

## Assessment of Insulin Resistance with Two Methods: HOMA-IR and TyG Index in Iranian Obese Women

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### Abstract

**Objective:** The aim of the present study is assessment of insulin resistance (IR) in obese women by TyG-Index and compared with the HOMA-IR index.

**Materials and Methods:** This cross-sectional study was performed on 61 obese women aged 18-45 years. Weights, height, waist circumference (WC) were measured and body mass index (BMI) was calculated and recorded. A sample of fasting serum was collected to determine the glucose, triglyceride, insulin, total cholesterol, HDL-C and LDL-C concentration. HOMA-IR and TyG-Index were calculated as markers of insulin resistance.

**Results:** The mean age of the precipitants was  $32.5 \pm 0.79$  years old and the mean weight was  $86.0 \pm 1.7$  Kg. The number of people with IR who determined by HOMA and TyG index were 21(34%) and 36(61%), respectively. There was a significant relationship between HOMA-IR and TyG Index,  $r = 0.044$  ( $P < 0.001$ ).

**Conclusion:** TyG index represents a useful and accessible tool for assessment of IR instead HOMA-IR in Iranian population, but more researches with greater sample size and via gold standard lab test need to evaluate the specificity and sensitivity of this new method.

**Keywords:** TyG-Index, HOMA-IR, Obesity

### Introduction

Adults' obesity is a serious health problem and associated with a number of metabolic disorders such as hypertension, dyslipidemia, insulin resistance (IR), type 2 diabetes mellitus (T2DM), arthritis and cardiovascular disease (1). The assessment of insulin resistance is important due to its key role in the pathophysiology of

listed diseases. IR refers a state in which cells of peripheral tissue have a lowered level of response to insulin, a hormone secreted by  $\beta$  cells of pancreas to maintain normal levels of blood glucose, as a result, a large amount of insulin is produced, which leads to chronic hyperinsulinemia (2). Evaluation of IR is a complex procedure and requires methods

which are not available in daily clinical practice, for example calculation HOMA index requires plasma insulin assessment and laboratory determination of insulin is not available and standardized in all services (3). More recently, some researchers proposed that the product of plasma triglyceride (TG) and glucose concentration (TyG index) represents an accessible tool for assessment of IR in clinical practice. (4,5) The aim of this study is assessment of IR in obese women by two methods HOMA-IR and TyG Index.

### Materials and Methods

An analytic cross-sectional study carried out in a private nutritional clinic in the Gorgan City (Golestan province in the east of Caspian Sea, Iran) from April to July 2012. A total of 61 eligible overweight or obese women were randomly selected. The inclusion criteria were women between 18–45 years old, BMI  $\geq 25$  kg/m<sup>2</sup>, blood pressure <140/90 mm Hg, no history of cardiovascular, renal or metabolic diseases, non smoker. None of the subjects had taken medication that influence lipid or glucose metabolism in last 6 months. All women had regular menstrual cycles with cycle length between 27 and 32 days.

Pregnant and lactating women were excluded. The subjects had similar levels of physical activity: less than 3 hours walking in a week.

At the first visit, a structured checklist contained baseline socio demographics data such as age, education and occupation was completed. Participant's weight, height and blood pressure were measured.

Body weight was measured with a Seca Digital scale (Clara 803 - Germany) to the nearest 0.1 kg in the evening of fast day, without shoes, and in light clothing. Height was measured with a Secastadiometer (seca 206). BMI was assessed as the weight in kilograms divided to the square of the height in meters. Waist circumference was measured in triplicate in standing subjects at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest. Blood samples were obtained from patients

after 10 hours fasting and centrifuged to separate plasma and stored in freeze (-70°C). Plasma total cholesterol, HDL-C, and TG concentrations were measured using enzymatic kits (Pars Azmoon Co., Tehran, Iran). LDL-C concentration was calculated using the Friedewald equation. Insulin levels assessed by solid-phase sandwich ELISA method using kits and calibrators from Monobind, Inc.

