



# Triglyceride glucose index as a predictor of impaired glucose tolerance in overweight and obese adolescents



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## Introduction

- Triglyceride glucose (TyG) index is a product of fasting triglyceride and glucose as formula:

$$\ln [\text{fasting triglyceride (mg/dL)} \times \text{fasting glucose (mg/dL)} / 2]$$

- It was widely used as an alternative marker for identifying insulin resistance in adults but not in children.
- Recent study in children showed association between the TyG index and HOMA-IR and a usefulness of TyG index as a surrogate marker of insulin resistance among adolescents.

## Objective

- Evaluated the potential role of the TyG index as a predictor of impaired glucose tolerance among overweight and obese children and adolescents.
- Identified the cutoff values of TyG index for diagnosis of abnormal glucose tolerance test.

## Material and method

**Design:** Retrospective study.

**Setting:** Department of Pediatric, Phramongkutklao Hospital, Bangkok, Thailand.

**Subjects:** Overweight and obese children and adolescent age 6-20 years who underwent clinical examination, fasting blood testing and oral glucose tolerance test (OGTT) from January 2002 to December 2016.

### Exclusion criteria:

- Syndromic and hypothalamic obesity.
- Genetic disorder.
- Endocrine disorders: hypothyroidism, Cushing syndrome, growth hormone deficiency and hypopituitarism.
- Steroid use.

### Study protocol:

- Fasting blood (> 8 hours) was analyzed for serum biochemistries by automated chemiluminescence assay using Cobas® e801 autoanalyzer.
- Impaired glucose tolerance was defined as 2-hour glucose levels of 140 to 199 mg/dL on the 75-gm OGTT.
- Homeostatic Model Assessment (HOMA) was calculated by  $[\text{fasting insulin (mIU/L)} \times \text{fasting glucose (mg/dL)}] / 405$
- Main Outcome Measures:** TyG index
- Statistical Analysis:** All categorical data are expressed as percent (%) and continuous data are mean  $\pm$  standard deviation (SD) and range. Data were analyzed using independent T-test. Receiver operating characteristic (ROC) curves were constructed and the area under the curve (AUC) was calculated to assess the clinical aptitude of the TyG index. Analyses were performed using the IBM SPSS statistics version 22 and  $p < 0.05$  was considered statistically significant.

## Results

- A total of 203 children and adolescents (122 males and 81 females) were included to our study.
- Mean age was  $12.04 \pm 2.61$  years (range 6.06-18.65) and BMI Z-score was  $2.24 \pm 0.34$  (range 1.41-3.01). One hundred and fifty-one children (74.4%) were obese.
- Two (1%) had type 2 diabetes and 38 (18.7%) had pre-diabetes: 1(0.5%) with impaired fasting glucose (IFG), 34 (16.7%) with impaired glucose tolerance (IGT) and 3 (1.5%) with IFG and IGT.

## Results

- The patient was divided to 2 groups: normal glucose tolerance or NGT (N = 163) and IGT (N = 37) group.
- Age, fasting blood glucose, HbA1C and TyG index were significantly higher in IGT than the NGT group. (Table 1)
- The TyG index was  $8.27 \pm 0.43$  and  $8.54 \pm 0.58$  in NGT and IGT, respectively ( $p < 0.001$ ). The area under the receiver operating characteristics (ROC) curve for TyG index and IGT was 0.648.
- In subgroup analysis of patients age  $\geq 13$  years, the optimal cut-off of the TyG index for diagnosis of impaired glucose tolerance was 8.3. The area under the ROC curve was 0.728 (95% confidence interval: 0.593 - 0.864) (Figure 1) and represent sensitivity of 77.3% and specificity of 50%.

Table 1: Baseline characteristics of the study subjects

Parameters	NGT (N = 163)	IGT (N = 37)	p-value
Age (yr)	11.8 $\pm$ 2.6	13.0 $\pm$ 2.5	0.02
BMI (kg/m <sup>2</sup> )	30.7 $\pm$ 4.7	31.9 $\pm$ 6.3	0.26
BMI SDS	2.3 $\pm$ 0.3	2.2 $\pm$ 0.4	0.72
Fasting blood glucose (mg/dL)	79.6 $\pm$ 6.6	83.8 $\pm$ 10.9	0.03
HbA1C (%)	5.5 $\pm$ 0.6	5.7 $\pm$ 0.4	0.02
Fasting insulin (mIU/L)	21.1 $\pm$ 15.4*	24.3 $\pm$ 15.8	0.26
HOMA-IR	4.0 $\pm$ 2.9*	5.4 $\pm$ 3.6	0.06
Triglyceride (mg/dL)	108.6 $\pm$ 56**	145.5 $\pm$ 118.0	0.07
Total cholesterol (mg/dL)	176.2 $\pm$ 32.3**	186.6 $\pm$ 37.1	0.09
LDL (mg/dL)	113.8 $\pm$ 29.1**	118.6 $\pm$ 39.2	0.40
HDL (mg/dL)	48.0 $\pm$ 11.1**	44.2 $\pm$ 10.1	0.06
AST (U/L)	25.9 $\pm$ 17.2 <sup>†</sup>	27.4 $\pm$ 13.3	0.61
ALT (U/L)	31.6 $\pm$ 34.7 <sup>†</sup>	39.8 $\pm$ 31.3	0.20
<b>TyG index</b>	<b>8.27 <math>\pm</math> 0.43**</b>	<b>8.54 <math>\pm</math> 0.58</b>	<b>0.001</b>

