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Association between Body fats distribution and Body mass index with Lipid profile in young adults

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ABSTRACT: Abnormal lipid metabolism can lead to obesity which in turn can predispose to certain diseases like hypertension, coronary artery disease (CAD), diabetes mellitus and Hepato-biliary disease. The development of obesity and the onset of dyslipidemia depend on both genetic predisposition and lifestyle habits, including diet, caloric expenditure with physical activity, among others. The study aims to determine the relationship of BMI with body fat%, visceral fat, skeletal muscle fat % & lipid profile; visceral fatwith serum lipid profile in young adults.This cross-sectional study was carried out on 128 volunteers (84 males and 44 females) in JNIMS hospital. Height and weight were measured and Body Mass Index (BMI) was calculated using Quetelet index. Body fat%, skeletal muscle fat% and visceral fat were measured by Bioelectrical Impedance (BI) method using OMRON-HBF-212(Body Composition Monitor). A fasting venous blood sample was drawn from volunteers for lipid profile.Data was analysed using SPSS version 22. The association between variables was determined using ANOVA and p value less than 0.05 was considered statistically significant.The study showed a significant association of Body fat% ($p<0.001$), visceral fat ($p<0.001$) &skeletal muscle fat% ($p<0.001$) with BMI in all the volunteers. There was a significant association between BMI and Triglycerides (TG), Total cholesterol (TC) and Very low density lipoprotein (VLDL) in females, while in males significant association was seen between BMI and High density lipoprotein (HDL), Low density lipoprotein (LDL) and VLDL. The study also showed statistically significant association between Visceral Fat (VF)and HDL and VLDL in both males and females. There was also significant association of VF with TG in females.The study showed a significant association between BMI and body fat%, visceral fat and skeletal muscle fat% and also showed a significant association of BMI & VF withLipid profile, which is more in males as compared to females. This may lead to increased risk for the development of obesity related health problem and thus arise the need for life style modification and maintaining a healthy lifestyle.

Keywords: Body Mass Index, Obesity, Body fat%, visceral fat, skeletal muscle fat%, lipid profile.

I. INTRODUCTION

Obesity has become an increasingly important medical concern associated with increase in incidence of metabolic and cardiovascular co-morbidity and mortality. When there isexcess accumulation of fat, lipid metabolism become abnormal.Abnormal lipid metabolism can lead to obesity which in turn can predispose to certain diseases like hypertension, coronary artery disease (CAD), Diabetes Millitus and Hepato-biliary disease. [1, 2].Genetic predisposition and lifestyle habits, including diet, caloric expenditure with physical activity may play an important role in the development of obesity and onset of dyslipidemia.

Dyslipidemia is considered as a prominent risk factor for cardiovascular diseases especially in obese individual.The anatomical fat distribution seems to plays a major role in dyslipidemia with central fat deposition beingassociated with abnormal lipid profile and increased risk of atherosclerosis and CVD. [3,9]

BMI increases with increased in weight which may be due to excess accumulation of the body fat so BMI is a useful indicator of individual well-being.While Body Mass Index(BMI) greatly increases with obesity, due to differences in body composition, their indicators of body fat provide more precise results, as individuals with more muscle mass or larger bones will have higher BMI [4].

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When there is accumulation of visceral fat, liver function and certain composition of blood can be deranged such as glucose, lipid which can lead to T2DM and cardiovascular diseases. [5,6].

People with visceral obesity usually had alteration in serum biochemical parameters, such as impaired fasting glucose, abnormal liver function and dyslipidaemia [5,7]. Serum lipid profile is one of the indicator of altered lipid metabolism which may lead to various diseaseslike coronary artery disease(CAD), Diabetes etc. [1,2].

