



## A study of triglyceride glucose index (TyG Index) as a predictor, in macro- and microvascular complications of diabetes mellitus

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### Abstract

**Introduction:** Poor glycemic control is commonly assessed by HbA1c levels. In resource limited setting and as a cost effective approach, Triglyceride glucose (TyG) index can also be used as a marker for glycemic control and to predict the complication of diabetes mellitus. It is more cost effective and can be calculated manually with fasting blood glucose and triglyceride levels.

**Aims:** To find the association between Triglyceride Glucose index (TyG index) and HbA1c levels in assessing the micro and macro vascular complications of diabetes mellitus.

**Methods:** Total of 60 diabetic patients admitted in our hospital were included and they were grouped into 4 categories according to their HbA1c and TyG values. Presence of micro vascular complications including diabetic retinopathy, elevated protein creatinine ratio, decreased eGFR, abnormal monofilament test and macro vascular complication including reduced ankle brachial pressure index and ischemic changes in ECG and ECHO were noted. Presence of these diabetic complications were compared with the TyG and HbA1c level.

**Results:** Among 60 patients enrolled in the study, 46 patients (76.66%) had atleast one complication and only 14 patients (23.33%) are without any complication. As the TyG and HbA1c level progressed, patients having both microvascular and macrovascular complications increased [(TyG Group I - 20% vs TyG Group IV- 62.6%) and (HbA1c group I – 35% vs HbA1c Group IV- 50%)] and percentage of patients without any complications decreased [(TyG group I-40% vs TyG group IV-12.5%) and (HbA1c group I - 35.71% vs HbA1c group IV -16.66%)].

**Conclusion:** Increased TyG index might be a cost effective predictor of complication of diabetes mellitus when compared to HbA1c levels and can be used in addition to HbA1C to offer additional benefit for predicting complications.

### Introduction

Insulin resistance (IR) is suggested to be one of the most important risk factors for the development of vascular complications in diabetic population. Many studies have shown that IR

leads to vascular damage and CVD. The homeostasis model assessment of insulin resistance (HOMA-IR) index is the most common method for evaluating insulin resistance in clinical practice.<sup>1</sup> However, this method of assessing

insulin resistance is complex and expensive. Therefore, many surrogate biomarkers have emerged. Recently, a number of studies have shown that the triglyceride-glucose (TyG) index, calculated as  $\ln[\text{fasting triglycerides (mg/dL)} \times \text{fasting glucose (mg/dL)} / 2]$ , was significantly related to HOMA-IR.<sup>2</sup> Thus, the TyG index could serve as a simple and credible surrogate marker of IR in predicting the development of vascular complications of diabetes mellitus<sup>3</sup>.

### Objective

To find the relationship between Triglyceride Glucose index (TgY index) and micro and macro vascular complications of diabetes mellitus.

### Methodology

**Study Design:** This study was conducted by department of General medicine department, Sri Manakula Vinayagar Medical College and Hospital (SMVMCH), Puducherry. It is a hospital based cross sectional study and conducted on the patients who have Diabetes (FBS= >125mg/dl, PPBS= >199mg/dl, HbA1C = > 6.5). Study was done after getting approval from institutional ethics committee with sample size of 60. Patient with history of vascular complications like ischemic heart disease, peripheral neuropathy, cerebro vascular accident, diabetic retinopathy, diabetic nephropathy and patients with hepatic and renal disease, active infection, thrombophilias, active malignancy on chemo / radiotherapy are excluded from the study.

**Study Procedure:** Diabetic patients who comes under the above Inclusion and exclusion criteria will be enrolled. Routine investigation including fasting and post prandial blood sugars, HbA1C

will be done after the getting the consent of the patient. Triglyceride glucose (TyG) index will be calculated by the formula  $\ln[\text{fasting triglycerides (mg/dl)} \times \text{fasting glucose (mg/dl)}] / 2$ . Presence of diabetic complications will be calculated by means of Optic fundoscopy for diabetic retinopathy, monofilament test for diabetic neuropathy, urine protein creatinine ratio and eGFR for diabetic nephropathy, ankle brachial pressure index for peripheral artery disease, ECG and ECHO for coronary artery disease will be done. Presence of these micro and macro vascular complications will be compared with TyG levels and HbA1C levels. Presence of diabetic retinal changes will be considered as significant for diabetic retinopathy, presence of urine protein creatinine ratio > 0.2 or eGFR <44ml/min/1.73m<sup>2</sup> will be considered significant for diabetic nephropathy, loss of protective sensation in monofilament test will be considered significant for diabetic neuropathy, presence of ankle brachial index <0.9 will be considered significant for peripheral artery disease, presence of ischemic ST-T wave or Q wave changes or presence of regional wall motion abnormality in 2D echo will be considered as significant for coronary artery disease.

### Results

All Patients were divided into two group (TyG group and HbA1c group) and each group were sub-divided into 4 quartiles depending on the values of TyG and HbA1c (table 1).

