Original Article

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Association of the Triglyceride-Glucose Index with Severity of Coronary Artery Disease in Patients Undergoing Coronary Angiography for Ischemic Heart Disease

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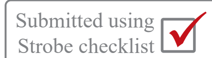

Abstract

Background: Coronary artery disease (CAD) remains the most prevalent cause of morbidity and mortality worldwide.1 The triglyceride glucose (TyG) index is a simple and surrogate marker of insulin resistance (IR) which has been linked to the severity of CAD in multiple international studies.2 Nevertheless, its correlation with angiographic severity of coronary artery disease (CAD) in the Nepalese population has not been established so far. This study aimed to evaluate the relationship between the TyG index and CAD severity quantified by the Gensini score in patients who underwent coronary angiography for ischemic heart disease.

Methods: This is a cross-sectional observational study conducted in the Department of Cardiology, NAMS Bir Hospital, Kathmandu. One hundred and one consecutive patients (mean age 64.17 ± 10 years; 55.4% male) undergoing coronary angiography for ischemic heart disease were enrolled. Fasting venous blood samples were taken for determination of glucose and triglyceride levels. The TyG index was calculated as ln (fasting triglycerides [mg/dL] × fasting glucose [mg/dL] / 2). Coronary angiograms were assessed with Gensini scoring system. Spearman's correlation test was employed to assess correlation between variables. Statistical significance was set at $p < 0.05$.

Results: Demography of the patients was analyzed (mean age 64.17 ± 10 years; 55.4% male); the majority belonged to the middle-aged group (54 patients, 53.5%). Hypertension was the most prevalent comorbidity (60.4%), followed by diabetes (33.7%) and smoking (25.7%). On coronary angiography, 43 patients (42.6%) had normal coronaries, 17 (16.8%) had minor coronary artery disease (CAD), 16 (15.8%) had single vessel disease, 17 (16.8%) had double vessel disease, and 8 (7.9%) had triple vessel disease. A statistically significant positive correlation was observed between the TyG index and the Gensini score ($r = 0.208$, $p = 0.037$). A similarly significant positive correlation was found between the TyG index and the presence of CAD ($r = 0.217$, $p = 0.029$).

Conclusions: The TyG index was significantly associated with the severity of CAD as measured by the Gensini score, but this association was modest. This simple and cost-effective biomarker may help clinicians stratify risk for patients with ischemic heart disease, especially in resource-limited settings where advanced metabolic testing is unavailable. Further prospective studies in Nepal are warranted to validate these findings and to establish population specific TyG cutoff values.

Keywords: *Triglyceride-Glucose index; Insulin resistance; Gensini Score; Coronary Artery Disease; Coronary Angiography; Nepal.*

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Introduction:

Cardiovascular disease (CVD) remains the leading cause of death worldwide, with an estimated 20.5 million deaths in 2021 alone.[3] Coronary artery disease (CAD) is characterized by inflammation and the buildup of and fatty deposits along the innermost layer of the coronary arteries. It constitutes the single largest contributor to this burden. In South Asia, including Nepal, the epidemiological transition has led to an increasing prevalence of CAD in younger cohorts.[4] Insulin resistance is increasingly recognized as an independent contributor to CAD risk in both diabetic and non-diabetic individuals.[5] It causes a cascade of cardiometabolic abnormalities that lead to endothelial dysfunction and atherogenesis.[6] The triglyceride-glucose (TyG) index, calculated as ln(fasting triglycerides [mg/dL] × fasting glucose [mg/dL] / 2), has emerged as a simple, reproducible surrogate marker for insulin resistance.[7] Higher TyG index has been shown to be positively associated with the presence and severity of CAD. A study from Hangzhou, China found that the TyG index was significantly and positively associated with Gensini score[8] even after adjustment for traditional cardiovascular risk factors.[9] In a meta-analysis of 12 cohort studies involving over 6.3 million participants, a linear association between TyG index and CAD incidence in the general population was confirmed.[10]

Data specific to the Nepalese population undergoing coronary angiography are very limited. The purpose of the study was to determine the correlation between the TyG index, and the extent of CAD measured with Gensini score in patients undergoing coronary angiography for ischemic heart disease in a tertiary care center in Nepal.

