ISSN (P) : 2589-9120 / (O) : 2589-9139
PubMed-National Library of Medicine - ID: 101773527

International Journal of Medical Science and Applied Research (IJMSAR)

Available Online at: https://www.ijmsar.com

Volume – 6, Issue – 1, February – 2023, Page No. : 94 – 101

Evaluation of Insulin Resistance in Obese and Non - Obese Subjects with Metabolic Syndrome - A Cross Sectional Study

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Citation of this Article: Dr. Chelluri Bhaskara Venkata Saradhi, Dr. Allu Jyothirlatha, Dr. Manne Sriharibabu, Dr. Vaddadi Suresh, Dr. Aishwarya Sree Divya, " Evaluation of Insulin Resistance in Obese and Non - Obese Subjects with Metabolic Syndrome - A Cross Sectional Study,'' IJMSAR – February – 2023, Vol. – 6, Issue - 1, Page No. 94-101.

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Type of Publication: Original Research Article

Conflicts of Interest: Nil

ABSTRACT

Introduction

Fatty acids impair insulin-mediated glucose uptake and accumulate as triglycerides in both cardiac and skeletal muscle, increasing the risk of non-communicable diseases such as coronary heart disease, type 2 DM.

Aim

To assess insulin resistance in obese and non-obese subjects with metabolic syndrome

Material & Methods

The study was a cross sectional study done in patients with metabolic syndrome attending to Department of General Medicine, GSL Medical College & General Hospital who were aged 18 years and above with features of metabolic syndrome

Results

Insulin resistance in obese individuals was found to have a statistically significant association with waist circumference, triglycerides among various components of metabolic syndrome. Insulin resistance in non-obese individuals was found to have

a statistically significant association with triglycerides among various components of metabolic syndrome.A strong positive correlation was observed between BMI and HOMA-IR.

Conclusion

The higher insulin resistance in non-obese individuals need to be taken into consideration as this may have ill effects and a higher chance of developing diabetes in the future. Hence, further studies should address whether targeted therapies aimed at dyslipidaemia, obesity and insulin resistance in young non-obese individuals may reduce the risk, as obesity and insulin resistance are significant factors for the development of the metabolic syndrome.

Keywords

Insulin resistance, triglycerides, obesity.

INTRODUCTION

The prevalence of MS among adult population in India was 30%[1] and few studies evidenced that insulin resistance is a central factor driving the abnormalities in criteria of metabolic syndrome. An early major contributor to the development of insulin resistance is excess circulating fatty acids.

The lipolysis of triglyceride-rich lipoproteins in tissues by lipoprotein lipase also produces free fatty acids. Inhibition of lipolysis in adipose tissue is the most sensitive pathway of insulin action. When Insulin Resistance develops, increased lipolysis produces more fatty acids, further decreasing the antilipolytic effect of insulin.Fatty acids impair insulin-mediated glucose uptake and accumulate as triglycerides in both cardiac and skeletal muscle, increasing the risk of non-communicable diseases such as coronary heart disease, type 2 DM.

AIM

To assess insulin resistance in obese and non-obese subjects with metabolic syndrome

OBJECTIVES

1. To examine the association between insulin resistance and components of metabolic syndrome in obese individuals
2. To examine the association between insulin resistance and components of metabolic syndrome in non-obese individuals
3. To compare both the groups regarding Insulin resistance

MATERIALS & METHODS

The present study was a cross sectional study done in patients(Inpatients and Outpatients) with metabolic syndrome attending to Department of General Medicine, GSL Medical College & General Hospital who were aged 18 years and above with features of metabolic syndrome according to NCEP ATP III criteria (at least 3 out of 5 criteria) {modified for southeast Asian population by WHO, Diabetes and heart in India, ICP guidelines}from October 1st, 2019, to March 31st, 2021.Subjects who are on drugs such as steroids, lipid-lowering agents, anti-diabetic medications, and diagnosed with pancreatitis, chronic liver disease were excluded from the study.

RESULTS

The mean age of the participants who are obese was 38.02 ±8.49 years and the mean age of participants who are non-obese was 38.51 ±8.37 years and the difference between both groups was similar and no statistically significant difference was observed. 24% were male and 76% were females in this study. Hence the patients included in the study groups were comparable with respect to age and gender.

Insulin Resistance and components of Metabolic syndrome in Obese individuals

Among obese individuals, in the insulin-resistant group (HOMA-IR>2.5), the mean waist circumference was 101.34±9.44 cm, the mean SBP was 133.21±14.59mm Hg, the mean DBP was 84.71±9.33mm Hg, the mean Triglycerides was 254.03±65.88mg/dl, the mean HDL was 38.82±4.58mg/dl, the mean FBS was 111.80±10.59mg/dl.

Among obese individuals, in the non- insulin-resistant group (HOMA-IR<2.5), the mean waist circumference was 95.71±8.73cm, the mean SBP was 138.36±11.46mm Hg, the mean DBP was 84.86±9.46mm Hg, the mean TG was 207.71±66.70mg/dl, the mean HDL was 38.85±5.39mg/dl, the mean FBS was 109.86±13.77mg/dl.

Upon analysis of insulin resistance in obese individuals it was found to have a statistically significant association with waist circumference, Triglycerides among various components of metabolic syndrome.

VARIABLES	HOMA-IR<2.5 (n=14)	HOMA-IR>2.5 (n=76)	P-value
Waist circumference (cm)	95.71 ± 8.73	101.34 ± 9.44	0.04
SBP (mm Hg)	138.36 ± 11.46	133.21 ± 14.59	0.21
DBP (mm Hg)	84.86 ± 9.46	84.71 ± 9.33	0.95
TG (mg/dl)	207.71 ± 66.70	254.03 ± 65.88	0.01
HDL (mg/dl)	38.85 ± 5.39	38.82 ± 4.58	0.97
FBS (mg/dl)	109.86 ± 13.77	111.80 ± 10.59	0.55

Table 1: Association between Insulin Resistance and components of Metabolic syndrome in Obese

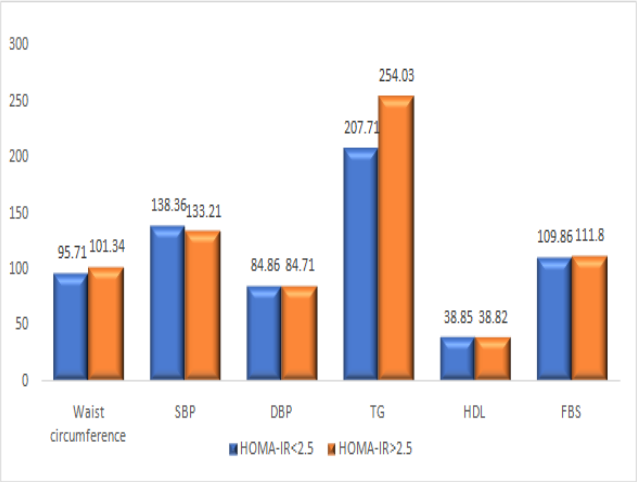

Figure 1: Bar diagram showing an association between Insulin Resistance and components of Metabolic syndrome in Obese

Insulin Resistance and components of Metabolic syndrome in non-Obese

Among non-obese individuals, in the insulin-resistant group (HOMA-IR>2.5), the mean waist circumference was 69.91±7.95cm, the mean SBP was 129.78±10.3mm Hg, the mean DBP was 80.78±6.72mm Hg, the mean Triglycerides was 210.78±62.75mg/dl, the mean HDL was 38.35±5.06mg/dl, the mean FBS was 84±7.17mg/dl.

Among non-obese individuals, in the non-insulin resistant group (HOMA-IR<2.5), the mean waist circumference was 70.95±8.25cm, the mean SBP was 129.59±8.53mm Hg, the mean DBP was 80.86±6.7mm Hg, the mean TG was 183.78±29.54mg/dl, the mean HDL was 40.05±5.53mg/dl, the mean FBS was 82.41±6.56mg/dl.

Upon analysis of insulin resistance in non-obese individuals it was found to have a statistically significant association with triglycerides among various components of metabolic syndrome.

VARIABLES	HOMA-IR<2.5 (n=37)	HOMA-IR>2.5 (n=23)	P-value
Waist circumference(cm)	70.95 ± 8.25	69.91 ± 7.95	0.63
SBP (mm Hg)	129.59 ± 8.53	129.78 ± 10.3	0.93
DBP (mm Hg)	80.86 ± 6.7	80.78 ± 6.72	0.96
TG (mg/dl)	183.78 ± 29.54	210.78 ± 62.75	0.028
HDL (mg/dl)	40.05 ± 5.53	38.35 ± 5.06	0.236
FBS (mg/dl)	82.41 ± 6.56	84.00 ± 7.17	0.38

Table 2: Association between Insulin Resistance and components of Metabolic syndrome in non-Obese

