### Original Article

Triglycerides and Glucose Index as Potential Marker of Metabolic Syndrome Mariya Tabassum<sup>1</sup>, Miliva Mozaffor<sup>2</sup>, Md. Matiur Rahman<sup>3</sup>, Reaz Mahmud Huda<sup>4</sup>

## Abstract:

Background: Triglycerides and Glucose Index (TyG index), a product from fasting levels of triglycerides and glucose, presented promising results as apotential marker of metabolic syndrome in different ethnicity. However, no such reports are available in our population to date. *Objective:* To see the effectiveness of 'Triglycerides and Glucose Index' to predict metabolic syndromein a Bangladeshi population. Methods: This cross-sectional study was carried out in Department of Biochemistry and Molecular Biology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from March 2016 to February 2017. A total of 200 apparently healthy subjects (127 men and 73 women) were selected for the study, who attended the out-patient-departments of the same institution. Anthropometric measurements were recorded – height, weight, waist circumference (WC) and body mass index (BMI). Overnight fasting blood samples were collected to estimate fasting serum glucose andlipid profile. Then TyG index was calculated and evaluated as a tool in diagnosis of metabolic syndrome in the study subjects. Receiver operating characteristic (ROC) curves were plotted to assess the performance of TyG index in MetS prediction by gender. The power of MetS prediction was quantified by the area under the curve (AUC) with 95% confidence intervals. Results: Sensitivity, specificity, positive predictive value and negative predictive value of TyG index to predict metabolic syndrome were 70.45%, 82.14%, 75.61% and 77.97% in males and 25.00%, 97.32%, 88.00% and 62.29% in females respectively. ROC curve showed optimal cut off value 8.72 and area under the curve 0.72 in male study subjects; in female study subjects, the values were 8.72 and 0.96 respectively (P<0.001). *Conclusion:* Triglycerides and Glucose Index (TyG index) represents a simple, accessible and effective tool for assessment of metabolic syndrome in Bangladeshi population.

**Keywords:** Metabolic Syndrome, Triglycerides and Glucose Index.

International Journal of Human and Health Sciences Vol. 05 No. 01 January '21 Page :85-89 DOI: http://dx.doi.org/10.31344/ijhhs.v5i1.239

#### **Introduction:**

The metabolic syndrome (MetS),as comprised of visceral obesity, dyslipidaemia, hyperglycaemia, and hypertension, has become one of the major challenges in clinical medicine as well as in publichealthworldwide<sup>1-3</sup>.MetS is a cluster of interrelated risk factors whichshows higher susceptibility to cardiovascular disease (CVD) by 2-fold increase of risk and type 2 diabetes mellitusby 5-fold<sup>4</sup> and that

tends to come to an effect within 5-10 years spanin an apparently healthy individual<sup>5</sup> – as it is evident that subjectively healthy individuals may have biochemical abnormalities along with presence of MetS<sup>6,7</sup>. The identification of modifiable CVD risk factors and predictors of MetS inan otherwise healthy population is necessary in order toidentify individuals who may benefit from early interventions<sup>6</sup>. Triglycerides and Glucose Index

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(TyG index), a product from the fasting levels of triglycerides and glucose, has been suggested to help as surrogate marker for insulin resistance as well as metabolic syndrome even in apparently healthy adults. The initial studythat demonstrated the utility of TyG index as a simple but effective marker was done by Simental-Mendía et al.<sup>8</sup>.Later,Vasques et al.<sup>9</sup> and Abbasi &Reaven<sup>10</sup> showed similar results in different population. Surprisingly, this measure only involves simple laboratory parameters like triglycerides and glucose, which can be measured without much effort or cost, which is very much feasible for a resource-poor country like Bangladesh.

We have mentioned earlier that TyG indexpresented promising results as a potential marker of metabolic syndrome in different ethnicity across the globe; however, no such study has been done in Bangladesh to date. Since we badly lack evidence in our population, TyG index needs tobe extensively studied in Bangladeshi population as an emerging marker of MetS. Hence, the present study was designed to see the effectiveness of TyG index as a potential marker to predict metabolic syndrome among Bangladeshi adult population.

### **Methods:**

This cross-sectional study was carried out in the Department of Biochemistry and Molecular Biology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. A total of 200 apparently healthy subjects were selected for the study, who attended the out-patient-departments of Bangabandhu Sheikh Mujib Medical University (BSMMU) Hospital, Dhaka, Bangladesh, from March 2016 to February 2017. A total of 200 apparently healthy subjects (127 male and 73 female) wereenrolled in the study based on inclusion and exclusion criteria. We used purposive and convenient samplingmethod.

