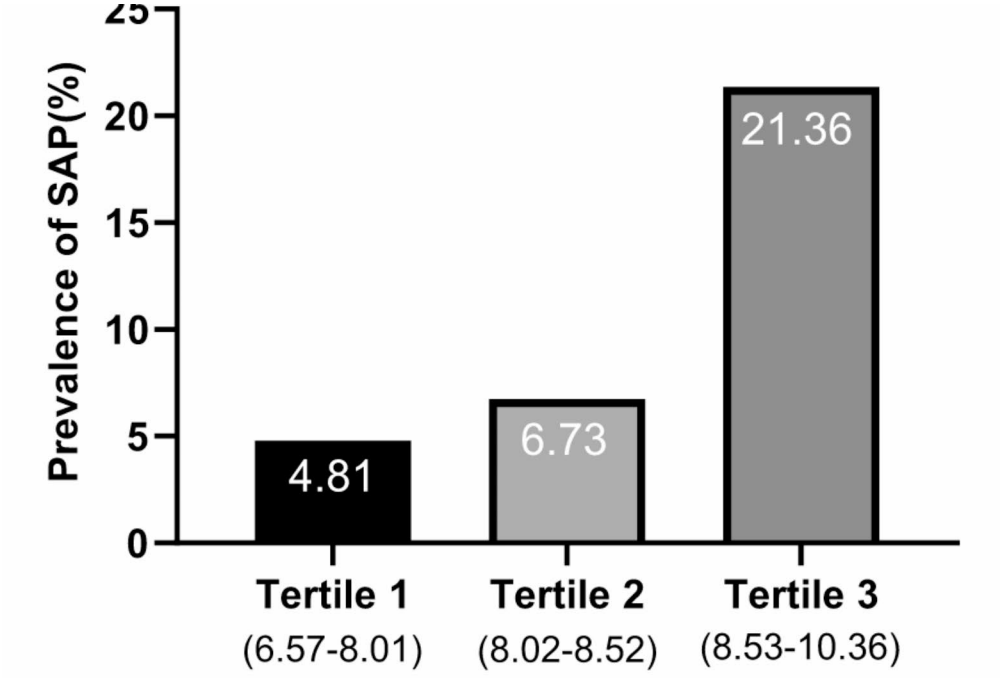
Spearman's correlation was performed to analyze the relationship between TyG index and TG/HDL-C ratio with SAP. The results showed that TyG index (Spearman rho = 0.262; $p < 0.001$) and TG/HDL-C ratio (Spearman rho = 0.206; $p < 0.001$) were significantly associated with SAP. Among them, TyG index had a better correlation with SAP (Table 2).

Subsequently, binary logistic regression analysis was conducted to further explore the relationship between TyG index and TG/HDL-C ratio with SAP (Table 3).

