

Association between triglyceride glucose index and coronary artery disease with type 2 diabetes mellitus in middle-aged and elderly people

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Abstract

This study aimed to investigate the correlation between triglyceride glucose (TyG) index and coronary artery disease (CAD) with type 2 diabetes mellitus (T2DM) and identify the risk associated TyG index in different subgroups.

A total of 1665 eligible inpatients (CAD with T2DM group [n=680], non-coronary artery disease without T2DM [n=985]) were consecutively enrolled in this study. They were assigned into 4 subgroups: middle-aged, elderly, male, and female subgroups. Receiver operating characteristic curve diagnostic test and a logistic regression model was established to analyze the risk factors for CAD with T2DM.

TyG index is an independent risk factor for patients with CAD with T2DM. The risk of increased TyG index is greater in the middle-aged and male subgroups than in the elderly and female subgroups, respectively (all $P < .05$). The specificity and the positive predictive value of the TyG index is greater than the sensitivity and the negative predictive value, respectively (all $P < .05$).

Increased TyG index is a new independent risk factor for CAD with T2DM, and its risk is higher in the middle-aged and male subgroups than in the elderly and female subgroups, respectively. TyG index may be used as a clinical predictor of CAD with T2DM.

Abbreviations: AUC = area under the receiver operating characteristic curve, BMI = body mass index, CAD = coronary artery disease, HDL-C = high-density lipoprotein cholesterol, LDL-C = low-density lipoprotein cholesterol, OR = odds ratio, T2DM = type 2 diabetes mellitus, TC = total cholesterol, TyG = triglyceride glucose.

Keywords: coronary artery disease, risk factor, triglyceride glucose index, type 2 diabetes mellitus

1. Introduction

Coronary artery disease (CAD) is the major cause of death in middle-aged and elderly populations. A number of researches have been done to explore the risk factors of CAD to improve the

diagnosis and prevention of CAD.^[1,2] Recently, the influence of triglyceride glucose (TyG) index on type 2 diabetes mellitus (T2DM) and coronary artery disease (CAD) has attracted much attention from researchers. TyG index is a simple and inexpensive alternative indicator for insulin resistance, which not only is related to the occurrence and development of T2DM but also affects the development of coronary atherosclerosis plaque and promotes the occurrence of adverse cardiovascular events.^[3-5] Previous studies have reported that TyG index predicts coronary artery calcification and CAD prognosis and is associated with the CAD severity.^[6,7]

There are diversities in body hormones and metabolic levels among different ages and sexes populations, and the risk of some CAD risk factors are different among different ages and sexes.^[8,9] However, no studies on the role of TyG index in CAD with T2DM in middle-aged and elderly populations and on the different risks of TyG index in CAD with T2DM in middle-aged and elderly populations and in both sexes have been conducted. Thus, this study aimed to investigate the relationship between TyG index and CAD with T2DM in middle-aged and elderly people and to determine the difference in the risk between middle-aged and elderly individuals and between sexes.

2. Methods

A total of 680 in patients with CAD with T2DM in the Department of Cardiology, Affiliated Hospital of Chengde Medical College, from November 2011 to May 2017, were consecutively enrolled in this retrospective study, and 985 non-

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coronary artery disease without T2DM inpatients were enrolled as the control group. All patients were assigned into the following subgroups according to age and sex: middle-aged ($40 \leq \text{age} < 60$ years, $n=821$) and elderly (age ≥ 60 years, $n=844$) subgroups and male ($n=671$) and female ($n=994$) subgroups. The inclusion criteria were as follows: age ≥ 40 years, CAD^[10] (unstable angina; non-ST elevation myocardial infarction; ST-elevation myocardial infarction; and coronary angiography showing the stenosis at least or more than 50% in 1 or more of the left main, left anterior descending, left circumflex, right coronary, or their main branches), and T2DM^[11] (diagnosed according to the American Diabetes Association of diabetes guidelines). The major exclusion criteria included recent acute coronary syndrome, type 1 diabetes or secondary diabetes, connective tissue disease, severe valvular heart disease, constrictive pericarditis, hypertrophic cardiomyopathy, clinical history of malignant cancer, and insufficient medical record for TyG index calculation. We conducted this study according to the standards of the Declaration of Helsinki on medical research, and the study protocol was approved by the Institutional Review Boards of The Affiliated Hospital of Chengde Medical University. All subjects provided written informed consent.