**Table 1:** Cutoff of TyG index and HbA1c values in different quartiles

TyG Index	Quartile	HbA1C values
3.4 - 4.44	I	6.5-7.9
4.5-4.99	II	8-9.9
5.0-5.49	III	10-11.9
>5.5	IV	>12

In our study population mean age was 59 and most of them are male gender (61.67%). Mean value of TyG index is 5.06 and mean value of HbA1c is 9.6%. Over all in our study 25% had features of diabetic retinopathy,24% had features

of diabetic retinopathy,23% patients had features of diabetic neuropathy,3% had features of peripheral artery disease,20% had features of coronary artery disease. when classified according to quartiles(table 2),

**Table 2:** Descriptive analysis of patients with micro and macro vascular complications in different quartile

Variables	Quartile – 1 (%)	Quartile – 2 (%)	Quartile – 3 (%)	Quartile - 4 (%)
<b>Microvascular complications</b>				
<b>Features of diabetic retinopathy on fundus examination</b>				
HbA1c	26.7	13.3	33.3	26.7
TyG	13.3	20	46.7	20
<b>Protein creatinine ratio (&lt;0.2)</b>				
HbA1c	11.1	44.4	27.8	16.7
TyG	11.1	16.7	55.6	16.7
<b>eGFR(&lt;44ml/min/1.73m<sup>2</sup>)</b>				
HbA1c	25.0	35.0	20.0	20.0
TyG	5	20	55	20.0
<b>Loss of protective sensation in monofilament test</b>				
HbA1c	17.4	34.8	34.8	13.0
TyG	4.3	21.7	56.5	17.4
<b>Macrovascular complications</b>				
<b>Ankle brachial pressure index &lt;0.9</b>				
HbA1C	0	0	33.3	66.7
TyG	0	0	66.7	33.3
<b>Regional wall motion abnormality in 2D ECHO</b>				
HbA1c	16.7	41.7	16.7	25.0
TyG	8.3	41.7	33.3	16.7
<b>Ischemic changes in ECG</b>				
HbA1	20.0	40.0	20.0	20.0
TyG	6.7	33.3	40.0	20

Percentage of patients who had significant vascular complications is found increasing from quartile 1 to quartile 3 in both HbA1c and TyG group but it is more significant in TyG group. on comparing to quartile 3 and 4, percentage of people with complication is reduced in quartile 4.

### Discussions

Because triglyceride and glucose levels are commonly tested and the cost of these measures is inexpensive, the TyG index has the advantage of being relevant in clinical practise. However, very less clinical study done in the past to know whether the TyG index can help identify individuals with type 2 diabetes who are at a high risk of developing micro- and macrovascular disease in the future. In this study, we looked into the relationship between the TyG index and

micro- and macro vascular complications in patients with type 2 diabetes, and discovered that a higher TyG index was linked to both micro and macro vascular complications. In our study we found that patients having diabetic retinopathy increases as TyG index increases. this can supported by Anan F et al<sup>4</sup> study,where they concluded that diabetic retinopathy was found increased in patients with insulin resistance. In our study it is also found that as TyG index value progresses features of diabetic nephropathy like increase in protein creatinine ratio> 0.2<sup>5,6</sup> and decrease in eGFR less than 44 ml/min/1.73m<sup>2</sup> is present. This is supported by a study conducted by sikander et al<sup>7</sup> which showed higher TyG index was associated with high risk of CKD and micro albuminuria. on analysing monofilament testing, loss of protective sensation (LOPS) which is an

indicator of diabetic neuropathy also increases as TyG index progresses which is proved by a study done by wiggin TD<sup>8</sup> who showed that diabetic neuropathy increases as TyG progresses. On coming to macro vascular complications of diabetes both peripheral artery disease and coronary artery disease are present more in quartile 3 and 4 compared to quartile 1 & 2. Association of TyG and peripheral artery disease is proved by zhaos et al<sup>9</sup>, and association of TyG with coronary artery disease is confirmed by the studies done by Inigo L et al<sup>10</sup> and Jin JL et al<sup>11</sup>. When quartiles in HbA1c is compared they also shows that complications increase once HbA1c increases. This association is proved by many studies<sup>12,13</sup>. It is also proved in UKPDS trial that 0.9% reduction of HbA1c is associated with significant reduction of vascular complications. But HbA1c can vary in many conditions<sup>15</sup>. Hence adding triglyceride glucose index along with HbA1C in diabetic patient may help in better prediction of micro and macro vascular complications of diabetes mellitus.

### Conclusion

- As like HbA1c values, elevated TyG index is also associated with vascular complications and adding it to the basic model offer an additional benefit at no extra cost.
- Elevated TyG index alone in rural diabetic population can be used to identify patients with reduced drug compliance, increased risk of vascular complications and to promote positive treatments such as exercise, diet management, medication adherence.

### Acknowledgement

We would want to thank all of the patients for their precious time and cooperation in completing the research

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