Table 1 Characteristics of study participants

Variable	Total	SAP	Non-SAP	*p* Value
Number of participants, (n)	311	34	277	-
Sex (male/female), (n)	131/180	14/20	117/160	0.906
Age, (y)	62.59 ± 9.03	60.03 ± 9.85	62.90 ± 8.90	0.080
BMI, (kg/m^2)	25.08 ± 3.88	27.90 ± 4.56	24.74 ± 3.65	**< 0.001**
Tobacco use, n (%)	58 (18.65%)	7 (20.59%)	51 (18.41%)	0.758
Alcohol consumption, n (%)	77 (24.76%)	10 (29.41%)	67 (24.19%)	0.505
Diabetes, n (%)	116 (37.30%)	18 (52.94%)	98 (35.38%)	**0.046**
Hypertension, n (%)	240 (77.17%)	31 (91.18%)	209 (75.45%)	**0.039**
Causes of AP, (n)				
cholelithiasis	135	13	122	
alcohol consumption	59	7	52	
hyperlipemia	117	14	103	
Death toll, (n)	6	6	0	**< 0.001**
Fasting plasma glucose, (mmol/L)	3.87 (3.37–4.98)	4.41 (3.52–5.96)	3.83 (3.37–4.83)	**0.042**
TG, (mmol/L)	1.19 (0.90–1.65)	1.79 (1.12–3.42)	1.18 (0.87–1.58)	**< 0.001**
TyG index	8.34 ± 0.72	8.88 ± 0.80	8.28 ± 0.68	**< 0.001**
Total cholesterol, (mmol/L)	4.25 ± 1.09	4.11 ± 1.25	4.27 ± 1.07	0.397
HDL-C, (mmol/L)	0.99 ± 0.27	1.04 ± 0.32	0.99 ± 0.26	0.279
LDL-C, (mmol/L)	2.59 ± 0.86	2.48 ± 0.93	2.61 ± 0.86	0.435
TG/HDL-C	2.07 (1.43–2.83)	3.03 (1.80–4.07)	2.02 (1.42–2.67)	**< 0.001**
Hemoglobin, (g/L)	123.89 ± 22.02	125.03 ± 20.37	123.75 ± 22.25	0.751
Albumin, (g/L)	39.42 ± 4.42	40.26 ± 2.92	39.32 ± 4.57	0.244
CRP, (mg/L)	25.82 (20.89–31.60)	32.15(25.81–76.13)	25.79 (20.86–30.62)	**< 0.001**

BMI, body mass index; AP, acute pancreatitis; SAP, severe acute pancreatitis; TG, triglyceride; TyG index, triglyceride-glucose index; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; CRP, C-reactive protein



(b)

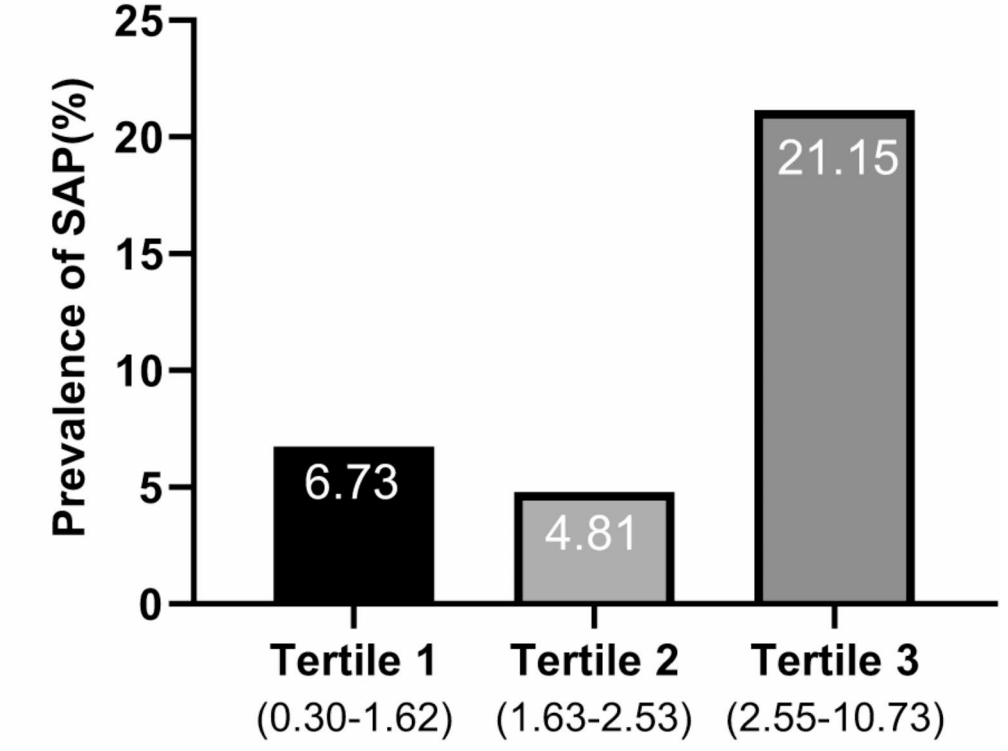


Fig. 1 (**a**) Prevalence of SAP according to TyG index tertiles. (**b**) Prevalence of SAP according to TG/HDL-C ratio tertiles

