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Association, Relationship of Various Caronary Artery Disease Risk Factors with Age, Gender and Different Obesity Indices among the South Indian Adult Subjects: A Regression Analysis

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Abstract

The Overall aim of this study was to assess the association and relationships of various anthropometry measures, metabolic characters and Adipokines in overweight, obese adult subjects with the risk for Coronary artery disease. In the present study a total of 490 subjects; male (228) and females (262) of aged 20 – 59 years were included. Subjects in different age groups were: 20–39 years 223 (110 males and 113 females) and 40–59 years 267 (118 males and 149 females). Height, weight, waist, hip circumferences and Blood pressure measured with calibrated instrument from all participants. Blood sample was collected; Serum was used to measure the following parameters glucose, insulin, and lipid profile, Leptin and Adiponectin. Age, sex adjusted and the three different obesity indices such as BMI, Waist circumference and Waist to hip ratio was considered as dependent factor, other characteristics were taken as an independent factor then Spearman correlation coefficients was used to find relationships between each of independent with dependent characteristics. The results of the present study showed good agreement among the different obesity indices. BMI was stronger and positively correlated with waist circumference (r= 0.83) as well as with waist to hip ratio (r= 0.72). The Waist circumference was also stronger and positively correlated with waist to hip ratio (r= 0.64). The study also showed that the Systolic BP, Diastolic BP, Fasting blood glucose, Insulin level and Insulin resistance were positively correlated with BMI, waist circumference and waist to hip ratio of the study subjects. The Total cholesterol, Triglycerides and LDL-Cholesterol levels were also positively correlated with BMI, waist circumference and waist to hip ratio but the HDL-Cholesterol level was negatively correlated with BMI, waist circumference and waist to hip ratio of the study subjects. The levels of Leptin was positively correlated with BMI, waist circumference and waist to hip ratio but the Adiponectin level was negatively correlated with BMI, waist circumference and waist to hip ratio of the study subjects.

Keywords : Coronary artery disease, Obesity, Leptin , Adiponectin, Spearman correlation and Body mass index

INRODUCTION

Coronary artery disease (CAD) is a narrowing or blockage of the arteries and vessels that provide oxygen and nutrients to the heart, resulting from an accumulation of fatty materials on the inner linings of arteries. Thrombosis or atherothrombosis is a condition of interrupted blood flow to the heart due to a blood clot in coronary artery, and is the leading cause of death and morbidity in the industrialized world and is rapidly achieving the same dubious distinction in developing nations as well. The prevention of CAD and its effective treatment remain paramount objectives of clinical practice as well as targets of ongoing research. The precise etiology and mechanism(s) leading to the development of CAD remain incompletely understood although a number of risk factors have been identified over the past several decades. These include abnormal levels of circulating cholesterol with elevated levels of LDL and reduced levels of HDL cholesterol, hypertension, cigarette smoking, diabetes, postmenopausal state, advancing age, sedentary lifestyle, obesity, and a positive family history of premature vascular disease.

Increasing recognition that many patients as many as 30%–50% with established CAD lack these traditional risk factors has initiated to a search for additional new risk factors that may predispose individuals to CAD [1]. Over the past several years, observational and epidemiologic studies have identified a host of new and potential risk factors for vascular disease. Of this growing list of new and emerging risk factors the components of metabolic syndrome such as atherogenic lipoprotein, elevated triglycerides, insulin resistance, Adipokines, inflammation, oxidative and nitrosative stress are of particular interest. The molecular and cellular mechanisms underlying the relationships between obesity, metabolic syndrome, oxidative stress and its association with increased cardiovascular risk are incompletely understood and only few reports available in India, therefore the present study was designed with the following aim.

The Overall aim of this study was to assess the association and relationships of anthropometry measures, metabolic characters, inflammatory markers, oxidative and nitrosative stress markers in overweight, obese adult subjects with the risk for Coronary artery disease.

