ISSN: 2320-9267

Indian Journal of Pharmaceutical and Biological Research (IJPBR)

Journal homepage: www.ijpbr.in

RESEARCH ARTICLE

Triglyceride-Glucose Index and Indian Diabetes Risk Score among Young Adults: A Cross-Sectional Study

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ABSTRACT

Background: Diabetes mellitus is an increasing public health concern, and identification of individuals at risk during early adulthood may facilitate timely preventive interventions. The Triglyceride-Glucose (TyG) Index is a simple biochemical surrogate marker of insulin resistance, whereas the Indian Diabetes Risk Score (IDRS) provides a practical assessment of diabetes risk using demographic, anthropometric, behavioural and family-history factors.

Methods: A cross-sectional study was conducted among 272 undergraduate medical students at a government tertiary care teaching hospital over 18 months. Participants aged ≥18 years who were willing to participate were included, while students with diabetes, cardiovascular disease or steroid use were excluded. Sociodemographic and lifestyle information was collected using a structured questionnaire. Anthropometric measurements, including body mass index and waist circumference, were recorded. Fasting blood samples were analysed for glucose and triglycerides. The TyG Index was calculated as ln [fasting triglycerides (mg/dL) × fasting glucose (mg/dL)/2]. Diabetes risk was assessed using IDRS. Correlations between TyG Index and IDRS components were evaluated, with $p<0.05$ considered statistically significant.

Results: The mean age of participants was 19.97 ± 1.02 years. Females constituted 69.5% and males 30.5% of the study population. Mean BMI was 22.09 ± 4.20 kg/m² and mean waist circumference was 85.99 ± 7.56 cm. Mean fasting blood glucose, triglycerides and TyG Index were 90.45 ± 10.15 mg/dL, 115.85 ± 36.61 mg/dL and 8.494 ± 0.412, respectively. According to IDRS, 61.8% had low risk, 36.8% moderate risk and 1.5% high risk. No significant correlation was observed between TyG and total IDRS ($r=0.025$, $p=0.678$), waist score ($r=0.048$, $p=0.428$), physical activity score ($r=0.003$, $p=0.960$), or family-history score ($r=-0.002$, $p=0.979$). Conclusion: TyG Index was not significantly associated with IDRS or its assessed components among these young adults. Further longitudinal studies are warranted.

Keyword: Triglyceride-Glucose Index.

Indian J. Pharm. Biol. Res. (2026): https://doi.org/10.30750/ijpbr.14.3.52

INTRODUCTION

Diabetes mellitus is one of the most important non-communicable diseases worldwide and represents a growing public health challenge. India carries a substantial burden of diabetes and prediabetes, with increasing prevalence associated with urbanization, sedentary lifestyles, unhealthy dietary practices and increasing obesity.[1] Type 2 diabetes mellitus (T2DM) develops through a complex interaction of genetic and environmental factors, with insulin resistance playing a central role in the early stages of disease. Insulin resistance may develop years before the onset of clinically apparent diabetes, making early identification of individuals at increased metabolic risk important for preventive interventions.

Direct assessment of insulin resistance using the euglycaemic-hyperinsulinaemic clamp is considered a reference method but is expensive, technically demanding and unsuitable for routine screening.[2] The Triglyceride-Glucose (TyG) Index, calculated from fasting triglyceride

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How to cite this article: Mote S, Ankush RD, Mane KB, Sawant SD.Triglyceride-Glucose Index and Indian Diabetes Risk Score among Young Adults: A Cross-Sectional Study. Indian J. Pharm. Biol. Res. 2026;14(3):338-342.

Source of support: Nil

Conflict of interest: None.

Received: 11/06/2026 **Revised:** 20/06/2026 **Accepted:** 13/07/2026 **Published:** 14/08/2026

and fasting glucose concentrations, has therefore emerged as a simple and accessible surrogate marker of insulin resistance. Guerrero-Romero et al. demonstrated a significant relationship between TyG and insulin sensitivity when compared with the euglycaemic-hyperinsulinaemic clamp.[2] Subsequent studies have reported associations of TyG with insulin resistance, metabolic syndrome and incident T2DM, supporting its potential role in identifying individuals at increased metabolic risk.[3–5]

However, diabetes risk is multifactorial and cannot be adequately assessed using biochemical parameters alone. Age, abdominal obesity, physical inactivity and family history are important determinants of future diabetes risk. The Indian Diabetes Risk Score (IDRS) was developed by the Madras Diabetes Research Foundation as a simple screening tool for identifying individuals at increased risk of diabetes.[6] It incorporates four easily obtainable parameters—age, waist circumference, physical activity and family history of diabetes—and does not require sophisticated laboratory investigations. This makes IDRS particularly suitable for community-based screening and resource-limited settings.

The usefulness of IDRS has also been demonstrated among young populations. Studies conducted among medical students in India have identified individuals belonging to moderate- and high-risk categories despite their relatively young age.[7–9] This is important because young adulthood represents a critical period during which sedentary behaviour, unhealthy dietary practices, increasing adiposity and other lifestyle-related risk factors may begin to accumulate. Early identification of these risk factors can provide an opportunity for lifestyle modification before the development of overt metabolic disease.

