Assessing Insulin Resistance and Its association with Substitute Clinical Indicators in Individuals with Obesity at a Tertiary Care Hospital in the Namakkal District

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Abstract

Background: Due to poor lifestyles and westernization, there is a higher likelihood of metabolic abnormalities and the subsequent development of metabolic syndrome due to insulin resistance (IR).

The aim of the study is a study to evaluate insulin resistance in normoglycemic normotensive obese individuals using Homeostasis Model Assessment and the correlation of insulin resistance with anthropometric measurements.

Methods: Using the conventional protocols, the anthropometric profile, lipid profile, fasting blood glucose, haemoglobin A1C, serum insulin, and lipidosis profile of one hundred individuals were measured**.** The homeostasis model (Homeostatic model assessment [HOMA]-IR) was used to evaluate IR.

Results: Among 100 subjects 43 were males, 57 were females. The waist-hip ratio of the participants, associated with HOMA IR, demonstrated a significant p value of.041 for the

group (HOMAIR>2.5).

Conclusions: In this study, all anthropometric measures showed significant correlations with clinical and biochemical variables related to insulin resistance (IR). Subscapular skinfold thickness (SAD) displayed stronger associations, including IR indices, while waist-hip ratio (WHR) had comparatively weaker correlations

Key words: Insulin Resistance, Obesity, anthropometric, Subscapular skinfold thickness, waist-hip ratio, HOMA IR

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Introduction:

Obesity increases the likelihood of various diseases, particularly heart disease, type 2 diabetes, obstructive sleep apnea, certain types of cancer, and osteoarthritis[1]. Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have a negative effect on health, leading to reduced life expectancy and/or increased health problems[2].

Insulin resistance (IR) is a physiological condition in which cells fail to respond to the normal actions of the hormone insulin. The body produces insulin. When the body produces insulin under conditions of insulin resistance, the cells in the body are resistant to the insulin and are unable to use it as effectively, leading to high blood sugar.

Obesity is a well-known condition were people commonly have insulin resistance[3].Insulin resistance has been shown to be a future predictor of many health-related adverse outcomes including coronary artery disease and stroke[4]. There are many ways to measure insulin resistance like Homeostasis Model Assessment for Insulin resistance (HOMA-IR) and Quantitative Insulin-Sensitivity Check Index (QUICKI), hyperinsulinemia, euglycemic clamp tests and insulin suppression tests[5-6]. Some of these investigations are invasive, costly, and mostly require a laboratory support.

The idea behind measuring an anthropometric index is to understand future risk of insulin resistance-based complications. The present study was done to correlate various commonly used anthropometric indices in obese individuals with insulin resistance.

AIM OF THE STUDY:

This study examines insulin resistance in obese normoglycemic normotensive people and determines how it correlates with anthropometric data by utilising the Homeostasis Model Assessment.

MATERIALS AND METHODS:

This is an observational study. 100 obese asymptomatic subjects were selected for the study. They are the subjects who visited to General Medicine Out Patient Department for routine health check-up in Swamy Vivekanandha Medical College and Research Institute , Thiruchengodu, Namakkal, during the period 2022 to 2023.

Inclusion criteria

- Asymptomatic normotensive
- Normoglycemic
- Obese subjects with BMI > 30 kg/m2

Exclusion criteria

- Diabetic patients on treatment
- Malignancy patients on treatment
- Pregnant Females
- Females on OCP, hypothyroid, PCOD treatment
- Chronic Kidney Disease patients
- Chronic Liver Disease patients
- Acute stress (within 6weeks of any acute illness)
- Patients on drugs which cause insulin resistance

Measurement of anthropometric indices:

All anthropometric measurements were performed by one investigator.

1. Body weight was measured using an electronic scale to the nearest 0.1 kg, with the subjects wearing light clothing and no shoes. Height was measured to the nearest 0.5 cm without shoes, and BMI was calculated as weight (in kilograms) divided by the square of height (in meters). BMI >30 kg/m2 are obese patients

2. Sagittal Abdominal Diameter (SAD) was measured to the nearest 0.1 cm after a normal expiration while in the supine position with bent knees on a firm examination table and without clothes in the measurement area. At the level of iliac crest (L4–5), SAD was measured

(using a sliding-beam caliper) as the distance between the examination table up to the horizontal level, allowing the caliper arm to touch the abdomen slightly but without compression. It should be less than 25cm.