METHODS AND MATERIALS

To study the various cardiovascular risk factors including circulating markers and insulin sensitivity with age, gender and different degree of body mass index in southern Indian adult subjects, we performed simple random sample; cross sectional study in vinayakamission hospital Salem, South India. The study was conducted between the year 2008 and 2010. The participants were recruited from the outpatient clinics who are attending for general health checkup and also student and faculty as volunteers. In the present study a total of 490 subjects; male (228) and females (262) of aged 20 – 59 years were included. Subjects in different age groups were: 20–39 years 223 (110 males and 113 females) and 40–59 years 267 (118 males and 149 females). Informed consent was obtained from all subjects. History of previously diagnosed hypertension, diabetes, any known cardiovascular disease or other disease and smoking status or tobacco use was obtained and these subjects were not included in this study. Height, weight, waist and hip circumferences measurements were recorded using previously reported methodology by a single trained observer [1]. Blood pressure (BP) was recorded using a standard mercury sphygmomanometer with the subject seated and rested for five minutes. At least two readings at 5 minute interval were recorded and in case of an abnormal reading, another reading was obtained after 30 minutes. The data of anthropometric parameters height, weight, waist size, and hip size and blood pressure measurements were available for all subjects. Height and weight were measured with calibrated instrument. Waist was measured using a non-stretch tape. [1].

Blood sample was collected from an antecubital vein after an overnight fasting. Serum sample was used to measure Fasting glucose, insulin, and lipid parameters immediately. For Leptin and Adiponectin a venous blood sample was put into tubes containing tri sodium citrate (1:9 dilution), Samples were centrifuged within 20 min at 3000 rpm for 10 min and the supernatant plasma samples were transferred into eppendorf tubes to be stored at - 80 0 C until analysis. Randox daytona analyzer was used for all biochemical parameters. Serum fasting glucose level was measured by the glucose oxidase method (randox kit). Serum insulin level was measured by chemiluminescent enzyme immunoassay (Abbott Axsym). Insulin sensitivity (HOMA-IR) was derived from the fasting plasma insulin and glucose values using the HOMA model [2] [16]..

STATISTICAL ANALYSIS

Approximate normality was assessed for anthropometric and biochemical parameters. SPSS 16 statistical software was used for data analyses. Quantitative characteristics were summarized by arithmetic mean and standard deviation. The differences in the anthropometric and biochemical parameters were compared using t-test. Three Groups based on BMI - mean values of various anthropometric and biochemical characteristics were compared using one way ANOVA followed by post-hoc Bonferroni test. Anthropometric and biochemical characteristics were further categorized according to the cut off values. P value < 0.05 was considered statistically significant.

RESULTS:

Correlation *among three different Obesity Indices in the study subjects*

Age, sex adjusted and the three different obesity indices such as BMI, Waist circumference and Waist to hip ratio was considered as dependent factor, other characteristics were taken as an independent factor then Spearman correlation coefficients was used to find relationships between each of independent with dependent characteristics. The following were the findings of this study.

BMI was stronger and positively correlated with waist circumference (r= 0.83), waist to hip ratio (r= 0.72); Waist circumference was also stronger and positively correlated with BMI (r= 0.83) and waist to hip ratio (r= 0.64); Waist to hip ratio was stronger and positively correlated with BMI (r= 0.72) and waist circumference was observed (r= 0.64) (Table 1 & Fig 1; Fig 2).

Correlation of Blood Pressure, Blood Sugar, Insulin and Insulin Resistance with different Obesity Indices

Systolic BP was positively correlated with BMI (r= 0.40), waist circumference (r= 0.39) and waist to hip ratio (r= 0.36) and also Diastolic BP was positively correlated with BMI (r= 0.67), waist circumference (r= 0.57) and waist to hip ratio (r= 0.55) (Table 1 & Fig 3; Fig 4).Fasting blood glucose was positively correlated with BMI (r= 0.29), waist circumference (r= 0.29) and waist to hip ratio (r= 0.27); Insulin level was positively correlated with BMI (r= 0.85), waist circumference (r= 0.77) and waist to hip ratio (r= 0.66) and Insulin resistance (HOMA-IR) was positively correlated with BMI (r= 0.85), waist circumference (r= 0.78) and waist to hip ratio (r= 0.62) (Table 1 & Fig 5; Fig 6 & Fig 7).

Correlation of lipid profile with different Obesity Indices

Total cholesterol was positively correlated with BMI (r= 0.43), waist circumference (r= 0.39) and waist to hip ratio (r= 0.37) (Table 1 & Fig 8). Triglycerides were positively correlated with BMI (r= 0.53), waist circumference (r= 0.47) and waist to hip ratio (r= 0.41) (Table 1 & Fig 10). LDL-Cholesterol was positively correlated with BMI (r= 0.46), waist circumference (r= 0.46) and waist to hip ratio (r= 0.39) (Table 1 & Fig 9). But HDL-Cholesterol was negatively correlated with BMI (r= - 0.39), waist circumference (r= - 0.37) and waist to hip ratio (r= - 0.24) (Table 1 & Fig 11).