TyG and IDRS assess diabetes risk from different perspectives. TyG is a biochemical surrogate related to insulin resistance, whereas IDRS incorporates demographic, anthropometric, behavioural and familial risk factors. Thus, assessment of both measures in the same population may provide complementary information regarding metabolic and clinically estimated diabetes risk. A significant correlation between the two could suggest that biochemical metabolic risk parallels clinically assessed diabetes risk, whereas a lack of correlation may indicate that the two measures capture different dimensions of susceptibility.

Although both TyG and IDRS have been extensively studied independently, relatively limited evidence is available regarding their direct relationship among young Indian adults. Examining the association of TyG with total IDRS and its individual components may provide further insight into the relationship between biochemical metabolic status and established clinical risk factors.

Therefore, the present study was undertaken to assess the Triglyceride-Glucose Index and Indian Diabetes Risk Score among young adults and to determine the correlation between TyG and total IDRS, as well as individual IDRS components including waist score, physical activity score and family-history score. The findings may contribute to understanding simple approaches for early identification of individuals who may benefit from preventive strategies against future diabetes.

METHODOLOGY

A cross-sectional study was conducted among 272 undergraduate medical students aged ≥18 years at a government tertiary care teaching hospital over a period of 18 months. Participants with diabetes mellitus, cardiovascular disease, or current steroid use were excluded. A predesigned structured questionnaire was used to collect information regarding sociodemographic characteristics, lifestyle factors, and family history of diabetes. Diabetes risk was assessed using the Indian Diabetes Risk Score (IDRS), which incorporates age, physical activity, family history of diabetes, and waist circumference. Anthropometric measurements including height, weight, body mass index, and waist circumference were recorded using standard procedures.

After an overnight fast of 8–12 hours, approximately 5 mL of venous blood was collected from each participant. Fasting plasma glucose and serum triglycerides were estimated using enzymatic methods. The Triglyceride-Glucose (TyG) Index was calculated using the formula: ln [fasting triglycerides (mg/dL) × fasting glucose (mg/dL)/2].

Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The association between TyG Index and total IDRS, as well as individual IDRS components, was assessed using correlation analysis. A p-value <0.05 was considered statistically significant. Ethical approval was obtained from the institutional ethics committee, and written informed consent was obtained from all participants before enrolment.

RESULT

The study included 272 young adults with a mean age of 19.97 ± 1.02 years. Females constituted 69.5% of the participants, while males accounted for 30.5%. The mean BMI was 22.09 ± 4.20 kg/m² and the mean waist circumference was 85.99 ± 7.56 cm, indicating the

Table 1: Baseline Characteristics of Study Participants (n = 272)

Variable	*Finding*
Age (years), mean ± SD	19.97 ± 1.02
Male, n (%)	83 (30.5%)
Female, n (%)	189 (69.5%)
BMI (kg/m²), mean ± SD	22.09 ± 4.20
Waist circumference (cm), mean ± SD	85.99 ± 7.56

Table 2: Biochemical Parameters and TyG Index among Study Participants (n = 272)

Parameter	*Unit*	*Mean ± SD*
Fasting blood glucose	mg/dL	90.45 ± 10.15
Triglycerides	mg/dL	115.85 ± 36.61
TyG Index	ln[TG × FPG/2]	8.494 ± 0.412

Table 3: Correlation of TyG Index with IDRS Components and Total IDRS (n = 272)

Variable	*Pearson correlation (r)*	*p-value*	*Significance*
Waist score	0.048	0.428	Not significant
Physical activity score	0.003	0.960	Not significant
Family history score	−0.002	0.979	Not significant
Total IDRS	0.025	0.678	Not significant

anthropometric profile of a predominantly young study population.

The mean fasting blood glucose was 90.45 ± 10.15 mg/dL, while the mean triglyceride level was 115.85 ± 36.61 mg/dL. The mean TyG Index was 8.494 ± 0.412. These biochemical findings provided the basis for assessment of the TyG Index in relation to diabetes risk assessed using IDRS.

According to IDRS classification, 168 (61.8%) participants were categorized as low risk, 100 (36.8%) as moderate risk, and 4 (1.5%) as high risk. Thus, although the majority had low diabetes risk, more than one-third of the participants had moderate risk, indicating the presence of potentially modifiable diabetes-risk factors even in this young population.

