

TRIGLYCERIDE GLUCOSE INDEX AS A PREDICTOR OF SEVERITY OF CORONARY ARTERY DISEASE IN ACUTE CORONARY SYNDROME

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KEYWORDS

Triglyceride glucose index, acute coronary syndrome.

ABSTRACT

INTRODUCTION: Coronary artery disease (CAD) is a major cause of morbidity and mortality in Indian population presenting to EMD with acute coronary syndrome (ACS). TyG index which is a new parameter assessed using fasting plasma glucose and Triglyceride levels is known to predict severity of insulin resistance. This study aims at validating the hypothesis that increase in TyG index is associated with increased risk of multivessel disease. **METHODS:** This study was conducted in cardiology department in a tertiary care hospital KIMS in Hubballi, Karnataka, over a period of 1 year (2023-24). Triglyceride glucose index was calculated with formula: $\text{Log} [\text{Fasting triglyceride (mg/dl)} \times \text{fasting plasma glucose (mg/dl)} / 2]$. Further the severity of CAD was calculated using SYNTAX and GENSINI score which was correlated with TyG index.

RESULTS: We have recruited 109 participants with CVD. The mean (SD) TyG index was 5.4 [median (IQR) -5.5 (5.0-5.8)]. There was a positive correlation between TyG index and Gensini score (correlation coefficient - 0.33) similarly, a positive correlation was observed between TyG index and SYNTAX score (correlation coefficient - 0.37). The mean (SD) TyG index score was 5.1 (0.32) in SVD group and 5.6 (0.46) in participants with multi vessel diseases ($p < 0.001$). For a TyG index cut-off of 5.4 we observed sensitivity of 80%, specificity of 72.7% with significant AUC of 0.83.

CONCLUSION: Our study demonstrated that increased TyG index is associated with increased risk of multi vessel CAD. The results further demonstrated that higher TyG index is associated with more severe CAD.

BACKGROUND:

Coronary artery disease (CAD) is a major cause of morbidity and mortality in Indian population presenting to EMD with acute coronary syndrome (ACS). Coronary Angiography (CAG) has been a gold standard investigation for CAD since several decades and has been used to assess severity and prognosis and has become tool to plan management which includes Coronary angioplasty or Bypass Graft(1). In a developing country like India there are various reasons which makes it difficult for patients presenting with ACS to undergo CAG the reasons include non-availability of service, social stigmata, long waiting period and due to less number of professionals.

Insulin resistance is considered one of the pathophysiology of coronary artery disease which results due to various mechanisms includes change in cardiovascular risk factors and downregulation of insulin signalling pathways in different tissues(2).

Triglyceride glucose (TyG) index is a new mathematical result which is used to indicate severity of Insulin resistance, which is calculated with simple parameters which include fasting plasma glucose level and triglyceride level(3). It is calculated as follows: $\text{Log} [\text{Fasting triglyceride (mg/dl)} \times \text{fasting plasma glucose (mg/dl)} / 2]$. As an indicator of Insulin resistance, it also demonstrates a good accuracy in predicting cardiovascular events with a sensitivity of 67-96% and specificity of 32.5-85% respectively(4). A study performed in China suggested that an increase in TyG index is associated with increased risk of Myocardial Infarction highlighting the importance of monitoring TyG index(5). The severity of coronary artery disease is calculated by various scores like CASS- 50, CASS-70, SYNTAX, GENSINI score etc. which are all angiographic based studies and are validated. Recent studies have shown that increase in TyG index is associated with increased risk of multivessel disease

in Diabetic patients(6), this study lacks sufficient power due to lack of adequate population and it lacks validity in Indian scenario. Hence this study aims at validating the hypothesis that increase in TyG index is associated with increased risk of multivessel disease.