3. Waist girth was measured in underwear with a stretchless tape in standing position after normal expiration, midway between the caudal part of the lateral costal arch and the iliac crest (World Health Organization standard), and hip girth was measured at the symphysis trochanter level.

4. Waist Hip ratio : The ratio between the waist and hip circumference.

Measurement of FBS and PPBS : Plasma glucose was measured by glucose oxidase peroxidase (GOD POD) method from the fasting and post prandial samples.

Measurement of HbA1c : HbA1c is glycated hemoglobin level measured using high pressureliquid chromatography (HPLC)

Measurement of insulin level: Insulin level is measured in fasting blood sample using chemiluminescence's micro particle immunoassay (CMIA).

Homeostasis Model Assessment for Insulin resistance (HOMA-IR) was used to measure insulin resistance. HOMA-IR required the evaluation of plasma glucose and serum insulin. Formula used

HOMA IR= [fasting insulin concentration(µU/ml) x fasting glucose concentration(mg/dl) /405]

Patients with HOMA IR >2.5 were defined as insulin resistance, < 2.5 were defined as insulin sensitivity group.

Measurement of FLP : Fasting lipid profile was measured on the same day by photometry. Total cholesterol by cholesterol oxidase, triglycerides by enzymztic method ,HDL and LDL by direct homogenous method.

Statistical analyses

Data were analyzed using the SPSS software for Windows (version 16.0) (SPSS Inc., Chicago, IL). To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference between the bivariate samples in Independent

groups the Unpaired sample t-test was used for normal data and Mann-Whitney U test was used skewed data. To find the significance in categorical data Chi-Square test was used. In all the above statistical tools the probability value <0.05 is considered as significant level. The p-value is considered highly significant when it is <0.01, no significant >0.05.

Ethics

Intuitional Ethical Committee approved the protocol. The study was approved by the institutional Ethical committee from Swamy Vivekanandha Medical College and Research Institute , Thiruchengodu, Namakkal,Tamilnadu. Informed written consent was taken from all the patients after full explanations of the nature and purpose of the procedure used for the study. Anonymity was maintained throughout the study, and none of the names was used in the database.

RESULTS:

During the study the cases were selected randomly in out-patient department. Among 100 subjects 43 were males, 57 were females. Out of 100 patients in this group 22 patients belong to 21-30, 37 patients belong to 31-40 age group, 29 patients werein41-50 age group, 12 were in above 51 age group.The HOMA IR correlated with age, mean age is37.83 in upto 2.5 HOMA IR value, mean age is 39.83 in >2.5 HOMA IR value.

The anthropometric mesurements were correlated with HOMA IR as two groups upto 2.5 is group 1 are 17 patients and >2.5 is group 2 are 83 patients

	HOMA IR	No	Mean
BMI	Upto 2.5	17	33.506
	> 2.5	83	34.153
Waist	Upto 2.5	17	108.76
	> 2.5	83	111.57
Hip	Upto 2.5	17	115.76

	> 2.5	83	119.06
W/H Ratio	Upto 2.5	17	1.000
	>2.5	83	0.939
SAD	Upto 2.5	17	26.818
	> 2.5	83	30.893

Table 1: The anthropometric mesurements correlated with HOMA IR

All 100 patients had a BMI over 30 (WHO criteria). They were split into two groups: 17 patients in group 1 (mean value 33.50, HOMA-IR < 2.5) and 83 patients in group 2 (mean value 34.15, HOMA-IR > 2.5). Statistical analysis yielded a non-significant p-value of 0.310. Figure:1 The bar diagram illustrates mean ages: group 1 at 33.50 and group 2 at 34.15.

