Section: General Medicine

Original Research Article

ASSOCIATION BETWEEN TRIGLYCERIDE - GLUCOSE INDEX AND SEVERITY OF CORONARY ARTERY DISEASE IN NONDIABETICS

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ABSTRACT

Background: Coronary angiography (CAG) is currently regarded as the gold standard for diagnosing coronary artery disease (CAD), despite varying evidence regarding its correlation with the underlying pathological condition. Despite determining the degree of coronary vascular blockage, this procedure is intrusive and has risks. TyG index might be associated with the risk of multi-vessel CAD in patients with diabetes mellitus (DM). The aim is to study the association between triglyceride-glucose index and severity of coronary artery disease in non-diabetics. **Materials and Methods:** This was a cross-sectional study conducted in Justice K S Hegde Charitable Hospital attached to K S Hegde Medical Academy, a unit of Nitte University, Mangalore between 1-6-2023 to 30-11-2024 to study the association between triglyceride- glucose index and severity of coronary artery disease in non-diabetics in 99 patients with CAD. **Result:** The mean age of the patients was 60.69 ± 11.19 years. Out of 99 patients, 77 (77.8%) were males and 22 (22.2%) were females. The mean triglyceride was 134.72 ± 87.85, mean FBS was 106.24 ± 10.11, mean Tyg index was 8.7 ± 0.4, mean HbA1C was 5.48 ± 0.34. Based on CAD severity , 35 (35.4%) had DVD, 40 (40.4%) had SVD and 24 (24.2%) had TVD. The association of age groups, gender, TyG, FBS, HbA1C with CAD was not statistically significant. **Conclusion:** TyG index has emerged as a simple, reliable surrogate marker for insulin resistance (IR), which is a key driver of atherosclerosis. Most importantly, the TyG index provides a convenient, cost-effective tool for assessing cardio metabolic risk, particularly in individuals who do not meet the diagnostic criteria for diabetes but may still harbour significant underlying metabolic abnormalities.

INTRODUCTION

Coronary artery disease (CAD) is characterized by the presence of vulnerable atherosclerotic plaques that lead to myocardial ischemia and coronary artery stenosis. An acute coronary event occurs due to the rupture or separation of these endovascular plaques, resulting in arterial obstruction. If not managed promptly, such events may pose a significant threat to the patient's life.[1]

Coronary angiography (CAG) is currently regarded as the gold standard for diagnosing coronary artery disease (CAD), despite varying evidence regarding its correlation with the underlying pathological condition.[2,3] While CAG accurately assesses the extent of coronary vascular obstruction, it is an invasive procedure associated with inherent procedural risks.[4] Insulin resistance (IR) is widely acknowledged as a risk factor for atherosclerotic cardiovascular diseases and plays a vital role in the pathogenesis of diabetes mellitus (DM).[5] The triglyceride–glucose (TyG) index, calculated using theformula Ln [fasting triglycerides (mg/dL) × fasting plasma glucose (mg/dL) / 2], prior studies have revealed a significant association between the TyG index and various cardiovascular conditions, including carotid atherosclerosis, coronary artery calcification, and coronary artery stenosis.[6]

Coronary angiography (CAG), recognized as the gold standard for diagnosing coronary artery disease (CAD), is a widely used and accurate imaging method aimed at assessing the degree and extent of coronary artery stenosis. Participants were diagnosed with CAD based on CAG findings if they exhibited at least 50% luminal narrowing in one or more major coronary arteries.[7] Moreover, the number of affected vessels was used to determine CAD severity, which significantly influences cardiovascular disease outcomes. Individuals with multi-vessel CAD, particularly those experiencing abnormal glucose

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metabolism, face a higher likelihood of cardiovascular events compared to those with single-vessel disease.[8-11] This investigation will assist in determining the true link between the triglyceride-glucose index and the severity of coronary artery disease, which has not been well investigated in nondiabetics. Therefore, the purpose of this study was to study the association between triglyceride-glucose index and severity of coronary artery disease in non-diabetics.