METHODS AND METHODOLOGY:

This study was conducted in cardiology department in KIMS, a tertiary care hospital in Hubballi, Karnataka, over a period of 1 year (2023-24). Patients presenting to EMD for whom diagnosis of Acute Coronary syndrome was confirmed and who underwent coronary angiogram were included in this study. After taking informed consent, socio-demographic data, history, and co-morbidities were collected. This was considered an observation study as no additional intervention was used in these patients and the blood investigations required which were fasting plasma triglyceride levels and fasting plasma glucose levels, for the study was a part of routine investigations. Triglyceride glucose index was calculated with formula: $\text{Log} [\text{Fasting triglyceride (mg/dl)} \times \text{fasting plasma glucose (mg/dl)} / 2]$. Once coronary angiography was done patients were divided into single vessel disease and multi vessel disease (double vessel disease + triple vessel disease). TyG index was further divided into tertile named T1, T2 and T3. the CAD which was divided into single vessel disease and multivessel disease was grouped into the tertile of TyG index. Further the severity of CAD was calculated using SYNTAX and GENSINI score which was correlated with TyG index.

STATISTICAL ANALYSIS:

Data were entered into Microsoft Excel and statistical analysis was carried out in SPSS software version 17.0. TyG index was divided as tertiles in the dataset. Qualitative variables were like gender, behavioural parameters, smoking, drinking alcohol and comorbid conditions like DM and hypertension across the TyG index tertiles and CVD type were done. Independent t test and one-way Anova was done. Quantitative variables were presented as mean (standard deviation). Bar diagrams were used for graphical presentation. A p value 0.05 was considered as statistically significant.

RESULTS:

We have recruited 109 participants with CVD. The study sample comprised 69 males and 40 females. The mean (SD) TyG index was 5.4 and the median (IQR) was 5.5 (5.0-5.8) with the minimum of 4.26 and the maximum of 6.16. When divided into tertiles, Tertile 1 included 23 males (62.2%) and 14 females (37.8%), Tertile 2 had 21 males (58.3%) and 15 females (41.7%), and Tertile 3 consisted of 25 males (69.4%) and 11 females (30.6%). There was no significant difference in the gender distribution across the tertiles ($p = .61$).

There was no statistical significance in age, gender, systolic blood pressure, diastolic blood pressure, BMI, total cholesterol, and presence of hypertension between subjects with single vessel disease and multivessel disease. However, on comparing the two groups there was significant difference with diabetes mellitus and HbA1c values. Multivessel disease group is noted to have higher HbA1c value and 84.4% of them had diabetes mellitus. Fundus examination was done in all hypertensive patients out of which 28 showed hypertensive retinopathy. Demographic distribution and comorbidities have been represented in Table 1.

Table 1: Demographic details, comorbidities, and laboratory parameters.

Parameter	Total	Single vessel CVD, (n=45)	Multi vessel CVD, (n=64)	P value
Age	56.79± 12.1	55.2 ± 11.8	57.9 ± 12.3	0.26
Male	69	27 (60.0)	42 (65.6)	0.55
Female	40	18 (40.0)	22 (34.4)	
SBP	124.62 ± 17.6	125.0 ± 18.8	124.3 ± 16.9	0.85
DBP	77.67 ± 10.5	77.3 ± 11.4	77.9 ± 9.9	0.79
BMI	28.05 ± 3.9	27.8 ± 4.2	28.3 ± 3.7	0.51

HbA1c	8.89 ± 2.8	7.2 ± 1.9	10.0 ± 2.8	<0.001
TC (mg/dl)	217.75 ± 53.0	208.5 ± 43.6	224.3 ± 59.7	0.11
Diabetes mellitus				
No	28	18 (40.0)	10 (15.6)	0.004
Yes	81	27 (60.00)	54 (84.4)	
Hypertension				
No	74	31 (68.9)	43 (67.2)	0.85
Yes	35	14 (31.1)	21 (32.8)	

Total No. of patients	No of hypertensives	Hypertensive retinopathy (fundus examination)	Percentage %
109	35	28	80%

A positive correlation was observed between TyG index with Gensini scores with the correlation coefficient of 0.33 and the p value of 0.004. Similarly, a positive correlation was observed between TyG index with Gensini scores with the correlation coefficient of 0.37 and the p value of <0.001. [Fig 1], [Fig 2]

Fig 1: Correlation between TyG score and GENSINI score.