The TyG index was calculated by the following formula:

$$\text{Ln} [\text{fasting triglycerides (mg/dl)} \times \text{fasting glucose (mg/dl)} / 2]$$

HOMA-IR was calculated by following formula:

$$[\text{Fasting insulin (mU/ml)} \times \text{fasting glucose (mmol/L)}] / 22.5$$

Normal distribution of data was examined by the one sample Kolmogorov-Sminnov test. Pearson and Spearman correlation used to evaluate the association between BMI by TyG index and HOMA-IR. Linear regression was built to compute the risk factors of insulin resistance by considering their covariates.

This study was approved by the research ethics committee of the Golestan University of Medical sciences, Gorgan, Iran.

### Results

A total of 61 subjects aged between 18-45 years old ( $32.5 \pm 0.79$ ) participated in this study. The main clinical features and the biochemical characteristics are shown in Table 1. The mean BMI of precipitants is  $33.1 \pm 0.56$ . The mean of HOMA-IR and TyG index are  $1.9 \pm 0.21$  and  $4.7 \pm 0.02$  respectively.

Based on HOMA-IR method, the prevalence of IR in our samples was 34% (n=21) and by using of TyG Index was 61% (36). There was a significant relationship between HOMA-IR and TyG Index ( $r=0.44$ ) ( $P<0.001$ ) (graph 1).

### Discussion

Our findings demonstrated a significant relationship between HOMA-IR and TyG Index. There are few studies about the comparison of previous and resent purposed

**Table 1. The descriptive clinical and biochemical characteristics of subjects**

Index	Mean± SE	Minimum	Maximum
Age (years)	32.5±0.79	21	45
BMI (kg/m <sup>2</sup> )	33.1±0.56	25.00	50.00
WC (cm)	91.1±1.0	69	124
Height(cm)	161± 0/87	141	188
Weight(kg)	86.0± 1.07	62.40	141.40
Hip Ratio(cm)	110.0± 1.2	81	142
Abdominal circumference(cm)	91.1± 1.02	82	143
Fasting glucose (mg/dL)	101.0 ±14.0	75	159
TG (mg/dL)	140.1 ± 5.5	75	329
Total cholesterol	136.1±3.8	96	230
Fasting insulin (μU/mL)	7.7±0.84	1.60	37.20
HDL-C*	43.4 ±0.92	28	64
LDL-C**	65.3±3.3	31	141
HOMA-IR index	1.9 ±0.21	0.35	7.28
TyG index	4.7 ± 0.02	4.39	5.32

\*HDL-C = High-Density Lipoprotein- cholesterol, \*\*LDL-C = Low-Density Lipoprotein-cholesterol

IR assessment methods.

However, it is important that laboratory determination of plasma insulin is not yet available, standardized and cost effective in all clinical services. Furthermore, using HOMA-IR could make inaccurate results in T2DM and hyperglycemia patients (6).

The results of this study showed that the prevalence of IR with TyG Index is higher than HOMA-IR method. Therefore, the results of this study confirmed the findings of previous studies. The study on 99 Mexican populations showed that TyG index could be more suitable method for the detection of individuals with IR. Fernando et al were examined the Sensitivity and specificity of the TyG index compared to the clamp method. They found that this indicator has high sensitivity (96.5%) and specificity (85/0%) compared the clamp test (7). Another study on 163 non-diabetic postmenopausal women indicated that in a large population, the TyG index needs to be investigated further for insulin resistance assessment.

A cross-sectional study on 82 Brazilian patients showed that the TyG index has better performance than the HOMA-IR. Also there was a strong correlation between TyG index and several factors of obesity including BMI ( $r=0.47$ ), fasting insulin ( $r=0.57$ ) and waist circumference( $r=0.52$ ). These correlations have been much greater than the HOMA index.