MATERIALS AND METHODS

It was a hospital based cross sectional study conducted at Justice K S Hegde Charitable Hospital attached to K S Hegde Medical Academy, a unit of Nitte (Deemed to be) University, Mangalore- 575018 between 1-6-2023 to 30-11-2024 through Convenience sampling technique.

The proportion of coronary artery disease (CAD) observed to increase with an elevated triglyceride-glucose (TyG) index was taken as $p = 0.148$. Accordingly, $q = 1 - p = 0.852$. With an expected precision (d) of 0.07 at a 95% confidence level ($Z = 1.96$), the required sample size was calculated using the formula:

$n = (Z^2 \times p \times q) / d^2$

Substituting the values:

$n = (1.96^2 \times 0.148 \times 0.852) / (0.07^2)$

The calculated sample size was found to be approximately 99.

Inclusion criteria

Participants who are nondiabetics. Patients willing to participate in the study. Age greater than 18years. Patients with coronary artery disease.

Exclusion criteria

People who had past history of CABG, who underwent percutaneous coronary intervention (PTCA) surgeries. People who are known case of diabetes. People who are not willing to participate in my study.

Data collection: Detailed history was taken from all participants including age, sex, past medical and surgical illness, duration of illness , number of previous lines of treatment, provisional diagnosis, other comorbidities , laboratory measurements, related treatments. After obtaining clearance from institutional ethical committee approval with written informed consent, 99 patients of either sex, greater than or equal to 18yrs of age admitted under Department of General medicine, Cardiology at Justice K.S. Hegde Charitable Hospital were selected for this in hospital-based study. In all study participants, 5 mL of venous blood was drawn under aseptic precautions and collected in a serum separator tube. Blood sampling was performed following an overnight fasting period of 8 hours. The triglyceride (TG) and fasting plasma glucose values obtained were subsequently utilized for calculating the triglyceride-glucose (TyG) index as a laboratory-derived surrogate marker. Severity of CAD was classified based on angiographic findings and defined according to the number of affected vessels: single-vessel disease (SVD), double-vessel disease (DVD), or triple-vessel disease (TVD), in accordance with definitions used in recent studies (multi-vessel CAD defined as ≥ 2 vessels with $\geq 50\%$ stenosis).[1,2]

TyG INDEX -

Ln [Fasting Triglycerides (mg/dl)× Fasting plasma glucose (mg/dl)/2]

Statistical Analysis: Data entry was performed using Microsoft Excel, and all statistical analyses were carried out using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the data. Quantitative variables were presented as mean ± standard deviation (SD), while qualitative variables were expressed as frequency and percentage. For inferential statistics, the Chi-square test was applied to assess the association between the TyG index and the severity of coronary artery disease (CAD), classified as single vessel disease (SVD) or multiple vessel disease (MVD). A p-value < 0.05 was considered statistically significant. The level of significance was set at 5% for all analyses.

RESULTS

The mean triglyceride was 134.72 ± 87.85, mean FBS was 106.24 ± 10.11, mean TyG index was 8.74 ± 0.49, mean HbA1C was 5.48 ± 0.34. 5 patients (5.1%) were in the age group of 32 to 40 years, 11 patients (11.1%) were in the age group of 41 to 50 years, 30 patients (30.3%) were in the age group of 51 to 60 years, 33 patients (33.3%) were in the age group of 61 to 70 years and 20 patients (20.2%) were >70 years. Out of 99 patients, 77 (77.8%) were males and 22 (22.2%) were females. Based on CAG, 35 (35.4%) had DVD, 40 (40.4%) had SVD and 24 (24.2%) had TVD.