Studies have suggested that the relationship between obesity and developing cardiovascular diseases begins early in life[8]. Early indicators or risk factors like obesity, altered lipid profile for development of these various diseases needs to be identified early and preventive measures should be taken for controlling various risks factors at the earliest[21]. In thepresent study, we aim to determine the association between BMI with body fat%, visceral fat, skeletal muscle fat % & lipid profile, and also the association between visceral fat and serum lipid profile in young adults and also find out if both males and females are affected in the same way or differently.

II. MATERIAL AND METHODS

This cross-sectional study was conductedat Jawaharlal Nehru Institute of Medical Sciences (JNIMS), Imphal, Manipur during the period from March to August 2019.A total of 128 volunteers, 84 males with mean age of 26.46±8.02 years and 44 females with mean age of 27.93±9.25 years were recruited from among the staffs and students of JNIMS hospital.The Institute Ethical Committee clearance was taken from the Institutional Ethics Committee (IEC) of the Institute. An informed written consent was taken from all the volunteers before the recruitment of the study.

All volunteers without the history of diabetes mellitus, hypertension, coronary artery disease (CAD) and endocrinopathy were included in the study. Weight was measured by using a standard weighing machine without shoes to the nearest 0.5Kg and height was measured by using a height meter without shoes to the nearest 0.5cm.BMI (kg/m^2) was calculated using Quetelet index and WHO classification was used for interpretation of the findings[4].

Subjects were classified according to their Body Mass Index (BMI) as-

1. Underweight:<18.5 Kg/m^2
2. Normal weight: 18.5-24.9 Kg/m^2
3. Overweight: 25-29.9 Kg/m^2
4. Obese: ≥ 30 Kg/ m^2

Body fat%, visceral fat and skeletal muscle fat% level were measured by Bioelectrical Impedance (BI) method by using OMRON-HBF-212 (Body Composition)and was measured 2 hours after breakfast, with the subjects in a standing position without shoes, wearing light clothes. The obesity classification value advocated by Nagamine (in 1972) and Lohman (in 1986) was used in reference[9,10].

For estimation of lipid profile, a morning venous blood sample was taken after an overnight fast of at least 12 hours. Total cholesterol, serum triglycerides, serum HDL, serum LDL & serum VLDL were estimated. Serum Lipid profile estimation was done by Enzymatic Colorimetric Test by using Kits marketed by Medsource Ozone Biomedicals Pvt. Ltd. Quantitative estimation of serum triglycerides was done by method adopted by Bucolo G and Harold D (1973) using liquizone triglycerides- MR. Estimation of total cholesterol was carried out by the enzymatic method described by Allain CC etal (1974) using liquizone Cholesterol & HDL Cholesterol – MR [11].

Figure-1 Body Fat% classification according to Omron Healthcare:

Body Fat% classification	Male	Female
-(low)	5.0 to 9.9 %	5.0 to 19.9 %
0 (Normal)	10.0 to 19.9%	20.0 to 29.9%
+ (High)	20.0 to 24.9%	30.0 to 34.9%
++ (Very High)	25.0 % to	35.0 % to

Figure-2 Visceral Fat Level according to Omron Healthcare:

Level classification	Visceral Fat Level
0(Normal)	1 to 9
+ (High)	10 to 14
++ (Very High)	15 to 30

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Figure-3 Skeletal Muscle Fat % classification according to Omron Healthcare Figures:

Skeletal Muscle Fat % classification	Male	Female
Low	5.0 to 32.8	5.0 to 25.8
Normal	32.9 to 35.7	25.9 to 27.9
High	35.8 to 37.3	28.0 to 29.0
Very High	37.4 to 60.0	29.1 to 60.0

III. STATISCAL ANALYSIS

Data was analysed using IBM Statistical Package for Social Sciences (SPSS) Version 22.0. The association between variables was determined using ANOVA. p value less than 0.05 was considered statistically significant.

IV. RESULTS

A total of 128 volunteers were screened among the staffs & students of JNIMS. In the present study, 84 males with mean age of 26.46±8.02 years and 44 females with mean age of 27.93±9.25 years were recruited.

