

## Atherogenic Index as a Predictor of Cardiovascular Risk among Women with Different Grades of Obesity

Pallavi S. Kanthe <sup>1\*</sup>, Bheemshetty S. Patil <sup>2</sup>, Shrilaxmi Bagali <sup>3</sup>, Anita Deshpande <sup>4</sup>, Gouhar Banu Shaikh <sup>5</sup>, Manjunatha Aithala <sup>6</sup>

1 Lecturer, Dept of Physiology, B.L.D.E.U's Shri B. M Patil Medical College, Karnataka, India

2 Lecturer, Dept of Anatomy, B.L.D.E.U's Shri B. M Patil Medical College, Karnataka, India

3 Asst. Professor, Dept of Physiology, B.L.D.E.U's Shri B. M Patil Medical College, Karnataka, India

4 Tutor; Dept of Physiology, B.L.D.E.U's Shri B. M Patil Medical College, Karnataka, India

5 Asst. Professor, Dept of Physiology, B.L.D.E.U's Shri B. M Patil Medical College, Karnataka, India

6 Prof & Head, Dept of Physiology, B.L.D.E.U's Shri B. M Patil Medical College, Karnataka, India

\* **Correspondence Address:** Dr. Pallavi S. Kanthe

Lecturer, Dept of Physiology, B.L.D.E.U's Shri B. M Patil Medical College

Hospital and Research centre, Bijapur-586101, Karnataka, India

Email: mepallavipatil@gmail.com | Phone No: +918762244309

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### Abstract

**Background:** Overweight and obesity represent a rapidly growing threat to the healthy populations in an increasing number of countries. Obesity is thought to have a greater influence on cardiovascular diseases.

**Aims & Objective:** Aim of present study was to assess an atherogenic index and lipid profile in obese women and to compare the same with non-obese women aged 40-55 years as above mentioned parameters are associated with increased risk for cardiovascular diseases.

**Materials & Methods:** A comparative and cross sectional study was conducted among 140 women (70-obese and 70-non-obese) of age 40-55 years. The study group was divided into four according to BMI, namely Group I ( BMI 25-29.9 kg/m<sup>2</sup>), Group II( BMI 30-34.9 kg/m<sup>2</sup>), Group III( BMI 35 – 39.9 kg/m<sup>2</sup>), Group IV (BMI > 40 kg/m<sup>2</sup>) including Control( BMI < 25 kg / m<sup>2</sup>). Anthropometric parameters like height (cm), weight (Kg), BMI were recorded. In lipid profile we studied TC, HDL, TG, LDL, and VLDL. Atherogenic index was calculated. Statistical analysis was done using Student's 't' test and correlation was done by using Pearson's coefficient.

**Results:** The results of our study showed that in middle aged women significant increase in atherogenic index with increasing BMI (p<0.05). Values of TC, TG and VLDL showed significant increase in group II, III, IV compared to control. HDL, LDL and VLDL levels were seen significantly decreased in group I compared to control. We showed positive insignificant correlation between BMI and atherogenic index in obese group ( $r= 0.19$ ,  $p= 0.113$ )

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**Conclusion:** Obesity, no doubt alters lipid profile. A triglyceride based index (AI) can significantly add value when assessing the cardiovascular risk in obese women.

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**Keywords:** Obesity, Body Mass Index, Lipid profile, atherogenic index

## **Introduction**

Historical references to what we now know as the Obesity arise early in medical history. According to “Charak Samhita”<sup>1</sup> the condition of obesity is referred as “Sthaulya”. Since Ayurvedic considers obesity to be a ‘roga’, that is a disease.<sup>1</sup>

We are in the midst of an obesity pandemic. In the past decade, there has been an alarming increase in the prevalence of obesity.<sup>2</sup>The obesity epidemic has had a major medical and public health impact.