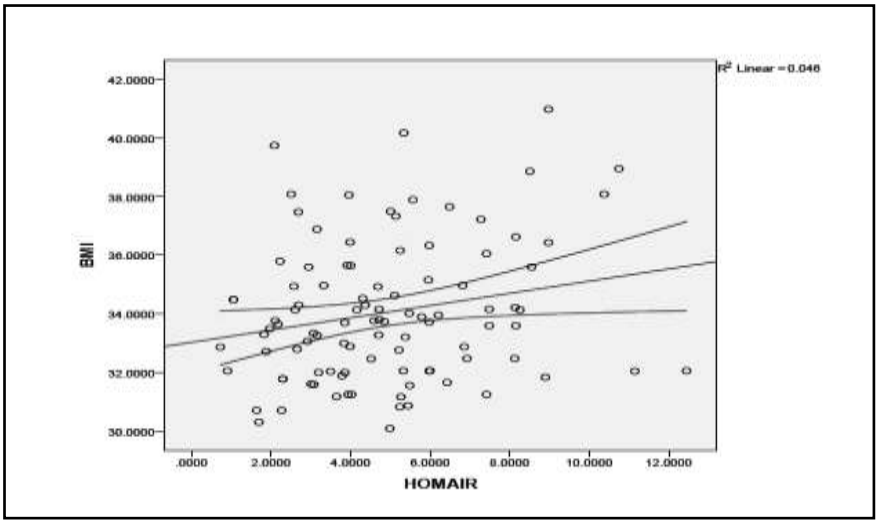

Figure:1 correlation between BMI and HOME IR

Among the 100 subjects waist circumference was correlated with HOMA IR which statistically analyzed between both groups 1 and 2 was not significant p value is .480. the figure 2 shows the bar diagram shows the mean value in group 1 is 108.76. and group 2 is 111.57.

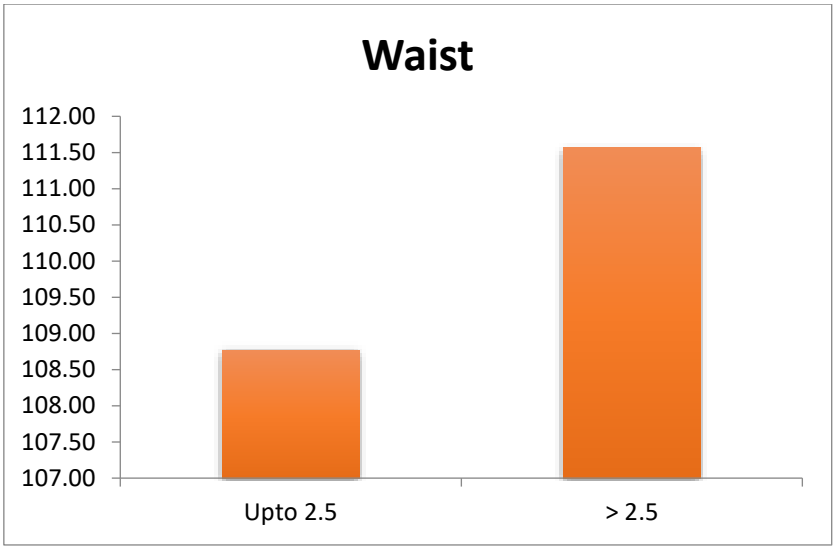

Figure-2: WAIST CIRCUMFRENCE VS HOMAIR

Among the 100 subjects hip circumference was correlated with HOMA IR which statistically analyzed between both groups 1 and 2 was not significant p value is .452. The mean value in group 1 is 115.76 and group 2 is 119.06.

Among the 100 subjects waist-hip ratio, correlated with HOMA IR which statistically analyzed between both groups 1 and 2, show significant p value as .041 to group 2 subjects. Figure -3 shows the mean value in group 1 is .939 and group 2 is 1.000.