The results of some studies on diabetic patients in Brazil and healthy population in Mexico are similar to our findings. In these studies, TyG Index was more cost effective method for assessing IR(8,9).

Irace also reported, TyG-Index has more accurate association with risk factors of carotid atherosclerosis in comparison with HOMA-IR (10).

In obese individuals, central adiposity and also some disorders in lipoprotein metabolism that lead to hypertriglyceridemia may have associated with IR.

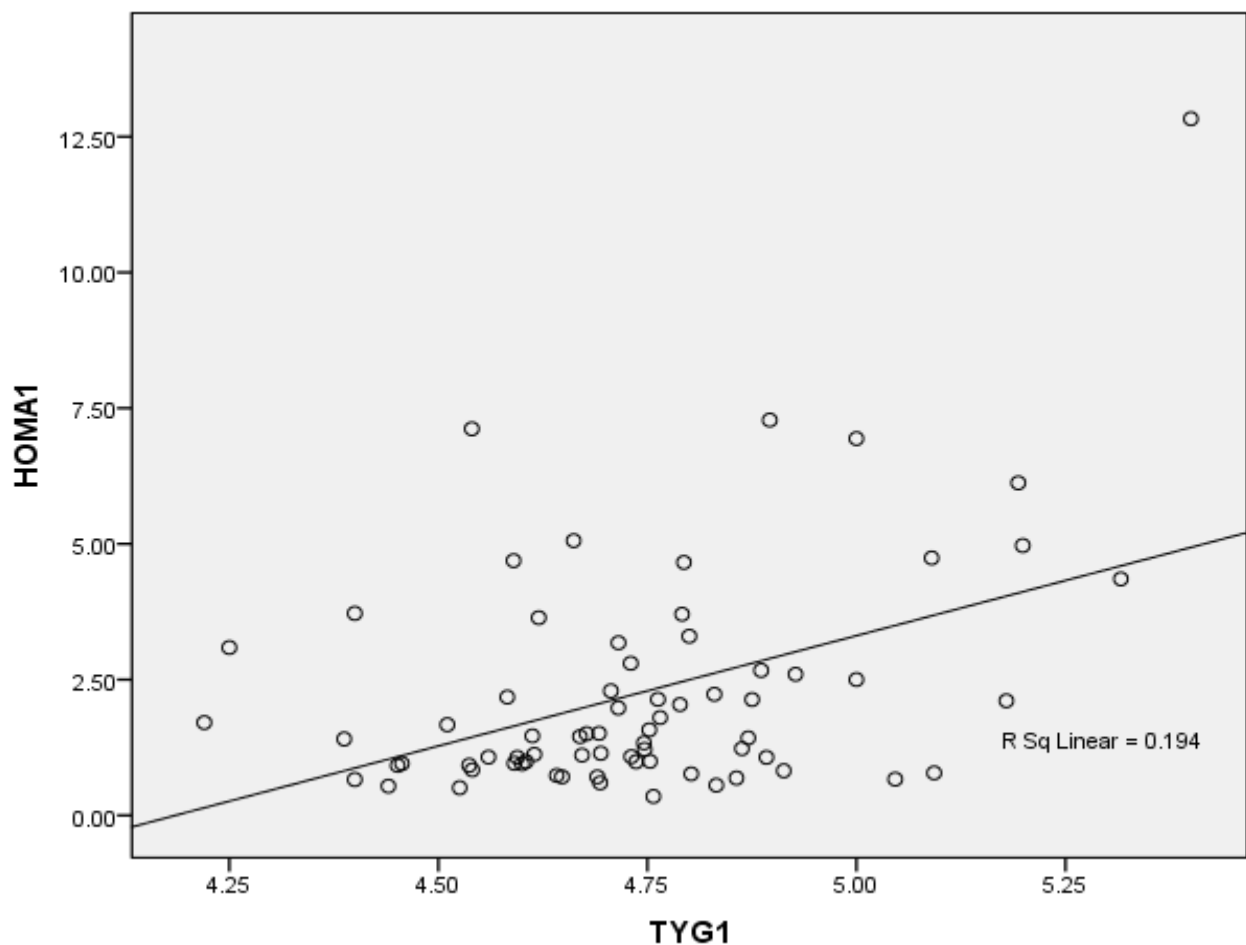
Therefore, TyG Index seems be more useful tool for assessment of IR in the obese population(7,8).