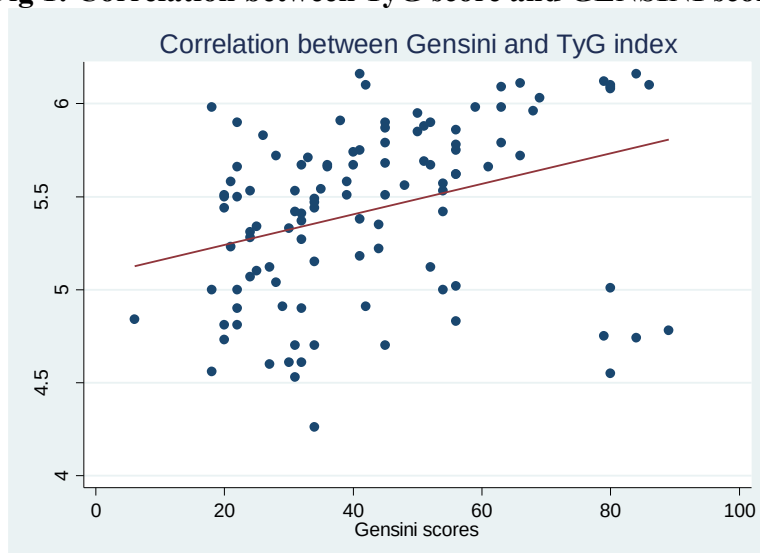
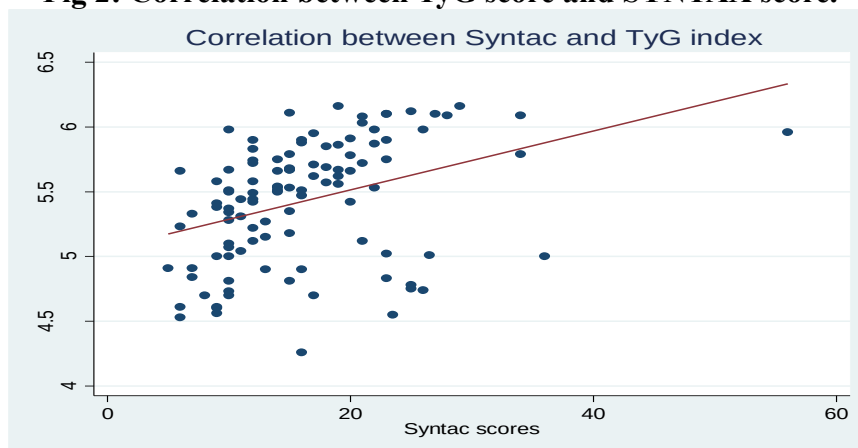


Fig 2: Correlation between TyG score and SYNTAX score.

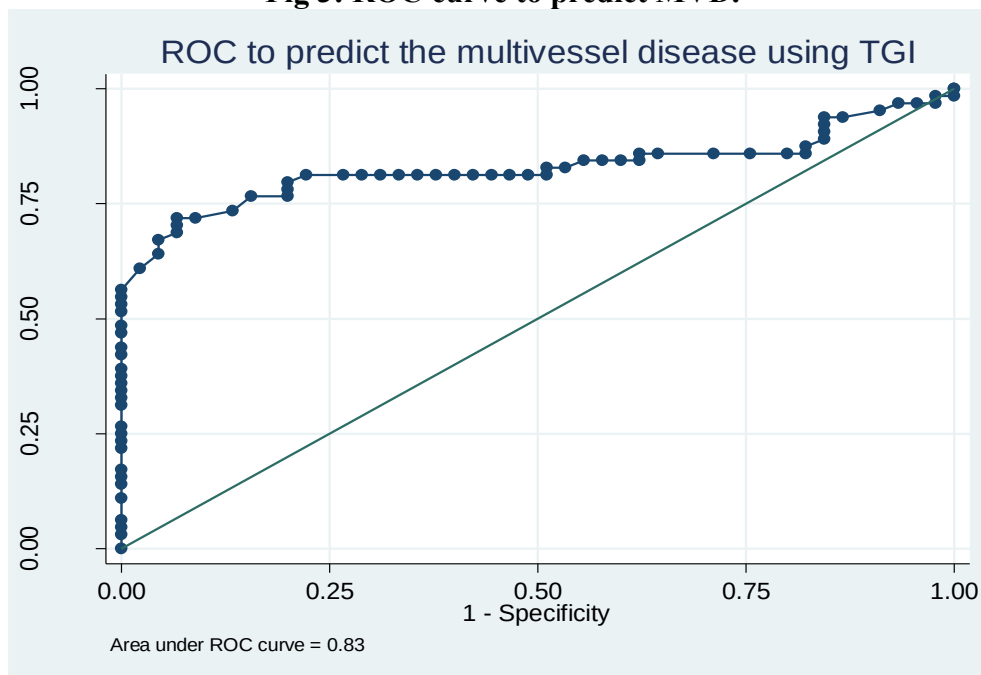


The mean (SD) TyG index score was 5.1 (SD=0.32) in SVD group and 5.6 (SD=0.46) in participants with multi vessel diseases. On independent t-test, there was statistical significance with the p values of <0.001.