Demographic characteristics and clinical data of all patients, including age, sex, height, weight, hypertension, dyslipidemia, ischemic stroke, systolic blood pressure, diastolic blood pressure, and ejection fraction, were retrospectively obtained by master students. All blood samples were obtained after >8 hour of fasting and were analyzed for lipid profile, glucose levels, blood routine, and biochemistry routine. Subsequently, pulse pressure, body mass index (BMI), and TyG index were calculated. Pulse pressure was calculated as systolic blood pressure minus diastolic blood pressure; BMI, as weight (kg) divided by height (m^2); and TyG index,^[12] as in $[\text{fasting triglycerides (mg/dl)} * \text{fasting glucose (mg/dl)}] / 2$.

All statistical analyses and data processes were performed using Statistical Software Package 19 (SPSS Inc., Chicago, IL) software. Kolmogorov-Smirnov test was performed to determine the distribution pattern of the continuous variables; all variables were skewed and expressed as quartile M (QR). Moreover, differences in patient characteristics between groups were tested with Mann-Whitney *U* test. Categorical variables were reported as percentages, and differences in patient characteristics between groups were tested with Chi-Squared test. Receiver operating characteristic curve diagnostic test was employed to determine the optimal cut-off point value for TyG index and diagnostic efficacy. The risk factors for CAD with T2DM were analyzed using a multivariate logistic regression model. Subsequently, a logistic regression model for the middle-aged and elderly subgroups and for the male and female subgroups was established, and the risk of TyG was compared. All statistical analyses were two-sided, and a *P* value $< .05$ was considered statistically significant.

3. Results

The proportion of male was higher, the median age and BMI were greater, and chest pain and abnormal wall motion were more common in the CAD with T2DM group than in the control group (all $P < .001$). The prevalence of smoking, hypertension, dyslipidemia, ischemic stroke, and TyG index ≥ 8.0 was significantly higher in the CAD with T2DM group (all $P < .001$). Similarly, the median of left ventricle end-diastolic

diameters were higher in the CAD with T2DM group than in the control group; however, the median ejection fraction was lower in the CAD with T2DM group (all $P < .001$). Moreover, the median leukocyte and neutrophil percentages in the blood routine examination were higher whereas the median platelet counts were lower in the CAD with T2DM group than in the control group (all $P < .001$). Total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) were higher in the CAD with T2DM group, whereas high-density lipoprotein cholesterol (HDL-C) was higher in the control group (all $P < .05$) (Table 1).

In the middle-aged and elderly subgroups, the median TyG index in the CAD with T2DM group was significantly higher than that in the control group (both $P < .05$). In the male and female subgroups, the median TyG index in the CAD with T2DM group was also significantly higher than that in the control group (both $P < .05$) (Figs. 1 and 2)

Based on the TyG diagnostic test analysis, the area under the receiver operating characteristic curve (AUC) of the TyG index was 0.776, the optimal diagnostic cut-off point value was 8.0, and the sensitivity and specificity were 42.27% and 85.06%, respectively. The positive and negative predictive values were 98.09% and 7.51%, respectively. Moreover, the TyG index diagnostic test analysis revealed that in the middle-aged, elderly, male, and female subgroups, the AUC of the TyG index was 0.816, 0.755, 0.775, and 0.782, respectively; the optimal diagnostic cut-off point value was 8.2, 8.3, 8.3, and 8.2, respectively; the sensitivity was 33.43%, 55.24%, 51.77%, and 39.80%, respectively; the specificity was 95.28%, 75.00%, 82.86%, and 86.27%, respectively; the positive predictive value was 97.95%, 94.27%, 94.21%, and 96.21%, respectively; and the negative predictive value was 17.50%, 18.38%, 24.17%, and 14.08%, respectively. In all subgroups, the specificity and the positive predictive value of the TyG index was greater than the sensitivity and the negative predictive value, respectively, in the CAD with T2DM group. Furthermore, the middle-aged subgroup had the greatest AUC, diagnostic specificity, and positive predictive value (Table 2).

