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Original Research Article

Impact of obesity on atherogenic index in young adult females in Gadag, Karnataka

Margaret Mary M.*, Jayalakshmi M. K.

Department of Physiology, Gadag Institute of Medical Sciences, Gadag, Karnataka, India

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***Correspondence:**
Dr. Margaret Mary M.,
E-mail: margaretmarym@gmail.com

ABSTRACT

Background: Obesity is one of the most blatantly apparent, yet most disregarded, public health challenges in the present times. The prevalence of abdominal obesity in India was resolved to be 40% in females in India in the NFHS 5 survey. The gynaecological and reproductive fitness of women living with obesity is significant with changes demanded for precautionary health screenings. Obesity is a significant hazard factor for and contributor to accelerated morbidity and mortality, originally from cardiovascular complications and metabolic disorders. The rise in cardiovascular events has demanded the identification of practicable predictors that can assist in foretelling atherogenicity.
Methods: This cross-sectional study was done between May 2022 to April 2024, in Gadag Institute of Medical Sciences, Gadag which comprised 240 female participants between the age of 18-40 years who were overweight/obese. Anthropometric parameters were measured and serum levels of lipid profile parameters were analysed Atherogenic Index was calculated.
Results: Fat mass showed the strongest correlation with atherogenic index (r = 0.261), followed by fat mass index (r = 0. 257), BMI (r = 0.167) and body fat index (0.141). Free fat mass showed the least correlation (r = -0.074).
Conclusions: Obesity and raised anthropometric parameters lead to an unfavourable lipid profile pattern and raises values of the atherogenic index.

Keywords: Anthropometry, Atherogenic index, Lipid profile, Obesity

INTRODUCTION

Obesity is a hastening challenge in India, the percentage of women who are overweight or obese has expanded to 40 according to NFHS-5 survey.[1] Obesity not only dispose to CHD and stroke, they are also associated with dyslipidaemia, metabolic syndrome and many gynaecological problems including infertility. Body mass index (BMI) is widely used as a marker of adiposity, as it is economic and it correlates well with body fatness.[2] But it shows heterogenicity at individual level and precision of BMI is narrower in Asian Indians compared to Caucasians.[3]

Total absolute fat is most often assessed by Body Mass Index (BMI), whereas abdominal fat is most often assessed with Waist Circumference (WC). Waist-to-height ratio (WHR) has also been proposed as a measure of obesity that takes the bodily distribution of fat into account in a way that BMI does not.[4] Body Fat Percentage (BF%) has been associated with metabolic dysregulation regardless of body weight. The FMI has been suggested to be a better marker than BMI or BF% when screening for metabolic syndrome as it is adjusted for a parameter of body size such as height, not related to fat mass.[5]

Various lipid profile derangements have been observed in obese individuals, including elevated cholesterol, triglycerides, high-density lipoprotein cholesterol (LDL) levels and lower high-density lipoprotein (HDL) cholesterol levels. Of these indicators, changes in triglyceride and HDL cholesterol levels are more consistent and pronounced.[6] Atherogenic Index of Plasma (AIP) is a strong indicator to predict the cardiovascular complications and development of atherogenicity. AIP mirrors the authentic linkage between protective and atherogenic lipoprotein. AIP is computed corresponding to the formula, log (TG/ HDL-C).[7]

Very few studies are present on anthropometric measurements as a screening method to predict dyslipidaemia and cardiovascular complications and even fewer studies have solely targeted the young adult female population of India. A valid screening test would help in forecasting the obesity pandemic and coronary artery disease (CAD). Timely and fervent efforts in women of reproductive age group will ensure a better health outcome for the future mother and her child.

METHODS

This cross-sectional study was done between May 2022 to April 2024, which comprised of 240 overweight or obese young adult females aged between 18-40 years. The subjects were volunteering young adult females attending the General Medicine Outpatient Department and staff at Gadag Institute of Medical Sciences, Gadag, Karnataka. The study was performed in accordance with the approval of the Institutional Ethics Committee (GIMS/IEC/19/22), and informed written consent was taken from all subjects.

Inclusion criteria

Asymptomatic, apparently healthy overweight/obese females in the age group of 18 to 40 yrs were included.

Exclusion criteria

History of diabetes mellitus, hypertension, coronary heart disease, thyroid disorder and females on oral contraceptive pills, or any other drugs which may influence lipid profile were excluded.