# Inclusion Criteria:

- 1. Age: 19 to 45 years; and
- 2. Sex: Both males and females.

### Exclusion Criteria:

- 1. Pregnancy;
- 2. Diabetes mellitus;
- 3. Chronic kidney disease;
- 4. Chronic liver disease;
- 5. Any malignant disease;
- 6. Endocrine diseases; and
- 7. Any acute or chronic infection.

The purpose and procedures were explained to the study participants in details and written informed consent was takenfrom all of them. They

were evaluated by history, clinical examinations and laboratory investigations as per data sheet.Anthropometricmeasurements collection wererecorded, which included their height, weight and waistcircumference (WC). Then BMI was calculated - weight in kilograms divided by the square of height in meters (Kg/m<sup>2</sup>), for each of them. In sitting position, systolic and diastolic blood pressure were recorded. Overnight fasting blood samples were collected from them to estimate fasting serumglucose and lipid profile. Fasting serum glucose was estimated by using hexokinasemethod (in AU680 Clinical Chemistry Analyzer - BeckmanCoulter, Inc., made in USA). Serum total cholesterol (TC), triglycerides (TG) and High-Density Lipoprotein cholesterol (HDL-C)were estimated by using by enzymatic method (in ARCHITECT c4000 Clinical Chemistry Analyzer- AbbottDiagnostics Inc., made in USA), and Low-Density Lipoprotein cholesterol (LDL-C) was calculated using the 'Friedewald formula'. Individuals were considered to have metabolic syndrome having at least three or more of the criteria determined by the American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement<sup>11</sup>, then categorized as having 'metabolic syndrome' and 'no metabolic syndrome'. Later, comparison was done by using our diagnostic tool:Triglycerides and Glucose Index.

Triglycerides and Glucose Index (TyG index) is the product of serum TG and fasting serum glucose levels. It was calculated as: [Serum Triglyceride (mg/dl) × Fasting Serum Glucose (mg/dl)/2] (according to Simental-Mendía et al.)8. To convert mmol/l of glucose to mg/dl, multiplied by 18, while to convert mmol/l of triglycerides to mg/dl, multiplied by 89. Then TyG indexwas evaluated as a tool indiagnosis of metabolic syndrome in the study subjects. Receiver operating characteristic (ROC) curves were plotted to assess the performance of TyG index in MetS prediction by gender. The power of MetS prediction was quantified by the area under the curve (AUC) with 95% confidence intervals, as the larger the AUC is, the better the predictive accuracyis.All statistical analyses were conducted using SPSS version 22.0. for Windows (SPSS, Chicago, IL, USA). The difference was considered statistically significant at p-value<0.001 based on a 2-sided probability.

### **Results:**

In the present study, 200 study participants (127

male and 73 female) were enrolled. Amongthem, 67 malesand 17femaleshad metabolic syndrome (MetS) (Table 1), as determined by the anthropometric and biochemical parameters, based on the criteria of the American Heart Association/ National Heart, Lung, and Blood Institute Scientific Statement<sup>11</sup>.Then study subjects were further evaluated by Triglycerides and Glucose Index (TyG Index) tool. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NVP) of TyG Index in prediction of MetS in male study subjects were 70.45%, 82.14%, 75.61% and 77.97% respectively (Table 2). However, in female study subjects, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NVP) were 25.00%, 97.32%, 88.00% and 62.29% respectively (Table 2). Receiver Operating Characteristic (ROC) curve analysis showedthat the optimal cutoff value of TyGindex in male study subjects was 8.72, and area under the curve (AUC) was 0.87;those indicated that TyG index is a good predictor of MetS in adult males. (Table 3, Figure 1). Similarly, in female study subjects, the optimal cutoff value was 8.72, and area under the curve (AUC) value was 0.96; those also indicated that TyGindex is a good tool for prediction of MetS in adult females (Table 3, Figure 2).