TyG index was correlated with CAD risk factors; it was positively correlated with BMI, systolic blood pressure, pulse pressure, TC, LDL-C, and leukocyte and was negatively correlated with HDL-C (all $P < .05$). TyG index was also positively associated with the left atrium, uric acid, and heart rate (all $P < .05$) (Table 3).

Univariate analysis was performed to determine the factors with $P < .05$; thereafter, multivariate logistic regression model analysis found that BMI $\geq 30 \text{ kg/m}^2$, smoking, hypertension, dyslipidemia, ischemic stroke, pulse pressure $\geq 50 \text{ mm Hg}$, and TyG index ≥ 8.0 are all independent risk factors for CAD with T2DM, and the odds ratio (OR) value of these factors were 1.749, 1.743, 2.960, 2.020, 2.449, 1.717, and 2.641, respectively (all $P < .05$). The risk of TyG index is higher than that of BMI $\geq 30 \text{ kg/m}^2$, smoking, dyslipidemia, ischemic stroke, and pulse pressure $\geq 50 \text{ mm Hg}$ (Table 4).

Moreover, based on the multivariate logistic regression models that were established for the middle-aged and elderly subgroups, BMI $\geq 30 \text{ kg/m}^2$, smoking, hypertension, dyslipidemia, ischemic stroke, and TyG index ≥ 8.2 were all independent risk factors for middle-age patients with CAD with T2DM and BMI $\geq 30 \text{ kg/m}^2$, hypertension, dyslipidemia, ischemic stroke, pulse pressure $\geq 50 \text{ mm Hg}$, and TyG index ≥ 8.3 were all independent risk factors for elderly patients with CAD with T2DM (all $P < .05$). The risk of

Table 1**Baseline characteristics of the CAD with T2DM and control groups.**

Variables	CAD with T2DM (n=680)	T2DM without CAD (n=156)	Control (n=985)	χ^2 *	P*	χ^2/Z^\dagger	P [‡]
Male (%)	311 (45.7)	66 (42.3)	360 (36.5)	14.332	.001	1.463	<.001
Age (years)	63 (57.71)	59 (53, 63)	58 (53, 63)	168.116	<.001	-12.697	<.001
BMI (kg/m ²)	26.0 (24.0, 28.5)	26.2 (23.9, 28.7)	25.0 (23.0, 27.3)	39.816	<.001	-5.596	<.001
Chest pain (%)	417 (63.9)	66 (43.7)	404 (41.6)	78.86	<.001	2.475	<.001
Smoking (%)	222 (33.1)	33 (21.2)	244 (24.8)	17.449	<.001	1.505	<.001
Hypertension (%)	483 (73.5)	102 (67.1)	445 (45.6)	133.707	<.001	3.306	<.001
Dyslipidemia (%)	295 (45.8)	63 (42.0)	261 (27.0)	63.705	<.001	2.283	<.001
Ischemic stroke (%)	100 (20.9)	11 (7.7)	63 (6.8)	64.089	<.001	3.598	<.001
Pulse pressure (mm Hg)	56 (50.70)	50 (44, 60)	50 (40, 60)	62.075	<.001	-7.68	<.001
Left atrium (cm)	35 (32, 39)	34 (31, 38)	33 (30, 35)	45.973	<.001	-6.723	<.001
Left ventricle end-diastolic diameter (cm)	50 (46, 54)	48 (46, 51)	49 (46, 52)	27.916	<.001	-5.16	<.001
Left ventricular Ejection fraction (%)	59 (54, 64)	62 (57, 67)	62 (58, 67)	113.885	<.001	-10.213	<.001
Leukocyte (109/L)	6.7 (5.5, 8.0)	6.4 (5.4, 7.4)	6.3 (5.3, 7.5)	48.519	<.001	-4.598	<.001
Platelet (109/L)	210 (170, 242)	207 (167, 239)	215 (181, 255)	24.059	<.001	-5.295	<.001
Neutrophil (%)	62.8 (55.7, 69.8)	59.7 (54.5, 65.6)	61.5 (54.2, 67.6)	41.91	<.001	-2.371	.018
TC (mmol/L)	4.31 (3.63, 5.20)	4.22 (3.71, 5.06)	4.24 (3.60, 4.90)	5.468	.065	-8.378	<.001
HDL-C (mmol/L)	1.0 (0.8, 1.2)	1.07 (0.9, 1.37)	1.1 (0.9, 1.4)	70.846	<.001	-2.874	.004
LDL-C (mmol/L)	2.34 (1.75, 3.06)	2.13 (1.67, 2.61)	2.33 (1.79, 2.88)	16.803	<.001	-3.406	.001
Uric acid (mmol/L)	304 (254, 369)	291 (241, 346)	291 (244, 343)	11.877	.003	-9.898	<.001
Blood urea nitrogen (mmol/L)	5.9 (4.8, 6.9)	5.88 (4.83, 6.70)	5.2 (4.3, 6.1)	102.525	<.001	-4.29	<.001
Creatinine (μ mol/L)	67.2 (56.0, 80.6)	63.2 (54.3, 75.3)	63.5 (55.4, 72.9)	19.489	<.001	1.458	.001
Abnormal wall motion (%)	302 (61.9)	84 (64.1)	432 (52.4)	14.597	.001	2.72	<.001
β -blockers (%)	382 (57.7)	62 (40.3)	324 (33.4)	95.324	<.001	3.45	<.001
ACEI/ARB (%)	328 (50.2)	46 (30.1)	219 (22.6)	134.451	<.001	7.314	<.001
Diuretics (%)	152 (24.0)	2 (1.3)	40 (4.1)	128.387	<.001	9.007	<.001
Statin (%)	627 (93.3)	122 (78.2)	594 (60.7)	223.868	<.001	-19.187	<.001
TyG index	9.42 (8.96, 9.83)	9.46 (8.99, 10.06)	8.72 (8.35, 9.13)	417.848	<.001	-19.187	<.001

