ORIGINAL ARTICLE

ANTHROPOMETRIC VARIABLES AS A SIGN FOR RISK OF INSULIN RESISTANCE

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Background: Insulin resistance (IR) is a metabolic state characterized by progressive decline in insulin sensitivity. The aim of this study was to evaluate the association of the Body Mass Index and Waist-hip ratio with insulin resistance in non-alcoholic fatty liver disease patients. **Methods:** This cross-sectional study was conducted in King Edward Medical University Lahore during 2016–17. A total of 148 non-alcoholic fatty liver disease (NAFLD) subjects aged 40–60 years were enrolled by non-probability convenient technique. Fasting blood samples of each subject were drawn. Anthropometric measures were recorded. Fasting sugar levels were checked on glucometer and serum insulin levels were determined by sandwich ELISA technique. Homeostatic model assessment-insulin resistance (HOMA-IR) was calculated by recorded glucose and insulin levels. All participants were divided into insulin resistance and non-insulin resistance group on basis of cut-off points of HOMA-IR value 2.5. **Results:** Study was comprised of 148 subjects with fatty liver disease. Mean±SD of age, Body mass index and waist to hip ratio of the participants were 44.81±6.20, 31.25±4.26, 0.94±0.05 respectively. Of total subjects, 70.9% were female and 29.1% were male. Eighty-six (58.1%) of total subjects had insulin resistance and 62 (41.9%) were non-insulin resistance subjects. Significant positive association of insulin resistance was found with Body mass index (p=0.01). Insulin resistance was not associated with waist to hip ratio (p=0.35), or waist circumference (p=0.5). **Conclusion:** BMI has positive correlation on insulin resistance, while WHR is not related to insulin resistance.

Keywords: Anthropometric variable, Body mass index, Insulin Resistance, Obesity, Waist Hip Ratio

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INTRODUCTION

Insulin resistance (IR) is a metabolic state characterized by progressive decline in insulin sensitivity. Impaired β-cell compensation in response to increase insulin resistance is a pathophysiological factor associated with impaired glucose metabolism and tolerance.[1] It has a significant role in pathogenesis of hypertension, hyperlipidemia, atherosclerosis leading to type 2 diabetes and cardiovascular ailments with severe consequences.[2] Hyperlipidemia due to insulin resistance can results in deposition of fat in liver leading to nonalcoholic fatty liver disease (NAFLD). Racial and regional differences in stabilization of insulin secretory function of beta cells (β-cell) for maintenance of normal glucose tolerance (NGT) have been reported by various researches. Previous Asian researches have documented high vulnerability of Asian population to increased insulin resistance due to decreased β-cell function in NGT conditions.[1] Homeostatic Model Assessment (HOMA-IR) being the most extensively arithmetical model used to evaluate IR with fasting plasma glucose and fasting serum insulin levels. Obesity is closely linked with the development of insulin resistance.[3] Various studies have documented that the visceral adipose tissue (VAT) releases inflammatory cytokines like adiponectin, resistin and visfat in that produces the oxidative stress and alters the activity of insulin.[4] However, current researchers have discovered that the obesity, whether measured by BMI or body fat percentage, is highly correlated with insulin resistance and associated with raised mortalit.y[5] BMI has been widely used for categorizing the obesity but it does not compute the visceral fat, and it doesn't distinguish among the muscle and the bone mass as it is calculated by height and weight only, not body composition. BMI has a limited accuracy for diagnosing normal weight obesity (NWO), that individuals having excess body fat presenting BMI within the normal range. Recent past study have reported the existence of metabolic dys-regulation in individuals with NWO and have more risk for metabolic syndrome than BMI indexed obesity.[6]

A few studies documented the significance of waist to hip ratio (WHR) as an anthropometric marker for both IR and VAT.[7] As evaluation of the IR has been receiving marked attention for the past few years, there is emergent concern in the clinical use of various anthropometric measures for categorizing the individuals at cardio metabolic risk. This study aims to evaluate the association of the anthropometric variable like BMI, waist circumference and WHR with IR.

METHODOLOGY

It was a cross-sectional study conducted at Mayo Hospital in alliance with King Edward Medical University, Lahore during 2016–17. The study

comprised of subjects with age ranging 40–60 years. Ethical approval was taken from the Ethical Review Committee of the institute. Sample size of 148 cases was estimated using 10% level of significance, and 90% power of test using formula:

$$n=z_1-\alpha\sqrt{2P(1-P)}+z_1-\beta\sqrt{P_1(1-P_1)+P_2(1-P_2)}/(P_1-P_2)^2$$

where $z_1-\alpha$=90% confidence level, $z_1-\beta$=90% power of test,
P_1=population proportion I (61.76%),
P_2=Population proportion II (40.9%)

Diagnosed NAFLD patients were enrolled from OPD of Radiology Department, Mayo Hospital, Lahore. Subjects with diabetes and other disorders of endocrinology were excluded from the study. To rule out diabetic subjects, pre-screening for diabetes mellitus was done on the basis of fasting sugar levels with the help of glucometer (model U-RIGHTTD-4251) and only the subject with sugar levels <126 g/dl were included in this study. Informed consent was taken from each patient. All relevant information of the subjects including age, gender, ethnicity, previous medical history of diabetes, liver diseases, and other disorders of endocrinology were recorded on pre-designed proforma.

All enrolled subjects were called on the next day with a 12-hour overnight fasting for blood sampling. Five (5) ml of blood was taken trough venipuncture under aseptic conditions in serum separator tubes for further analysis. Serum insulin levels were analyzed through Human Insulin ELISA kit by Abcam Company (ab200011).