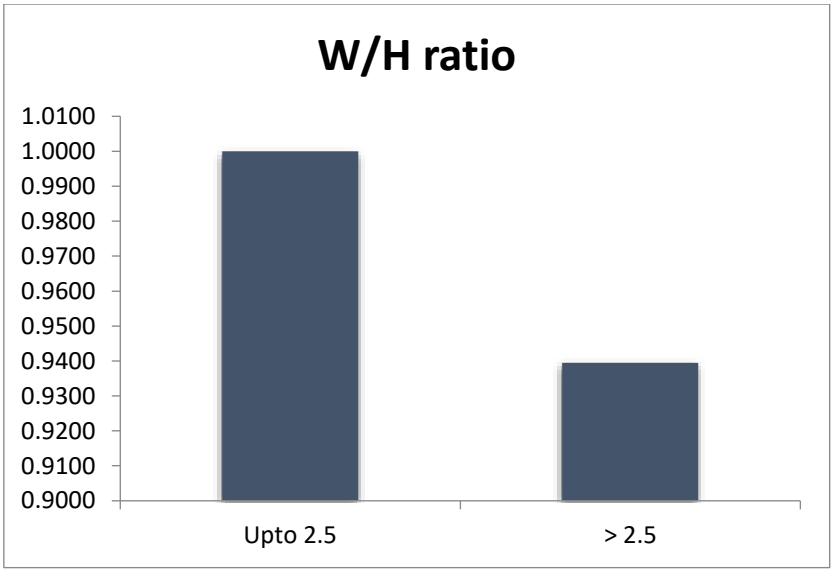

Figure-3: waist-hip ratio, correlated with HOMA IR

Among the 100 subjects hip circumference was correlated with HOMA IR which statistically analyzed between both groups 1 and 2, shows highly significant p value .000 for group 2 . The figure 4 shows the mean SAD value in group 1 is 26.81 and group 2 is 30.89.

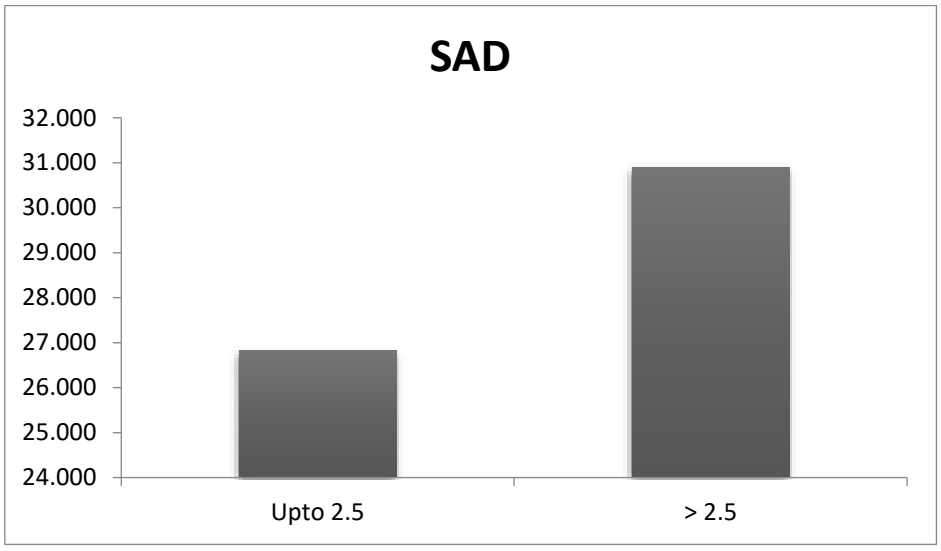

Figure-4: Hip circumference was correlated with HOMA IR

Serum insulin was correlated with HOMA IR value of both group 1 and group 2, which shows highly significant p value of .000 for group 2. The figure

5 shows, the mean value of serum insulin upto 2.5 HOMA IR is 9.09 and >2.5 HOMA IR is 24.96.

