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Relationship Between Triglyceride-Glucose Index And Cardiovascular Disease Complexity In Patients With Acute Coronary Syndrome

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ABSTRACT
Background: *Cardiovascular disease (CVD) is a prominent cause of morbidity and mortality worldwide, creating significant public health concerns and imposing a financial burden on patients. The TyG index has been identified as a credible alternative marker of insulin resistance (IR), which may explain its relationship to CVD.*
Aim of the study: *The purpose of our study was to determine the relationship between the triglyceride-glucose index and cardiovascular disease complexity in patients with acute coronary syndrome.*
Methods: *This cross-sectional observational study was conducted in the department of Cardiology, National Institute of Cardiovascular Diseases and Hospital (NICVD), Dhaka, Bangladesh, from September 2021 to August 2022. The study included 200 patients. All acquired data was entered into a Microsoft Excel Work Sheet and analyzed using descriptive statistics in SPSS 24.0.*
Results: *The mean age (in years) for Group 1 was 60.20±4.65 (SD) years, and that for Group 2 was 63.03±6.16 (SD) years. The majority of the studied patients were male from both groups (69.0% of Group-1 and 71.0% of Group-2). In terms of symptoms, the majority of the patients in both groups had chest pain (75.0% in Group 1 and 80.0% in Group 2), palpitations were present in 60.0% of Group 1 and 65.0% of Group 2 patients, and shortness of breath was present in 69.0% of Group 1 and 65.0% of Group 2 patients. MACEs were significantly higher for the Group 2 patients than Group 1 patients when compared as the p-value was <0.05. Patients with a high TyG index had 2.72 times more chances of having MACEs than patients with a low TyG index, and this difference was significant (p<0.05). The ROC curve, where the AUC 69.0% with a tyG index cut-off value of 8.74 with 77.8% sensitivity and 58.1% specificity in predicting MACEs.*
Conclusion: *This study found that the TyG index independently predicted coronary artery disease severity and major adverse cardiovascular events (MACEs). Therefore, the TyG index might be an important marker to predict MACEs and is also helpful to take the required steps to prevent MACEs.*
Keywords: *Acute coronary syndrome, cardiovascular diseases, Triglyceride Glucose index, Insulin resistance.*

I. INTRODUCTION

Cardiovascular diseases (CVDs) are a serious public health concern throughout the world. It is the leading cause of morbidity and mortality globally. The economic burden of various forms of CVD is substantial [1]. In 2019, an estimated 17.9 million people died from cardiovascular disease, accounting for 32% of all global deaths. 85% of these deaths were caused by heart attacks or strokes. CVDs were responsible for 38% of the 17 million premature deaths (before the age of 70) from noncommunicable diseases in 2019. Low- and middle-income countries account for more than three-quarters of CVD mortality [2]. CVDs account for half of

all noncommunicable disease (NCD) fatalities worldwide each year, posing a serious danger to human wellbeing and sustainable development [3]. Bangladesh has always been a developing country with communicable diseases. Over the last few decades, the prevailing illness pattern in this country has shifted from mostly communicable to predominantly noncommunicable disease (NCD), with CVD playing a significant role in the latter. The burden of CVD, particularly CAD, is expanding faster in South Asia than anywhere else in the world [1]. Coronary artery disease (CAD) is a major and growing health-care issue in developing countries, including Bangladesh. The exact prevalence of CAD in Bangladesh is unknown. More recent statistics show that the prevalence of coronary artery disease ranges from 1.85% to 3.4% in rural communities and 19.6% in an urban sample of working professionals [4]. According to the government health bulletin for 2013, CVDs were the leading cause of mortality (12,149 fatalities; 12.2%) in Bangladesh's 504 public hospitals [5]. Acute coronary syndrome (ACS) includes ST segment elevation myocardial infarction (STEMI), non-ST segment elevation myocardial infarction (NSTEMI), and unstable angina (UA) [6]. NST-ACS continues to be the major cause of death in people with coronary artery disease (CAD). NSTEMI and UA are often referred to as NST-ACS. As a result, identifying patients at high risk of suffering major adverse cardiovascular events (MACEs) that may require ocular care is critical. Insulin resistance (IR) is a broad term that refers to insulin's inability to exert its typical effects in insulin-sensitive target tissues such as skeletal muscle, adipose tissue, and the liver, which are the primary targets for insulin action in glucose metabolism. IR promotes the development of diabetes and cardiovascular disease by a variety of mechanisms, including alterations in traditional cardiovascular risk variables and downregulation of insulin signaling pathways in many tissues. It also refers to impaired sensitivity and response to insulin's metabolic activities, as seen by abnormalities in glucose absorption and oxidation [7]. Insulin resistance causes a variety of metabolic changes that contribute to the development of cardiovascular disease. For instance, insulin resistance can induce an imbalance in glucose metabolism that generates chronic hyperglycemia that triggers oxidative stress and causes an inflammatory response which leads to cell damage. Insulin resistance can also change systemic lipid metabolism, resulting in dyslipidemia and the well-known lipid triad: (1) elevated plasma triglycerides, (2) low levels of high-density lipoprotein, and (3) the formation of small dense low-density lipoproteins. This triad, along with vascular endothelial dysfunction contribute to atherosclerotic plaque formation. In addition, IR also contributes to vasoconstriction, inflammation and thrombosis leading to accelerated atherosclerosis [8]. The triglyceride glucose (TyG) index is an indirect biomarker for metabolic syndrome (MetS) [9], as well as an affordable, simple, and novel clinical surrogate marker for insulin resistance (IR) due to its connection to lipotoxicity and glucotoxicity. It is the logarithmized product of fasting triglycerides and fasting glucose. The index is calculated using fasting triglyceride (TG) and fasting blood glucose (FBG) measurements that has been proven to have high sensitivity and specificity in identifying IR [10]. The current study aimed to evaluate the association between the TyG index and CAD severity in patients with acute coronary syndrome.