Methods

Study Design and Setting

This was a hospital-based, cross-sectional observational study conducted in the Department of Cardiology at the National Academy of Medical Sciences (NAMS), Bir Hospital, Kathmandu, Nepal. The study was carried out from April 2025 to January 2026.

Study Population

All consecutive patients aged 18 years or older who underwent coronary angiography for suspected or documented ischemic heart disease during the study period were eligible for enrollment. The study included 101 participants. Patients who refused to participate were excluded. No restriction was placed on age, sex, diabetic status, or indication for angiography beyond the diagnosis of ischemic heart disease. The sample size was calculated using the formula for correlation coefficient, with a two-tailed significance level of 5% ($Z\alpha/2 = 1.96$), statistical power of 80% ($Z\beta = 0.84$), and an expected correlation coefficient (ρ) of 0.3.

Data Collection

Demographic data including age, sex, presence of diabetes mellitus, blood pressure and smoking habits were recorded from each participant. Fasting venous blood samples were collected after a minimum of eight hours of fasting. Fasting plasma glucose and serum triglycerides were measured in the NAMS Bir Hospital laboratory using standardized protocols and calibrated equipment.

TyG index Calculation

The TyG index was calculated using the formula:

TyG index = ln [Triglycerides (mg/dL) × Fasting Glucose (mg/dL) / 2][11]

Gensini Score Assessment

All coronary angiograms were reviewed by a consultant interventional cardiologist, blinded to the biochemical results. The Gensini score was assigned to every patient as a quantitative measure of the extent and severity of coronary artery disease. For every coronary stenosis of 1% or greater identified on angiography, a lesion score was obtained by multiplying a severity factor by a corresponding location factor. The severity factor assigned to any totally occluded vessel was halved when Rentrop grade 2 or 3 collaterals were present. No such adjustment was applied in cases of Rentrop grade 0 or 1 collaterals, where collateral flow was considered hemodynamically negligible. The final Gensini score represented the sum of all individual lesion scores, assimilating these collateral-based adjustments where indicated.[12]

Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 23.0. Continuous data were expressed as mean ± standard deviation (mean + SD). Categorical variables were presented as frequencies and percentages. Spearman's rho (r) was used to examine the linear relationship between the TyG index and the Gensini score. A secondary analysis examined the correlation between the TyG index and the presence of obstructive CAD. A two-tailed p-value < 0.05 was considered statistically significant

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board of the National Academy of Medical Sciences, Bir Hospital. Written informed consent in Nepali was obtained from every patient before enrollment. Participants were explicitly informed of their right to withdraw from the study at any time without affecting their medical care. Confidentiality of all collected data was strictly maintained, and data were stored in password-protected computers accessible only to the principal investigator.

Results

Baseline Demographic Characteristics

A total of 101 patients undergoing coronary angiography for ischemic heart disease were enrolled in this study. The demographic profile is summarized in Table 1. The mean age of the study population was 64.17 ± 10 years, with a range of 41 to 93 years. The cohort comprised 56 males (55.44%) and 45 females (44.56%).

Table 1: Age and Gender Distribution of Study Population

Particulars	Parameters	Values
Age (years)	Mean ± SD	64.17 ± 10
	Range	52 (93–41)
Gender	Male	56 (55.44%)
	Female	45 (44.56%)

SD: Standard deviation.

Most patients were middle-aged (53.46%), followed closely by the elderly (40.59%); only one young adult was included in the study (Figure-1).

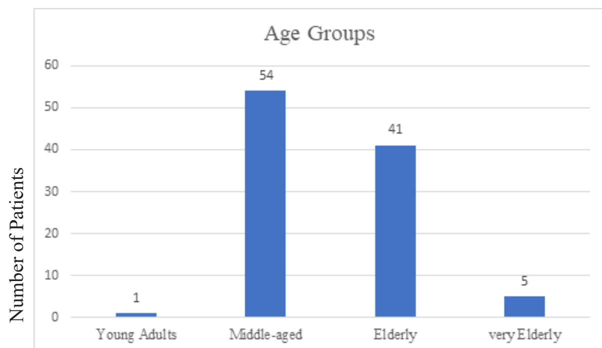

***Figure 1:** Age-wise distribution of Patient Population*

Brahmins were the most common in the cohort (35.64%) followed by Baishya (32.67%). Madheshi was under-represented (Figure 2).