Methods of collection of data

A questionnaire form was designed for the study, which included age, marital status, family size, diet, any medications, and history of previous hospitalization if any. A complete physical and systemic examination was carried out on each subject. The collection of blood samples, which is an invasive procedure to be performed in the study, was explained to the subjects. The volunteers were asked to do overnight fasting, and the blood sample was collected the next day morning. Informed consent for the procedure was taken prior to the collection. They were advised to continue their normal daily diet and working routine.

Anthropometric data

Measurements were taken while subjects were relaxed, standing erect and had their arms at their sides and feet together. Body height was measured in meters (m) by a wall-mounted Stadiometer. Body weight was recorded in kilograms (kg) by clinical weighing machine, with subjects dressed in light clothes and no shoes. BMI was calculated as per the formula: Weight (Kg)/Height(m)^2 (Quetelet's Index). Waist and hip circumference (cms) were measured using a plastic measuring tape. Waist-hip ratio (WHR) was calculated as per the formula: Waist Circumference/hip circumference. Skin fold thickness was taken from four sites in mm. Body fat percentage (BF%) was calculated by using the Durbin and Womersley formula: Body density = 1.1599-(0.0717 x log of the sum of all 4 skin fold measurements).[8]

BF% = (4.95 / body density-4.50) x 100

Fat mass was calculated as FM = Weight/100 x BF% and expressed in kgs.

Fat free mass will be calculated as FFM = Weight - Fat mass.

Fat mass index will be calculated from Fat mass in (kg)/Height in (m^2).[9]

An 3ml of blood collected in a plain vacutainer was allowed to clot and serum was separated after centrifugation at 3,000 RPM for 10 minutes. The lipids and lipoproteins were measured immediately using an automated chemical analyzer (Abbott ci 4100). Total cholesterol, triglycerides, LDL-C, HDL-C and VLDL-C were measured parallel with control samples. The atherogenic index of plasma was calculated from TG/HDL-C.

Statistical analysis

Statistical analysis was completed using IBM SPSS Statistics 20. Simple descriptive statistics (mean and Standard Deviation; SD), were used to describe the observed variation in lipids and lipoproteins in the study. Pearson's correlation analysis was done to study the correlation between anthropometric parameters and the atherogenic index of plasma.

RESULTS

The present study had a total of 240 participants with BMI ≥25.0 kg/m^2. The descriptive statistics of mean values of anthropometric parameters are shown in Table 1.

Table 1: Mean values of anthropometric parameters.

Parameter	Mean	Standard deviation
Age (yrs)	27.51	6.07
Height (cm)	155	0.06
Weight (kg)	66.18	5.45
BMI (kg/m^2)	27.52	2.12
WC (cm)	93.89	8.20
HC (cm)	112.93	67.44
WHR	0.88	0.05
Body fat %	35.33	3.27
Fat mass (kg)	23.45	2.71
Free fat mass (kg)	42.79	4.52
Fat mass index (kg/m^2)	9.77	1.24

Table 2: Mean values of lipid parameters.

Parameter	Mean	Standard deviation
Total cholesterol (mg/dl)	176.89	70.45
Triglyceride (mg/dl)	157.80	80.80
HDL-C (mg/dl)	47.33	18.58
LDL-C (mg/dl)	94.50	34.30
VLDL-C (mg/dl)	42.62	21.24
Atherogenic index	3.49	2.18

Table 3: Correlation of various anthropometric measurements with atherogenic index.

Parameter	r value	P value
BMI (kg/m^2)	0.167	0.010
WC (cm)	0.086	0.186
HC (cm)	-0.009	0.888
WHR	0.061	0.346
Body fat %	0.141	0.029
Fat mass (kg)	0.261	0.000
Free fat mass (kg)	-0.074	0.255
Fat mass index (kg/m^2)	0.257	0.000

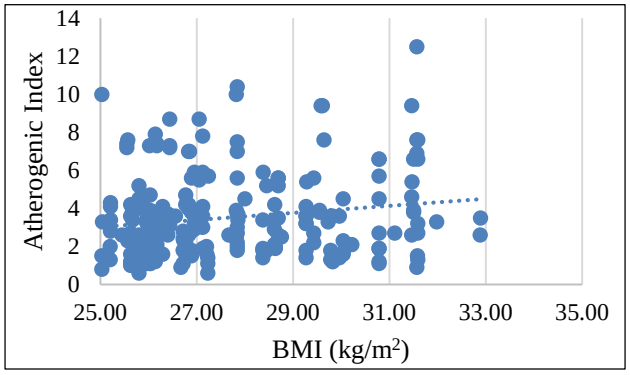

Figure 1: Scatter diagram showing BMI and atherogenic index.