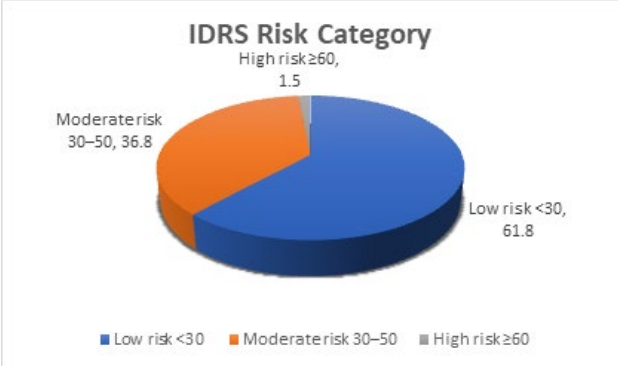

Chart 1: Distribution of Participants According to IDRS Risk Category (n = 272)

Correlation analysis demonstrated no statistically significant association between TyG Index and waist score (r = 0.048, p = 0.428), physical activity score (r = 0.003, p = 0.960), or family history score (r = −0.002, p = 0.979). Similarly, TyG showed a very weak positive correlation with total IDRS (r = 0.025, p = 0.678), which was not statistically significant. Therefore, this study did not demonstrate a significant relationship between TyG Index and IDRS or its assessed components among the young participants.

DISCUSSION

The present study evaluated the Triglyceride-Glucose (TyG) Index and Indian Diabetes Risk Score (IDRS) among 272 young adults and examined the relationship between these two measures. The study population was predominantly young, with a mean age of 19.97 ± 1.02 years, and females constituted 69.5% of participants. This age profile is important because diabetes and its metabolic risk factors are increasingly recognized at younger ages, particularly in populations undergoing rapid lifestyle and nutritional transitions. The growing burden of diabetes in India and globally highlights the importance of identifying individuals at increased metabolic risk before the development of overt disease.[1,2]

The mean fasting blood glucose was 90.45 ± 10.15 mg/dL and mean triglyceride level was 115.85 ± 36.61 mg/dL, resulting in a mean TyG Index of 8.494 ± 0.412. TyG is derived from fasting triglyceride and glucose concentrations and has been proposed as a simple surrogate marker of insulin resistance. Guerrero-Romero et al. demonstrated a significant relationship between TyG and insulin sensitivity measured using the euglycemic-hyperinsulinemic clamp, supporting its use as an accessible metabolic marker.[8] Subsequent studies have also reported the usefulness of

TyG and related indices in identifying insulin resistance and cardiometabolic risk.[9,10]

In the present study, 61.8% of participants were categorized as having low diabetes risk according to IDRS, while 36.8% had moderate risk and 1.5% had high risk. The predominance of low-risk individuals is understandable given the very young age of the study population. The IDRS was originally developed as a simple screening tool using age, abdominal obesity, physical activity and family history of diabetes.[3] Studies among young medical students have similarly demonstrated that although most participants are classified as low risk, a considerable proportion may fall into the moderate-risk category. Vardhan et al. reported the usefulness of IDRS among medical students, while Singh et al. found that IDRS could identify varying levels of diabetes susceptibility among young medical students.[5,6] Rajan and Muthunarayanan also reported the applicability of IDRS for diabetes-risk assessment among young medical students.[7]

The principal finding of the present study was the absence of a statistically significant correlation between TyG Index and total IDRS ($r = 0.025$, $p = 0.678$). Similarly, TyG showed no significant correlation with waist score ($r = 0.048$, $p = 0.428$), physical activity score ($r = 0.003$, $p = 0.960$), or family-history score ($r = -0.002$, $p = 0.979$). This finding differs from studies demonstrating associations between elevated TyG and future diabetes or metabolic risk. Several cohort studies and meta-analyses have reported that higher TyG values are associated with increased risk of incident type 2 diabetes.[11,13,14] However, these studies largely involved broader or older populations with greater variation in metabolic characteristics and diabetes risk.

The lack of association in the present study may therefore partly reflect the characteristics of the study population. Participants were predominantly young adults with relatively normal fasting glucose and triglyceride concentrations and limited age variation. Importantly, all participants were younger than 35 years, resulting in an age score of zero for every individual in the IDRS. Consequently, one of the four components of IDRS contributed no variability to the total score. This restricted variability may have reduced the ability to demonstrate a relationship between TyG and total IDRS. Furthermore, IDRS and TyG assess different dimensions of metabolic risk: TyG primarily reflects a biochemical surrogate of insulin resistance, whereas IDRS incorporates demographic, anthropometric, behavioural and hereditary risk factors.[3,12]

The findings therefore suggest that TyG and IDRS should not necessarily be considered interchangeable measures. The absence of a significant correlation does not imply that TyG lacks clinical relevance; rather, it may indicate that biochemical insulin-resistance-related risk and questionnaire-based diabetes susceptibility are not closely aligned in a young, predominantly healthy population. Previous systematic reviews have supported TyG as a predictor of future type 2 diabetes, while emphasizing its role as a surrogate metabolic marker rather than a diagnostic test.[13,14]

CONCLUSION

The present study found that the majority of young adults had low diabetes risk according to IDRS, although more than one-third were classified as having moderate risk. The mean TyG Index was 8.494 ± 0.412. No statistically significant correlation was observed between TyG Index and total IDRS or its assessed components. These findings suggest that TyG and IDRS may provide complementary information regarding metabolic and diabetes risk in young adults. Given the young age and relatively homogeneous metabolic profile of the study population, further studies involving larger and more diverse populations, with longitudinal follow-up, are warranted to determine whether TyG can improve early identification of individuals at future risk of diabetes.

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