In conclusion: TyG index is correlated with adiposity, metabolic and subclinical atherosclerosis markers related to IR, and different population need to use different methods for assessment IR. According to the findings, since a larger number of people have been identified with TyG, it seems TyG index is better method for evaluating of patients with insulin resistance

In our study, increased TG levels in most patients have associated with more distinction of IR by TyG index than HOMA-IR.

On the other hand, the challenge is whether TyG index can be accurate enough in patients with hypertriglyceridemia.

However, more research on this topic needs to be done to comparison these two methods. We propose more researches with greater sample



Graph 1. The correlation between HOMA-IR and TyG Index

size and using a gold standard lab test need to evaluate the specificity and sensitivity of this new method.

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### References

1. Bhardwaj S, Misra A, Khurana L, Gulati S, Shah P, Vikram NK. Childhood obesity in Asian Indians: a burgeoning cause of insulin resistance, diabetes and sub-clinical inflammation. *Asia Pac J Clin Nutr*. 2008;17(1):172-5.
2. Choi K, Kim Y-B. Molecular mechanism of insulin resistance in obesity and type 2 diabetes. *The Korean journal of internal medicine*. 2010;25(2):119-29.
3. Wallace TM, Levy JC, Matthews DR. Use and abuse of HOMA modeling. *Diabetes Care* 2004;27:1487-95
4. Vasques ACJ, Novaes FS, Matos Souza JR, Yamanaka A, Pareja JC, Tambascia MA, et al. TyG index performs better than

- HOMA in a Brazilian population: A hyperglycemic clamp validated study. *Diabetes research and clinical practice*. 2011;93(3):98-100.
5. Guerrero-Romero F, Simental-Mendía LE, Gonzalez-Ortiz M, Martinez-Abundis E, Ramos-Zavala MG, Hernandez-Gonzalez SO, et al. The product of triglycerides and glucose, a simple measure of insulin sensitivity. Comparison with the euglycemic-hyperinsulinemic clamp. *J Clin Endocrinol Metab* 2010;95:3347-51.
  6. 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. *Metabolic syndrome and related disorders*. 2008;6(4):299-304.
  7. Guerrero-Romero F, Simental-Mendía LE, González-Ortiz M, Martínez-Abundis E, Ramos-Zavala MG, Hernández-González SO, et al. The product of triglycerides and glucose, a simple measure of insulin sensitivity. Comparison with the euglycemic-hyperinsulinemic clamp. *Journal of Clinical Endocrinology & Metabolism*. 2010;95(7):3347-51.
  8. Bastard J-P, Lavoie M-E, Messier V, Prud'homme D, Rabasa-Lhoret R. Evaluation of two new surrogate indices including parameters not using insulin to assess insulin sensitivity/resistance in non-diabetic postmenopausal women: A MONET group study. *Diabetes & metabolism*. 2012;38(3):258-63.
  9. Vasques ACJ, Novaes FS, Matos Souza JR, Yamanaka A, Pareja JC, Tambascia MA, et al. TyG index performs better than HOMA in a Brazilian population: A hyperglycemic clamp validated study. *Diabetes research and clinical practice*. 2011;93(3):98-100.
  10. Irace C, Carallo C, Scavelli FB, De Franceschi MS, Esposito T, Tripolino C, Gnasso A. Markers of insulin resistance and carotid atherosclerosis. A comparison of the homeostasis model assessment and triglyceride glucose index. *Int J Clin Pract*. 2013;67(7):665-72.