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A Hospital Based Cross Sectional Study to Determine The Role of High Triglyceride Glucose Index in Early Prediction of Metabolic Syndrome in Adults

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Abstract

Introduction: Metabolic Syndrome is an umbrella term for a plethora of metabolic dysfunctions seen as a result of development of Insulin resistance. As insulin resistance progresses in a patient, the clinical hallmarks of metabolic syndrome start to appear namely - visceral obesity, hypertension, and dyslipidemia. Insulin resistance and thus metabolic syndrome is further exacerbated by excess calorie surplus and sedentary lifestyle. As a result of these complex interrelated pathways, the probability of atherogenic cardiovascular disease, diabetes mellitus and stroke is markedly increased in these patients. Out of the various definitions of metabolic syndrome given by different bodies, it is the definition given by NCEP ATP III is most followed.

Objectives: This study aims to evaluate the effectiveness of the Triglyceride Glucose Index (TGI) as a tool for early diagnosis of MetS, given its potential sensitivity and specificity.

Methods: A cross-sectional study was conducted at the Department of Medicine, S. N. Medical College, Agra, between January 2022 to June 2024. Participants aged >30 years were enrolled into the study who partially or fully satisfied the ATP III criteria. Exclusion criteria included steroid therapy, endocrine disorders, and liver diseases. Data were analyzed using SPSS version 26.0, and descriptive and comparative statistics were applied.

Results: Among 215 patients (mean age 49.42 years, 60.9% male), the study found an average BMI of 26.1 kg/m² and waist circumference of 96.1 cm. Blood pressure averaged 140.5/84.7 mmHg. The study revealed significant correlations between TGI and blood pressure, glucose levels, triglycerides, and HDL cholesterol. TGI

was notably higher in smokers and those meeting the ATP III criteria.

Conclusion: The TGI index demonstrates significant potential in the early detection of Metabolic Syndrome and its associated metabolic risks. It could serve as a practical tool for identifying individuals at higher risk, enabling early intervention and management.

Keywords: Metabolic Syndrome, Triglyceride Glucose Index, Insulin Resistance, Cardiovascular Disease, Diabetes Mellitus, Obesity, Risk Assessment, cross-sectional

Introduction

Metabolic Syndrome as a term encompasses a multitude of biochemically linked metabolic abnormalities, all of which has insulin resistance as their chariot. At least some of the known determinants are visceral adiposity, rising blood pressure and atherogenic dyslipidemia. Metabolic Syndrome is a challenge entire humanity faces because of sedentary lifestyles, fast urbanization, and caloric surplus. These problems , not only by themselves are troublesome enough but also raise the possibility of various other atherogenic conditions like CAD, Stroke which are of even higher gravity.

NCEP-ATP III criteria is a classification criteria already in use for the diagnosis of metabolic syndrome. A patient is said to be having metabolic syndrome if 3/5 are present in him-

i. Waist circumference over 40 inches (men) or 35 inches (women),
ii. Blood pressure over 130/85 mmHg,
iii. Fasting triglyceride (TG) level over 150 mg/dl,
iv. Fasting high-density lipoprotein (HDL) cholesterol level less than 40 mg/dl (men) or 50 mg/dl (women)
v. and fasting blood sugar over 100 mg/dl.

However, even before the advent of these entities, there is a period often spanning decades where a patient only has underlying insulin resistance. If only we could find a marker which could be used to predict the advent of metabolic syndrome, we could make a definite change in its trajectory.

Over the years, parameters like hyperinsulinemic-euglycemic clamp and the IR Homeostatic Model Assessment (HOMA-IR) have been in use to evaluate the degree of insulin resistance a given patient is afflicted with. But these methods although accurate have limitations of their own like - cumbersome, complex, painful and the high cost incurred can not be ignored. Keeping this in mind we have tried to accomplish the Triglyceride Glucose Index as a simple, easy to use and economical indicator of insulin resistance.

It is computed using blood glucose measured in the fasting condition and blood values of triglyceride (TG).

A link[1] between high levels of the TGI and with the development of stroke, carotid atherosclerosis, CVDs, has already been established. Therefore, we are conducting this study intending to study the role of the High Triglyceride Glucose Index in the Early Prediction of Metabolic Syndrome.

Aim of the study

To study the role of the High Triglyceride Glucose Index in early prediction of metabolic syndrome.