II. METHODOLOGY

This cross-sectional observational study was conducted in the department of Cardiology, National Institute of Cardiovascular Diseases and Hospital (NICVD), Dhaka, Bangladesh, from September 2021 to August 2022. After careful history taking fulfilling inclusion and exclusion criteria, a total of 200 NSTEMI patients admitted into NICVD undergoing coronary angiography during hospitalization irrespective of their age, sex, race and ethnic group and divided them between two groups: Group 1: Low TyG index (≤8.805) (n=100), Group 2: High TyG index (>8.805) (n=100). All acquired data was entered into a Microsoft Excel Work Sheet and analyzed using descriptive statistics in SPSS 24.0.

III. RESULT

The mean age (in years) for Group 1 was 60.20±4.65 (SD) years, and that for Group 2 was 63.03±6.16 (SD) years. The majority of the studied patients were male from both groups (69.0% of Group-1 and 71.0% of Group-2). Age was significantly different between groups (p0.05 when compared [Table-1]. [Table-2] reveals that in terms of symptoms, the majority of the patients in both groups had chest pain (75.0% in Group 1 and 80.0% in Group 2), palpitations were present in 60.0% of Group 1 and 65.0% of Group 2 patients, and shortness of breath was present in 69.0% of Group 1 and 65.0% of Group 2 patients. No significant difference was seen regarding symptoms between groups (p>0.05). Findings of the study shows that MACEs were significantly higher for the Group 2 patients than Group 1 patients when compared as the p-value was <0.05 [Table-3]. Patients with a high TyG index had 2.72 times more chances of having MACEs than patients with a low TyG index, and this difference was significant (p<0.05). In addition, patients with a high TyG index had 3.062 times more chances of in-hospital cardiac death, 2.020 times more chances of having nonfatal stroke, 2.57 times more chances of having MI and 2.38 times more chances of having acute LVF [Table-4]. Patients with a high TyG index had 2.06 times more chances of having MACEs than patients with a low TyG index, and this difference was significant (p<0.05). In addition, patients with a high TyG index had 1.046 times more chances of in-

hospital cardiac death, 1.731 times more chances of having nonfatal stroke, 2.72 times more chances of having MI and 1.574 times more chances of having acute LVF [Table-5]. [Table-6] shows that the ROC curve, where the AUC 69.0% with a tyG index cut-off value of 8.74 with 77.8% sensitivity and 58.1% specificity in predicting MACEs.

Table -1: Age and gender distribution of the studied patients between groups (N=200)

Variables	Group-I (n=100) (Low TyG index)	Group-II (n=100) (High TyG index)	P-value
Age (in years)	60.20±4.65	63.03±6.16	0.001*
Gender			
Male	69.0	71.0	0.758**
Female	31.0	29.0	

Table-2: Distribution of the studied patients by symptoms (N=200)

Symptoms	Group-I (n=100) (Low TyG index)	Group-II (n=100) (High TyG index)	P-value
Chest pain	75.0	80.0	0.397
Palpitation	60.0	65.0	0.465
Shortness of breath	69.0	65.0	0.547

Table-3: Distribution of the studied patients by the hospital outcome (N=200)

