

CORRELATION OF BODY FAT INDEX WITH INSULIN RESISTANCE ACROSS NORMAL, OVERWEIGHT AND OBESE INDIVIDUALS

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ABSTRACT: INTRODUCTION: Obesity is defined as abnormal or excessive fat accumulation that may impair health. Insulin resistance (IR) is associated with obesity, metabolic syndrome (MS), type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) in adults and in the elderly. Waist-hip ratio (WHR) was suggested as a measure of body fat distribution and HOMA IR as a measure of insulin resistance. In this study, we assessed the body fat index and insulin resistance across normal, overweight and obese individuals. **Methods:** In this cross sectional study, we evaluated, height, weight, waist circumference, hip circumference, body mass index, waist to hip ratio, fasting blood glucose, fasting insulin and HOMA insulin resistance in healthy subjects attending routine health checkup in our college during. Subjects were excluded if they have any clinical, biochemical or diagnostic abnormalities. **RESULTS:** A total of 71 subjects were studied, there were 21 normal, 24 overweight and 26 obese subjects. They were age and gender matched. We observed an increasing trend in WHR across increasing BMI. However it was not statistically significant. We also observed that HOMA IR is significantly more in obese than in both overweight and normal individuals. WHR correlated best with IR in obese. **CONCLUSION:** We observed that HOMA IR is significantly more in obese than in both overweight and normal individuals. WHR correlated best with IR in obese.

KEYWORDS: BMI, Insulin resistance, Waist hip ratio, Obesity.

INTRODUCTION: Overweight and obesity are the fifth leading risk for global deaths. In addition, 44% of the diabetes burden, 23% of the ischaemic heart disease burden and between 7% and 41% of certain cancer burdens are attributable to overweight and obesity. Obesity is defined as abnormal or excessive fat accumulation that may impair health.⁽¹⁾ Body Mass Index (BMI), a simple index of weight-height relationship that indicates amount of body fat used to classify overweight and obesity in adults.^(2,3) Both generalized and abdominal obesity are associated with increased risk of morbidity and mortality.⁽⁴⁾ Waist-hip ratio (WHR) was suggested as a measure of body fat distribution which can vary considerably within a narrow range of total body fat and body mass index (BMI). Insulin resistance (IR) defined as decreased sensitivity or responsiveness to the metabolic actions of insulin, such as insulin-mediated glucose disposal and inhibition of hepatic glucose production have been associated with metabolic syndrome (MS), type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) in adults and in the elderly. In this study, we assessed the body fat index and insulin resistance across a range of body mass index.

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METHODS: Study was conducted in the department of General Medicine Siddhartha Medical College during the period 2013 to 2014. The Ethical Committee approved the study protocol. All subjects gave informed consent. Subjects attending the outpatient department for routine health checkup were enrolled. They were excluded if they have any clinical, biochemical or diagnostic abnormalities. Height was measured to the nearest 0.1 cm using a portable wall-mounted stadiometer. Weight was measured to the nearest 0.1 kg, without shoes and wearing light clothes, using an electronic digital weighing machine. The body mass index (BMI) was calculated as the weight (kg) divided by the square of the height (meters). BMI was categorized as Underweight = $<18.5 \text{ kg/m}^2$, Normal weight = $18.5\text{--}24.9 \text{ kg/m}^2$, Overweight = $25\text{--}29.9 \text{ kg/m}^2$ and Obesity = BMI of 30 kg/m^2 or greater. Waist circumference (WC) was measured midway between the superior border of the iliac crest and the lowermost margin of the ribs at the end of normal expiration. Hip circumference was measured around the point with the maximum circumference over the buttocks, with feet fairly close together (about 12-15 cm apart) and weight equally distributed on each leg. Distribution of fat between the upper and lower body was assessed from the waist/hip ratio. (WHR) Abdominal obesity is further defined as WHR >0.90 for males and >0.85 for females.⁽⁵⁾All the blood samples were collected after an overnight fast of >8 h. Plasma glucose levels were measured using a hexokinase enzymatic reference method. Fasting insulin levels were measured using a radioimmunoassay (RIA) method. HOMA-IR was used to evaluate insulin resistance (fasting serum insulin ($\mu\text{U/ml}$) \times fasting plasma glucose (mmol/L) / (22.5). A HOMA-IR value of 2.5 is taken as an indicator of IR in adults.⁽⁶⁾

Statistical Analysis: Baseline subject characteristics are expressed as the mean \pm SD or as percentages. Cross-tabulation significance levels were based on chi-square test for categorical variables. ANOVA with Bonferroni post hoc test was employed for comparison of quantitative variables. Pearson and Spearman correlation between HOMA IR and body anthropometric indices were analyzed and their r values were tabulated. A two tailed p value of 0.05 was considered statistically significant.