Table 1: Mean descriptives with demographic distribution

	N	Minimum	Maximum	Mean	S.D
TRIGLYCERIDE	99	54	678	134.72	87.85
FBS	99	74	123	106.24	10.11
TYG INDEX	99	7.86	10.60	8.741	.4925
HBA1C	99	4	6	5.48	0.34

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Table 2: Mean TYG index based on CAD

CAG	N	Minimum	Maximum	Mean	S.D	P value
DVD	35	8.05	10.03	8.672	.4131	
SVD	40	7.86	10.60	8.782	.6113	
TVD	24	8.18	9.43	8.772	.3694	
TOTAL	99					0.804

The mean TyG index among patients with single vessel disease (SVD) was 8.78 ± 0.61, for double vessel disease (DVD) it was 8.67 ± 0.41, and for triple vessel disease (TVD) it was 8.77 ± 0.37. Although there was a slight numerical variation in mean TyG index values across the CAD severity groups, no significant difference was observed between the groups. The mean TyG index did not show a statistically significant difference across SVD, DVD, and TVD groups (p = 0.804).

Table 3: association of triglycerides with CAD

Triglycerides		CAD			Total
		DVD	SVD	TVD	
Borderline high (150-199 mg/dl)	Count	4	2	5	11
	%	11.4%	5.0%	20.8%	11.1%
High (200-499 mg/dl)	Count	3	7	3	13
	%	8.6%	17.5%	12.5%	13.1%
Normal (<150 mg/dl)	Count	28	30	16	74
	%	80.0%	75.0%	66.7%	74.7%
Very High (>500 mg/dl or higher)	Count	0	1	0	1
	%	0.0%	2.5%	0.0%	1.0%
Total	Count	35	40	24	99
	%	100.0%	100.0%	100.0%	100.0%

Table 4: Association between cad and TYG index

TYG INDEX		CAD		Total
		Multiple	Single	
< 8.66	Count	28	20	48
	%	47.5%	50.0%	48.5%
≥ 8.66	Count	31	20	51
	%	52.5%	50.0%	51.5%
Total	Count	59	40	99
	%	100.0%	100.0%	100.0%
Chi-square value- 0.062				
p value- 0.804				

The distribution of coronary artery disease (CAD) severity was analyzed in relation to the triglyceride-glucose (TyG) index using a cutoff value of 8.66, which was determined based on the median TyG index observed in the study population, aligning with cutoffs reported in previous literature evaluating cardiovascular risk stratification. Among patients with a TyG index of < 8.66, 47.5% had multiple vessel disease, while 50.0% had single vessel disease. Similarly, in the group with a TyG index ≥ 8.66, 52.5% had multiple vessel disease, and 50.0% had single vessel disease. The overall proportion of patients with multiple vessel disease was 59 out of 99 (59.6%), while those with single vessel disease accounted for 40 out of 99 (40.4%). Statistical analysis using the Chi-square test revealed a Chi-square value of 0.062 with a p- value of 0.804, indicating no statistically significant association between the TyG index (with the specified cutoff of 8.66) and CAD severity in this study population.

DISCUSSION

In the present study, the triglyceride-glucose (TyG) index did not show a statistically significant association with the severity of coronary artery disease (CAD) in non- diabetic patients. Although patients with single vessel disease (SVD), double vessel disease (DVD), and triple vessel disease (TVD) demonstrated numerically different mean TyG index values, these differences were not statistically significant. In the present study, the mean age of the patients was 60.69 ± 11.19 years. Majority of the patients (33.3%) were in the age group of 61 to 70 years. This finding is consistent with other studies assessing CAD in non-diabetic cohorts. Won KB et al. reported a mean age of 59.7 ± 11.4 years in a similar population investigating the role of the TyG index in coronary artery calcification among non-diabetic patients.[8] Similarly, Liang S et al. found the mean age to be 61.3 ± 10.2 years in a large cohort analyzing TyG index and its predictive ability for obstructive CAD.[9] However, in our study, despite the significant presence of CAD in elderly individuals, no statistically significant association between age group and CAD severity (CAG subgrouping) was found. (p = 0.67) This may reflect that once CAD is established, factors beyond age such as metabolic dysfunction and subclinical insulin resistance measured by TyG index could be more influential in determining CAD severity. In the

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present study, 77 (77.8%) were males and 22 (22.2%) were females.

