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TRIGLYCERIDE-GLUCOSE INDEX: A NOVEL MARKER OF THE INSULIN RESISTANCE FOR THE PREDICTION OF DIABETIC NEPHROPATHY

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Abstract

This study aims at the identification of the relationship between insulin resistances (IR) in patients with type 2 diabetes mellitus (T2DM) and the triglyceride-glucose (TyG) index as determined by the homeostasis model assessment (HOMA-IR). Furthermore, the relationship between the TyG index and the urine albumin-to-creatinine ratio (UACR) was investigated in order to evaluate the TyG index's potential as a diagnostic for diabetic nephropathy.

Place and Duration of Study: This study was conducted in Bilawal Medical College Hospital Kotri From January 2023 to December 2023

Methodology

This was a cross-sectional study involving people recently diagnosed with T2DM. Vital signs, body mass index (BMI), age, gender, length of diabetes, and other clinical and demographic data were gathered. Important markers such as the UACR, TyG index, HOMA-IR, HbA1c, triglycerides, serum creatinine, and total cholesterol were assessed in the study. Based on their TyG index values, participants had been categorized into four quartiles: Q1=4.5–5, Q2=5.1–5.5, Q3=5.6–6, and Q4=>6. SPSS version 26 had been used to analyze the data.

Results

There were 200 participants in all, 130 of whom were female (65%) and 70 of whom were male (35%). The average age was 11.21 +/- 10.21 years. According to BMI classification, 75 (37.5%) had a normal BMI, 30 (15%) were obese, and 95 (47.5%) were overweight. In Q1, 80 (40%) in Q2, 40 (20%) in Q3, and 25 (12.5%) in Q4 was the quartile distribution. Higher levels of fasting glucose, total cholesterol, LDL cholesterol, triglycerides, HbA1c, HOMA-IR, and UACR were seen in Q4 participants ($p<0.05$). On the other hand, this group's eGFR and HDL levels were lower ($p<0.05$). TyG index ($r=0.74$, $p<0.001$), HOMA-IR ($r=0.47$, $p<0.001$), and UACR ($r=0.11$, $p<0.05$) all

significantly correlated positively with HbA1c, but fasting serum insulin had an inverse relationship with both.

Conclusion

In people with T2DM, the TyG index was found as a good predictor of diabetic nephropathy because to its substantial connection with HOMA-IR. More research is necessary to determine its potential value as a clinical tool for nephropathy early identification.

Keywords: Diabetic nephropathy, Insulin resistance, HDL, Type 2 diabetes mellitus, Triglyceride-glucose index

Introduction

One prevalent consequence of T2DM that significantly increases morbidity as well as mortality worldwide is diabetic nephropathy (DN) [1]. Finding reliable biomarkers for the early identification and prediction of DN is becoming more and more crucial as T2DM becomes more common [2]. A major factor in the etiology of T2DM and its aftereffects, such as DN, is insulin resistance (IR) [3]. Although IR has traditionally been assessed using the HOMA-IR [4], recent studies show that the TyG index may be a more practical and accurate substitute [5].

In comparison to HOMA-IR, the TyG index—which has been derived from fasting plasma glucose and triglyceride levels—has been becoming more widely acknowledged as a useful and affordable alternative [6]. Various studies have shown a strong relationship between the TyG index and a higher risk of microvascular and cardiovascular problems, making it an important tool for early risk stratification in patients with diabetes [7]. According to certain research, the TyG index may predict DN more accurately than conventional markers [8].

Furthermore, in diabetic individuals, the UACR is a reliable indicator of early kidney impairment. Its correlation with the TyG index raises the possibility of increasing the precision of DN prediction [9].

In order to learn more about the early detection of DN in patients with T2DM, the present study intends to recognize the link between the HOMA-IR, TyG index, and UACR [10].

Methodology

The objective of this cross-sectional study was to identify the relationship between the HOMA-IR and TyG index in patients with T2DM and to assess the TyG index's predictive value for UACR in relation to diabetic nephropathy. 200 people, ages 30 to 70, who had received a T2DM treatment during the previous two years were recruited for the study from an outpatient clinic. Patients on nephrotoxic or lipid-lowering drugs, those with a history of cardiovascular events, or those with chronic kidney disease were excluded.