**Table 1:** Presence of metabolic syndrome among the study subjects (n = 200)

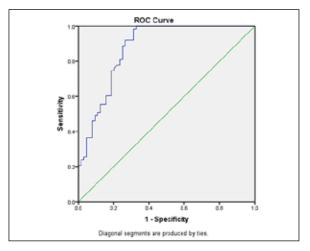
Sex	Metabolic Syndrome			
	Yes (%)	No (%)	Total	
Male	67 (33.50 %)	60 (30.00 %)	127	
Female	17 (8.50 %)	56 (28.00 %)	73	
Total	84 (42.00 %)	116 (58.00 %)	200	

**Table 2:** Effectiveness of Triglycerides and Glucose Index in diagnosis of metabolic syndrome

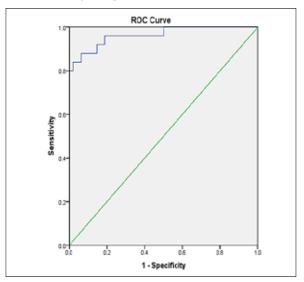
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Variables	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	
TyG index (Male)	70.45%	82.14%	75.61%	77.97%	
TyG index (Female)	25.00%	97.32%	88.00%	62.29%	

**Table 3:** Analysis of Receiver Operating Characteristic (ROC) curvesof Triglycerides and Glucose Index in male and female study subjects

Variable	Area under the curve (AUC)	P Value	Optimal Cutoff Point
TyG index (Male)	0.874	0.000	8.7240
TyG index (Female)	0.963	0.000	8.7240



**Figure 1.** Receiver Operating Characteristic (ROC) Curve for Triglycerides and Glucose Index in Male Study Subjects



**Figure 2.**Receiver Operating Characteristic (ROC) Curve for Triglycerides and Glucose Index in Female Study Subjects

#### **Discussion:**

The present study demonstrated the utility of TyG index as a simple but effective marker in detection of metabolic syndrome in apparently healthy Bangladeshi individuals. Simental-Mendía et al.8 studied on 748 apparently healthy subjects aged 18-65 years in Mexico; TyG index for diagnosis of insulin resistance showed 84% sensitivity and 45% specificity (45.0%), whilethe positive and negative predictive values were 81.1% and 84.8% respectively. Vasques et al. 9 studied on 82 subjects aged 22-81 years with wide range of adiposity and glucose tolerance inBrazil and showed found the area under the ROC curve (AUC) 0.79(P<0.001). They concluded that TyG index presented a slightly better performance in comparison to other indexes. Unger et al. 12 studied on 525 adults

in Argentina; they showed that TyG index had 79% sensitivity and86% specificity, while the cutoff point for the TyG index was 8.8 in men and 8.7 in women.Du et al.13 studied on 7629 Chinese adults based on their health data and found that TyG presented the value of AUC 0.709 in men and 0.711 in women.Er et al.14studied on 511 Taiwanese individuals and found the area under the ROC curve (AUC) for TyG 0.708. The results of the above-mentioned studies are more or less in agreement with the results of the present study. We found only a few studies to supportour results as because very limited number of studies have been conducted around the globe to dateto evaluateTriglycerides and Glucose Index as a diagnostic tool for metabolic syndrome. Moreover, no previous studies were found in Bangladeshi people to compare with our findings. Themain limitation of our studywas that it was done on small sample in a singlecentre, due to time constraint and limited budget. Therefore, it would be practically challenging to generalize the finding and apply on the specified population. Moreover, its design was cross-sectional, which limits its capability to draw a causal inference, which could be done in a prospective cohort study. However, with our results, it is still convincible that the study wasan appropriate one because of its simple mathematical calculations for clinical

use, cost-effectivenessand accessibility (with minimum laboratory facilities of a resource-poor country like Bangladesh). The result of the present study is expected to help clinicians to detect MetS easily and confidently, counsel their patients to consider lifestyle interventions, and thereby prevent significant morbidity and mortality.

### **Conclusion:**

Our study revealed thatthere is a significant prevalence of metabolic syndromein Bangladesh especially among adult males and 'Triglycerides and Glucose Index' could be used as a simple, accessible and effective tool to predict metabolic syndrome in adults. Further studies in the same ethnic population with lager samples, longer duration and of prospective designs withbetter clinical facilityare recommended.

Conflict of interest: None declared.

**Ethical approval issue:** The study was approved by the Institutional Review Board (IRB) of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh.

Funding statement: No funding.

**Authors' contribution:** Conception and design of the study: MT, MMR; Data collection and compilation: MT, MM, MMR, RMH; Data analysis: MT, MM; Critical writing, revision and finalizingthe manuscript: MT, MM, MMR, RMH.

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