# Correlation of cardiovascular parameter with General and Visceral Obesity Indices in young male adult of Western Rajasthan

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**ABSTRACT:**

**Aim:** *Abdominal adiposity is suggested to be more closely associated with CVD risk and has been highlighted as a growing problem particularly in countries of Asia-Pacific region where individuals may exhibit a relatively normal BMI (<25 kg/m2) but have a disproportionately large waist circumference. Our objective was to compare body mass index(BMI), waist circumference (WC), waist hip ratio (WHR), waist stature ratio(WSR) and Body Fat % (BF %) as indices of obesity and assess the respective association with cardiovascular parameter.*

**Method:** *A cross sectional descriptive study was made on 200 subjects. Anthropometric measurement was obtained and indices of general obesity BMI and indices of visceral obesity WC, WHR, WSR, BF % were calculated. Blood pressure was measured by using sphygmomanometer.*

**Result:** *study showed a strong correlation between obesity indices and BP parameters in young adult males. We observe significant higher Blood pressures in obese young adults. Multiple regression analysis shows that only WC was the significant contributor ($p<0.05$) for SBP, DBP, MAP and RPP for the population of Western Rajasthan adult males.*

**Conclusion:** *it is worthwhile to mention that in adult male of Western Rajasthan mainly WC (central obesity indices) along with BMI and BF % (general obesity indices) have to be considered for early evaluation of cardiovascular risk factors.*

**Keywords:** *Body Fat Percentage, Body Mass Index, Rate pressure product, Waist Circumference, Waist Hip ratio, Waist Stature ratio*

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## INTRODUCTION

The worldwide prevalence of overweight and obesity has been increasing at an alarming rate, affecting populations of both higher and lower middle income countries[(1)]. Excess adiposity has been shown to be an independent risk factor for cardiovascular diseases(CVD), Type II diabetes, dyslipidemia and hypertension. Although body mass index (BMI) is the most frequently used index of adiposity, it does not reflect fat mass uniformly in all populations [(2)].

Abdominal adiposity is suggested to be more closely associated with CVD risk and have been highlighted as a growing problem particularly in countries of Asia-Pacific region where individuals may exhibit a relatively normal BMI (<25 kg/m2) but have a disproportionately large waist circumference[(3)].

The World Health Organization (WHO) has proposed lower values of general and abdominal obesity indicators to define obesity and risk of CVD for inhabitants of the Asia-Pacific region. However, it has been suggested that more studies need to be performed to determine the relationship between BMI, WC and risk of development of co-morbidities to allow for the establishment of validated cut-points[(4)]. The predictive power of an anthropometric index is population dependent and varies from race to race[(5)]. The appropriate cutoffs for measurement of abdominal obesity i.e. WC and WHR also need to be validated in case of different populations in India. So the present study was done to find the cardiovascular parameter correlation with BMI, BF% (general obesity parameter), and WC, WSR, WHR (visceral obesity parameters) in young adult male from western Rajasthan.

## MATERIAL AND METHOD

Study was carried out in Physiology Department of Dr. S. N. Medical College, Jodhpur. Two hundred male subjects were included in this study between age group of 21- 40 years which were divided into 2 groups. Control Subject (N=104) who were having body mass index between 18.5-24.99 .Obese individual (N=96) who were having body mass index >25.

We had selected physically and mentally fit subjects. They voluntarily participated in the study with prior informed consent and were briefed about the procedure to achieve full cooperation. Subject was examined for their anthropometric indices like

weight, height, waist circumference & hip circumference. Weight was measured nearest to 0.1 Kg. by weighing balance after removal of shoes with light clothing only. Height was measured to the nearest 0.5 cm. against the wall without shoes using a stadiometer. Waist circumference was measured using a measuring tape in standing position at the level midway between the lower rib margin and the iliac crest in a horizontal plane. Hip circumference was measured in standing position at the widest point over the buttocks. BMI was calculated by dividing the weight taken in Kg by the square of height taken in meters. WHR (Waist to hip ration) was calculated by dividing waist measurement by the hip measurement.WSR (waist to stature ration) was calculated by dividing the waist measurement (cm) by height measurement (cm).

BF% is another parameter for defining obesity. Standard value of BF% for normal and obese person is >25% for male and > 30% for female. BF% was calculated from following formula (Deurenberg P, Westsrate JA, Seidell JC, 1991)[6]:

**BF%= (BMI x 1.20) + (Age x 0.23) – (Sex x 10.8)-5.4**
**(BMI in kg/m$^2$; Age n Years; Sex is 1 for male and 0 for female)**

Anthropometric indices categorized according to the WHO criteria for South Asian Population [7].

| Anthropometric Indices | Normal cut off value |
|---|---|
| BMI | 25 Kg/m$^2$ |
| Waist Circumference | 85 cm |
| WHR | 0.85 |
| WSR | 0.50 |

Cardiovascular parameters measured were blood pressure, pulse pressure, mean arterial pressure and rate pressure product by using mercury sphygmomanometer. The blood pressure was measured by using mercury sphygmomanometer with the right forearm horizontal on the table when subjects in seated position. Two readings were recorded at an interval of 2-3 min. The mean of the two reading was calculated and considered for the final analysis.

