



## EVALUATION OF TRIGLYCERIDE-GLUCOSE INDEX AS A MARKER OF GLYCEMIC CONTROL IN THE PATIENTS OF TYPE 2 DIABETES MELLITUS IN THE POPULATION IN A TERTIARY CARE CENTRE OF MURSHIDABAD

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### ABSTRACT:

**Introduction:** The study aims to evaluate the role of the triglyceride-glucose index in determining glycemic control in patients with type 2 diabetes mellitus in a tertiary care center in Murshidabad. There are other studies that have shown the utility of triglyceride-glucose index for glycemic monitoring purposes but evaluation of this marker in glycemic control has not been done in the population in eastern part of India especially in Murshidabad.

**Objective:** To evaluate TyG index as a marker of glycemic control in the patients of type 2 diabetes mellitus of Murshidabad District situated at eastern part of India.

**Methodology:** The study consists of 120 type 2 diabetes mellitus patients, and biochemical parameters such as fasting blood glucose, triglyceride and HbA1c were analyzed using standard biochemical methods. Type 2 diabetes mellitus patients, were categorized into two groups according to their HbA1c value: good control ( $\leq 7.0$ ) and poor control ( $> 7.0$ ) based on previous study. After analysis of biochemical parameters, statistical analysis done in Statistical Software for Social Sciences software (SPSS) version 20.

**Result:** The triglyceride-glucose index (TyG index), fasting blood glucose (FBS), HbA1c (Glycosylated hemoglobin) were analyzed, and statistical analysis between two groups (previously divided as good control and poor control) showed that triglyceride-glucose index has good discriminating ability between good glycemic control and poor glycemic control in that population.

**Conclusion:** The study found that TyG index has good discriminating ability between good and poor glycemic control patients of type 2 diabetes mellitus in the population of Murshidabad situated in the state of West Bengal. The study concludes that TyG index can be used as an affordable and available parameter for glycemic monitoring purposes in patients with type 2 diabetes mellitus in the population eastern part of India.

**Keywords:** triglyceride-glucose index, glycemic control, type 2 diabetes mellitus

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**INTRODUCTION:**

As the global prevalence type 2 diabetes mellitus is increasing day by day and India is considered as the diabetic capital of the world(1).In India the prevalence of type 2 diabetes mellitus is increasing day by day due to sedentary lifestyle and increased calorie intake as a main cause for this current scenario(2) .So a better available, affordable parameter is very much necessary for the treatment planning as well as glycemic monitoring purpose of the patients of type 2 diabetes mellitus.

The use of glycosylated hemoglobin as a marker of glycemic control of type 2 diabetes mellitus is already established(3).

The triglyceride-glucose(TyG) index correlates well with Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) (4).As per the previous studies Insulin resistance has good correlation with diabetic dyslipidemia, metabolic syndrome, coronary artery disease etc(5).The role of triglyceride-glucose index in coronary artery atherosclerosis and non-alcoholic fatty liver disease has already established by other studies(6).Furthermore several studies has shown the role of triglyceride-glucose index in the glycemic control(7).Utilization of this marker has not been done to assess glycemic control of type 2 diabetes mellitus patients in eastern India specially in Murshidabad District, situated in West Bengal. In our study we have tried to identify the correlation among triglyceride-glucose index, HbA1c, and triglyceride-glucose index in determining the glycemic control in a tertiary care centre of Murshidabad involving the patient population of Murshidabad with, situated at eastern part of India. As India is going to be capital of diabetes, this study will be helpful to plan tight glycemic control of type 2 diabetes mellitus patients.