The mean values of serum total cholesterol (TC), serum triglycerides (TG), HDL-C, LDL-C, VLDL-C and atherogenic index is shown in Table 2. It showed a statistically significant higher value of various lipid parameters like triglycerides (TG) and VLDL-C in overweight or obese individuals. Correlation between anthropometric measurements and atherogenic index of plasma in the subjects (Table 3).

Figure 1, 2 and 5 showed the linear correlations between atherogenic index and three anthropometric parameters BMI, waist hip ratio and free fat mass respectively which was not significant ($p>0.05$).

Figure 3, 4 and 6 showed the linear correlations between atherogenic index and anthropometric parameters body fat percentage, fat mass and fat mass index respectively which was a significant positive correlation ($p<0.05$).

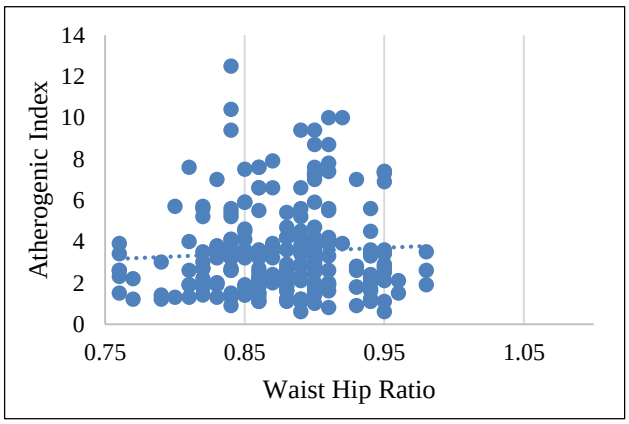

Figure 2: Scatter diagram showing waist hip ratio and atherogenic index.

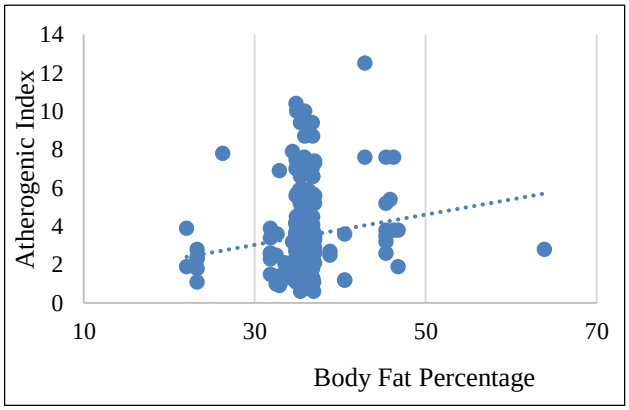

Figure 3: Scatter diagram showing body fat percentage and atherogenic index.

DISCUSSION

Recent research has shown accelerating trends with increased incidence of obesity among young adults. Our study showed a statistically significant higher value of various lipid parameters like triglycerides (TG) and VLDL-C in overweight or obese individuals. These results are in accordance with a cross-sectional study

done during 2016-2017 by Gayathri et al which showed a statistically significant association between lipid profile and measures of adiposity.[10]

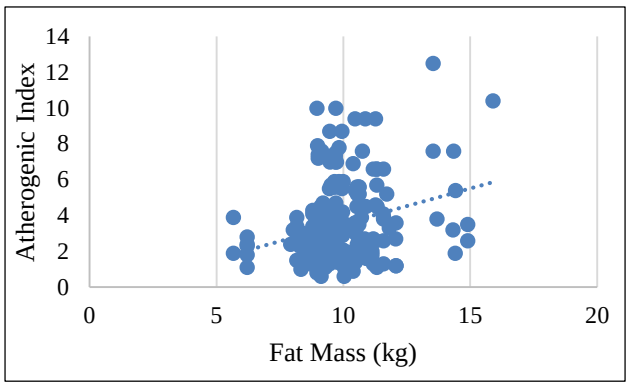

Figure 4: Scatter diagram showing fat mass (kg) and atherogenic index.

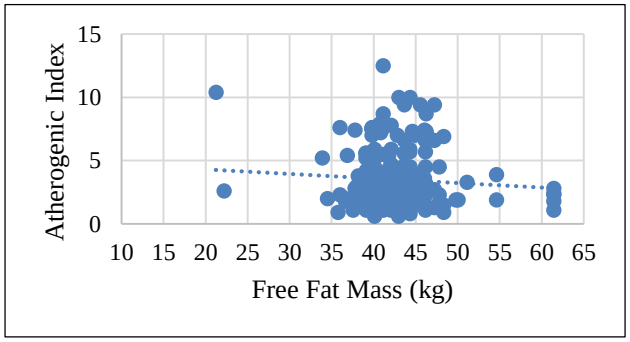

Figure 5: Scatter diagram showing free fat mass (kg) and atherogenic index.

