Original Article

Triglycerides and Glucose Index as Potential Marker of Metabolic Syndrome
Mariya Tabassum¹, Miliva Mozaffor², Md. Matiur Rahman³, Reaz Mahmud Huda⁴

Abstract:
Background: Triglycerides and Glucose Index (TyG index), a product from fasting levels of triglycerides and glucose, presented promising results as a potential 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 syndrome in 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 and lipid 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.

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 public-health worldwide¹⁻³. MetS is a cluster of interrelated risk factors which shows higher susceptibility to cardiovascular disease (CVD) by 2-fold increase of risk and type 2 diabetes mellitus by 5-fold⁴ and that tends to come to an effect within 5-10 years span in an apparently healthy individual⁵ – as it is evident that subjectively healthy individuals may have biochemical abnormalities along with presence of MetS⁶,⁷. The identification of modifiable CVD risk factors and predictors of MetS in an otherwise healthy population is necessary in order to identify individuals who may benefit from early interventions⁸. 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 study that demonstrated the utility of TyG index as a simple but effective marker was done by Simental-Mendía et al. Later, Vasques et al. and Abbasi & Reaven 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 index presented 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 to be 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) were enrolled in the study based on inclusion and exclusion criteria. We used purposive and convenient sampling method.

**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 taken from all of them. They were evaluated by history, clinical examinations and laboratory investigations as per data collection sheet. Anthropometric measurements were recorded, which included their height, weight and waist circumference (WC). Then BMI was calculated – weight in kilograms divided by the square of height in meters (Kg/m^2), 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 serum glucose and lipid profile. Fasting serum glucose was estimated by using hexokinase method (in AU680 Clinical Chemistry Analyzer – Beckman Coulter, Inc., made in USA). Serum total cholesterol (TC), triglycerides (TG) and High-Density Lipoprotein cholesterol (HDL-C) were estimated by using enzymatic method (in ARCHITECT c4000 Clinical Chemistry Analyzer – Abbott Diagnostics 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, 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.). 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 index was 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 accuracy is. 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. Among them, 67 males and 17 females had 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. 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 showed that the optimal cutoff value of TyG index 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 TyG index 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)

<table>
<thead>
<tr>
<th>Sex</th>
<th>Metabolic Syndrome</th>
<th>Yes (%)</th>
<th>No (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Yes</td>
<td>67 (33.50%)</td>
<td>60 (30.00%)</td>
<td>127</td>
</tr>
<tr>
<td>Female</td>
<td>Yes</td>
<td>17 (8.50%)</td>
<td>56 (28.00%)</td>
<td>73</td>
</tr>
<tr>
<td>Total</td>
<td>Yes</td>
<td>84 (42.00%)</td>
<td>116 (58.00%)</td>
<td>200</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NVP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TyG index (Male)</td>
<td>70.45%</td>
<td>82.14%</td>
<td>75.61%</td>
<td>77.97%</td>
</tr>
<tr>
<td>TyG index (Female)</td>
<td>25.00%</td>
<td>97.32%</td>
<td>88.00%</td>
<td>62.29%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Area under the curve (AUC)</th>
<th>P Value</th>
<th>Optimal Cutoff Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>TyG index (Male)</td>
<td>0.874</td>
<td>0.000</td>
<td>8.7240</td>
</tr>
<tr>
<td>TyG index (Female)</td>
<td>0.963</td>
<td>0.000</td>
<td>8.7240</td>
</tr>
</tbody>
</table>
in Argentina; they showed that TyG index had 79% sensitivity and 86% specificity, while the cut-off point for the TyG index was 8.8 in men and 8.7 in women. Du et al. 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. studied 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 support our results as because very limited number of studies have been conducted around the globe to date to evaluate Triglycerides and Glucose Index as a diagnostic tool for metabolic syndrome. Moreover, no previous studies were found in Bangladeshi people to compare with our findings. The main limitation of our study was that it was done on small sample in a single centre, 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 was an appropriate one because of its simple mathematical calculations for clinical use, cost-effectiveness and 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 that there is a significant prevalence of metabolic syndrome in 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 larger samples, longer duration and of prospective designs with better clinical facilities are 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.

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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 finalizing the manuscript: MT, MM, MMR, RMH.
References: