

Study On Insulin Levels and Insulin Resistance in Obese: Findings from a Tertiary Care Hospital, Andhra Pradesh.

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Abstract

INTRODUCTION: Overweight and obesity are major risk factors for a number of chronic diseases, including diabetes. The possible mechanism by which obesity increases insulin resistance is large fat stores leading to increased turnover of free fatty acids and triglycerides in the skeletal muscle thereby increasing insulin resistance. **MATERIAL & METHODS:** A hospital based observational study was carried out where 125 participants were selected by convenient sampling technique in the study duration of 6 months from March to August 2019. Obese individuals with BMI >25 kg/m² and previously undiagnosed cases of Type 2 diabetes mellitus were included. Fasting Insulin levels were assessed using ELISA method. Homeostatic model assessment for insulin resistance (HOMA-IR) index was calculated by using the formula: fasting insulin concentration (microunits per millilitre) X fasting glucose concentration (millimolar)/22.5. **RESULTS:** More than half the proportion of the cases (n=65, 52%) belonged to 30-40 years age group. Gender distribution showed a slight female preponderance with 50.4% (n=63) being females and 49.6% males. With regards to severity of obesity, one third of them were severely obese. Mean Homeostatic model assessment for insulin resistance (HOMA-IR) index was found to be 2.96. More than one third (36%, n=45) individuals in the present study had Insulin resistance. **CONCLUSIONS:** Obesity and Insulin resistance showed a definite significant association with degree of obesity playing an important role. Metabolic characteristics such as fasting plasma glucose, 2 hour glucose levels, fasting insulin levels and triglycerides were significantly more among Insulin resistance group.

Keywords: insulin levels, insulin resistance, obese, HOMA-IR

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I. Introduction

Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. A crude population measure of obesity is the body mass index (BMI), a person's weight (in kilograms) divided by the square of his or her height (in metres). A person with a BMI of 30 or more is generally considered obese. A person with a BMI equal to or more than 25 is considered overweight. The cut off limits for Asian population have further been lowered^[1].

Overweight and obesity are major risk factors for a number of chronic diseases, including diabetes, cardiovascular diseases and cancer. Once considered a problem only in high income countries, overweight and obesity are now dramatically on the rise in low- and middle-income countries, particularly in urban settings^[1] due to changes in the lifestyles.

The relationship between diabetes and obesity is well established. In both men and women, in all ethnic groups and across all ages, the risk of developing type 2 diabetes is directly proportional to the degree of overweight. Overweight and obesity are associated with insulin resistance and metabolic syndrome. Metabolic syndrome may be defined as a cluster of metabolic abnormalities, which occur together in an individual more often than might be expected by chance^[2].

The possible mechanism by which obesity increases insulin resistance is large fat stores leading to increased turnover of free fatty acids and triglycerides in the skeletal muscle thereby increasing insulin resistance, raising blood glucose levels and likelihood of developing diabetes. Decreased insulin action leads to an even greater rate of fat breakdown (lipolysis) and further elevations of insulin resistance, creating a vicious cycle^[3,4].

There are several methods that could be used for assessing insulin resistance: hyperinsulinemic euglycemic clamp and intravenous glucose tolerance test, homeostasis model assessment (HOMA), quantitative insulin sensitivity check index (QUICKI), McAuley index, Matsuda index, and few others. Although hyperinsulinaemic-euglycaemic clamp test is the gold-standard for the measurement of insulin sensitivity, homeostatic model assessment has been considered as a useful, cost-effective, and most widely used tool for the assessment of insulin resistance^[5,6,7].

II. Material & Methods

Study Design: It was a hospital based observational study done at a tertiary care hospital from Vijayawada. A total of 125 participants were selected by convenient sampling technique in the study duration of 6 months from March to August 2019.

Study participants:

Inclusion criteria- Obese individuals with BMI >25 kg/m² and previously undiagnosed cases of Type 2 diabetes mellitus.

Exclusion criteria-

- Already known type 2 diabetic patients
- Those on long-term corticosteroid use
- Endocrinal disorders such as Primary hyperinsulinemia
- Hypothyroidism and hyperlipidemia

After taking informed consent, demographic data & brief history was taken from a pre designed proforma followed by general examination such as height, weight, waist circumference using standard procedures. Body Mass Index was calculated as weight in kilograms divided by height in square meters.

Study participants meeting the inclusion criteria were subjected to certain laboratory investigations such as Fasting Blood Glucose, 2 hour post prandial glucose levels, Fasting insulin levels, total cholesterol and triglycerides. World Health Organization guidelines were used to categorize into impaired glucose tolerance, type 2 diabetes mellitus.

Fasting Insulin levels were assessed using ELISA method. Homeostatic model assessment for insulin resistance (HOMA-IR) index was calculated by using the formula: fasting insulin concentration (microunits per millilitre) X fasting glucose concentration (millimolar)/22.5^[8].

Statistical analysis: Data was entered in Microsoft Excel 2010 version and analyzed using Open Epi software version 3.01^[9]. Numerical data was presented in mean and standard deviation and categorical variables in percentages and proportions. Chi square test and 't' test were applied wherever necessary with p<0.05 considered as statistically significant.

III. Results:

Demographic characteristics-

More than half the proportion of the cases (n=65, 52%) belonged to 30-40 years age group followed by 20-30 years age group (n=32, 25.6%). Mean age of the study population was found to be 32.4±5.1 years. Gender distribution showed a slight female preponderance with 50.4% (n=63) being females and 49.6% males. Two thirds of the study population were literates and majority (27.2%) belonged to upper middle class. With regards to severity of obesity, one third of them were severely obese.