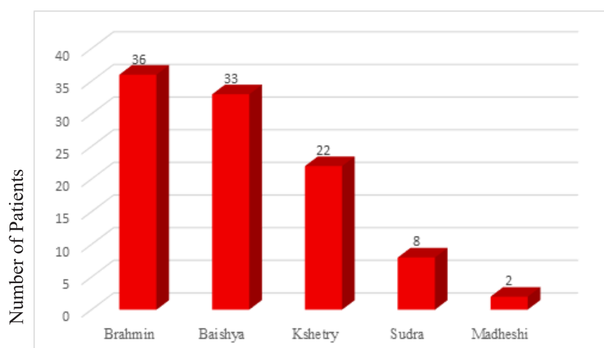

***Figure 2:** Ethnicity-wise distribution of patient population*

The mean values of all the components of lipids were in the normal range. Variance was highest with triglyceride followed by total cholesterol (Table-2).

Table 2: Lipid Levels in Patient Population

Particu-lars	Total Choles-terol	HDL Choles-terol	LDL Choles-terol	Triglycer-ide
Mean + SD	174.11 + 42.66	44.64 + 11.59	97.13 + 33.81	148.12 + 66.88
Range	230	73	173	379
Minimum	95	24	28	37
Maximum	325	97	201	416

Hypertension was seen in 60.39% of patients. Diabetes (33.66%) and smoking (25.74%) were the other common risk factors for coronary artery disease in the study of cohort (Figure-3).

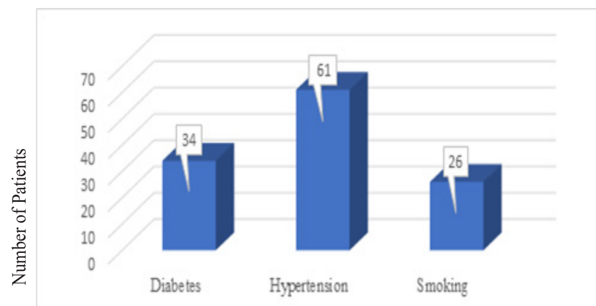

***Figure 3:** Risk factors in Patient Population*

Normal coronaries were found in 42.57% of the total angiography procedure. Minor CAD (plaque burden <50%), single and double vessel diseases were almost equal in number; triple vessel disease (7.92%) was the least common finding (Figure-4).

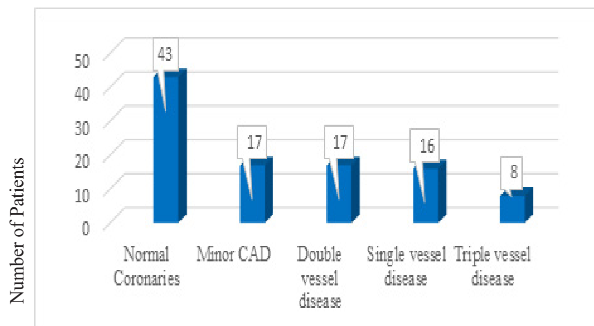

***Figure 4:** Coronary artery diseases in Patient Population*

TyG index and Gensini Score

The Regression variable plot shows a positive correlation between Gensini Score and TyG index, though the strength is weak (Figure-5).