Obesity as per the WHO<sup>3</sup> is defined as, “Abnormal or excessive collection of fat in the body to the extent that the health is impaired”. It is the result of imbalance between food intake and energy expenditure. It is expressed in terms of Body Mass Index. BMI provides the most useful despite its being coarse, population level measure of obesity.<sup>4</sup> There are about 315 million adults whose body mass index exceeds the limit of the obese category determined by WHO.<sup>5</sup>

Lipid profile and atherogenic index have been shown to be weighty (significant) predictors for metabolic disturbances including Dyslipidemia, atherosclerosis, hypertension and cardiovascular diseases.<sup>6</sup>

Any changes in the levels of lipids make the individuals more inclined to develop atherosclerotic cardiovascular diseases as well as endothelial dysfunction.<sup>6</sup> We limited our study population to women because obesity is more common in women than in men and the proportionate risk of cardiovascular diseases is greater in obese women than in obese men.<sup>7</sup>

The aim of present study was to assess lipid profile and atherogenic index in obese women and to compare the same with non obese women. Lipid profile includes Total cholesterol, Triglycerides, HDL-cholesterol, LDL- cholesterol. Atherogenic index was calculated by using formula =  $\log(TG/HDL-C)$ .<sup>8</sup>

This study implemented the correlation of the atherogenic index with BMI in attempt to contrive cardiac risk factors in middle aged obese women. By knowing this present study, we can advise to overweight and obese persons to change in lifestyle, to do regular exercise and to have proper diet management.

## Materials & Methods

This is a comparative and cross sectional study assessing atherogenic index in obese women to non obese women. The study was conducted on 140 (control= 70, obese= 70) volunteer women of age 40-55 years. After explaining details of the study, Informed consent was obtained from each of the subject. Ethical clearance was obtained from institution.

Inclusion criteria: Women with BMI between 18.5-24.9 kg / m<sup>2</sup>-  $\geq$  40 kg/m<sup>2</sup> aged between 40-55 years, included in the study.

Exclusion criteria: subjects with Diabetes mellitus or any cardiovascular diseases, taking medications interfering with vascular reactivity and those are underweight, pregnant and lactating women.

All the parameters were recorded in the departmental laboratory between 8 to 10 am. Anthropometric parameters like height (cm), weight (Kg) were recorded. The BMI or Quetelet Index was conventionally calculated as weight in kg/height (in meters<sup>2</sup>) for each subject.

Depending upon body mass index these subjects were divided into four groups.

(Control –BMI 18.5-24.9 kg / m<sup>2</sup>), (Group I - BMI 25-29.9 kg/m<sup>2</sup>), (Group II- BMI 30-34.9 kg/m<sup>2</sup>), (Group III- BMI 35 – 39.9 kg/m<sup>2</sup>), (Group IV- BMI > 40 kg/m<sup>2</sup>). The classification of BMI applied were those used by the WHO Expert Committee 1955. For lipid profile study 3ml of blood was collected from each subject after overnight fasting of 12 hours. Serum values of TC, HDL, TG were measured by enzymatic method using semi auto analyzer. LDL and VLDL were calculated by Friedwald formula, VLDL = TG ÷ 5, LDL = Total Cholesterol – (VLDL + HDL). Concentration represented in mg/dl.

Atherogenic index was calculated by using formula =  $\log (TG/HDL-C)$ .<sup>8</sup>

### *Statistical analysis*

All values are presented as Mean  $\pm$  Standard Deviation. The results were statistically analyzed by using student's 't' test and by Pearson's correlation coefficient using SPSS software Version 9. 'p' Value <0.05 is considered as significant.

## Results

### *Comparison of study trial with control trial*

Values of BMI, AI and TC are significantly higher in group I compared to control. Values of HDL, TG, LDL and VLDL are significantly lower in group I compared to control (Table 1).

***Comparison of study trial with control trial***

There was very high significant increase in values of BMI and LDL in group II compared to control. Also significant increase in values of TC, HDL, TG and VLDL in group II. There is insignificant increase in values of AI in group II compared to control (Table 2).