1. **Pulse Pressure:** Pulse Pressure was calculated as the Difference between the SBP and DBP.
**PP= (SBP-DBP).**
2. **Mean Arterial Pressure:** MAP was calculate by one third of Pulse Pressure is added to Diastolic Pressure
**MAP = DBP + ⅓ PP**
3. **Rate Pressure Product:** It is a major determinant of cardiac oxygen consumption. It is easily applicable, non invasive predictor of myocardial oxygen consumption that can be easily used on a larger population
**RPP= HR ×SBP/100**

## STATISTICAL ANALYSIS

The significance of differences within groups and across the groups was evaluated by student T-test. The correlation between various Anthropometric Indices and Blood Pressure (SBP, DBP) was done using Pearson's correlation coefficient. The correlation coefficient values 'r' was compared with the table of coefficient correlation in Biostatistics.

## RESULT

**Table 1: Distribution of subjects in to normal & obese groups based on the cut-off points of obesity indices**

| Obesity Indices | Cut-off | Normal | | Obese | |
|---|---|---|---|---|---|
| | | No. of subjects | Percentage | No. of subjects | Percentage |
| Body Mass Index (kg/m$^2$) | 25 | 104 | 52% | 96 | 48% |
| WC (cm) | 85 | 115 | 57.5% | 85 | 42.5% |
| WHR (ratio) | 0.85 | 116 | 58% | 84 | 42% |
| WSR (ratio) | 0.50 | 110 | 55% | 90 | 45% |
| BF (%) | 25 | 142 | 71% | 58 | 29% |

As shown inTable-1 using BMI as obesity criteria with cut of 25 kg/m$^2$, about 52% volunteers were of normal category while 48% comes under obese group. On using West Circumference with cut-off point of 85 cm about 42.5% subject shows obesity, while 57.5% were categories under normal group. WHR shows 42% subject under obese group and 58% of normal group. Using the cut-off 0.85 while WSR, showed 55% subject in normal

group & 45% in the obese group, using 0.50 as cut-off point between two group BF % shows 29 % of persons in obese group, when using 25 % as cut-off point.

**Table 2: Comparison of cardio vascular parameter among normal & obese group mean ±SD**

| Obesity Indices | | SBP | DBP | PP | MAP | RPP |
|---|---|---|---|---|---|---|
| BMI | NW | 115.34±6.37 | 77.85±4.15 | 37.51±4.49 | 90.34±4.53 | 65.76±4.74 |
| | OB | 131.51±8.56* | 86.26±5.55* | 45.28±5.94* | 101.34±6.09* | 84.50±10.69* |
| WHR | NW | 116.91±6.37 | 78.78±4.06 | 38.14±4.57 | 91.49±4.46 | 66.57±4.44 |
| | OB | 134.40±7.77* | 88.02±5.25* | 46.38±5.81* | 103.48±5.56* | 87.67±9.23* |
| WSR | NW | 116.67±6.38 | 78.62±4.07 | 38.05±4.63 | 91.30±4.46 | 66.40±4.43 |
| | OB | 133.53±8.25* | 87.60±5.35* | 45.93±5.91* | 102.91±5.83* | 86.47±10.04* |
| WC | NW | 116.97±6.50 | 78.77±4.06 | 38.21±4.68 | 91.50±4.49 | 66.65±4.65 |
| | OB | 134.12±8.01* | 87.93±5.30* | 46.19±5.88* | 103.33±5.70* | 87.31±9.59* |
| BF% | NW | 119.13±7.90 | 79.96±4.68 | 39.17±5.12 | 93.01±5.44 | 69.25±7.51 |
| | OB | 136.83±7.10* | 89.28±5.43* | 47.55±5.82* | 105.13±5.38* | 90.56±8.78* |

NW: normal weight, OB: obese, $p<0.001$ highly significant.