Table 2 Correlation of TyG index and TG/HDL-C ratio with SAP

Variable	*r*	*p* Value
TyG index	0.262	< 0.001
TG/HDL-C	0.206	< 0.001

SAP, severe acute pancreatitis; TyG index, triglyceride-glucose index; TG, triglyceride; HDL-C, high-density lipoprotein cholesterol

In the univariate analysis, the TyG index [odds ratio (OR), 5.378; 95% confidence interval (CI), 1.950-14.831; $p = 0.001$] and TG/HDL-C ratio (OR, 3.679; 95% CI, 1.496–9.051; $p = 0.005$) were significantly associated with SAP. Factors with $p < 0.2$ in univariate logistic regression and factors considered clinically influential were gradually included in the multivariate logistic regression model. As shown in Table 3, after adjusting for age, gender, BMI, causes of AP, diabetes, hypertension, alcohol consumption and CRP, multivariate analysis showed that the TyG index (OR, 4.311; 95% CI, 1.222–15.208; $p = 0.023$) was significantly associated with SAP. TyG index was an independent risk factor for SAP, and the risk of SAP increased 4.311-fold for every unit increase in TyG index.However, the TG/HDL-C ratio (OR, 2.530; 95% CI, 0.883–7.251; $p = 0.084$) was not significantly associated with SAP.

The diagnostic value of TyG index and TG/HDL-C ratio in SAP

ROC curve was used to analyze the diagnostic value of TyG index and TG/HDL-C ratio for SAP (Fig. 2). According to the ROC curve analysis, the area under the curve (AUC) for the TyG index was 0.712 ($p < 0.001$). The cut-off value of the TyG index was 8.39 with a sensitivity of

Table 3 Multivariate logistic regression analysis

	Model 1		Model 2		Model 3	
	OR(95% CI)	*p* Value	OR(95% CI)	*p* Value	OR(95% CI)	*p* Value
TyG index						
T1(6.57–8.01)	Ref.		Ref.		Ref.	-
T2(8.02–8.52)	1.429(0.438–4.656)	0.554	1.268(0.385–4.181)	0.696	1.539(0.404–5.871)	0.528
T3(8.53–10.36)	5.378(1.950-14.831)	0.001	4.520(1.606–12.722)	0.004	4.311(1.222–15.208)	0.023
TG/HDL-C						
T1(0.30–1.62)	Ref.		Ref.		Ref.	-
T2(1.63–2.53)	0.693(0.213–2.257)	0.542	0.581(0.176–1.925)	0.375	0.609(0.170–2.179)	0.446
T3(2.55–10.73)	3.679(1.496–9.051)	0.005	3.155(1.260–7.900)	0.014	2.530(0.883–7.251)	0.084

Model 1: Unjusted

Model 2: Age, Sex, BMI

Model 3: Age, Sex, BMI, Causes of AP, Diabetes, Hypertension, Alcohol consumption, CRP