***Comparison of study trial with control trial***

There was very highly significant increase in values of BMI, HDL and TG in group III compared to control. TC, LDL, VLDL and AI showed significant increase in values in group III compared to control (Table 3).

***Comparison of study trial with control trial***

This showed very high significant increase in values of BMI, TG, LDL and VLDL in group IV compared to control (Table 4).

As shown in Figure 1, we observed positive correlation between BMI and atherogenic index in obese group even though it was not statistically significant ( $r= 0.19$ ,  $p= 0.113$ ) (Figure 1).

**Discussion**

The results of our study showed that in middle aged women significant increase in atherogenic index with increasing BMI. Values of TC, TG and VLDL showed significant increase in group II, III, IV compared to control. HDL, LDL and VLDL levels were seen significantly decreased in group I compared to control. We showed positive insignificant correlation between BMI and atherogenic index in obese group ( $r= 0.19$ ,  $p= 0.113$ ) in present study.

According to Flier J S<sup>9</sup>, the abnormalities of blood lipids are related mainly to different dietary habits of people, lifestyle and heredity along with the other factors. Obese people seem to have an adverse pattern of plasma lipoproteins. This is manifested by low concentration of HDL cholesterol, increased LDL cholesterol concentration. This could be due to increase in adipocyte mass and accompanying decrease in insulin sensitivity associated with obesity has multiple effects on lipid metabolism. More free fatty acids are delivered from the expanded adipose tissue to the liver where they are re-esterified in hepatocytes to form triglycerides, which are packaged into VLDL for secretion into the circulation. High dietary intake of simple carbohydrates also drives hepatic production of VLDL, leading to increase in VLDL and/or LDL. In some obese individuals Plasma HDL-C tends to be low in obesity.<sup>9</sup>

Hilal Y<sup>10</sup> et al reported in their study that low HDL-C, high LDL-C and high TG level are positively associated with an increase in BMI.

P Kopelman<sup>11</sup> et al reported alteration in lipid profile associated with obesity Dyslipidemia progressively develops with increasing abdominal fatness and body mass index. With elevated LDL concentrations as well as high concentrations of TG coronary heart disease risk rises.

PL Tornøe<sup>12</sup> et al reported obesity in women has been found to be strongly associated with elevated levels of TC, LDL-C and TG and lowered HDL-C. This correlation was strongest in women 35-54 years of age. He found significant association between BMI and TC, HDL-C, TG and LDL-C which was similarly observed in our study.<sup>12</sup> In agreement with our study, Oladipo A<sup>13</sup> et al shown significant increase in values of AI in women when compared with men ( $p < 0.05$ ).

Anupama Kamath<sup>14</sup> et al showed significant negative correlation of HDL-C with BMI in women of age group 18- 26 years which was similarly observed in present study.

CJ Ikewuchi<sup>15</sup> reported in their study that atherogenic indices are powerful indicators of the risk of heart diseases, the higher the value the higher the risk of developing cardiovascular disease & vice versa.

Our finding that increasing atherogenic index associated with an increase in BMI is an independent predictor of cardiovascular diseases extends the findings of previous ex vivo studies to obese humans. Collective information from various studies reflected that obesity is itself a significant predictor of cardiovascular diseases. Studies even revealed the adverse effect of abnormal blood lipid and lipoprotein levels in the pathogenesis & progression of atherosclerosis & cardiovascular diseases in obese women.<sup>13</sup>

## **Conclusion**

Body mass index as a simple, easy, accurate & age independent index with high applicability to screening over weight & obesity amongst current participants. Obesity, no doubt alters lipid profile. A triglyceride based index (AI) can significantly add value when assessing the cardiovascular risk in obese women. Thus from the present study atherogenic index can be regarded as the best predictor of cardiovascular diseases followed by abnormal blood lipid level. Hence dietary interventions and regular physical activity should be encouraged in obese women.