On observing the B.P. obese group is showing statistical highly significant ($p<.001$) increased systolic, diastolic, Pulse Pressure along with increase in mean arterial pressure & Rate pressure product (table-2)

**Table 3: Correlation of BMI, WC, WSR, WHR & BF% with Cardiovascular Parameters**

| Obesity indices | SBP | DBP | PP | MAP | RPP |
|---|---|---|---|---|---|
| BMI | 0.81 | 0.73 | 0.65 | 0.80 | 0.75 |
| WC | 0.80 | 0.74 | 0.64 | 0.80 | 0.79 |
| WHR | 0.71 | 0.67 | 0.55 | 0.72 | 0.68 |
| WSR | 0.72 | 0.74 | 0.63 | 0.71 | 0.79 |
| BF% | 0.80 | 0.72 | 0.65 | 0.79 | 0.71 |

Table-3 showing that SBP was strongly corelated with BMI while DBP was strongly corelated with WC and WSR, PP with BMI & BF%, MAP with BMI, WC and WSR and RPP with WC and WSR.

## DISCUSSION

The prevalence of obesity is now reaching epidemic proportions in India and is of great concern because it increases risk of Coronary Heart disease, Stroke, Diabetes and mortality[8] as per WHO report.

To our knowledge, there are very less studies investigating the relationship between indices of general and central obesity cardiovascular parameter in young adult male subjects of western Rajasthan (a desert state of India). Present study was done with the aim to determine correlation of cardiovascular parameter with obesity indices in Young Male subjects of Western Rajasthan.

Present study display that obese group showed a significant increase in Systolic Blood Pressure, Diastolic Blood Pressure & Rate Pressure product ($p<.001$).

When anthropometric indices of obesity were correlated with SBP, DBP, Pulse Pressure, MAP & RPP although all the indices, (BMI, WC, WHR, WSR, BF %) were positively and significantly correlated with these parameters.

Upper body fat distribution and increased visceral fat mass have been found to be better predictors of hypertension and cardiovascular morbidity than over all fat mass. Thus it has been suggested that WC, WHR & WSR are better measures of obesity than BMI in predicting cardiovascular risk factors[9,10].

Multiple regression method was applied to find the effect of BMI, WC, HC and BF% on SBP, DBP, MAP and RPP. Multiple regression shows that only WC was the significant contributor ($p<0.05$) for SBP, DBP, MAP and RPP for the population of Western Rajasthan adult male.

The body mass index has been used routinely to classify subjects as obese or non-obese. (WHO and International Obesity Task Force) Several studies have separately established that the BMI cut off point for obesity for Asian populations is relatively lower (Pegged between 23 and 27 kg/m² for Asians) compared to European & American population. More studies[11,12,13] have shown that Asian populations have higher risks of cardiovascular disease and mortality from other causes at relatively lower BMI, which they postulated to be largely attributable to the higher proportion of body fat in Asian populations. Researches on cut off value of the BMI based on the ROC curve among Indian population has shown that a BMI of 21.5 kg/m$^2$ for male subjects 19.0 kg/m$^2$ for female subjects displayed optimal sensitivity and specificity in identifying subjects with a high percentage of body fat and supports the view that a BMI of 23.0 kg/m$^2$

might be ideal for the Asian Indian population. The cut off values derived for WC were 85 cm for men and 80 cm for women, and for WHR they were 0.85 for young adult men and 0.81 for women were also lower than those suggested in earlier studies.

Rate pressure product (RPP) is a major determinant of cardiac oxygen consumption. It is an important indicator of ventricular function. Rate pressure product, a product of heart rate and systolic blood pressure is an indirect measure of myocardial oxygen consumption ($MVO_2$). It is easily applicable, non-invasive predictor of myocardial oxygen consumption that can be easily used on a larger population. It defines the response of the coronary circulation to myocardial metabolic demands. It is a good index of Myocardial Oxygen Consumption ($MVO_2$) in patients with ischemic heart disease.

In present study RPP was showing significant rise ($p<0.001$) in Obese group as compared to Normal Weight Group. So increase in RPP means increase in myocardial oxygen consumption. Obesity is an independent predictor of increased myocardial oxygen consumption ($MVO_2$). This may cause increase in fatty acid metabolism & decrease in cardiac efficiency. These metabolic changes may play a role in the pathogenesis of decreased cardiac performance in obese.

Obesity increases sympathetic tone, preload and fatty acid metabolism. Increased fatty acid uptake and oxidation by the heart can also increase myocardial oxygen consumption ($MVO_2$), because more oxygen is required to generate ATP from fatty acid than by glucose metabolism. Increased myocardial oxygen consumption leads to increased oxidative stress, apoptosis and cardiac dysfunction .We found that an increase in WC, WHR, BMI are significantly associated with an increase in myocardial oxygen consumption ($MVO_2$).

## CONCLUSION

The present study showed significant higher Blood pressures in obese young adults. There was strong correlation between obesity indices and cardiovascular parameters in young adult males. There was stronger correlation of WC (intra abdominal fat), compared to that with BMI has led to the suggestion that WC should be used as an index of abdominal obesity and may be more sensitive in the assessment of disease risk than BMI alone in the population of Western Rajasthan adult males.

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