Objectives of the study

1. To identify patients at the verge of developing metabolic syndrome through clinical assessment.
2. To study the fasting lipid profile and Fasting blood glucose profile in these patients and calculate the Triglyceride Glucose index (TGI).
3. To study the corelation of the calculated TGI with the known determinants of metabolic syndrome i.e.

DM, Dyslipidemia, increased waist circumference and HTN.

Materials and methods

This observational cross-sectional study was conducted in the P.G. Department of Medicine in SN Medical College between January 2022 and June 2024 in 215(sample size) consenting adults after getting approval from the Institutional Ethics Committee.

Inclusion criteria

1. Age >30 years.
2. Patients with obesity or BMI >23, or increased waist--hip ratio (i.e., > 0.85 in females and >1 in male).
3. Patients with other equivalents of insulin resistance such as Acanthosis Nigricans, PCOS in females, acne eruption, or other manifestations of hyperandrogenism.
4. Patients not fully or fully satisfying the ATPIII criterion for diagnosis of Metabolic Syndrome.

Exclusion Criteria

1. Patients on steroid therapy.
2. Patients with existing endocrine disorders such as hypothyroidism, hypopituitarism, Cushing syndromes, Conn's syndrome, etc.
3. Patients with liver diseases such as liver carcinoma, metastasis to the liver, or other infectious etiologies.

Various anthropometric indices like age, sex, height, weight, BMI, waist circumference were measured in these patients. Also relevant history pertaining to risk factors like alcohol, smoking, tobacco chewing, sedentary lifestyle was also taken into. Thirdly, biochemical parameters like Fasting Blood Glucose, FAsting Triglyceride, Fasting LDL, Fasting HDL were also measured. Past history regarding existing HTN, Dyslipidaemia, or Diabetes or treatment status of the same was also studied. ATP III score was then calculated and also Triglyceride Glucose Index was then calculated using the formula

$$= log\ e\ (FBG * FTG)/2$$

The data which was obtained was entered in a systematic manner in an excel sheet and then analysed using statistical package for social sciences (SPSS). And then it was analysed using statistical terms of mean with standard deviation, and student's t-test and a 95% confidence interval was taken.

Result and Discussion

A total of 215 patients were included in the study to study High Triglyceride Glucose Index in them. Age group with maximum patients (79) was between 41-50 years. Mean Age+- SD in these patients was 49+-10.3 years. 60.9% of study subjects were male and rest were female. Their mean height was 166.5+- 5.6 mean weight was 69.8+-11, mean BMI was 26.1±4.5, mean waist circumference was 96.1±12.5 , mean Systolic Blood Pressure was 140.5±17, mean Diastolic Blood Pressure was 84.7±8.5 .

Distribution according to history and habits was as follows - smokers and nonsmokers were approximately 20.5% and 79.5%, tobacco chewing 15.8% and non chewers were 84.2%, alcoholics were 12.6% and non alcoholics 87.4% respectively. 46% of study subjects were Hypertensives, and 54% were not. 23.3% of study subjects were Dyslipidaemic and 76.7% were not and 60.9% patients were on OHA and 39.1% were non compliant to treatment.

Mean HbA1c (%) in these patients was 9.1+-2.5, Fasting Plasma Glucose(mg/dl) was 140.0+-6.1, Post Prandial Glucose(mg/dl) was 210.5+-55.4, mean Triglyceride(mg/dl) was 150.8+-38 , mean HDL(mg/dl) 34.3+-64 , mean LDL(mg/dl) was 122.7+-40 and the

mean Triglyceride Glucose Index calculated was 5.1+-0.24.

Thus a cutoff of TGI of 5.1 was established as high and thus 75.8% patients had High TGI and rest (24.2%) had low TGI(<5.1) . And thus patients were classified into two groups according to high and low TGI and correlation was tried to establish between these parameters which was as follows -

Table 1: Distribution of metabolic determinants in accordance with TGI

Variables		Triglyceride-glucose index		P value
		≥5.1 (n=163)	<5.1 (n=52)	
		Mean ± SD	Mean ± SD	
Blood Pressure	SBP	144.9±16	126.9±11	<0.001
	DBP	85.6±5	82.0±13.8	0.007
Blood Glucose	HbA1c	9.1±2.5	8.5±2.1	0.062
	FPG (mg/dl)	135.5±50	112.1±31	<0.001
	PPG (mg/dl)	205.3±65.2	155.5±48.2	<0.001
Lipid Profile	TG	159.3±37	124.2±29	<0.001
	HDL	32.5±5	39.8±6	<0.001
	LDL	122.3±41	123.8±36	0.814