Age, gender, BMI, and clinical history were among the demographic details that were noted. Following an overnight fast, fasting blood samples were taken in order to evaluate serum creatinine, triglycerides, total cholesterol, HbA1c, and fasting plasma glucose and fasting serum insulin. Triglyceride along with glucose levels from fasting were used to create the TyG index, whereas glucose levels from fasting and insulin level were used to calculate the HOMA-IR. To find early indicators of kidney impairment, the UACR was calculated from a urine sample.

In accordance with the values of their TyG index, participants were categorized into quartiles. The TyG index, HOMA-IR, UACR, and other clinical indicators were compared using descriptive statistics and Pearson correlation analysis in a statistical study carried out with SPSS version 26. Less than 0.05 was the threshold for statistical significance.

Results

The study comprised 70 (35% male) and 130 (65% female) participants, with a mean age of 50.12±11.21 years. Following BMI classification, 95 individuals (47.5%) were classified as overweight, 30 (15%) as obese, and 75 (37.5%) as normal weight. In Q1, 80 (40%) in Q2, 40 (20%) in Q3, and 25 (12.5%) in Q4 was the quartile distribution.

Triglycerides, LDL cholesterol, HbA1c, total cholesterol and fasting plasma glucose were all significantly higher in the individuals with the highest TyG index quartile (Q4) ($p<0.05$). Additionally, they showed higher UACR and HOMA-IR values ($p<0.05$), which are signs of early kidney failure and insulin resistance. The Q4 group had decreased eGFR and HDL cholesterol levels ($p<0.05$).
The HbA1c and TyG index demonstrated a strong positive relationship ($r=0.74$, $p<0.001$), according to correlation analysis, suggesting that higher TyG index values were related with worse glycemic control. Additionally, the TyG index showed strong correlations with UACR ($r=0.11$, $p=0.05$) and HOMA-IR ($r=0.47$, $p<0.001$), indicating its potential utility in evaluating insulin resistance and declining kidney function. There was an inverse association between fasting serum insulin and the TyG index ($r=-0.12$, $p=0.04$) as well as the HbA1c ($r=-0.14$, $p=0.06$).
As indicated by raised UACR and lowered eGFR, patients in the Q4 group had the most severe metabolic abnormalities and were at higher risk for developing diabetic nephropathy. This emphasizes the TyG index as a possible predictor of DN in individuals with type 2 diabetes as well as a measure for insulin resistance.

Table 1: Demographic Characteristics

Characteristic	Value (n = 200)
Female	130 (65%)
Male	70 (35%)
Mean Age (years)	50.12 ± 10.87
Overweight	95 (47.5%)
Obese	30 (15%)
Normal Weight	75 (37.5%)

Discussion

The study's findings highlight the TyG index's substantial correlation with insulin resistance (IR) and suggest that it may be useful in predicting diabetic nephropathy in individuals with T2DM. The TyG index and HbA1c values show a strong positive connection that is consistent with other research, indicating that the TyG index is a useful indicator of both IR and inadequate glycemic management.

The TyG index and the euglycemic-hyperinsulinemic clamp test, which is thought to be the gold standard for the determination of insulin sensitivity, were found to be strongly correlated by Guerrero-Romero et al. [11]. This supports the use of the TyG index as a practical and affordable technique for assessing IR, especially in populations with T2DM. In a similar vein, higher TyG index values were correlated with a higher risk of microvascular problems, such as diabetic nephropathy [12], which corroborates the findings of the present investigation regarding the TyG index's utility as a renal risk indicator.
Furthermore, the TyG index outperformed conventional indicators in predicting cardiovascular risks among individuals with diabetes, according to research by Irace et al. This highlights even more how well the TyG index can identify the underlying metabolic problems that underlie type 2 diabetes. These results add weight to the claim that the TyG index is a useful tool for evaluating renal and cardiovascular risks [13].

Salas-Salvadó et al., however, only discovered a weak correlation between renal function markers and the TyG index, indicating that more investigation is necessary to develop a stronger connection between the renal outcomes and TyG index. The TyG index and the UACR were shown to be significantly correlated in this study [14]. However, variations in these relationships may be explained by population differences.

Finally, a meta-analysis by Xu et al. reaffirmed the relevance of the TyG index in predicting diabetes sequelae, including nephropathy. Their findings supported for the TyG index as a feasible tool to early detect of kidney disease due T2DM. This is consistent with the current research, which shows that patients with higher TyG index values had lower eGFR and higher UACR levels, further supporting the TyG index's use as a predictor of the risk of diabetic nephropathy [15].

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Conflict of Interest
None

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