Outcomes	Group-I (n=100) (Low TyG index)	Group-II (n=100) (High TyG index)	P-value
MACEs	7.0	17.0	0.030
In hospital cardiac death	1.0	3.0	0.312
Non-fatal stroke	1.0	2.0	0.561
Acute LVF	3.0	8.0	0.121
MI	2.0	4.0	0.407

Table-4: Univariate logistic regression showing association between the TyG index and outcomes (N=200)

Outcome variables	OR	95% CI (Lower Upper)	P-value
MACEs	2.72	1.08-6.89	0.035
In hospital cardiac death	3.06	0.31-29.94	0.336
Non-fatal stroke	2.02	0.18-22.65	0.568
Acute LVF	2.38	0.71-7.98	0.162
MI	2.57	0.49-13.62	0.264

Table-5: Multivariate logistic regression showing association between the TyG index and outcomes (N=200)

Outcome variables	OR	95% CI (Lower Upper)	P-value
MACEs	2.06	1.11-8.19	0.031
In hospital cardiac death	1.05	0.09-12.52	0.972
Non-fatal stroke	1.73	0.14-20.75	0.665
Acute LVF	1.57	0.43-5.80	0.496
MI	2.72	0.51-14.65	0.243

Table-6: Summary of the ROC curve for TyG index in having MACEs (N=200)

AUC	Cut off value for TyG	95% CI (Lower Upper)	Sensitivity	Specificity	P-value
69.0	8.74	0.61-0.77	0.778	0.581	0.000

IV. DISCUSSION

In this study, 200 patients with NSTEMI were included and divided into two groups: Group 1 –Patients with low TyG index and Group 2- Patients with high TyG index. In the current study, the mean age (in years) for the low TyG index patients was 60.20±4.65 (SD) years, and for high index patients, the mean age was 63.03±6.16 (SD) years. The majority of the studied patients were male from both groups (69% of Group-1 and

71% of Group-2). Age was significantly different between groups (p0.05 when compared. A similar study showed that the median age for the patients in the low TyG index group was 60 and for the high TyG index group was 64 years, and they also found a significant difference between groups regarding age (in years) [11]. Another study that was performed to see the association of age and sex with NSTEMI found that men have a 2.4-fold overall risk for NSTEMI when compared with females [12]. In terms of symptoms, the majority of the studied patients in both groups had chest pain (75% in Group 1 and 80% in Group 2), palpitation was present in 60% of Group 1 and 65% of Group 2 patients, and shortness of breath was present in 69% of Group 1 and 65% of Group 2 patients. No significant difference was seen regarding symptoms between groups ($p>0.05$). A study was performed to determine the clinical presentation of AMI, and they found that 84% of the patients with acute myocardial infarction had chest pain [13]. The present study found that patients with a high TyG index had 2.72 times more chances of having MACEs than patients with a low TyG index, and this difference was significant ($p<0.05$). In addition, patients with a high TyG index had 3.06 times more chances of in-hospital cardiac death, 2.02 times more chances of having nonfatal stroke, 2.57 times more chances of having MI and 2.38 times more chances of having acute LVF. A study by Zhang et al. showed that patients with a high TyG index had significantly 1.16 times higher chances of having MACEs than patients with a low TyG index [14]. The ROC curve of the present study in predicting MACEs showed a cut-off value for the TyG index of 8.74 with an area under the curve (AUC) of 69% with 77.8% sensitivity and 58.1% specificity. The study by Zhang et al. showed that the receiver operating characteristics (ROC) curve of the TyG index as a marker to predict MACEs in AMI patients had an AUC of 60.2% [14]. A study by Mao et al. showed that the cut-off point of 8.56 for the TyG index to predict MACEs in AMI patients had a significant 63.9% AUC with 87.2% sensitivity and 64.7% specificity [11]. In conclusion, this study showed that a high TyG index was a strong independent predictor of an increased risk of MACEs. This study was a single-center study with a small sample size and a short duration of follow-up, so these findings may not reflect the actual scenario. More multicenter studies with large sample sizes and long durations of follow-up are recommended to corroborate my research findings.

Limitation of the study:

This study was a single-center study with a small sample size and a short duration of follow-up, so these findings may not reflect the actual scenario.

V. CONCLUSION & RECOMMENDATION

This study found that the TyG index independently predicted coronary artery disease severity and major adverse cardiovascular events (MACEs). Therefore, the TyG index might be an important marker to predict MACEs and is also helpful to take the required steps to prevent MACEs. However, a larger multicentre study is necessary, since it may provide additional information about the impact of the TyG index on predicting coronary artery disease severity and in-hospital outcome.

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