In future there is a scope for the study to find the risk of 'Metabolic syndrome' in apparently healthy obese subjects by doing insulin resistance and Glucose Tolerance Test (GTT).

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**Conflict of Interests:** None to declare

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**Table 1:** Comparison of parameters between control and group I

Parameters	Controls Mean $\pm$ SD	Group I Mean $\pm$ SD	't' Test	'p' Value
BMI Kg/m <sup>2</sup>	22.72 $\pm$ 2.46	30.94 $\pm$ 2.75	0.002	<0.01
TC mg/dl	175.40 $\pm$ 38.97	194.02 $\pm$ 26.76	0.04	< 0.05
HDL mg/dl	48.02 $\pm$ 9.70	37.75 $\pm$ 4.28	0.0028	<0.01
TG mg/dl	176.26 $\pm$ 77.03	109.25 $\pm$ 26.64	0.011	<0.05
LDL mg/dl	119.87 $\pm$ 32.90	98.90 $\pm$ 32.71	0.02	< 0.05
VLDL mg/dl	33.95 $\pm$ 16.08	21.20 $\pm$ 5.70	0.022	<0.01
AI	0.18 $\pm$ 0.22	0.33 $\pm$ 0.2	0.03	<0.05

Values are expressed as (mean  $\pm$  SD). \*p<0.05 significant, \*\*p<0.01 highly significant, \*\*\*p<0.001 very high significant. BMI- Body mass index, AI - Atherogenic index.

**Table 2:** Comparison of parameters between controls and group II

Parameters	Controls Mean $\pm$ SD	Group II Mean $\pm$ Sd	't' Test	'p' Value
BMI Kg/m <sup>2</sup>	21.80 $\pm$ 1.30	31.92 $\pm$ 3.74	2.3X10 <sup>-11</sup>	< 0.001
TC mg/dl	165.06 $\pm$ 38.20	188.61 $\pm$ 38.81	0.04	< 0.05
HDL mg/dl	40.06 $\pm$ 7.48	46.71 $\pm$ 10.86	0.02	< 0.05
TG mg/dl	127.39 $\pm$ 36.17	176.68 $\pm$ 98.64	0.03	< 0.05
LDL mg/dl	83.72 $\pm$ 30.92	108.24 $\pm$ 24.99	7.8X10 <sup>-2</sup>	< 0.001
VLDL mg/dl	25.22 $\pm$ 7.57	33.57 $\pm$ 19.54	0.06	> 0.05
AI	0.15 $\pm$ 0.2	0.17 $\pm$ 0.26	0.5	0.5

Values are expressed as (mean  $\pm$  SD). \*p<0.05 significant, \*\*p<0.01 highly significant, \*\*\*p<0.001 very high significant. BMI- Body mass index, AI - Atherogenic index.