* The comparison among CAD with T2DM group, T2DM without CAD and Control group.

[†] CAD with T2DM group compared with Control group. Because TyG index is not statistically significant between the CAD with DM and the DM without CAD group, the T2DM without CAD group were not performed statistical analysis.

BMI = body mass index, HDL-C = high-density lipoprotein cholesterol, LDL-C = low-density lipoprotein cholesterol, TC = total cholesterol, TyG = triglyceride glucose.

Data are presented as number (%) of patients, median (interquartile range).

increased TyG index is greater in the middle-aged group (OR 5.732) than in the elderly group (2.841) (Table 5).

Multivariate logistic regression models were also established for the male and female subgroups. BMI ≥ 30 kg/m², hypertension, dyslipidemia, ischemic stroke, and TyG index ≥ 8.3 were independent risk factors for male patients with CAD with T2DM and hypertension, dyslipidemia, ischemic stroke, pulse pressure ≥ 50 mm Hg, and TyG index ≥ 8.2 were independent risk factors for female patients with CAD with T2DM (all $P < .05$). The risk of increased TyG index was greater

in the male group (OR 3.935) than in the female group (OR 2.309) (Table 6).

4. Discussion

The main findings of this study were that TyG index is an independent risk factor for patients with CAD with T2DM and the median TyG index and the prevalence of increased TyG index are higher in the CAD with T2DM group than in control group. TyG index was first found by Guerrero-Romero to be associated