**METHODOLOGY:**

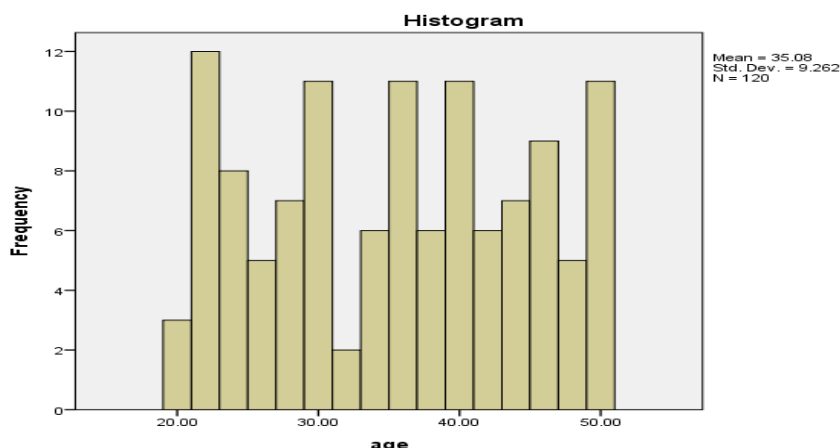
The study consists of 126 number of patients including 10 percent non-compliance, and it is a cross sectional, analytical study in nature. The patients, visiting the outpatient department of General Medicine of Murshidabad Medical College and Hospital have been included in the study. The study was conducted from 1<sup>st</sup>january 2023 to 31th march 2023.At first total 126 number of patients was included in the study but due to non-compliance 3 patient dropped out from the study and after rounding off the sample size and addition of new patients in accordance with the American Diabetic Association(ADA) type 2 diabetes mellitus diagnosis criteria and exclusion criteria mentioned below to get equal number of both groups (poorly controlled and good controlled), we have finally included 120 patients. The patient on steroid therapy, thyroid medication, pregnant women, patient with a history of smoking and alcoholism, seriously ill patient like chronic kidney disease on dialysis, taking medication for lowering triglyceride like fenofibrate, statins, nicotinic acid, patient with very high triglyceride level (>500mg/dl) has been excluded from this study.

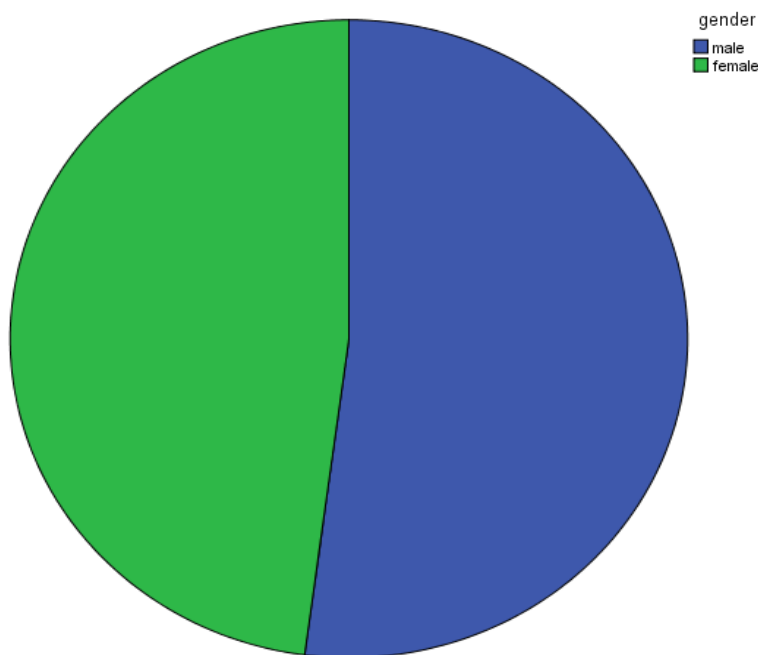
Gender	Male (51.7%), female (48.3%)
Age(in years)	35±9.26
Triglyceride(mg/dl)	155±13.2
Fasting blood glucose(mg/dl)	191.3±53.4
Triglyceride-glucose index	9.41±0.41

➤ **Table 1** showing baseline characteristics of the study population.

The continuous variable has been expressed as percentage and categorical variables as mean±SD.

Histogram showing the distribution of age among study population





➤ Pie diagram showing the population of male and female participants involved in the study

The ethical approval was obtained from the ethics committee of Murshidabad Medical College and Hospital (Reg no: ECR/1620/Inst/WB/2021 under CDSCO).

Type 2 diabetes mellitus was diagnosed in the study population using the American Diabetic Association (ADA) criteria (8). Explanation of the study and collection of written consent done from the study subjects and all the clinical data from the research participants were collected by standard protocol on day 1.

Blood collection done in fasting state (a minimum 8 hour of overnight fasting) using aseptic technique along with venipuncture on the next morning (day 2) in two vacutainer, one for whole blood (vacutainer with anticoagulant EDTA) and other in clot vial (for serum analysis).

The biochemical parameters investigated are fasting blood glucose, triglyceride and HbA1c using standard biochemical methods. Patients were categorized into two groups according to their HbA1c value ( $\leq 7.0$  good control and  $> 7.0$  poor control). This classification is done on the basis of the previous study (9).