Correlation of Adipokines with different Obesity Indices

Leptin level was positively correlated with BMI (r= 0.73) (Table 1 & Fig 13), waist circumference (r= 0.65) and waist to hip ratio (r= 0.49); Adiponectin level was negatively correlated with BMI (r= - 0.78) (Table 1 & Fig 12), waist circumference (r= - 0.71) and waist to hip ratio (r= - 0.56).

Table 1: Spearman's correlation coefficients and associated *p*-values relationships of various anthropometric, metabolic status with different obesity index

Variables		Body mass index	Waist circumference	Waist to hip ratio
Body mass index	*r*	*1.000*	*0.83*	*0.72*
	p	-	*< 0.01*	*< 0.01*
Waist circumference	*r*	*0.83*	*1.000*	*0.64*
	p	*< 0.01*	-	*< 0.01*
Waist to hip ratio	*r*	*0.72*	*0.64*	*1.000*
	p	*< 0.01*	*< 0.01*	-
Systolic BP	*r*	*0.40*	*0.39*	*0.36*
	P	*< 0.01*	*< 0.01*	*< 0.01*
Diastolic BP	*r*	*0.67*	*0.57*	*0.55*
	p	*< 0.01*	*< 0.01*	*< 0.01*
Fasting glucose	*r*	*0.29*	*0.29*	*0.27*
	p	*< 0.01*	*< 0.01*	*< 0.01*
Insulin	*r*	*0.85*	*0.77*	*0.66*
	p	*< 0.01*	*< 0.01*	*< 0.01*
Insulin resistant	*r*	*0.85*	*0.78*	*0.62*
	P	*< 0.01*	*< 0.01*	*< 0.01*
Total cholesterol	*r*	*0.43*	*0.39*	*0.37*
	p	*< 0.01*	*< 0.01*	*< 0.01*
Triglycerides	*r*	*0.53*	*0.47*	*0.41*
	p	*< 0.01*	*< 0.01*	*< 0.01*
LDL	*r*	*0.46*	*0.46*	*0.39*
	P	*< 0.01*	*< 0.01*	*< 0.01*
HDL	*r*	*-.39*	*-.37*	*-.24*
	p	*< 0.01*	*< 0.01*	*< 0.01*
Leptin	*r*	*0.73*	*0.65*	*0.49*
	p	*< 0.01*	*< 0.01*	*< 0.01*
Adiponectin	*r*	*-.78*	*-.71*	*-.56*
	p	*< 0.01*	*< 0.01*	*< 0.01*

Fig. 1 - 13: Regression analysis of Body Mass Index with various anthropometric and metabolic characters