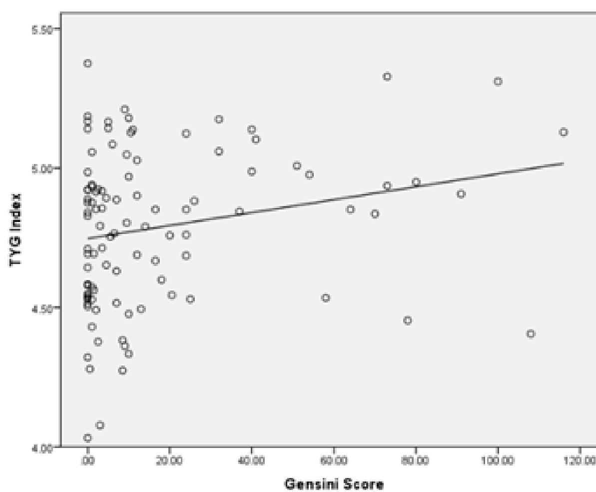

Figure 5: Regression variable Plot between TyG index and Gensini Score

The study investigated the correlation between the TyG index, and the severity of CAD as measured by the Gensini score. Spearman's rho(r) analysis revealed a statistically significant positive correlation between these two variables ($r = 0.208$; $p = 0.037$). These results are presented in Table 3.

Table 3: Spearman's Correlation between TyG index and Gensini Score

Variable	Spearman's rho(r)	p-value
TyG index vs. Gensini Score	0.208	0.037

TyG index and Presence of Coronary Artery Disease

The correlation between the TyG index and the binary presence of obstructive CAD (defined as any stenosis of ≥50% in a major epicardial coronary artery) was also assessed. As shown in Table 4, the TyG index again demonstrated a statistically significant positive correlation with presence of CAD ($r = 0.217$; $p = 0.029$).

Table 4:Spearman's Correlation Between TyG index and Presence of Coronary Artery Disease

Variable	Pearson Correlation (r)	p-value
TyG index vs. CAD (Presence)	0.217	0.029

The median values of Gensini score differed as per the severity of coronary artery disease. Higher values corroborated with severe forms of the disease (Figure 6).

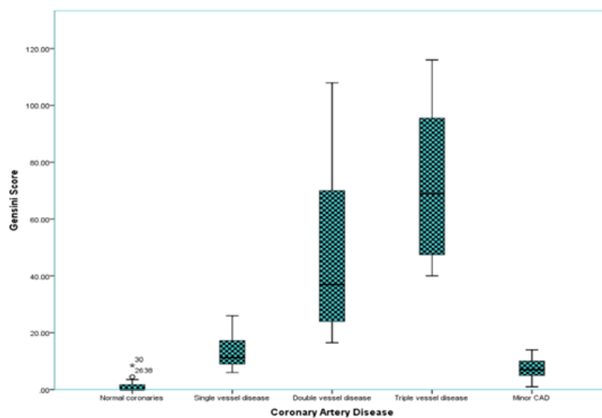

Figure 6: *Gensini Score and Coronary Artery Disease Severity*

Discussion

Demographic Profile of the Study Population

The present study enrolled 101 patients with a mean age of 64.17 ± 10 years and an age range of 41 to 93 years. The study cohort comprised 56 males (55.44%) and 45 females (44.56%), reflecting a modest male predominance. This demographic profile is consistent with epidemiological patterns of coronary artery disease (CAD) in native South Asian populations and the diaspora, wherein the disease manifests predominantly in the fifth and sixth decades of life. [13,14]

A study done in Sahid Gangalal National Heart Centre on assessment of demographic characteristics among CAD patients by ethnicity showed higher proportion of males (71.9%) with the mean age of the study population being 58.6 years.[15] Similarly, in another study from eastern part of Nepal on prevalence of conventional risk factors in acute coronary syndrome patients, the mean age of the patients was 59 years and two thirds (66.7%) of the them were male.[16]

Distribution of Cardiovascular Risk Factors

Coronary artery disease is a multifactorial condition. The prevalence of cardiovascular risk factors in our study population (hypertension in 60.39%, diabetes in 33.66% and smoking in 25.74%) is broadly similar to the cardiometabolic risk burden documented in other Nepalese studies and is comparable with South Asian cohorts. The findings are variable even within the country reflecting the combined effect of genetic, environmental, and lifestyle factors in the community. A cross-sectional study by Dhungana et al. (2018) in a peri-urban Kathmandu community documented hypertension in 34.4%, diabetes in 10.5%, elevated triglycerides in 10.8%, physical inactivity in 21.0%, and smoking in 17.6%.[17] A rural Nepalese study by Sharma et al. (2018) found even higher prevalences: hypertension (42.9%), diabetes (16.2%), dyslipidemia (56.0%), and overweight/obesity (59.4%).[18]