Data were shown as mean  $\pm$  SD, \* N = 159, \*\* N = 161, <sup>†</sup>N = 158.  
Abbreviations: BMI: body mass index, HOMA: homeostasis model assessment, LDL: low-density lipoprotein cholesterol, HDL: high-density lipoprotein cholesterol, AST: aspartate transaminase, ALT: alanine transaminase, TyG: triglycerides/glucose index..

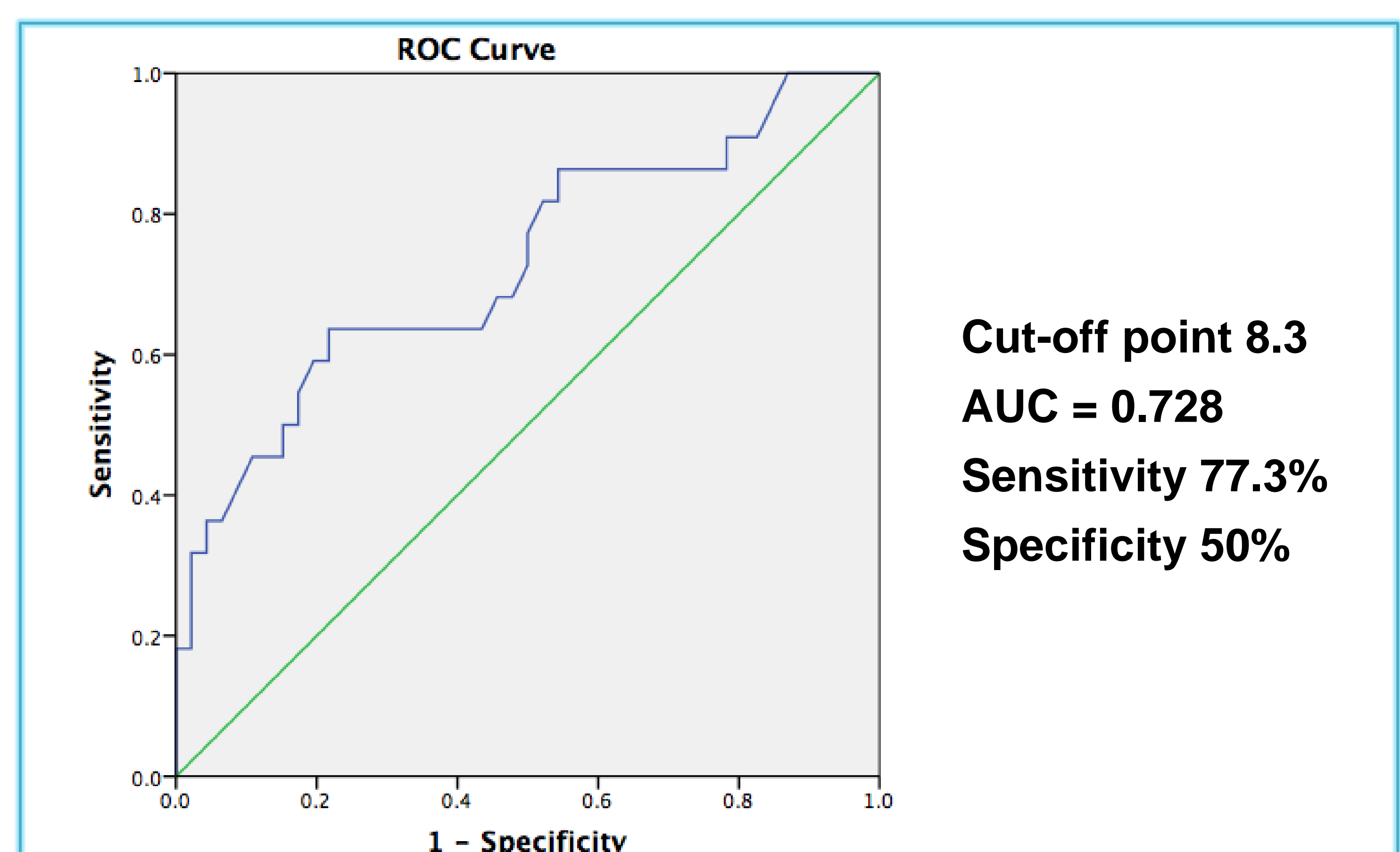


Figure 1: Receiver operating characteristic curves of TyG index for diagnosis of impaired glucose tolerance in patients age > 13 years

## Conclusion

The TyG index is a simple parameter to use as a surrogate marker of impaired glucose tolerance in overweight and obese children age  $\geq 13$  years compared with oral glucose tolerance test.

### References:

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