Fig. 1: BMI *vs* WC

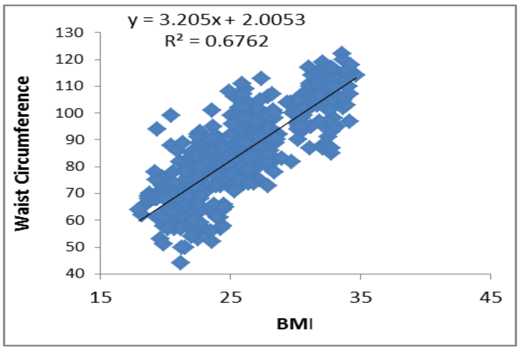

Fig. 2: BMI *vs* WHR

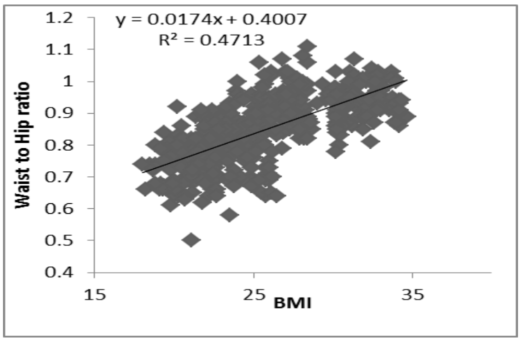

Fig. 3: BMI *vs* S.BP

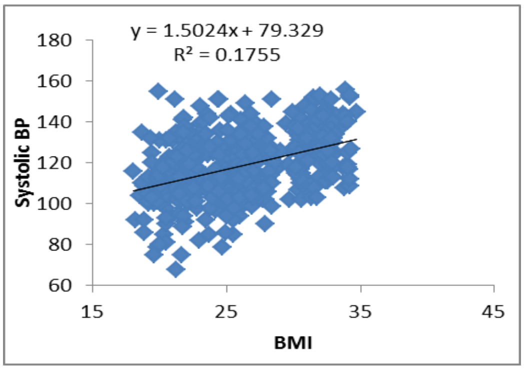

Fig. 4: BMI *vs* D.BP

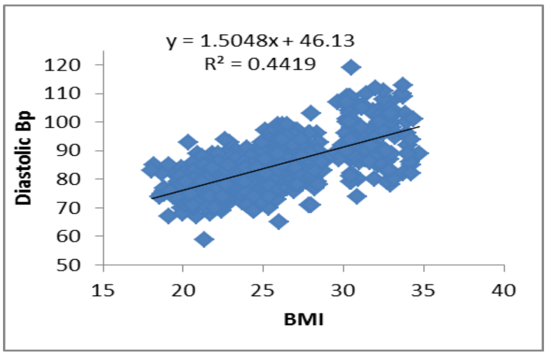

Fig. 5: BMI *vs* FBS

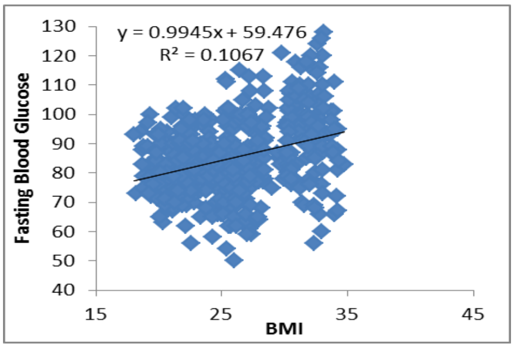

Fig. 6: BMI *vs* Insulin

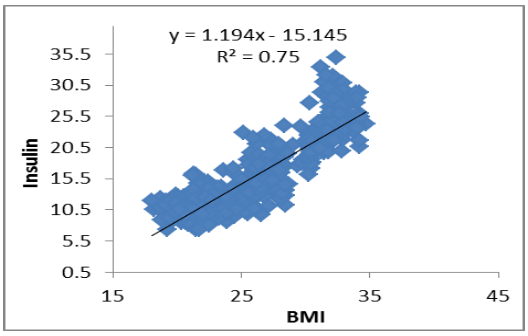

Fig. 7: BMI *vs* IR

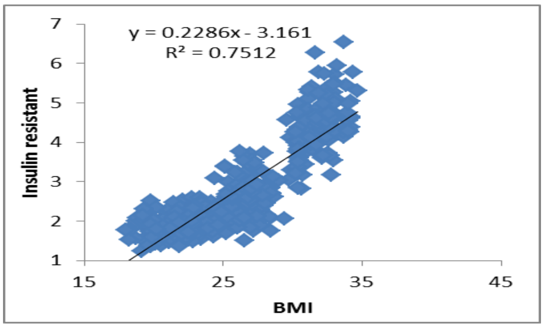

Fig. 8: BMI *vs* T. Chol

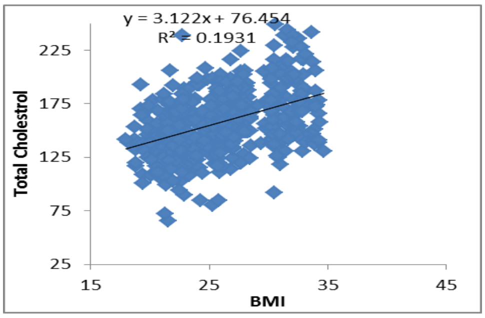

Fig. 9: BMI *vs* LDL

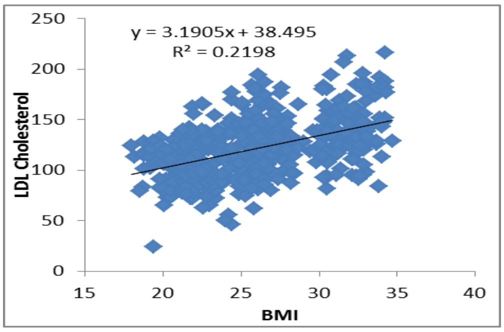

Fig. 10: BMI *vs* TGL

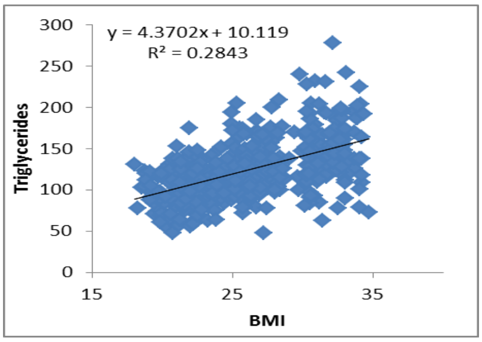

Fig. 11: BMI *vs* HDL

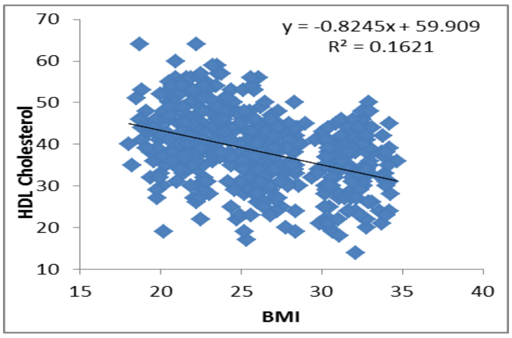

Fig. 12: BMI *vs* Adiponectin

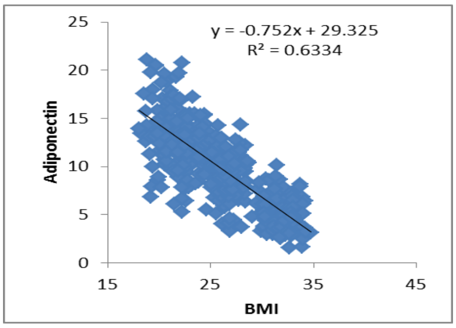

Fig. 13: BMI *vs* Leptin

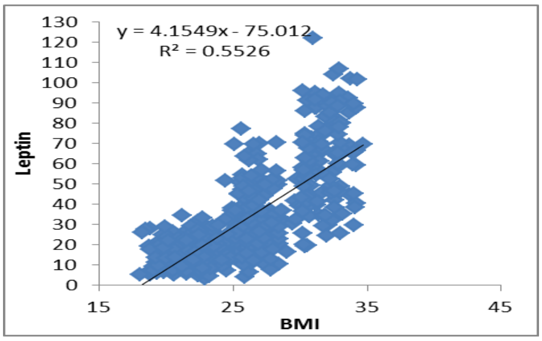

Table 2: Spearman's correlation coefficients and associated *p*-values relationships of various anthropometric, metabolic status with different obesity index at Gender wise

Variables		Male			Female		
		WC	***WHR***	***BMI***	***WC***	***WHR***	***BMI***
Sys BP	*r*	*0.277*	*0.200*	*0.318*	*0.419*	*0.397*	*0.448*
	p	*<0.01*	*0.002*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Dia BP	*r*	*0.420*	*0.533*	*0.655*	*0.599*	*0.531*	*0.667*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
FBS	*r*	*0.303*	*0.233*	*0.369*	*0.221*	*0.243*	*0.224*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Insulin	*r*	*0.655*	*0.677*	*0.840*	*0.829*	*0.716*	*0.859*
	P	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Insulin resistant	*r*	*0.572*	*0.570*	*0.751*	*0.870*	*0.729*	*0.891*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Total cholesterol	*r*	*0.282*	*0.297*	*0.392*	*0.452*	*0.448*	*0.453*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Triglycerides	*r*	*0.384*	*0.363*	*0.472*	*0.514*	*0.435*	*0.570*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
LDL	*r*	*0.378*	*0.297*	*0.423*	*0.476*	*0.411*	*0.457*
	P	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
HDL	*r*	*- .357*	*-.284*	*-.336*	*-.422*	*-.387*	*-.467*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Leptin	*r*	*0.592*	*0.510*	*0.741*	*0.746*	*0.637*	*0.770*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Adiponectin	*r*	*- .524*	*-.528*	*-.702*	*-.778*	*-.616*	*-.823*
	P	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*

Table 3: Spearman's correlation coefficients and associated *p*-values relationships of various anthropometric, metabolic status with different obesity index at Age wise