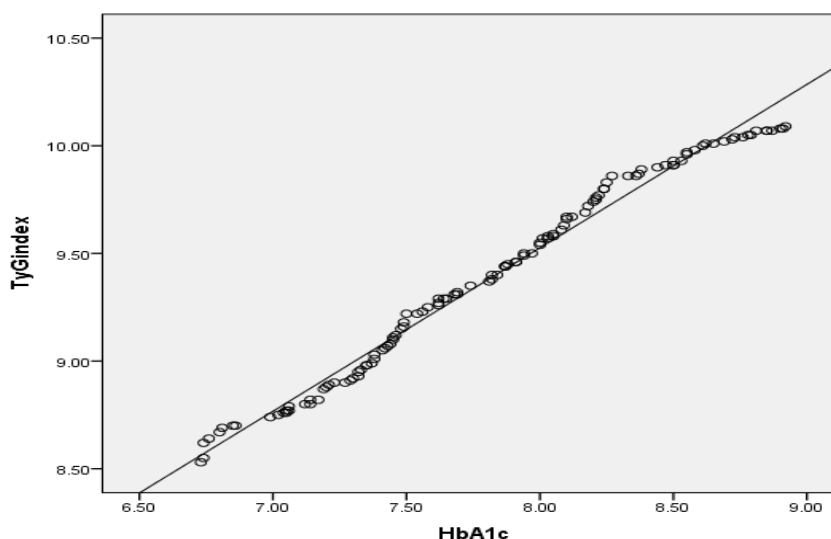
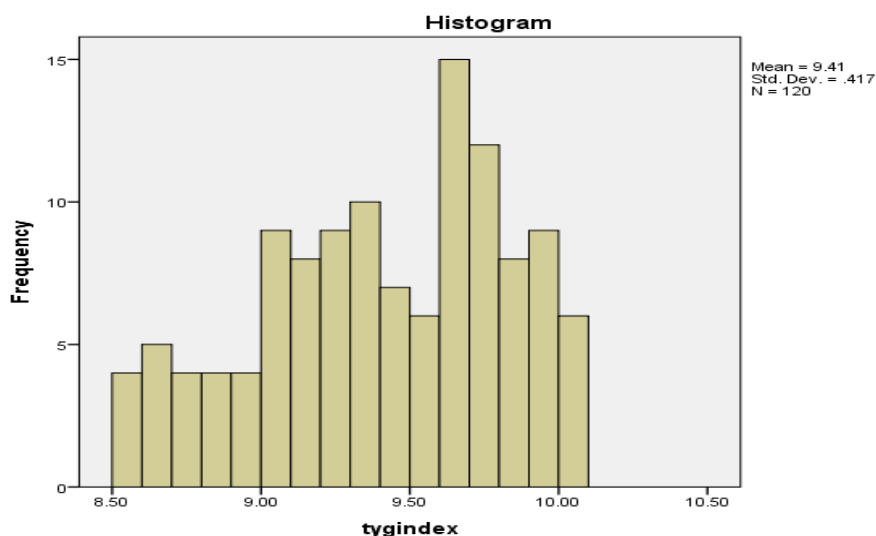
Other variables like triglyceride and fasting blood sugar, triglyceride-glucose index (TyG index) were calculated using already established formulas used in other studies mentioned below (7,10,11). Then independent sample t test (two-tailed) were performed using Statistical Software for Social Sciences software (SPSS) software version 20. The statistical result is given below.

TyG index were calculated using the already established formula  $TyG\ index = \ln(\text{fasting triglyceride [mg/dl]} \times \text{fasting glucose [mg/dl]}) / 2$  (7,10,11)

Biochemical parameter	Poor control group(60)	Good control group(60)	P-value(two-tailed)
HbA1c (%)	8.92±0.015	6.71±0.011	<0.001
Triglyceride(mg/dl)	172.4±3.64	136.8±3.27	<0.001
Fasting blood glucose(mg/dl)	226±55.9	119±14.7	<0.05
Triglyceride-glucose index	9.94±0.16	8.80±0.28	<0.001

**Table 2:** showing the result of two-tailed test of the variables between poor control group and good control group.

Bar diagram showing the frequency of TyG index among study population



➤ **Scatter plot showing strong positive correlation between two variable TyG index and HbA1c**

According to conventional criteria p value of less than 0.001 has been taken as highly statistically significant and less than 0.05 has been taken as statistically significant. The biochemical parameter we have analyzed (HbA1c, triglyceride, fasting blood glucose) and the calculated parameter triglyceride-glucose index has good discriminating ability between good glycemic control and poor glycemic control.