Graph 1:

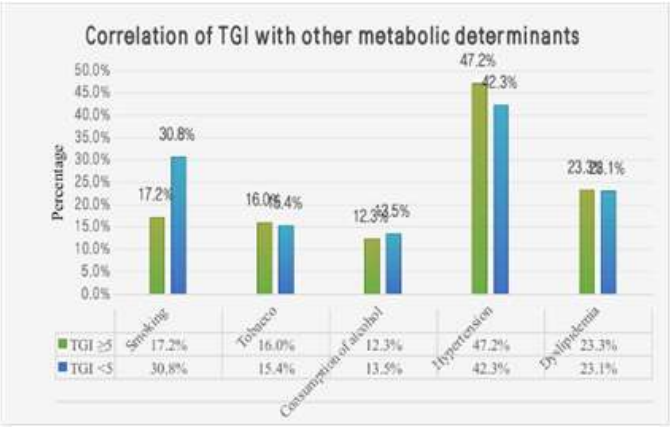

Table 2: Establishing TGI cut-off in Indian population for detection of metabolic syndrome

ATP III	Triglyceride-glucose index (Mean ± SD)	p-value
Yes (n=176)	5.13±0.19	<0.001
No (n=39)	4.73±0.19	

The results showed no significant differences in height between the insulin resistance group (163.2±5.7 cm) and the non-insulin resistance group (164.5±5.2 cm, p = 00.179). Similarly, there were no significant differences in weight (70.00 ± 11.3 kg vs. 68.2 ± 12.2 kg, p = 0.641), BMI (26.4 ± 4. kg/m² vs. 25.2 ± 4.2 kg/m², p = 0.321), or waist circumference (96.2±11.9 cm vs. 95.8±14.3 cm, p = 0.652) between the two groups.

Discussion

In this study, a definitely significant positive correlation was noted between the TGI and SBP (p< 0.001), DBP (p=0.007), FPG (p<0.001), PPBG (p<0.001), and triglycerides (p<0.001). Also, a significant correlation was observed between triglyceride-glucose index and HDL cholesterol (p<0.001) however No significant correlation was found between triglyceride-glucose index and HbA1c (p=0.062) or LDL cholesterol (p=0.814). Our findings were in concordance with the findings of Araújo SP et al in their study reported that in comparison to people with low TGI (TGI<9.04), those with high TGI (TGI ≥ 9.05) had substantially higher values for the waist-hip ratio, TC, LDL, VLDL, uric acid, ALT, AST, SBP, and HOMAIR. They also had greater incidence of smoking, MS, diabetes, and fatty infiltration of liver. Lin HY et al77 in their study also reported that when comparing participants with MetS to those without MetS, there was a significant in between-group variation in TGI (8.75 (8.69, 8.83) vs. 8.46 (8.43, 8.49); P<0.0001). Subjects with MS tended to have

greater amounts of inflammatory cells in comparison to those without the condition. Furthermore, patients with MetS had decreased value of HDL-C and raised value of BMI, SBP, DBP, CH, TG, LDL-C, and fasting blood glucose ($P < 0.01$ for all). Due to its complexity, expense, and time commitment, the approach is challenging to successfully implicate HOMAIR in large - scale epidemiological studies. TGI can be employed as a straightforward and accurate surrogate measure of IR. Furthermore, there exists a strong relationship between the TGI and the other more established determinants of IR i.e. the hyperinsulinaemic-euglycaemic clamp and the HOMA-IR. According to Zhang et al., higher TGI was associated with higher cumulative total incidence of diabetes mellitus. Sanchez et al. also showed that the TGI index can be employed in early prediction of metabolic syndrome and that higher the values, higher the prevalence of hypertension and stroke.

Recommendations

The cross sectional design of this study is a weakness since it does not guarantee the temporal validity of the observed correlations. Therefore, longitudinal research across a range of demographics and age profile is required to validate our results about the importance of predictive power of the TGI for metabolic syndrome.

Conclusion

We concluded that there was a connection between MS and its constituents and the TGI. The TGI showed considerable promise in the early identification of metabolic syndrome (MS), indicating that many metabolically linked risk factors need to be identified and controlled in a population with an elevated TGI .

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