Variables		Age 20 – 39 years			Age 40 – 59 years		
		WC	***WHR***	***BMI***	***WC***	***WHR***	***BMI***
Sys BP	*r*	*0.325*	*0.367*	*0.377*	*0.410*	*0.343*	*0.407*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Dia BP	*r*	*0.540*	*0.497*	*0.673*	*0.521*	*0.571*	*0.619*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
FBS	*r*	*0.336*	*0.315*	*0.336*	*0.245*	*0.228*	*0.249*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Insulin	*r*	*0.759*	*0.611*	*0.836*	*0.779*	*0.663*	*0.840*
	P	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Insulin resistant	*r*	*0.659*	*0.453*	*0.743*	*0.826*	*0.669*	*0.888*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Total cholesterol	*r*	*0.290*	*0.290*	*0.348*	*0.402*	*0.375*	*0.422*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Triglycerides	*r*	*0.449*	*0.296*	*0.464*	*0.496*	*0.469*	*0.550*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
LDL	*r*	*0.461*	*0.402*	*0.465*	*0.445*	*0.349*	*0.442*
	P	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
HDL	*r*	*-.406*	*-.281*	*-.437*	*-.335*	*-.167*	*-.296*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Leptin	*r*	*0.556*	*0.483*	*0.727*	*0.703*	*0.519*	*0.731*
	p	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Adiponectin	*r*	*-.711*	*-.542*	*-.788*	*-.695*	*-.555*	*-.763*
	P	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*

***Correlation of Blood Pressure, Blood Sugar, Insulin and Insulin Resistance with different Obesity Indices at* gender wise**

Systolic BP of males and females was positively correlated with BMI (r= 0.31; r= 0.44) , waist circumference (r= 0.28; r= 0.42) and waist to hip ratio (r= 0.20; r= 0.40) and Diastolic BP of males and females was positively correlated with BMI (r= 0.65; r= 0.66), waist circumference (r= 0.42; r= 0.59) and waist to hip ratio (r= 0.53; r= 0.53) respectively (Table 2). Fasting blood glucose of males and females was positively correlated with BMI (r= 0.36; r= 0.22), waist circumference (r= 0.30; r= 0.22) and waist to hip ratio (r= 0.23; r= 0.24) respectively (Table 2).

Insulin level in males and females was positively correlated with BMI (r= 0.84; r= 0.64), waist circumference (r= 0.65; r= 0.82) and waist to hip ratio (r= 0.67; r= 0.71) and Insulin resistance (HOMA-IR) was positively correlated with BMI (r= 0.89; r= 0.75), waist circumference (r= 0.87; r= 0.57) and waist to hip ratio (r= 0.72; r= 0.57) respectively (Table 2).

***Correlation of lipid profile with different Obesity Indices at* gender wise**

Total cholesterol of males and females was positively correlated with BMI (r= 0.39; r= 0.45), waist circumference (r= 0.28; r= 0.44) and waist to hip ratio (r= 0.29; r= 0.44). Triglycerides were positively correlated with BMI (r= 0.57; r= 0.47), waist circumference (r= 0.51; r= 0.38) and waist to hip ratio (r= 0.43; r= 0.36). LDL-Cholesterol was positively correlated with BMI (r= 0.42; r= 0.45), waist circumference (r= 0.37; r= 0.47) and waist to hip ratio (r= 0.29; r= 0.41). HDL-Cholesterol was negatively correlated with BMI (r= -0.46; r= -0.37) waist circumference (r= -0.42; r= -0.36) and waist to hip ratio (r= -0.38; r= -0.28) respectively (Table 2).

Correlation of Adipokines with different Obesity Indices at gender wise

Leptin level in males and females was positively correlated with BMI (r= 0.74; r= 0.77), waist circumference (r= 0.59; r= 0.74) and waist to hip ratio (r= 0.51; r= 0.63); Adiponectin level was negatively correlated with BMI (r= -0.70; r= -0.82), waist circumference (r= -0.52; r= -0.77) and waist to hip ratio (r= -0.53; r= -0.62) respectively (Table 2).

Correlation of Blood Pressure, Blood Sugar, Insulin and Insulin Resistance with different Obesity Indices at Age wise

Systolic BP of Age 20-39 years and age 40-59 years subjects were positively correlated with BMI (r= 0.38; r= 0.40), waist circumference (r= 0.33; r= 0.41) and waist to hip ratio (r= 0.37; r= 0.34); Diastolic BP was positively correlated with BMI (r= 0.67; r= 0.62), waist circumference (r= 0.54; r= 0.52) and waist to hip ratio (r= 0.50; r= 0.57) respectively (Table 3). Fasting blood glucose of Age 20-39 years and age 40-59 years subjects was positively correlated with BMI (r= 0.34; r= 0.25), waist circumference (r= 0.34; r= 0.25) and waist to hip ratio (r= 0.32; r= 0.23); Insulin level was positively correlated with BMI (r= 0.83; r= 0.84), waist circumference (r= 0.76; r= 0.78) and waist to hip ratio (r= 0.61; r= 0.66); Insulin resistance (HOMA-IR) was positively correlated with BMI (r= 0.74; r= 0.89), waist circumference (r= 0.66; r= 0.83) and waist to hip ratio (r= 0.45; r= 0.67) respectively (Table 3).