The mean value of the various variables assessed is shown in [Table 1]. The study showed a significant association of Body Fat% ($p<0.001$), skeletal muscle Fat% ($p<0.001$)& Visceral fat ($p<0.001$) with BMI in both males and females.

As shown in [Table2], there was a significant association between BMI and TG ($p=0.001$), TC ($p=0.005$) and VLDL ($p=0.012$) in females and there was also significant association between BMI and HDL ($p<0.001$), LDL ($p=0.007$) and VLDL ($p<0.001$) in males.

[Table3]shows the association of Visceral Fat level with lipid profile. Significant association of visceral fat level with TG ($p=0.007$), HDL ($p=0.003$), VLDL ($p=0.041$) was seen in females while significant association of VF level with HDL($p<0.001$) and VLDL($p=0.033$)was seen in males.

BMI	Body fat%		Skeletal Muscle fat %		Visceral fat	
	Male (n=84)	Female (n=44)	Male (n=84)	Female (n=44)	Male (n=84)	Female (n=44)
Underweight	20.62±7.06	29.29±4.38	36.38±5.79	27.33±2.01	3.35±2.97	4.39±1.82
Normal	29.01±8.14	36.02±2.21	30.21±6.49	24.46±.913	9.40±.516	9.20±9.19
Overweight	33.48±5.20	38.50±.000	27.82±4.58	23.00±.000	12.00±.877	13.00±.000
Obese	42.88±1.84		21.09±.927		19.23±4.51	
P value	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***

[Table 1]: Association between Body Mass Index and Body fat%, Skeletal muscle fat% and visceral fat in both male and female.
*p<0.05, ***p<0.001

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BMI	TG(mg/dl)		TC(mg/dl)		HDL(mg/dl)		LDL(mg/dl)		VLDL(mg/dl)	
	Male (n=84)	Female (n=44)	Male (n=84)	Female (n=44)	Male (n=84)	Female (n=44)	Male (n=84)	Female (n=44)	Male (n=84)	Female (n=44)
Under Weight	21.41±20.29	23.23±28.42	17.05±15.91	14.10±2.55	41.59±9.64	45.29±10.26	63.41±16.55	74.68±20.56	41.40±45.53	24.64±5.90
Normal	22.00±7.15	43.00±42.60	14.40±4.17	38.40±40.56	44.80±11.84	44.30±10.05	60.70±22.29	61.00±33.50	44.00±14.29	19.50±1.35
Overweight	30.00±29.39	97.00±.000	14.79±3.62	16.00±.000	46.57±10.28	58.00±.000	71.64±37.99	87.00±.000	35.64±16.53	19.00±.000
Obese	27.62±22.15		18.54±5.10		59.92±5.15		93.15±37.43		34.92±16.44	
P value	0.560	0.001*	0.782	0.005*	<0.001**	0.103	0.007*	0.164	<0.001**	0.012*

[Table 2]: Association between Body Mass Index and TG, TC, HDL, LDL, VLDL in both male and female.
TG- Triglyceride, TC- Total cholesterol, HDL- High density lipoprotein, LDL- Low density lipoprotein, VLDL- Very low density lipoprotein.
*p<0.05, ***p<0.001

VF level	TG(mg/dl)		TC(mg/dl)		HDL(mg/dl)		LDL(mg/dl)		VLDL(mg/dl)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Normal	22.47±20.48	25.94±31.15	17.28±16.19	20.83±23.42	41.17±10.27	43.86±10.16	63.44±17.50	71.08±21.32	32.29±12.39	23.89±5.80
High	25.14±21.55	63.38±44.23	15.64±4.70	14.88±3.44	47.96±10.27	55.25±3.37	75.57±35.10	78.38±35.10	52.54±50.62	19.50±1.30
Very high	27.80±25.58		46.30±3.27		59.30±5.79		76.70±23.77		29.20±14.24	
P value	0.756	0.007*	0.858	0.481	<0.001**	0.003*	0.173	0.445	0.033*	0.041*