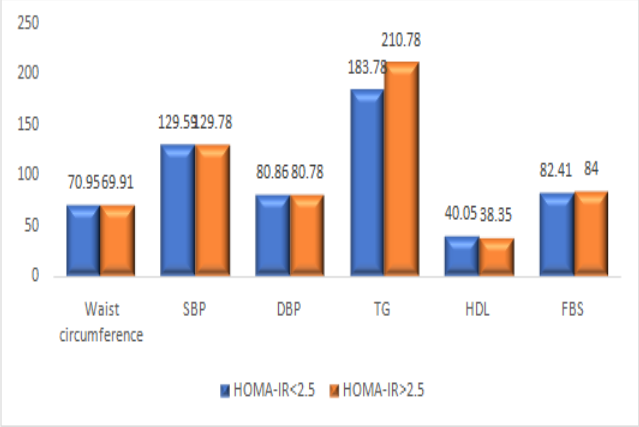

Figure 2: Bar diagram showing an association between Insulin Resistance and components of Metabolic syndrome in non-Obese

Correlation between BMI and HOMA IR

A strong positive correlation was observed between BMI and HOMA-IR.

	Variable	R-value	P-value
BMI	HOMA-IR	0.50	<0.0001*

Table 3: Correlation between BMI and HOMA IR

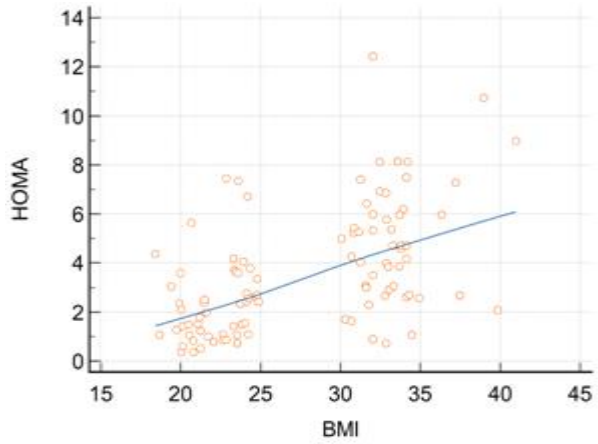

Figure 3: Diagram showing Correlation between BMI and HOMA IR

In the case of obese individuals, insulin resistance was <2.5 in 27.5% of the patients, and in the case of non-obese individuals, the insulin resistance was <2.5 in 72.5% of the individuals. Insulin resistance was >2.5 in 76.8% of the obese individuals and 23.2% of the non-obese individuals. The difference in insulin resistance was found to be statistically significant in terms of obesity. The obese individuals were found to have statistically significantly (Chi square test = 33.88, p=<0.0001) higher insulin resistance when compared to non-obese individuals.

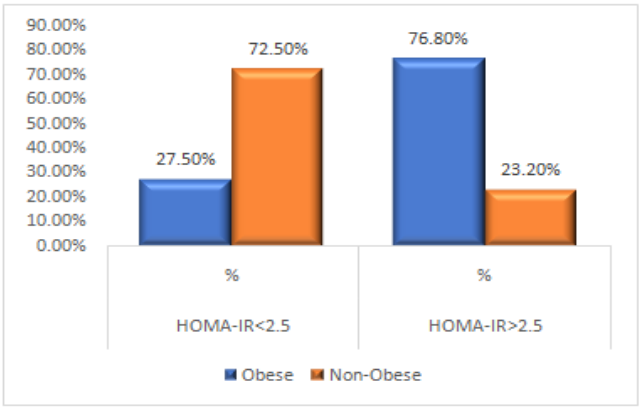

Figure 4: Bar diagram showing association between Insulin resistance and Study groups.

Comparison between obese and non-obese concerning Insulin resistance

Among insulin-resistant individuals, in the obese group, the mean waist circumference was 101.34±9.44cm, the mean SBP was 133.21±14.59mm Hg, the mean DBP was 84.71±9.33mm Hg, the mean Triglycerides was 254.03±65.88mg/dl, the mean HDL was 32.01±5.05mg/dl, the mean FBS was 111.80±10.58mg/dl.

Among insulin-resistant individuals, in the non-obese group, the mean waist circumference was 69.91±7.95cm, the mean SBP was 129.78±10.3mm Hg, the mean DBP was 80.78±6.72mm Hg, the mean TG was 210.78±62.75mg/dl, the mean HDL was 38.35±5.06mg/dl, the mean FBS was 84±7.17mg/dl.