Correlation of lipid profile with different Obesity Indices at Age wise

Total cholesterol of Age 20-39 years and age 40-59 years subjects were positively correlated with BMI (r= 0.35; r= 0.42), waist circumference (r= 0.29; r= 0.40). Waist to hip ratio (r= 0.29; r= 0.38); Triglycerides were positively correlated with BMI (r= 0.46; r= 0.55), waist circumference (r= 0.45; r= 0.49) and waist to hip ratio (r= 0.29; r= 0.47). LDL-Cholesterol was positively correlated with BMI (r= 0.46; r= 0.44), waist circumference (r= 0.46; r= 0.45) and waist to hip ratio (r= 0.40; r= 0.35). HDL-Cholesterol was negatively correlated with BMI (r= - 0.43; r= - 0.29) Waist circumference (r= - 0.41; r= -0 .34) and waist to hip ratio (r= - 0.28; r= - 0.17) Respectively (Table 3).

Correlation of Adipokines with different Obesity Indices at Age wise

Leptin level of Age 20-39 years and age 40-59 years subjects were positively correlated with BMI (r= 0.72; r= 0.73), waist circumference (r= 0.56; r= 0.70) and waist to hip ratio (r= 0.48; r= 0.52); Adiponectin level was negatively correlated with BMI (r= - 0.79; r= -0 .76), waist circumference (r= - 0.71; r= -0 .69) And waist to hip ratio (r= - 0.54; r= - 0.55) Respectively (Table 3).

DISCUSSION

Obesity is a chronic disease consisting of the increase in body fat stores. Therefore, ideally, the definition of obesity should be considered the amount of body fat but there are not precisely defined normal values of body fat. However, assessing body fat requires quite sophisticated methods that would do a population based measure of body fat almost impossible to perform. Thus, for practical reasons, obesity is measured by means of the Body Mass Index (BMI),a calculation taking into account the Weight and height of the subject: i.e. BMI = Weight (kg) /height (m) ^{2}. An elevated BMI usually accepted as an indication of overall adiposity. BMI is highly correlated with total body fat and is very useful for epidemiological purposes [3]. WHO classification of obesity is universally accepted as a measure of obesity in adults, recently efforts have been made to universalize these BMI cutoff points, and the results have been released by Cole and co-workers. [4]

Regarding the health risks related to obesity, we have to take into account not only the degree of obesity but also and perhaps more relevant the body fat distribution. There are two main types of obesity regarding the fat distribution pattern. The first one is the android or central obesity with the majority of fat depots located in the abdominal area. The second one is the gynoid or visceral (peripheral) obesity in which the fat depots are mainly located subcutaneously in the lower body (hips and lower extremities).

The difference between these two types is central, because the metabolic and cardiovascular complications of obesity are almost exclusively related to visceral fat depots. Because of its high correlation with visceral adipose tissue a measure such as the waist circumference is a good way to assess cardiovascular risk. [5]

Earlier study, had established cut off points for waist circumference for both men and women to assess cardiovascular risk. A waist circumference over 88 cm for women and above 102 cm for men indicates a high cardiovascular risk and the need for action. [6] Though there are different ways of measuring body fat distribution, the waist-to-hip ratio (WHR) is still a useful measure to be considered in obesity evaluation.

Moreover, it is recognized that WHR is dependent on age and gender and that after the age of 11 years, WHR decreases stronger in females than males. [7]. some experts consider that the hip measurement provides additional information about the gluteo femoral muscle mass and bone structure. In our opinion, patients with severe forms of obesity (class II and III obesities in the WHO classification) the waist circumferences clearly beyond the upper risk limits the WHR would be the best way to evaluate the fat distribution pattern. Without having any universally established way of measuring adiposity, body mass index (BMI), Waist circumference (WC) and Waist to hip ratio (WHR) are the most commonly used measure of adiposity in the epidemiological and clinical studies.

In the present study, body mass index (BMI), Waist circumference (WC) and Waist to hip ratio (WHR), were the different obesity indices used as independent variables. The results of the present study showed that BMI, waist circumference and Waist to hip ratio were significantly increased in the overweight and obese subjects as compared to that of normal weight subjects. The Spearman correlation coefficients were done to assess the strength and relationships among the independent obesity indices.