#### DISCUSSION:

It is clear from our study that TyG index has a discriminating ability between good glycemic control and poor glycemic control groups. In other study it has been shown that among triglyceride derived indexes like triglyceride-waist circumference and triglyceride-bmi index and triglyceride-glucose index, triglyceride-glucose index has better prediction ability (7).

In insulin resistance there is metabolic derangement which is the fundamental basis of the complication of type 2 diabetes mellitus known as metabolic syndrome(12).In insulin resistance there is impaired hepatic glucose production and output, the sensitivity of adipose tissue and muscle toward insulin is also decreased(13).In insulin resistance the utilization of free fatty acid is impaired. As the oxidation of the free fatty acid is also altered along with utilization there is flux of free fatty acid from adipose tissue to non-adipose tissue(14).

In our study from statistical analysis it is clear that fasting blood glucose, triglyceride, HbA1c and the calculated variable triglyceride-glucose index has significantly differ in mean value between the good control and poorly control group. A similar study by Timalina et al in Nepal has shown that the superiority of triglyceride-glucose

index compared to other triglyceride index suggest triglyceride-bmi or triglyceride-waist circumference etc in differentiating poor and good glycemic control of type 2 diabetes mellitus patients(7).

In our study we have seen that triglyceride-glucose index it significantly associated with HbA1c level in the diabetic patients who is also has been proved by other studies. According to study done by Babic et al involving 113 patients of type 2 diabetes mellitus has shown that elevation of triglyceride-glucose in patient with poor glycemic control(15) and has given a view of using the triglyceride-glucose index as a control marker of diabetes. A study done by Ekhlal Khalid Hameed shown that involves 293 patient found that triglyceride and triglyceride derived index is significantly increased in the poor glycemic control group compared to the good diabetes control group.(16)

In the patient of type 2 diabetes mellitus, the increased free fatty acid due to elevated triglyceride level is also an important factor in the development of beta cell dysfunction and insulin resistance(17).The increased levels of free fatty acid by interaction with cascade linking insulin receptor's with transporters of glucose leads to the development of insulin resistance(18). The pro inflammatory cytokines that are released by adipose tissue are also responsible for this increased fatty acid induced insulin resistance.(19)

As per the existing studies the measurement of HbA1c ,insulin resistance is very much important to assess the upcoming and present complication risk of type 2 diabetes mellitus(20).HbA1c is highly sensitive and specific for detection of glycemic control(21),but the requirement of standardization of its assay, cost effectiveness, availability particularly in a developing country like India, there by triglyceride-glucose index may a good assessment tool to monitor the adequacy of treatment of type 2 diabetes patient as well as prevent the future macro vascular ,micro vascular and metabolic complications of the patient of type 2 diabetes mellitus patients.

#### CONCLUSION:

As per the existing study and from our study it can be concluded that TyG index can be a assessment tool for glycemic control like glycosylated hemoglobin in the patients suffering from type 2 diabetes mellitus of Murshidabad, situated at eastern part of India . However further research is required for more detailed and precise role of TyG

index in diabetes mellitus as a marker of glycemic control.

#### LIMITATIONS OF THE STUDY:

From this study we can't predict the time period for glycemic control monitoring capacity of TyG index like three month in case of HbA1c.The other limitations are small sample size and study in a single centre. Some of the clinical information like use of hypoglycemic agents and family history are missing. So further detailed research is required to determine the time period over which TyG index value is changing along with glycemic status with all possible detailed information and multicentre strategies.