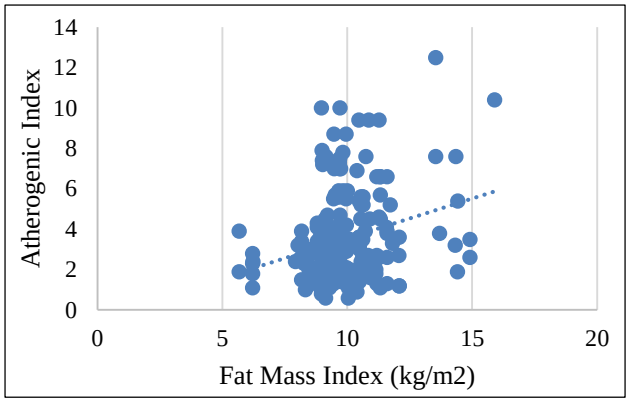

Figure 6: Scatter diagram showing fat mass index (kg/m2) and atherogenic index.

Another cross-sectional study in females done by Mudabasappagol et al also revealed that LDL-C values were significantly associated with obesity.[11] Studies have demonstrated that in cases when the conventional lipid profile parameters (TG, HDL-C, LDL-C, and TC) continue as normal, lipoprotein ratios such as atherogenic index of plasma are the diagnostic alternatives that have been shown in screening the risk of developing cardiovascular events.

AIP, a new marker of atherogenicity, is directly related to the risk of atherosclerosis. People with high AIP have a higher risk of coronary heart disease than those with low AIP, and vice versa. The study by Ezeukwu et al showed a significant correlation ($p<0.000$) was obtained between each of the anthropometric and AIP.[7]

Obesity is associated with several co-morbid conditions: dyslipidaemia, hypertension, hyperglycaemia, non-alcoholic fatty liver disease (NAFLD) and a conglomeration of conditions known as metabolic syndrome. There is an increased incidence of dyslipidaemia in the population of developed countries. However, prevalence varies depending on the ethnic group studied. There is a wide variation in the prevalence of dyslipidaemia in India depending on habitat, socioeconomic stratum and lifestyle practices.[12]

Our study showed a significant increase in mean values of triglycerides and VLDL-C levels and a significant correlation between BMI, body fat percentage, fat mass and fat mass index ($p\leq0.05$).

For a candidate who is genetically vulnerable to weight gain and who leads a sedentary and unhealthy lifestyle, the risk of becoming obese is on the higher end. Oestrogen promotes the accumulation of subcutaneous fat, and the loss of oestrogen with menopause is associated with an increase in central fat. Visceral fat varies inversely with oestrogen levels. When oestrogen levels become sufficiently low visceral fat accumulation occurs in females.[13]

The hallmark of dyslipidaemia in obesity is hypertriglyceridemia in part due to increased free fatty acid (FFA) fluxes to the liver, which leads to hepatic accumulation of triglycerides (TG). Dyslipidaemia, particularly hypercholesterolemia and atherogenic dyslipidaemia, have been closely implicated in the pathogenesis of coronary heart disease (CHD). A great deal of attention has been recently given to Asian Indians because of the high prevalence of CHD in this ethnic group.[14]

The strengths of our study is the specific age group and gender recruited in the study was less involved in similar studies. The simultaneous evaluation of BMI, and other anthropometric parameters helped in reducing the variation due to body fat distribution. The evaluation of other lipid parameters other than atherogenic index also gave an idea of the overall lipid profile status of the individual. The limitations of our study are the lack of testing the diabetic profile and other endocrine profile of the individuals. We have relied on the medical history. The lack of comparison with healthy individuals makes it difficult to convey how much change is present for

parameters. The lack of collection of blood based on menstrual cycle day is also posing a limitation.

CONCLUSION

Overweight and obese young adult female subjects show a significant increase in the serum levels of triglycerides and VLDL-C with high atherogenic index. Several factors including rapid urbanization, demographic changes, rural-to-urban migration, faulty diets, sedentary lifestyle, socio-cultural factors along with genetic predisposition have emerged as major contributory factors. Prompt and upfront interventional measures like increase in physical activity and exercise, healthy dietary habits and regular surveillance are required to prevent development of irreversible dangerous health complications.

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Ethical approval: The study was approved by the Institutional Ethics Committee (GIMS/IEC/19/22)

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