BMI, body mass index; AP, acute pancreatitis; CRP, C-reactive protein

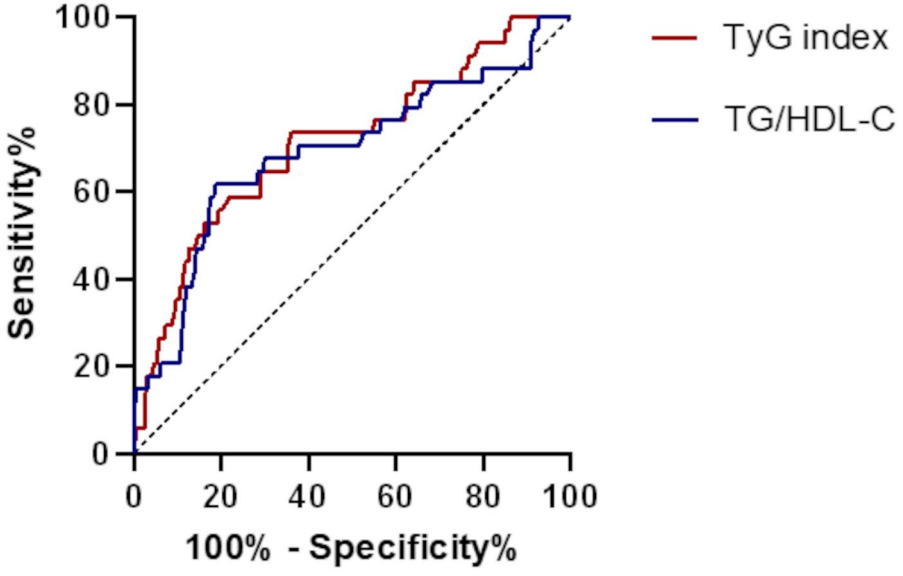


Fig. 2 Receiver-operating characteristics (ROC) curves of TyG index and TG/HDL-C

73.50% and specificity of 64.30%. The AUC for the TG/HDL-C ratio was 0.691 ($p < 0.001$) and the cutoff value of the TG/HDL-C ratio was 2.86 with a sensitivity of 61.80% and specificity of 81.60%. The results show that TyG index has a better test efficiency for SAP.

Discussion

AP is a common cause of emergency digestive system diseases, which can progress to involve multiple organs and cause serious complications [26, 27]. Pancreatic inflammation is the main pathophysiological process of AP. Inflammation accompanied with metabolic abnormalities and IR will increase the incidence of AP and the risk of SAP [28]. In this clinical cross-sectional study, we investigated the relationship between TyG index and TG/HDL-C ratio with SAP. The results showed that TyG index and TG/HDL-C ratio were associated with SAP. It is worth noting that TyG index has better test power for SAP and is an independent risk factor for SAP.

Insulin resistance, a chronic inflammatory state characterized by decreased sensitivity of the body to insulin, is the intersection of several key health problems, including obesity, metabolic syndrome, and diabetes [29, 30]. Metabolic abnormalities and IR may trigger and aggravate AP, resulting in serious adverse outcomes [31]. Several studies have shown a significant association between IR and SAP [9, 12, 32]. IR can promote the body to release proinflammatory factors, thereby amplifying the ability of the immune response and ultimately aggravating the incidence of SAP [33]. In recent years, the TG/HDL-C ratio and TyG index were proposed to be useful biomarkers for IR identification because of their significant correlation with hyperinsulinemic-euglycemic clamp results [19, 20]. Park et al. analyzed 373 AP patients, and showed that TyG index was an independent prognostic factor for AP patients, and could be used as a simple prognostic indicator for SAP [34]. Huang et al. demonstrated a positive correlation between TG/HDL-C ratio and SAP [17]. The TG/HDL-C ratio reflects lipid metabolism in IR, whereas the TyG index is calculated using fasting TG and glucose levels and reflects the interaction between lipid and glucose metabolism [35]. Each IR index represents a different aspect of insulin resistance, so we believe that there are differences in the predictive ability of these surrogate measures for SAP [14]. Although TG/HDL-C ratio and TyG index have been investigated in a small number of clinical studies, there is a lack of comparison of their effectiveness in predicting the clinical outcome of SAP patients.