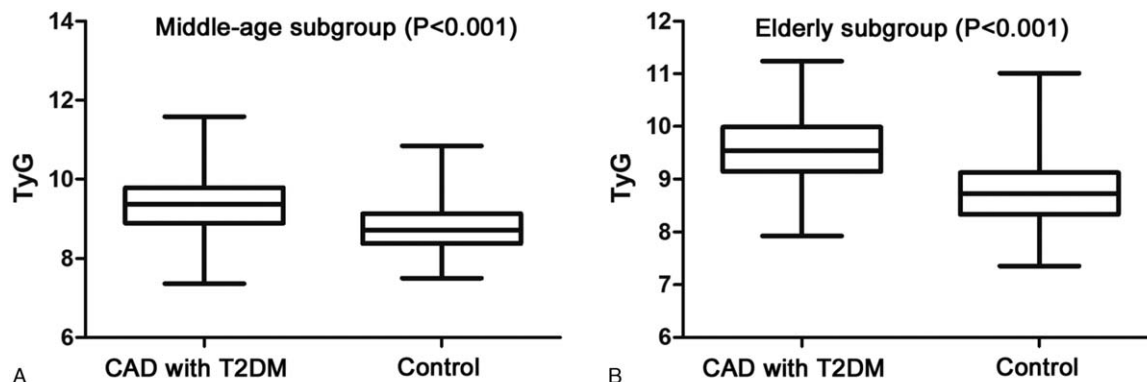


Figure 1. Comparison of TyG index between the CAD with T2DM and control groups in the middle-aged (A) and elderly subgroups (B).

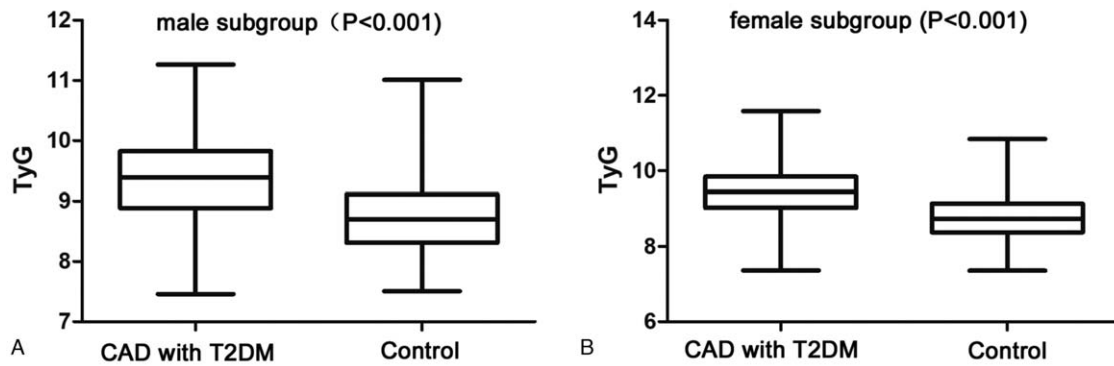


Figure 2. Comparison of TyG index between the CAD with T2DM and control groups in the male (A) and female subgroups (B).

with insulin resistance, and previous studies also showed that its predicted value for insulin resistance may be better than HOMA-IR.^[13–15] In insulin resistance, the sensitivity and responsiveness to insulin metabolism weakens, which could in turn lead to vasoconstriction, promote inflammatory response and thrombosis, and accelerate coronary atherosclerosis.^[16–18] A previous study also found that TyG index is a predictor of cardiovascular risk and is associated with cardiovascular outcomes in stable CAD with T2DM.^[19] Moreover, TyG index is associated with coronary artery stiffness and calcification, influences the formation and progression of atherosclerotic plaque, and is associated with coronary stenosis, cardiovascular disease, and adverse cardiovascular events.^[20–22] An observational cohort study found that TyG index is associated with an increased risk of coronary artery stenosis in patients with asymptomatic T2DM.^[16] Cho et al^[7] showed that TyG index is independently correlated with CAD and obstructive CAD in patients without

T2DM and that it increases the risk of CAD. In addition, TyG index plays a potential role in CAD with T2DM. Elevated TyG index indicates insulin resistance, which in turn increases the risk of CAD, promotes the formation and development of coronary atherosclerotic plaque, and accelerates deterioration in CAD with T2DM.

In our study, the multivariate logistic regression models for middle-aged, elderly, male, and female subgroups found that TyG index is an independent risk factor for patients with CAD with T2DM. The risk of increased TyG index was different between the middle-aged and elderly subgroups and between the male and female subgroups. No studies on the risk of TyG index in CAD with T2DM according to different age and sex groups have been conducted; our study is the first to report that the risk of elevated TyG index is greater in the middle-aged and male groups than in the elderly and female groups, respectively.^[23,24]

Table 2
TyG index diagnostic test in different subgroups.