The logistic regression analysis indicated that the TyG index when taken as continuous parameter, was statistically correlated with multi-vessel CAD (OR: 12.7 for unadjusted, 12.7 for model 2 and 55.2 for model 3). However, the Tertile 2 group had odds of 1.7 (95% CI 0.64-4.3; P = 0.29) times risk of getting MVD in unadjusted analysis when compared with tertile 1. Similarly, odds of getting MVD in groups adjusted for age & sex and adjusted for age, sex, diabetes, and hypertension were AOR: 1.6, 95% CI: 0.6-4.2 and AOR: 2.3, 95% CI: 0.5-10.2 for model 2 and 3 respectively, model 1 being unadjusted, model 2 adjusted for age and sex, model 3 adjusted for age, sex, diabetes and hypertension.

In Tertile 1, which included 37 participants, 25 (67.6%) had single vessel CVD, in Tertile 2, with 36 participants, 20 individuals (55.6%) had single vessel CVD. Notably, Tertile 3, also comprising 36 participants, all 36 (100.0%) with multi vessel CVD. The differences across tertiles were statistically significant (P <0.001).

Fig 3: ROC curve to predict MVD.



The AUC of TGI to differentiate the MVD from other valvular diseases in 0.83 with 95% CI was 0.75-0.91 and this was significant. The diagnostic test demonstrated a sensitivity of 80% (95% CI [68.2, 88.9]), specificity of 72.7% (95% CI [57.2, 85.0]), positive predictive value was 81.3% (95% CI [69.5, 89.9]), and negative predictive value was 71.1% (95% CI [55.7, 83.6]). Overall, the diagnostic accuracy of the test was 77.1% (95% CI [68.0, 84.5]).

DISCUSSION:

In our study, we have observed the association of TyG index with severity of CAD. TyG being a low cost, easy to calculate index of insulin resistance can be used to predict the incidence and severity of CAD(7). It is known that elevated TyG index is associated with diabetes mellitus(8). In our study we have noted that higher tertiles of TyG index group had highest prevalence of diabetes mellitus and higher HbA1c value. Prevalence of hypertensive retinopathy among our Patients with Hypertension is 80%.

We have observed a mean TyG of 5.1. A higher value of TyG was associated with multivessel disease (100%) with OR of 1.7, AOR of 2.3 in adjusted group. This shows that TyG can be used as a marker for prognostication and stratification of CAD. This also conveys that elevated HbA1c and presence of diabetes mellitus has higher risk of multivessel involvement.

Previous studies have shown a positive correlation with Framingham risk score(9). Our study has shown a positive correlation with GENSINI score (Co-efficient - 0.33) and SYNTAX score (co-efficient-0.37). TyG index being simpler, requiring less parameters compared to other existing scores like FRS, GENSINI, SYNTAX, can replace them. Also, TyG can be used as a cost-effective screening. In our study, for a TyG index cut-off of 5.4 we observed sensitivity of 80%, specificity of 72.7% with significant AUC of 0.83.

CONCLUSION:

Our study demonstrated that increased TyG index is associated with increased risk of multi vessel CAD. Also, cases with diabetes mellitus and elevated HbA1c are at higher risk of multivessel disease. The results further demonstrated that higher TyG index is associated with more severe CAD. In our patients the patients who had hypertension had high prevalence of hypertensive retinopathy. The results need further evaluation in larger population for confirmation.

LIMITATIONS OF THE STUDY:

The study was conducted in rather a small population and needs to be further evaluated in larger sample size. History of use of Lipid lowering agents was not included in the study. The study was confined to a single region and should include more regional and ethnic variability.

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