Our study illuminates several important and novel findings. Firstly, TyG index and TG/HDL-C ratio were significantly higher in the SAP group than in the non-SAP group. With the increase of TyG index and TG/HDL-C, the prevalence of SAP seems to show an increasing trend. Among them, the number of patients with a history of diabetes in the SAP group was significantly higher than that in the non-SAP group. Previous studies have demonstrated a significant correlation between hyperglycemia and increased susceptibility to AP [36, 37]. Hyperglycemia is a powerful trigger that can not only increase the production of inflammatory substances, but also cause blood viscosity to worsen due to abnormally elevated lipid and uric acid levels. Further more cellular metabolic disorders, which then develop into tissue inflammatory exudates, hyperplasia and the development of other lesions, all of which contribute to the occurrence and development of AP [38, 39]. Since TyG index reflects the interaction between lipid and glucose metabolism, it is reasonable to assume that it is more comprehensive and accurate than TG/HDL-C ratio, which reflects lipid metabolism. Secondly, after adjusting for age, gender, BMI, causes of AP, diabetes, hypertension, alcohol consumption, CRP and other clinical confounding factors, logistic regression results showed that TyG index was independently and positively correlated with SAP. However, there was no significant statistical difference between the TG/HDL-C ratio and SAP. The TG/HDL-C ratio is a simple combination of blood lipid indicators, which may be more suitable for focusing on screening the risk of acute pancreatitis associated with hypertriglyceridemia. Finally, the results of ROC curve further confirmed the superiority of TyG index in predicting SAP (AUC = 0.712, $p < 0.001$). In summary, the TyG index, by integrating dual signals of metabolic disorders and inflammatory responses, offers a non-invasive and effective biomarker for assessing the risk of SAP. While additional multicenter studies are required to confirm its universality, its potential for early identification of high-risk patients and optimization of clinical decision-making has been preliminarily validated.

It is crucial to highlight that AP is a multifaceted issue influenced by numerous factors and causes, with IR being one of the significant pathological factors. Effective lifestyle management is essential to prevent the onset of AP and to enhance metabolic risk factors associated with IR [40]. Techniques that incorporate moderate energy restriction, regular physical activity, and dietary behavior modification have been demonstrated to be effective strategies for managing insulin resistance and metabolism [41]. Despite the efforts made in this study, there are still several limitations that should be mentioned. This study employed a cross-sectional design, indicating that it cannot establish a causal relationship between a higher TyG index and SAP. Furthermore, the limited number of SAP cases ($n = 34$) may have constrained the statistical power of the analysis. Future research, particularly larger multicenter studies, should aim to validate these findings.

Conclusions

TyG index and TG/HDL-C ratio have different diagnostic values in AP patients. And the TyG index can more comprehensively reflect the IR and the degree of metabolic disorders in patients with AP. The TyG index may be a useful auxiliary tool for predicting SAP, but its value as a standalone tool needs more research.

Abbreviations

ANOVA	One-way analysis of variance
AP	Acute pancreatitis
AUC	The area under the curve
BMI	Body mass index
CI	Confidence interval
CRP	C-reactive protein
HDL-C	High-density lipoprotein cholesterol
IR	Insulin resistance
LDL-C	Low-density lipoprotein cholesterol
OR	Odds ratio
ROC	Receiver operating characteristic
SAP	Severe acute pancreatitis
SIRS	Systematic inflammatory reaction syndrome
TG	Triglyceride
TG/HDL-C	Triglyceride-to-high-density lipoprotein cholesterol
TyG	Triglyceride-glucose