Among hospitalized CAD patients in Nepal, the risk factor burden was demonstrated to be substantially higher. In a study done by Deepak Kumar Mishra et al in Patan Academy of Medical Sciences, hypertension (30.67%) and diabetes (21.07%) were found to be the prevalent risk factors in Nepalese ACS cohorts.[19]

Pattern of Coronary Artery Involvement:

A study of young Nepalese ACS patients revealed single-vessel disease in 65%, double-vessel disease in 27.5% and triple-vessel disease in 7.5%.[20] The pattern of coronary artery disease is varied in different studies reported in South Asian countries including Nepal; single-vessel disease (SVD) has been reported in 16.7% to 88.3%, double vessel disease (DVD) in 4.9% to 36.9% , and triple vessel disease (TVD) in 12.5% to 55%.[21] The finding of SVD and DVD in around 16% each and TVD in around 8% in our study is not different from other studies.

TyG index and Gensini Score:

This study demonstrated a statistically significant positive correlation between the TyG index, and the severity of CAD as assessed by the Gensini score ($r = 0.208$, $p = 0.037$). However, the magnitude of the coefficient falls within the conventionally defined weak correlation range (0.1 to 0.3), suggesting that the TyG index alone explains only approximately 4.3% ($r^2 = 0.043$) of the variance in Gensini scores.

A Chinese study done by Tang et al. demonstrated a significant positive correlation between the TyG index and Gensini score even after adjustment for traditional cardiovascular risk factors.9 Shali et al. demonstrated that among young adults (≤45 years), a higher TyG index was significantly associated with severe obstructive CAD and target lesion failure.[22]

The magnitude of correlation observed in our study ($r = 0.208$) is comparable to, though slightly lower than, some previously reported coefficients. This discrepancy may be explained by differences in sample characteristics, sample size, population-specific factors such as dietary patterns, genetic predisposition, and the prevalence of other confounders not adjusted for in our analysis.

TyG index and coronary artery disease:

The other finding that the TyG index correlates with the presence of CAD (r = 0.217, p = 0.029) extends the potential utility of this biomarker to initial screening purpose. This finding indicates that patients with higher TyG index values are more likely to have angiographically detectable obstructive CAD. Park et al. demonstrated that the TyG index provides incremental diagnostic power for early-onset atherosclerotic cardiovascular disease beyond well-established risk factors, suggesting that routine TyG index measurement could facilitate earlier identification of at-risk individuals.[23]

Study Limitations

Several limitations of this study warrant acknowledgment.

1. The sample size, while adequate to detect the observed correlation with 80% power, is relatively small for subgroup analyses or multivariable adjustment.
2. Our analysis did not control for potential confounders such as body mass index, smoking status, hypertension, diabetes duration and control, use of lipid-lowering medications (particularly statins, which influence triglyceride levels), or anti-diabetic agents. Consequently, we cannot exclude the possibility that the observed association is partially explained by these factors. A larger study with multivariable regression analysis is needed to establish independence.
3. The cross-sectional nature of this study precludes any inference of causality. Whether an elevated TyG index precedes and promotes severe CAD, or whether severe CAD (or its associated lifestyle factors) elevates the TyG index, cannot be determined from these data.
4. The TyG index was calculated from a single fasting blood sample. Intra-individual variability in glucose and triglyceride levels, due to diet, recent illness, or medication changes, could lead to misclassification of insulin resistance status. Multiple measurements over time would provide a more reliable estimate.
5. Inter-observer variability in Gensini score calculation, though minimized by independent dual assessment and consensus, cannot be eliminated.
6. The prognostic value of the TyG index for future outcomes in this cohort remains unknown.

Conclusions

The triglyceride-glucose index demonstrates a statistically significant, albeit weak, positive correlation with the severity of coronary artery disease as measured by the Gensini score. An elevated TyG index should be taken into consideration for comprehensive cardiovascular risk assessment, aggressive lifestyle modification, and further diagnostic evaluation. This simple and cost-effective biomarker may assist clinicians in cardiovascular risk stratification, particularly in resource-limited settings.

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