Clinical and Metabolic profile:

Mean levels of body mass index, fasting plasma glucose, 2 hour post prandial glucose levels, Fasting Insulin levels, Total cholesterol, Triglycerides have been mentioned in table no 1.

Table 1: Clinical and Metabolic profile of the study population

Variable	Mean±SD
Weight (kg)	68.7±7.3
Height (cm)	161.2±12.5
BMI (kg/m ²)	30.8±5.7
Fasting plasmagluose (mmol/L)	4.6±2.4
2 hour post prandial glucose levels (mmol/L)	6.1±3.2
Fasting Insulin levels (uU/mL)	20.8±6.3
HOMA-IR	2.96±3.5
Total cholesterol (mmol/L)	4.7±1.6
Triglycerides (mmol/L)	1.3±0.5

Homeostatic model assessment for insulin resistance (HOMA-IR) index was calculated by using the formula: fasting insulin concentration (microunits per millilitre) X fasting glucose concentration (millimolar)/22.5. Insulin resistance was defined as HOMA-IR index > 3.16.

In the present study, mean Homeostatic model assessment for insulin resistance (HOMA-IR) index was found to be 2.96. More than one third (36%, n=45) individuals in the present study had Insulin resistance.

Table 2: Comparison between clinical and metabolic characteristics among Insulin resistant (IR) and Non-Insulin resistant (non-IR)

Characteristic	Insulin resistant (IR)(n=45)	Non-Insulin resistant (non-IR)(n=80)	p value
Mean age (years)	35.2±3.6	31.8±2.5	0.004*
Degree of Obesity			
Obese	20	63	0.00009**
Severely obese	25	17	
Mean BMI (kg/m ²)	32.4±3.5	29.6±3.1	0.00002*
Mean FI (uU/mL)	21.7±1.4	12.8±3.4	<0.00001*
FPG (mmol/L)	4.1±1.7	3.8±2.2	0.06*
2-h G (mmol/L)	6.5±1.1	6.1±0.7	0.03*
TC (mmol/L)	4.4±0.8	4.1±0.9	0.4*
TG (mmol/L)	1.5±0.6	1.2±0.7	0.02*

*‘t’ test **Chi square test p<0.05 considered statistically significant

Comparison between clinical and metabolic characteristics among Insulin resistant (IR) and Non-Insulin resistant (non-IR) was noted. This comparison found that increasing age, higher degree of obesity, higher BMI values, high mean fasting insulin levels, high mean fasting plasma glucose & 2 hour insulin levels and Triglyceride values were significantly higher among Insulin resistance individuals compared to non-insulin resistant individuals (p<0.05).

IV. Discussion

The association of obesity with type 2 diabetes has been recognized for decades, and the major basis for this link is the ability of obesity to engender insulin resistance. Insulin resistance is a fundamental aspect of the etiology of type 2 diabetes and is also linked to a wide array of other pathophysiologic sequelae including hypertension, hyperlipidemia, atherosclerosis (i.e., the metabolic syndrome, or syndrome X), and polycystic ovarian disease. Hence the present study has been done with an objective to determine insulin levels and insulin resistance among obese individuals.

In the present study, Insulin resistance was seen in more than one third of the study population (36%) with mean Fasting insulin levels being 20.8 uU/mL. Statistically significant association was noted between Insulin resistance and Age, degree of obesity, Fasting insulin levels, fasting plasma glucose and triglycerides.

Yashpal Singh et al^[9] study found that The HOMA-IR values increased progressively from normal weight to obese adolescents in both sexes. Mean HOMA-IR values increased progressively according to sexual maturity rating in both sexes. HOMA-IR value of 2.5 had a sensitivity of >70% and specificity of >60% for MS. This cut-off identified larger number of adolescents with MS in different BMI categories (19.7% in normal weight, 51.7% in overweight, and 77.0% in obese subjects) as compared to the use of IDF or ATP III criteria for diagnosing MS. Odds ratio for having IR (HOMA-IR of >2.5) was highest with WHtR (4.9, p <0.0001) and WC (4.8, p <0.0001), compared to WHR (3.3, p <0.0001).

Similar kind of study by Marko Kostovski et al^[10] observed that Insulin resistance was determined in 58.33% of study participants. Insulin resistant participants had significantly higher level of 2-h G (p = 0.02), FI level (p = 0.000) as well as TG levels (p = 0.01), compared to non-insulin resistant group. Strikingly, 70.73% of the pubertal adolescents were insulin resistant in comparison to 49.09% of the preadolescents (p = 0.03). Significantly higher percentage of insulin-resistant participants were girls (p = 0.009). Moreover, a higher percentage of the girls (70.59%) than boys (44.44%) had HOMA-IR above 3.16 and had elevated FI levels (70.59% vs 48.89%). The difference in the frequency of insulin resistance among obese versus severely obese children and adolescents was not significant (p = 0.73, p > 0.05). Their study results also showed positive, but weak, correlation of HOMA-IR with age, FPG, TG and BMI of the participants (p < 0.05). These findings were similar to the present study findings.

V. Conclusions:

Obesity and Insulin resistance showed a definite significant association with degree of obesity playing an important role. Metabolic characteristics such as fasting plasma glucose, 2 hour glucose levels, fasting insulin levels and triglycerides were significantly more among Insulin resistance group compared with non-insulin resistance cases with a higher risk of Metabolic resistance. Though there are several methods that could be used for assessing insulin resistance; homeostasis model assessment (HOMA) can be considered as a useful, cost-effective, and most widely used tool.

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