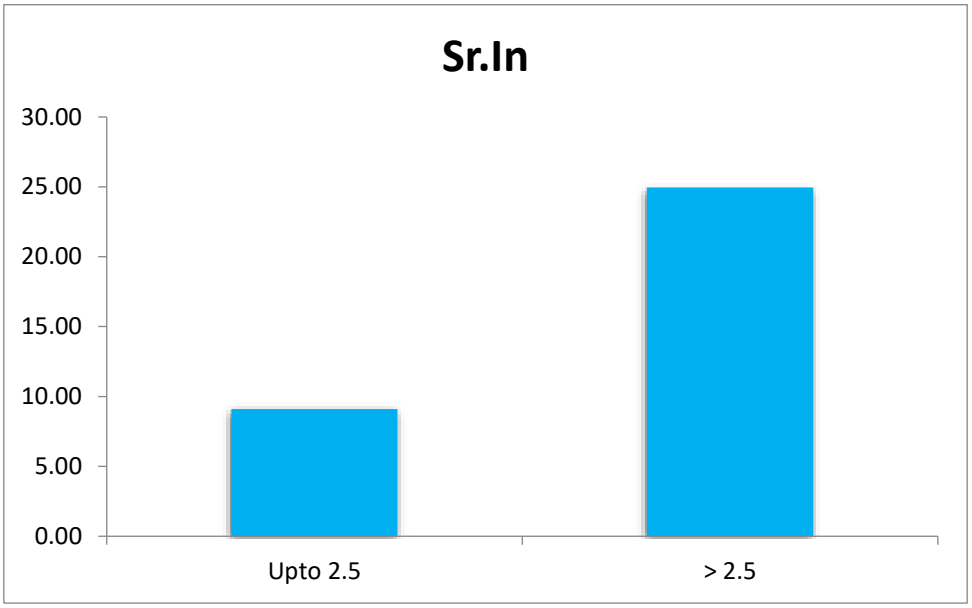

Figure-5: Serum insulin was correlated with HOMA IR

DISCUSSION:

The influence of obesity on the impairment of IR is not only determined by the degree of adiposity but also primarily by the site where the accumulation of fat occurs. Abdominal obesity is strongly associated with IR and metabolic diseases. Although refined and costly laboratory techniques provide an accurate assessment of IR, low-cost and readily available methods are needed for clinical practice and for epidemiologic studies. Among a diversity of anthropometric measurements, SAD has been proposed as a valuable surrogate marker of IR, visceral fat mass and cardiometabolic risk[7].

SAD was surprisingly strong predictor ininsulin resistance as compared to other anthropometric measures. The close correlation between SADof clinical importance, as elevated serum insulin concentrations independentlypredict cardiovascular mortality[8-9] and type 2 diabetes. SAD is a good marker of elevated insulin secretion in non-diabetic obese patients.

SAD is a good correlator of visceral fat mass. Initially SAD measurements were done on CT images[10-11] and it showed good predictive values of assessing the visceral adipose tissue.

Previous studies with magnetic resonance imaging demonstrated that in the supine position an increase in WC may reflect an increase in subcutaneous fat storage[12].

The experience of our group with SAD measurements obtained in the supine position supports a previous report that SAD can be obtained with a high degree of precision[13]. In the present study, SAD was assessed with the legs bent, which improves reliability compared with the measurements of SAD with straight legs[14].

Our results, on men and women subjects have shown that SADis closely related to IR and cardiovascular risk[15-18] than BMI, waist girth, and WHR.

The present data are of clinical relevance, as investigated the potential use of SAD for the screening of IR in 100 subjects. We also compared SAD with classical anthropometric measures (BMI, WC, HC,WHR), using the HOMA-IR index. The primary findings of the present study was all of the anthropometrical parameters correlated significantly with the clinical and biochemical variables related to IR, SAD appeared more closely associated with the majority of them, including the IR indices, whereas WHR was slightly correlated to them.

CONCLUSION:

HOMA IR is a good measure of insulin resistance. Majority of obese subjects had insulin resistance and family history of metabolic syndrome. SAD is a single, easy and cheap marker to identify the insulin resistance in obese subjects who are prone to develop metabolic syndrome and needs life style therapy.

LIMITATIONS:

The sample size was modest, and it only came from one Tertiary Hospital. The mother's socioeconomic situation and diet were not taken into account.

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Conflicts of interest: There are no conflicts of interest.

Author's contribution: ***Dr. Sujeetha Chandrababu*** - conceptualization, data curation, investigation, methodology, project administration, visualization, writing—original draft, writing—review and editing; ***Dr. T. S. Chellakumarasamy*** -conceptualization, methodology, writing—original draft, writing—review and editing; ***Dr.Kalpana chellakumarasamy***-conceptualization, visualization, supervision, writing—original draft; ***Dr.Priya Jeevanandam*** and ***Panneerselvam Periasamy*** - methodology, writing—original draft, writing, review and editing. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work. All authors have read and agreed to the published version of the manuscript.

DATA AVAILABILITY:

All datasets generated or analyzed during this study are included in the manuscript.

IEC APPROVAL:

Intuitional Ethical Committee approved the protocol. The study was approved by the institutional Ethical committee from Swamy Vivekanandha Medical College and Research Institute , Thiruchengodu, Namakkal,Tamilnadu. Informed written consent was taken from all the patients after full explanations of the nature and purpose of the procedure used for the study. Anonymity was maintained throughout the study, and none of the names was used in the database.

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