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

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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 β 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 privat 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$^2$, 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:

$$\ln \left( \frac{\text{fasting triglycerides (mg/dl)} \times \text{fasting glucose (mg/dl)}}{2} \right)$$

HOMA-IR was calculated by following formula:

$$\left( \frac{\text{fasting insulin (mU/ml)} \times \text{fasting glucose (mmol/L)}}{22.5} \right)$$

Normal distribution of data was examined by the one sample Kolmogorov-Sminnove test. Pearson and Spearmen 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±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±0.56. The mean of HOMA-IR and TyG index are 1.9 ±0.21 and 4.7 ± 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
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 (6).

Table 1. The descriptive clinical and biochemical characteristics of subjects

<table>
<thead>
<tr>
<th>Index</th>
<th>Mean ± SE</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>32.5 ± 0.79</td>
<td>21</td>
<td>45</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>33.1 ± 0.56</td>
<td>25.00</td>
<td>50.00</td>
</tr>
<tr>
<td>WC (cm)</td>
<td>91.1 ± 1.0</td>
<td>69</td>
<td>124</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>161 ± 0.87</td>
<td>141</td>
<td>188</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>86.0 ± 1.07</td>
<td>62.40</td>
<td>141.40</td>
</tr>
<tr>
<td>Hip Ratio (cm)</td>
<td>110.0 ± 1.2</td>
<td>81</td>
<td>142</td>
</tr>
<tr>
<td>Abdominal circumference (cm)</td>
<td>91.1 ± 1.02</td>
<td>82</td>
<td>143</td>
</tr>
<tr>
<td>Fasting glucose (mg/dL)</td>
<td>101.0 ± 14.0</td>
<td>75</td>
<td>159</td>
</tr>
<tr>
<td>TG (mg/dL)</td>
<td>140.1 ± 5.5</td>
<td>75</td>
<td>329</td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>136.1 ± 3.8</td>
<td>96</td>
<td>230</td>
</tr>
<tr>
<td>Fasting insulin (µU/mL)</td>
<td>7.7 ± 0.84</td>
<td>1.60</td>
<td>37.20</td>
</tr>
<tr>
<td>HDL-C*</td>
<td>43.4 ± 0.92</td>
<td>28</td>
<td>64</td>
</tr>
<tr>
<td>LDL-C**</td>
<td>65.3 ± 3.3</td>
<td>31</td>
<td>141</td>
</tr>
<tr>
<td>HOMA-IR Index</td>
<td>1.9 ± 0.21</td>
<td>0.35</td>
<td>7.28</td>
</tr>
<tr>
<td>TyG Index</td>
<td>4.7 ± 0.02</td>
<td>4.39</td>
<td>5.32</td>
</tr>
</tbody>
</table>

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

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

Acknowledgement
This study was supported by Research Deputy of Golestan University of Medical Sciences. The authors would like to acknowledge “Research Deputy” for financial supports. We thank Mrs. Poursharifi, staff from biochemistry laboratory of medicine faculty, for her technical help. We appreciate the help of all the participants in this study.

References

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