WHO extended standard procedures were used for measuring the height (m), weight (Kg) waist and hip circumference (Cm) for estimation of WHR. BMI was calculated from height and weight by formula:

$$\text{BMI}= [\text{Weight in Kg}]/[\text{Height in m}]^2$$

Participants were divided into two groups, i.e., insulin resistance and non-insulin resistance on the basis of Homeostasis Model Assessment of insulin resistance (HOMA-IR) cut-off values, that can be determined by formula: [fasting serum insulin (μU/ml) ×fasting plasma glucose (mmol/L)]/22.5.[8] Cut-off values of HOMA-IR for insulin resistance was taken as ≥2.5, as reported by previous Asian studies.[1]

Data was analyzed by using SPSS-1. Data was described as Mean±SD for quantitative variables. Normality of the data was checked by Shapriowilk's test. Mean of continuous variables, waist circumference, WHR and BMI were compared by *t*-test among the studied group. Linear regression model was used to analyze the association of independent variables including BMI and waist to hip ratio with dependent variable HOMA-IR, and $p\leq0.05$ was considered as statistically significant.

RESULTS

This study included 148 subjects aged 44.81±6.20 years. Among the study population 105 (70.9%) were females and 43 (29.1%) were males. The anthropometric and the biochemical parameters of the studied population are shown in Table-1.

Of total population 86 (58.1%) subjects had insulin resistance and 62 (41.9%) had no insulin resistance. The subjects with insulin resistance had higher BMI as compared to no-insulin resistant, (p=0.001). No significant differences were found between the studied groups in terms of waist circumference (p=0.85) and WHR (p=0.49) (Table-2).

Linear regression reveals statistically significant positive association of BMI with HOMA-IR (p=0.01). Waist circumference (p=0.5) and WHR were not statistically associated with IR (p=0.35). (Table-3).

Table-1: Descriptive statistics of the subjects (n=148)

Anthropometric and Biochemical Statistics	Mean±SD
Age (Years)	44.81±6.20
Height (m)	1.59±0.06
Weight (Kg)	79.59±10.11
Waist to Hip ratio	0.94±0.05
Body Mass Index (BMI)	31.25±4.26
Basal Sugar Level (mg/dl)	114.83±12.81
Insulin (μIU/ml)	26.84±26.05

Table-2: Comparison of variables among the insulin resistance and non-insulin resistance groups (Mean±SD)

Variables	Insulin Resistance (HOMA IR≥2.5) (n=86)	Non-Insulin Resistance (HOMA IR<2.5) (n=62)	*p*
WC (Cm)	99.3±7.08	96.6±11.6	0.85
WHR	2.38±0.12	2.36±0.15	0.49
BMI (Kg/m^2)	32.27±4.31	29.83±3.77	0.001*
HOMA IR	10.62±7.71	1.98±1.19	0.000*

Comparisons were done by independent *t*-test

Table-3: Regression analysis between independent variables and HOMA-IR

Independent variables	β	SE	*p*	95% CI
WC	0.11	0.16	0.5	-0.23–0.43
WHR	11.48	12.45	0.35	-13.13–36.09
BMI (Kg/m^2)	0.343	0.143	0.01*	0.06–0.62

DISCUSSION

Current study highlights the linkage among IR and indicators of obesity including BMI and WHR. Impairment in insulin sensitivity is attributed to excessive accumulation of fat in visceral adipose tissues, liver and muscles.[9] Evaluation of IR has been in serious consideration of researchers in recent past years due to its involvement in the pathogenesis of metabolic syndrome.[10] Association between anthropometric indicators and IR suggested that adiposity deteriorates insulin sensitivity and promotes health risks for metabolic syndrome. Madeira FB *et al*[11] suggested that recognizing subjects who are at risk of metabolic disorders on basis of BMI only is not sufficient because it might result in failure to recognize significant proportion of the population with normal weight obesity having excess body fat but normal BMI, who are also at high risk of metabolic dysregulation. Keeping this in mind we designed our study to evaluate the association

of insulin resistance with anthropometric indices like BMI, waist circumference and WHR. WC and WHR are the good indicators of body fat; however our study did not find any significant association of Insulin Resistance with WHR. Vasques AC *et al*[12] were in agreement with our results concerning WHR as they did not find association between insulin resistance and WHR. In contrast to current study Yang XY *et al*[13] reported significant positive relation of WHR with insulin resistance. Present study did not find any correlation between waist circumference and IR. Contrary to this Elbassuoni E *et al*[14], documented positive association of waist circumference with IR and suggested that the WC can be used to screen for the risk of IR and metabolic disorders.

Significant correlation of IR with BMI was noted in the current study. Previous studies from Asia[15] are in agreement to our findings showing that BMI is significantly associated with insulin resistance. On the other hand, Abbasi F[16] presented considerable insight into the relationship between obesity and insulin resistance and found that persons having BMI ≥25 have IR which is in agreement with our results. Overall results of current study were justified by Bannet L *et al*[9] study conducted in Sweden which reported the association of IR with WC in Iraqi immigrant while with BMI in pure Sweden population. This study suggested that the racial variations concerning relation of IR with various indicators of obesity is due to diversity in fat distribution across the various ethnicities. Along with the well-established indicator of obesity, like BMI, other indices, e.g., WC, WHR, sagittal abdominal diameter (SAD) and waist-thigh ratio (WTR) should also be considered for evaluation of health risk like IR in future broad scale studies.

CONCLUSION

BMI has positive impact on insulin resistance, while WHR is not related to IR.

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RMTS: Helped in writing results, critically analyzed it for intellectual content and approved it.

SJ: Statistical analysis, interpretation of results, writing the manuscript. Reviewed and approved the manuscript.

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