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#### REFERENCES:

1. Khan mab, hashim mj, king jk, govender rd, mustafa h, al kaabi j. Epidemiology of type 2 diabetes - global burden of disease and forecasted trends. J epidemiol glob health. 2020 mar; 10(1):107–11.
2. Hu fb. Sedentary lifestyle and risk of obesity and type 2 diabetes. Lipids. 2003 feb;38 (2): 103–8.
3. Weykamp c. HbA1c: a review of analytical and clinical aspects. Ann lab med. 2013 nov; 33(6):393–400.
4. Tahapary dl, pratisthita lb, fitri na, marcella c, wafa s, kurniawan f, et al. Challenges in the diagnosis of insulin resistance: focusing on the role of homa-ir and tryglyceride /glucose index. Diabetes metab syndr. 2022 aug;16(8):102581.
5. Athyros vg, doumas m, imprialos kp, stavropoulos k, georgianou e, katsimardou a, et al. Diabetes and lipid metabolism. Horm athens greece. 2018 mar;17(1):61–7.
6. Association between triglyceride–glucose index and nonalcoholic fatty liver disease in type 2 diabetes mellitus | bmc endocrine disorders | full text [internet]. [cited 2023 apr 6]. Available from: <https://bmcendocrdisord>.



- biomedcentral.com/articles/10.1186/s12902-022-01172-7
7. Timalina s, mahato s, nepal s. Utility of triglyceride-glucose index in predicting glycemic control in type 2 diabetes mellitus. *Birat j health sci.* 2021 nov 3;6(2):1444–8.
  8. Resnick he, harris mi, brock db, harris tb. American diabetes association diabetes diagnostic criteria, advancing age, and cardiovascular disease risk profiles: results from the third national health and nutrition examination survey. *Diabetes care.* 2000 feb; 23(2):176–80.
  9. Qaseem a, wilt tj, kansagara d, horwitch c, barry mj, forcica ma, et al. Hemoglobin a1c targets for glycemic control with pharmacologic therapy for nonpregnant adults with type 2 diabetes mellitus: a guidance statement update from the american college of physicians. *Ann intern med.* 2018 apr 17; 168 (8):569–76.
  10. Simental-mendía le, rodríguez-morán m, guerrero-romero f. The product of fasting glucose and triglycerides as surrogate for identifying insulin resistance in apparently healthy subjects. *Metab syndr relat disord.* 2008 dec; 6(4):299–304.
  11. Er lk, wu s, chou hh, hsu la, teng ms, sun yc, et al. Triglyceride glucose-body mass index is a simple and clinically useful surrogate marker for insulin resistance in nondiabetic individuals. *Plos one.* 2016 mar 1;11 (3): e0149731.
  12. Raz i, eldor r, cernea s, shafir e. Diabetes: insulin resistance and derangements in lipid metabolism. Cure through intervention in fat transport and storage. *Diabetes metab res rev.* 2005; 21(1):3–14.
  13. Fazakerley dj, krycer jr, kearney al, hocking sl, james de. Muscle and adipose tissue insulin resistance: malady without mechanism? *J lipid res.* 2019 oct 1;60(10): 1720–32.
  14. Delarue j, magnan c. Free fatty acids and insulin resistance. *Curr opin clin nutr metab care.* 2007 mar; 10(2):142–8.
  15. Selvi nmk, nandhini s, sakthivadivel v, lokesh s, srinivasan ar, sumathi s. Association of triglyceride-glucose index (TyG index) with HbA1c and insulin resistance in type 2 diabetes mellitus. *Maedica.* 2021 sep; 16 (3): 375–81.
  16. Hameed ek. TyG index a promising biomarker for glycemic control in type 2 diabetes mellitus. *Diabetes metab syndr.* 2019;13 (1): 560–3.
  17. Ma m, liu h, yu j, he s, li p, ma c, et al. Triglyceride is independently correlated with insulin resistance and islet beta cell function: a study in population with different glucose and lipid metabolism states. *Lipids health dis.* 2020 jun 2;19(1):121.
  18. Saini v. Molecular mechanisms of insulin resistance in type 2 diabetes mellitus. *World j diabetes.* 2010 jul 15;1(3):68–75.
  19. Zatterale f, longo m, naderi j, raciti ga, desiderio a, miele c, et al. Chronic adipose tissue inflammation linking obesity to insulin resistance and type 2 diabetes. *Front physiol [internet].* 2020 [cited 2023 apr 19];10. Available from: <https://www.frontiersin.org/articles/10.3389/fphys.2019.01607>
  20. Sherwani si, khan ha, ekhzaimy a, masood a, sakharkar mk. Significance of HbA1c test in diagnosis and prognosis of diabetic patients. *Biomark insights.* 2016 jul 3; 11:95–104.
  21. Journal of the association of physicians of India - japi [internet]. [cited 2023 apr 19]. Available from: <https://www.japi.org/v264/HbA1c-result-does-it-depend-upon-the-testing-methods->