Groups	AUC	95% CI	P	Se (%)	Sp (%)	PPV (%)	NPV (%)	Cut-off point
All subjects	0.776	0.753–0.799	<.001	42.27	85.06	98.09	7.51	8.0
Middle-aged subgroup	0.816	0.784–0.847	<.001	33.43	95.28	97.95	17.50	8.2
Elderly subgroup	0.755	0.722–0.787	.017	55.24	75.00	94.27	18.38	8.3
Male subgroup	0.775	0.740–0.810	<.001	51.77	82.86	94.21	24.17	8.3
Female subgroup	0.782	0.752–0.812	<.001	39.80	86.27	96.21	14.08	8.2

AUC = area under the curve, CI = confidence interval, NPV = negative predictive value, PPV = positive predictive value, Se = sensitivity, Sp = specificity.

Table 3
Correlation array between TyG index and CAD risk factors.

	TyG index	BMI	Systolic blood pressure	Pulse pressure	Left atrium	TC	HDL-C	LDL-C	Uric acid	Leukocyte	Heart rate
Age	.091**	−0.051	.168**	.263**	.077**	−.028	−.035	0.001	0.039	0.014	.058*
TyG index		.195**	.148**	.117**	.108**	.278**	−.280**	.058*	.164**	.182**	.174**
BMI			.152**	.055*	.276**	0.031	−.154**	0.037	.160**	0.044	.083**
Pulse pressure					.086**	0.029	0.031	0.005	−0.033	0.035	−0.031
Left atrium						−.084**	−.132**	−.066*	.141**	0.038	−0.002
TC							.281**	.824**	0.025	0.016	.098**
HDL-C								.209**	−.167**	−.156**	−.068**
LDL-C									−0.017	−0.009	.069**
Uric acid										.125**	.079**
Leukocyte											.181**

* P < .01.

** P < .001.

BMI = body mass index, HDL-C = high-density lipoprotein cholesterol, LDL-C = low-density lipoprotein cholesterol, TC = total cholesterol, TyG = triglyceride glucose.

Table 4
Multiple logistic regression model for CAD with T2DM.

Variables	Unadjusted			Multivariate-adjusted		
	OR	95% CI	P	OR	95% CI	P
BMI ≥ 30 kg/m ²	2.214	1.580–3.103	<.001	1.749	1.171–2.611	.006
Smoking	1.502	1.211–1.863	<.001	1.743	1.297–2.342	<.001
Hypertension	3.353	2.706–4.154	<.001	2.960	2.193–3.996	<.001
Dyslipidemia	2.291	1.857–2.827	<.001	2.020	1.528–2.671	<.001
Ischemic stroke	3.598	2.567–5.043	<.001	2.449	1.626–3.690	<.001
Pulse pressure ≥ 50 mm Hg	1.952	1.581–2.409	<.001	1.717	1.264–2.332	.001
TyG index ≥ 8.0	4.168	2.292–7.577	<.001	2.641	1.154–6.045	.022

BMI = body mass index, CI = confidence interval, OR = odds ratio, TyG = triglyceride glucose.

Table 5
Multivariate logistic regression model for the middle-aged and elderly subgroups.

Variables	Unadjusted			Multivariate-adjusted		
	OR	95% CI	P	OR	95% CI	P
Middle-aged subgroup						
BMI ≥ 30 kg/m ²	2.317	1.446–3.711	<.001	1.884	1.049–3.384	.034
Smoking	2.760	2.018–3.773	<.001	3.327	2.160–5.123	<.001
Hypertension	3.335	2.414–4.606	<.001	3.302	2.117–5.150	<.001
Dyslipidemia	2.691	1.968–3.679	<.001	2.213	1.447–3.385	<.001
Ischemic stroke	3.711	1.999–6.889	<.001	2.341	1.059–5.172	.036
TyG index ≥ 8.2	10.142	4.077–25.230	<.001	5.732	1.722–19.075	.004
Elderly subgroup						
BMI ≥ 30 kg/m ²	2.498	1.487–4.196	<.001	1.969	1.091–3.552	.024
Hypertension	2.893	2.151–3.893	<.001	2.683	1.779–4.048	<.001
Dyslipidemia	2.381	1.756–3.230	<.001	1.679	1.128–2.499	.011
Ischemic stroke	2.778	1.841–4.193	<.001	2.090	1.278–3.419	.003
Pulse pressure ≥ 50 mm Hg	1.786	1.317–2.423	<.001	1.613	1.037–2.510	.034
TyG index ≥ 8.3	3.703	2.302–5.955	<.001	2.841	1.495–5.399	.001

BMI = body mass index, CI = confidence interval, OR = odds ratio, TyG = triglyceride glucose index.