Upon comparison between obese and non-obese individuals among the insulin-resistant group (HOMA IR > 2.5), it was observed that differences in mean waist circumference, mean TG, mean HDL, mean FBS values showed statistically significant in association with HOMA IR.

Here it was observed that the mean Waist circumference values, mean triglyceride values, mean FBS values were significantly higher in the case of obese individuals when compared to non-obese individuals. However, it was found that mean HDL values were significantly higher in non-obese individuals.

VARIABLES	OBESE (n=76)	NON-OBESE (n=23)	P-value
Waist circumference(cm)	101.34± 9.44	69.91 ± 7.95	<0.0001*
SBP (mm Hg)	133.21 ± 14.59	129.78 ± 10.3	0.297
DBP (mm Hg)	84.71 ± 9.33	80.78 ± 6.72	0.064
TG (mg/dl)	254.03 ± 65.88	210.78 ± 62.75	<0.006*
HDL (mg/dl)	32.01 ± 5.05	38.35 ± 5.06	<0.0001*
FBS (mg/dl)	111.80 ± 10.58	84.00 ± 7.17	<0.0005*

Table 4: Comparison between obese and non-obese with insulin resistance.

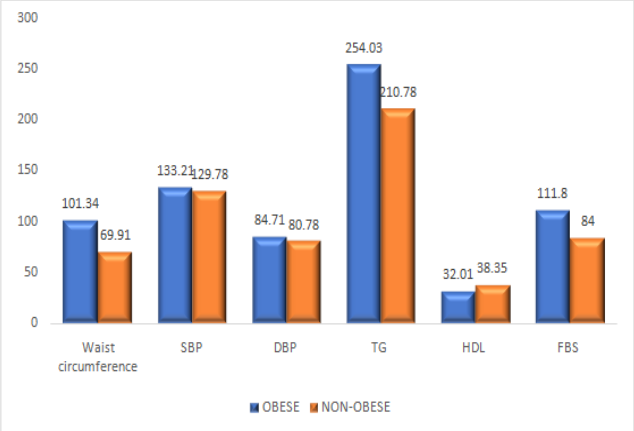

Figure 5: Comparison between obese and non-obese with Insulin resistance.

DISCUSSION

Insulin resistance was >2.5 in 76.8% of the obese individuals and 23.2% of the non-obese individuals.

In the case of obese individuals, insulin resistance was <2.5 in 27.5% of the patients, and in the case of non-obese individuals, the insulin resistance was <2.5 in the case of 72.5% of the individuals. The difference in insulin resistance was found to be statistically significant in terms of obesity. The obese individuals were found to have significantly higher insulin resistance when compared to non-obese individuals.There have been very few studies to determine the IR in pure obese i.e., without any other metabolic condition like impaired fasting glucose, impaired glucose tolerance, diabetes, hypertension which by themselves may confer IR.

In the study done by **EleFerrannini et al**[2], where non-diabetic normotensive subjects were considered as in the present study; IR was present in 26% of the obese subgroup. In the study done by **Enzo Bonora et al**[3] the prevalence of IR in overweight subjects (BMI>25 Kg/m^2) with no metabolic abnormalities, was 42%.In the study done by **Muscelli F et al**[4], it was noted that the obese group presented hyperinsulinemia in the basal state and after glucose loading.

The above studies were done on the European population. Different definitions were used to define IR in both studies. In the study by **EleFerrannini et al**[2] (using euglycemic insulin clamp technique), and in the study by **Enzo Bonora et al**[5], IR was defined as the lowest decile of insulin sensitivity in the lean subgroup.

The mean Waist circumference, mean triglyceride levels, mean FBS levels were significantly higher in the case of obese individuals when compared to non-obese individuals. However, the mean HDL values were significantly higher in non-obese individuals. This shows that waist circumference and body fat mass are better predictors of IR.Similarly, significantly higher mean triglycerides values were found in obese insulin-resistant individuals compared to non-obese insulin-resistant individuals in studies done by Chenbing Liu et al[6] ($p<0.001$), K W Ter Horst et al[7] ($p<0.001$), Owei et al[8] ($p<0.001$), Yumei Yang et al[9].

CONCLUSION

The higher insulin resistance in non-obese individuals also need to be taken into consideration as this may have ill effects and a higher chance of developing diabetes in the future. Hence, further studies should address whether targeted therapies aimed at dyslipidaemia, obesity and insulin resistance in young non-obese individuals may reduce the risk, as obesity and insulin resistance are significant factors for the development of the metabolic syndrome.

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