RESULTS: A total of 71 subjects were studied, there were 21 normal, 24 overweight and 26 obese subjects. They were age and gender matched. The anthropometric measurements and correlation values with Insulin resistance were tabulated in table-1.

Based on BMI	Normal	Overweight	Obese	Total	P values
n	21	24	26	71	P> 0.05=ns
Gender (M/F)	12/9	14/10	12/16		ns
Age (yrs)	43.40 \pm 10.72	45.51 \pm 10.67	44.55 \pm 14.91	44.24 \pm 11.73	N vs.Ow-ns N vs.O-ns Ow vs.O-ns

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WHR	0.80±0.24	0.88±0.27	0.94±0.21	0.86±0.25	N vs.Ow-ns N vs.O-ns OW vs.O-ns
HOMA IR	1.02±0.97	1.64±1.07	2.56±1.59	1.40±1.30	N vs.Ow-ns N vs.O<0.0001 OW vs.O <0.05
Correlation (r & pvalues) of HOMA IR					
WHR	0.22, p-ns	0.28, p-ns	0.37, p<0.05	0.29, p-ns	-----
BMI- body mass index, TBF- total body fat, WHR- waist hip ratio, HOMA IR- insulin resistance					
Table 1					

DISCUSSION: Both generalized and abdominal obesity are associated with increased risk of morbidity and mortality. The waist hip (WHR) ratio (WHR) provides an index of both subcutaneous and intra-abdominal adipose tissue.⁽⁷⁾ A 12-year follow-up of middle-aged men, showed that abdominal obesity (measured as waist–hip ratio) was associated with an increased risk of myocardial infarction, stroke and premature death, whereas these diseases were not associated with measures of generalized obesity such as BMI.^(8,9) BMI has traditionally been the chosen indicator by which to measure body size and composition, and to diagnose underweight and overweight. In women, BMI was associated with increased risk of these diseases; however, waist–hip ratio appeared to be a stronger independent risk factor than BMI.⁽¹⁰⁾

However, alternative measures that reflect abdominal adiposity, such as waist circumference, waist–hip ratio and waist– height ratio, have been suggested as being superior to BMI in predicting CVD risk. This is based largely on the rationale that increased visceral adipose tissue is associated with a range of metabolic abnormalities, including decreased glucose tolerance, reduced insulin sensitivity and adverse lipid profiles, which are risk factors for type 2 diabetes and CVD.

Huxley, et al. 2010, examined the performance of waist circumference, waist–hip ratio and BMI in predicting and differentiating risks of hypertension, dyslipidaemia and diabetes (as major risk factors for CVD), and risks of CVD events.⁽¹¹⁾ Other studies examined the relative associations of waist circumference, waist–hip ratio and BMI with diabetes risk.^(12,13) Seidell^(14,15) reviewed data on all-cause mortality, cancer and sleep apnoea in association with waist circumference, waist–hip ratio and BMI, highlighting variations in findings according to choice of indicator, age and BMI status of the population. He concluded that: waist circumference and waist–hip ratio are both related to increased risk of all-cause mortality, throughout the range of adult BMIs; waist circumference and waist–hip ratio are strongly predictive in young and middle aged adults compared to older people and those with low BMI; and waist circumference alone could replace waist–hip ratio and BMI as a single risk factor for all-cause mortality.

In this study, we showed a progressive increase in mean HOMA-IR values with increasing BMI. A significant difference among the HOMA-IR values of normal weight, overweight, and obese adolescents was observed. High values for HOMA-IR in obese subjects compared to normal adolescents have also been validated in a large study among adolescents from USA.⁽¹⁶⁾

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In this study, HOMA-IR showed significant correlations with WHR in obese subjects, while this correlation between WHR and HOMA-IR was poor among normal and overweight individuals. Other studies including one from India () also observed the strongest correlation of HOMA-IR with WC.⁽¹⁷⁾ Another parameter which has shown good correlation with HOMA-IR in our study is WHR. A similar result was reported in a large study from Europe.⁽¹⁸⁾ All these studies have shown that WC and WHR are good predictors of IR in adolescents and can be used to identify at risk individuals.

CONCLUSION: We observed that HOMA IR is significantly more in obese than in both overweight and normal individuals. WHR correlated best with IR in obese.

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