Previous studies have proven that the clinical features of CAD differ between middle-aged and older people as well as between sexes; moreover, some risk factors are different in each group.^[25,26] Nakagomi et al^[27] reported sex differences in the association between TyG index and arterial stiffness. This may be due to the age increased, the hormone secretion have changed, and body metabolism decreased.^[28] There are differences of hormone secretion and composition in male and female, and the ability of lipid metabolism and glucose metabolism in the body

are different, so, the tolerance to CAD risk factors and the development of cardiovascular disease may also different.^[9,29] Therefore, TyG index can be used to predict CAD patients with T2DM, but we must pay attention to the differences among patients of different ages and genders, to promote making better prevention and treatment programs.

The specificity and the positive predictive value of the TyG index is greater than the sensitivity and the negative predictive value, respectively. The AUC of each group is >0.7 , and the

Table 6
Multiple logistic regression model for the male and female subgroups.

Variables	Unadjusted			Multivariate-adjusted		
	OR	95% CI	P	OR	95% CI	P
Male subgroup						
BMI ≥ 30 kg/m ²	3.528	1.993–6.244	<.001	2.884	1.468–5.668	.002
Hypertension	2.864	2.076–3.953	<.001	3.473	2.255–5.349	<.001
Dyslipidemia	2.548	1.819–3.569	<.001	1.872	1.199–2.923	.006
Ischemic stroke	3.008	1.734–5.218	<.001	2.078	1.062–4.067	.033
TyG index ≥ 8.3	5.187	3.042–8.845	<.001	3.935	1.893–8.178	<.001
Female subgroup						
Hypertension	3.918	2.923–5.253	<.001	3.067	2.123–4.432	<.001
Dyslipidemia	2.229	1.696–2.929	<.001	1.949	1.392–2.728	<.001
Ischemic stroke	4.199	2.731–6.454	<.001	3.123	1.942–5.021	<.001
Pulse pressure ≥ 50 mm Hg	2.402	1.791–3.222	<.001	1.901	1.295–2.789	.001
TyG index ≥ 8.2	4.155	2.327–7.419	<.001	2.309	1.127–4.729	.022

BMI = body mass index, CI = confidence interval, OR = odds ratio, TyG = triglyceride glucose index.

diagnostic efficiency of TyG index in the middle-aged subgroup is greater than that in the elderly subgroup; the diagnostic efficiency of TyG index is similar between the female and male subgroups. Thus, the TyG index could be used as a predictive indicator for CAD with T2DM, especially for middle-aged people regardless of sex.

Moreover, TyG index is associated with age, BMI, systolic blood pressure, pulse pressure, TC, LDL-C, leukocyte, and HDL-C. Previous studies found that TyG index could be used as a biomarker for atherosclerosis and is positively correlated with risk factors for CAD, such as BMI, systolic blood pressure, and LDL-C.^[30–32] TyG index could be used as a biomarker for insulin resistance in patients with or without diabetes and is also associated with metabolic disorders and vasoconstriction.^[33,34] These factors increase the risk of CAD and accelerate the development of CAD. Hence, an increased TyG index plays a potential role in CAD.

This study has some limitations. Firstly, there is a methodological error with biases between groups, with different populations and different vascular risks, which may limit the study. Secondly, as this was a single-center study, all patients were selected from one hospital within a specific period of time. Hence, a multi-regional and multi-ethnic study is needed in the future. Lastly, the sample size of the young population is extremely small, this study only explored the middle-aged and elderly population; thus, an investigation of a large sample including young individuals is warranted.

In conclusion, increased TyG index is an independent risk factor for patients with CAD with T2DM, and the risk differs between the middle-aged and elderly group and between males and females. TyG index could be used as a convenient and inexpensive clinical predictor of CAD with T2DM.

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