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Author contributions
Yakun Wang designed the study, and wrote the manuscript. Zhenfei Yu contributed to clinical data acquisition, and participated in drafting the work. Yakun Wang and Limei Yu performed the statistical analyses and discussed the data. Chen Li contributed to design of this study and revised the draft. All authors have read and agreed with the manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
All participants gave informed consent. And this study was approved by the Research Ethics Committee of Hangzhou Hospital of Traditional Chinese Medicine (batch number: 2021KY057). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Szatmary P, Grammatikopoulos T, CAI W, et al. Acute Pancreatitis: Diagnosis Treat [J] Drugs. 2022;82(12):1251–76.
2. Iannuzzi J P, King J A, Leong J H, et al. Global incidence of acute pancreatitis is increasing over time: A systematic review and Meta-Analysis [J]. Gastroenterology. 2022;162(1):122–34.
3. GARDNER T B. Acute pancreatitis [J]. Ann Intern Med. 2021;174(2):ltc17–32.
4. Trikudanathan G, Yazici C, Evans Phillips A, et al. Diagnosis and management of acute pancreatitis [J]. Gastroenterology. 2024;167(4):673–88.
5. Søreide K, Barreto S G Pandanaboyanas. Severe acute pancreatitis [J]. Br J Surg, 2024, 111(8).
6. Boxhoorn L, Voermans R P, Bouwense S A, et al. Acute pancreatitis [J]. Lancet. 2020;396(10252):726–34.
7. Trikudanathan G, Wolbrink D R J, Van Santvoort H C, et al. Current concepts in severe acute and necrotizing pancreatitis: an Evidence-Based approach [J]. Gastroenterology. 2019;156(7):1994–e20073.
8. Wagner R, Eckstein S S, Yamazaki H, et al. Metabolic implications of pancreatic fat accumulation [J]. Nat Rev Endocrinol. 2022;18(1):43–54.
9. Niknam R, Moradi J, Jahanshahi K A, et al. Association between metabolic syndrome and its components with severity of acute pancreatitis [J]. Diabetes Metab Syndr Obes. 2020;13:1289–96.
10. Nagy A, Juhász MF, Görbe A, et al. Glucose levels show independent and dose-dependent association with worsening acute pancreatitis outcomes: Post-hoc analysis of a prospective, international cohort of 2250 acute pancreatitis cases [J]. Pancreatology. 2021;21(7):1237–46.
11. Yang A L, Mcnabb-Baltar J. Hypertriglyceridemia and acute pancreatitis [J]. Pancreatology. 2020;20(5):795–800.
12. Zhu S, Ding Z. Acute pancreatitis and metabolic syndrome: genetic correlations and causal associations [J]. Endocrine. 2024;84(2):380–7.
13. Quan Y, Yang X J. Metabolic syndrome and acute pancreatitis: current status and future prospects [J]. World J Gastroenterol. 2024;30(45):4859–63.
14. Gastaldelli A. Measuring and estimating insulin resistance in clinical and research settings [J]. Obes (Silver Spring), 2022, 30(8): 1549–63.
15. Park Hm, Lee H S, Lee Y J, et al. The triglyceride-glucose index is a more powerful surrogate marker for predicting the prevalence and incidence of type 2 diabetes mellitus than the homeostatic model assessment of insulin resistance [J]. Diabetes Res Clin Pract. 2021;180:109042.
16. Qin X, Li Xiangs. Analysis of factors influencing onset and survival of patients with severe acute pancreatitis: A clinical study [J]. Immun Inflamm Dis. 2024;12(6):e1267.
17. Huang Y, Zhu Y, Peng Y, et al. Triglycerides to high-density lipoprotein cholesterol (TG/HDL-C) ratio is an independent predictor of the severity of hyperlipidaemic acute pancreatitis [J]. J Hepatobiliary Pancreat Sci. 2023;30(6):784–91.
18. Dang K, Wang X. The association between triglyceride-glucose index and its combination with obesity indicators and cardiovascular disease: NHANES 2003–2018 [J]. Cardiovasc Diabetol. 2024;23(1):8.
19. Nayak Ss, Polisetty L D Kuriyakosed, et al. Diagnostic and prognostic value of triglyceride glucose index: a comprehensive evaluation of meta-analysis [J]. Cardiovasc Diabetol. 2024;23(1):310.
20. Oliveri A, Rebernick R J, Kuppa A, et al. Comprehensive genetic study of the insulin resistance marker TG:HDL-C in the UK biobank [J]. Nat Genet. 2024;56(2):212–21.
21. Nur Zati Iwani A K, Jalaludin M Y, YAHYA A, et al. TG: HDL-C ratio as insulin resistance marker for metabolic syndrome in children with obesity [J]. Front Endocrinol (Lausanne). 2022;13:852290.
22. Tao, L C, Xu J N, Wang T T, et al. Triglyceride-glucose index as a marker in cardiovascular diseases: landscape and limitations [J]. Cardiovasc Diabetol. 2022;21(1):68.
23. Che B, Zhong C, Zhang R, et al. Triglyceride-glucose index and triglyceride to high-density lipoprotein cholesterol ratio as potential cardiovascular disease risk factors: an analysis of UK biobank data [J]. Cardiovasc Diabetol. 2023;22(1):34.
24. Zerem E, Kurtcehajic A, Kunosić S, et al. Current trends in acute pancreatitis: diagnostic and therapeutic challenges [J]. World J Gastroenterol. 2023;29(18):2747–63.
25. Hines O J, Pandol SJ. Management of severe acute pancreatitis [J]. BMJ. 2019;367:l6227.
26. Garg P K, Singh VP. Organ failure due to systemic injury in acute pancreatitis [J]. Gastroenterology. 2019;156(7):2008–23.
27. Lee Pj. Papachristou G I. New insights into acute pancreatitis [J]. Nat Rev Gastroenterol Hepatol. 2019;16(8):479–96.
28. Cho S K, Huh J H, YOO JS, et al. HOMA-estimated insulin resistance as an independent prognostic factor in patients with acute pancreatitis [J]. Sci Rep. 2019;9(1):14894.