The present study had a male predominance (77.8%), which is consistent with the gender distribution commonly seen in coronary angiography registries. Men have traditionally shown higher rates of obstructive CAD, particularly before the age of 70 However, no significant association between gender and CAD severity was noted in our cohort (p=0.22). The mean TyG index for SVD was 8.78 ± 0.61, for DVD it was 8.67 ± 0.41, and for TVD it was 8.77 ± 0.37. Using a TyG index cutoff of 8.66, 51.5% of patients with TyG ≥ 8.66 had CAD, while 48.5% of those with TyG < 8.66 had CAD. Statistical testing using the Chi-square method revealed a p-value of 0.804, indicating no significant association between the TyG index and CAD severity in the study population.

The TyG index is particularly noteworthy. It integrates fasting triglyceride and glucose levels into a logarithmic formula: TyG = ln [fasting TG (mg/dL) × FBG (mg/dL)/2], and has been validated against the gold standard euglycemic- hyperinsulinemic clamp method for insulin resistance detection.[10]

Several studies have reported that a TyG index >4.5 is predictive of coronary atherosclerosis even in non-diabetics. In a large Korean cohort study, Park et al. showed that TyG was significantly associated with coronary artery calcification (CAC), independent of traditional risk factors.[11] Similarly, Sánchez-Íñigo et al. found TyG to be superior to HOMA-IR in predicting cardiovascular events in metabolically unhealthy individuals.[12] In the present study, based on CAG, 35 (35.4%) had DVD, 40 (40.4%) had SVD and 24 (24.2%) had TVD. Interestingly, despite elevated TyG levels in this study population, no significant association was found between triglycerides alone and CAD severity (p=0.38). Notably, in our study, the prevalence of DVD and TVD is higher than in some regional angiographic registries of non-diabetic populations. For example, a study by Irace et al. in an Italian non-diabetic cohort found SVD to be the most common pattern, which may reflect ethnic or lifestyle differences in cardiovascular risk phenotypes.[13]

Our findings could be indicative of underlying subclinical insulin resistance and lipid abnormalities in this population, as reflected in the elevated mean TyG index. These findings underscore the potential of the TyG index to serve as a metabolic risk integrator, especially in younger and normoglycemic individuals who may otherwise be misclassified as low-risk by traditional screening approaches. The results reinforce observations from other large cohorts and point toward the importance of metabolic phenotyping in CAD risk assessment. Minor CAD patients included in single vessel disease. Limitations- Small sample size, Single centre study.

CONCLUSION

In this study conducted among non-diabetic patients undergoing coronary angiography, the triglyceride-glucose (TyG) index did not demonstrate a statistically significant association with the severity of coronary artery disease (CAD). Although numerical differences in mean TyG index values were observed across single, double, and triple vessel disease groups, these differences were not clinically or statistically meaningful. These findings suggest that, within the studied population, the TyG index may not serve as a reliable indicator for assessing the severity of CAD.

In recent years, the TyG index has emerged as a simple, reliable surrogate marker for insulin resistance (IR), which is a key driver of atherosclerosis. Most importantly, the TyG index provides a convenient, cost-effective tool for assessing cardiometabolic risk, particularly in individuals who do not meet the diagnostic criteria for diabetes but may still harbor significant underlying metabolic abnormalities.

Among the 99 nondiabetic patients studied, a significant proportion had advanced CAD: 35.4% had double-vessel disease (DVD), and 24.2 % had triple- vessel disease (TVD). This suggests that non-diabetic individuals can still manifest severe coronary involvement, likely due to unrecognized metabolic risk factors, including insulin resistance. The relatively lower prevalence of single- vessel disease (40.4%) underscores the possibility that many non-diabetic patients present with late-stage atherosclerosis. However, further large-scale prospective studies are needed to assess causality in larger populations.

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