The results of the present study showed good agreement among the different obesity indices. BMI was stronger and positively correlated with waist circumference (r= 0.83) as well as with waist to hip ratio (r= 0.72). The Waist circumference was also stronger and positively correlated with waist to hip ratio (r= 0.64). Since BMI was more strongly correlated with waist circumference, waist to hip ratio and Waist circumference was also more strongly correlated with waist to hip ratio, it was clearly evidenced that the three obesity indices had good agreement with each other in the study subjects. Hence, the correlation and relationship of the different obesity indices with all the measured parameters was studied.

The spearman correlation coefficients were done to assess the relationships between each independent obesity indices, body mass index (BMI), Waist circumference (WC) and Waist to hip ratio (WHR) with various measured dependent variables such as Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Fasting blood glucose(FBS), Fasting Insulin, Insulin resistance (IR), Total Cholesterol (TC), Low Density lipoprotein cholesterol (LDL), High density lipoprotein cholesterol (HDL) ,Total: HDL- cholesterol ratio, Triglycerides(TGL), Leptin and Adiponectin of the study subjects.

The present study showed that the Systolic BP, Diastolic BP, Fasting blood glucose, Insulin level and Insulin resistance were positively correlated with BMI, waist circumference and waist to hip ratio of the study subjects. The Total cholesterol, Triglycerides and LDL-Cholesterol levels were also positively correlated with BMI, waist circumference and waist to hip ratio but the HDL-Cholesterol level was negatively correlated with BMI, waist circumference and waist to hip ratio of the study subjects.

The levels of Leptin was positively correlated with BMI, waist circumference and waist to hip ratio but the Adiponectin level was negatively correlated with BMI, waist circumference and waist to hip ratio of the study subjects. Previously a number of cross-sectional studies have explored the relationship between CAD risk factors and multiple measures of adiposity [8],[9],[10] [18]. However, so far it is not clear as to which anthropometric measure best predicts the obesity-related disorders, particularly among Asians.

There has been a debate on the relative importance of BMI and body fat distribution in predicting CAD. As a measure of adiposity, BMI does not distinguish fat mass from lean body mass, and its validity varies by age, sex, and ethnicity. Waist circumference, a surrogate measure of upper body or abdominal obesity, is considered central to the metabolic syndrome and a root cause of the clustering of multiple cardiovascular risk factors (e.g., Hypertension, dyslipidemia, and type II diabetes). Ideally, waist circumference or waist-to-hip ratio (WHR) should be superior to BMI in predicting CVD risk. However, there are limitations when interpreting such data.

First, the high correlation between BMI and waist circumference as seen in our study makes it difficult to separate the effects of overall adiposity from abdominal obesity. Second, when BMI and waist circumference are included in the same model, the latter accounts for abdominal fatness, while a BMI reflects lean body mass more than overall fatness. Thus, with simultaneous adjustment for waist circumference and WHR, the association between BMI and CHD becomes weakened or even contrary. Finally, because WHR can reflect both increased visceral fat mass and/or reduced gluteo femoral muscle mass, its interpretation is complex. However, earlier studies have reported that overweight and obesity significantly predicts the incidents of CHD even after adjustment for hypertension, high cholesterol, and diabetes. Earlier reports from the Johns Hopkins Sibling Study, observed the relationship between BMI and incident of CHD in 827 apparently healthy relatives of less than 60 years of age. Multivariate analyses indicated that BMI significantly predicted risk of CHD independently [11] [17]

In our study we observed that BMI was more strongly associated with all the measured CAD risk factors in men and women as compared with other obesity measures that are WC and WHR. In contrary to our report other investigators have reported that WHR is a better predictor of CVD risk than other anthropometric measurements [12],[13]. Apart from this, some earlier studies reported that WC and BMI are equally predictive of CVD risk [9]. Earlier study has even shown that WC is a better indicator of CVD risk than BMI [8].

Results from a recent meta-analysis however suggests that measures of overall obesity (BMI) and measures of central obesity (waist to hip ratio and waist circumference) performed equally well in predicting CAD risk [14] [19] . Our study findings are mostly similar to those reported by Vazquez et al.[14]. There is increasing evidence exist over the past several years; more than 100 prospective cohort studies on the relationship between adiposity and risk of CHD in various populations.

One of the major Meta analyses including 92 prospective studies, and more than 1.1 million participants worldwide showed the association between BMI and CAD incidence and mortality [14],[15].

Thus it can be concluded that the risk for CAD was greater in individuals with high BMI and/or high WC and WHR values irrespective of their age and gender. The combined use of BMI, WC and WHR appeared to be more predictive of CAD risk factors.

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