**Table III:** Comparison of parameters between control and group III

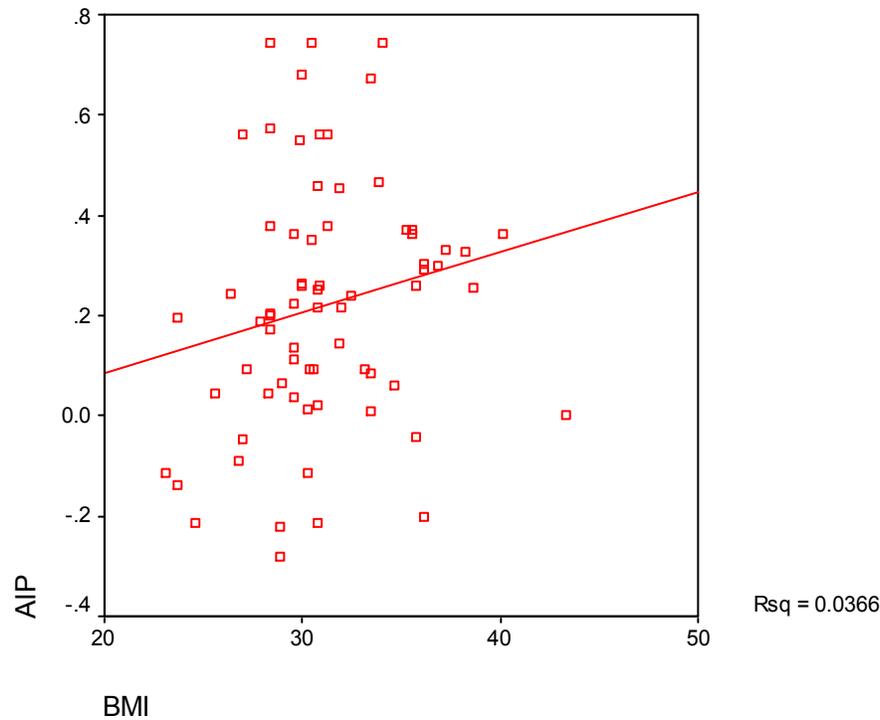
Parameters	Controls Mean $\pm$ SD	Group III Mean $\pm$ SD	't' Test	'p' Value
BMI Kg/m <sup>2</sup>	21.50 $\pm$ 2.28	30.92 $\pm$ 5.29	1.1X10 <sup>-8</sup>	< 0.001
TC mg/dl	162.45 $\pm$ 54.43	190.76 $\pm$ 49.22	0.04	< 0.05
HDL mg/dl	37.90 $\pm$ 3.11	47.22 $\pm$ 11.94	1.3X10 <sup>-3</sup>	< 0.001
TG mg/dl	122.45 $\pm$ 35.81	214.41 $\pm$ 115.74	1.2X10 <sup>-3</sup>	< 0.001
LDL mg/dl	100.10 $\pm$ 43.56	127.07 $\pm$ 45.89	0.03	< 0.05
VLDL mg/dl	25.05 $\pm$ 6.70	37.09 $\pm$ 23.69	0.01	0.01
AI	0.19 $\pm$ 0.21	0.26 $\pm$ 0.26	0.05	0.05

Values are expressed as (mean  $\pm$  SD). \*p<0.05 significant, \*\*p<0.01 highly significant, \*\*\*p<0.001 very high significant. BMI- Body mass index, AI - Atherogenic index.

**Table IV:** Comparison of parameters between control and group IV

Parameters	Controls Mean $\pm$ SD	Group IV Mean $\pm$ SD	't' Test	'p' Value
BMI Kg/m <sup>2</sup>	21.62 $\pm$ 2.52	31.92 $\pm$ 4.68	7.4X10 <sup>-7</sup>	<0.001
TC mg/dl	170.67 $\pm$ 37.77	196.66 $\pm$ 32.31	0.03	< 0.05
HDL mg/dl	38.92 $\pm$ 6.93	44.59 $\pm$ 8.81	0.03	< 0.05
TG mg/dl	113.50 $\pm$ 25.90	192.72 $\pm$ 87.65	1.4X10 <sup>-2</sup>	< 0.001
LDL mg/dl	108.42 $\pm$ 20.41	92.78 $\pm$ 24.71	0.03	< 0.001
VLDL mg/dl	22.50 $\pm$ 6.93	35.41 $\pm$ 18.09	8X10 <sup>-2</sup>	< 0.001
AI	0.18 $\pm$ 0.21	0.24 $\pm$ 0.25	0.05	0.05

Values are expressed as (mean  $\pm$  SD). \*p<0.05 significant, \*\*p<0.01 highly significant, \*\*\*p<0.001 very high significant. BMI- Body mass index, AI - Atherogenic index.

**Figure 1:** Correlation between BMI and Atherogenic index in obese group