29. Mikolasevic I, Milic S. Metabolic syndrome and acute pancreatitis [J]. Eur J Intern Med. 2016;32:79–83.
30. Oiva J, Mustonen H, Kylänpää ML, et al. Acute pancreatitis with organ dysfunction associates with abnormal blood lymphocyte signaling: controlled laboratory study [J]. Crit Care. 2010;14(6):R207.
31. Shen Z, Wang X. Metabolic syndrome components and acute pancreatitis: a case-control study in China [J]. BMC Gastroenterol. 2021;21(1):17.
32. Van Dijk S M, Hallensleben N D L, Van Santvoort H C, et al. Acute pancreatitis: recent advances through randomised trials [J]. Gut. 2017;66(11):2024–32.
33. Lee Yh, Pratley R E. The evolving role of inflammation in obesity and the metabolic syndrome [J]. Curr Diab Rep. 2005;5(1):70–5.
34. Park Jm, Shin S P, CHO S K, et al. Triglyceride and glucose (TyG) index is an effective biomarker to identify severe acute pancreatitis [J]. Pancreatology. 2020;20(8):1587–91.
35. Zhou Z, Liu Q, Zheng M, et al. Comparative study on the predictive value of TG/HDL-C, TyG and TyG-BMI indices for 5-year mortality in critically ill patients with chronic heart failure: a retrospective study [J]. Cardiovasc Diabetol. 2024;23(1):213.
36. Yaribeygi H, Mohammadi M T Sahebkara. Ppar-α agonist improves Hyperglycemia-Induced oxidative stress in pancreatic cells by potentiating antioxidant defense system [J]. Drug Res (Stuttg). 2018;68(6):355–60.
37. Cho I R, Han K D, Lee Sh, et al. Association between glycemic status and the risk of acute pancreatitis: a nationwide population-based study [J]. Diabetol Metab Syndr. 2023;15(1):104.
38. Czech M P. Insulin action and resistance in obesity and type 2 diabetes [J]. Nat Med. 2017;23(7):804–14.
39. OSkarsson V, Sadr-Azodi O, Orsini N, et al. High dietary glycemic load increases the risk of non-gallstone-related acute pancreatitis: a prospective cohort study [J]. Clin Gastroenterol Hepatol. 2014;12(4):676–82.
40. Tricò D, Moriconi D, Berta R et al. Effects of Low-Carbohydrate versus mediterranean diets on weight loss, glucose metabolism, insulin kinetics and β-Cell function in morbidly obese individuals [J]. Nutrients, 2021, 13(4).
41. Papakonstantinou E, Oikonomou C, Nychas G et al. Effects of diet, lifestyle, chrononutrition and alternative dietary interventions on postprandial glycemia and insulin resistance [J]. Nutrients, 2022, 14(4).

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