[Table 3]: Association between visceral fat and TG, TC, HDL, LDL and VLDL in both male and female. TG- Triglyceride, TC- Total cholesterol, HDL- High density lipoprotein, LDL- Low density lipoprotein, VLDL- Very low density lipoprotein
*p<0.05, ***p<0.001

V. DISCUSSION

In the present study as shown in Table 1, there was significant association between BMI and Body Fat% (p<0.001), Skeletal Muscle Fat% (p<0.001), Visceral Fat level (p<0.001) in both males and females. In table 2, there was a significant association between BMI and HDL, LDL and VLDL in males. Significant association was seen between BMI and TG, TC and VLDL in females. Table 3 shows a significant association between visceral fat and TG, HDL and VLDL in females. There was a significant association between visceral fat and HDL and VLDL in males.

In the present study as shown in [Table1], there was significant association between BMI and Body Fat% (p<0.001), Skeletal Muscle Fat% (p<0.001), Visceral Fat level (p<0.001). This may be suggestive of a corresponding increase in the BF%, Visceral Fat % with increased in BMI and thereby leading to increased risk for development of obesity related health problem and need for life style modification and maintaining a healthy lifestyle. According to a study done by Deurenberg-Yap M et al., in immigrants of Singaporewho are from different ethnic groups, the Indians have the highest BF% in comparison to muscle mass [12]. Another study done on Indian people, found a higher BF% and risk factors like hypertension and type 2 diabetes at normal range BMI proposed by the WHO [4,13].

As shown in the [Table 2], there was significant association between BMI and HDL in male. Similar to our finding Despres et al., showed similar results showing association between BMI and HDL, as men generally have more abdominal fat than women, the association between BMI and HDL cholesterol level was stronger in men than in women [14]. In contrast to our study Hu et al., showed the association between BMI and waist circumference had more adverse effects on TG and HDL in men[15].In the present study, there is significant association between BMI and HDL,

LDL and VLDL in male, while in females there was significant association between BMI and TG, TC and VLDL.In another study by Despres at el., found that obese women had significantly higher plasma levels of TG, LDL and VLDL cholesterol level as compared to non-obese controls[14].

In our study, [Table 3], there is a significant association between visceral fat and TG, HDL, VLDL in females. In male there was significant association between VF and HDL & VLDL. Similar to our study, Huang et al also demonstrated the positive association between serum TGs level and visceral fat among nondiabetic obese subjects[16]. This association between TGs and VAT accumulation in visceral obesity may be due to increased TG production and impaired clearance of TGs from the circulation[5,17,18]. The hyper-lipolytic state in visceral obesity may cause increasing influx of fatty acid into liver and result in the overproduction of TGs[19].

Studies have found major correlates of various atherothrombotic and inflammatory metabolic abnormalities with excess of visceral adipose tissue (VAT) accumulation [20] though the exact mechanism is not known, metabolism of glucose and lipid can be altered when there is accumulation of abdominal fat. Anandkumar et al., in their study included that measures of central obesity are more reliable for predicting Atherogenic index of plasma (AIP) compared to traditionally and BMI in young adult females [21]

According to portal hypothesis, VAT being highly lipolytic, there is increased delivery of free fatty acid into the portal circulation leading to increase production of VLDL that is rich in TG, decreased insulin sensitivity, enhance gluconeogenesis and hepatic insulin resistance. This will lead to impaired glucose tolerance (IGT) and diabetes[22,23].

Study by Peiris et al., showed thatone of the risk factor of CVD is visceral fat deposition. [24]. It is found that visceral fat accumulation occurs more in males than females[25,26] and visceral fat increases in both sexes with age. [5,27]. This could be a major factor in the difference found in the association of level of fatness and metabolic complications in different sex.

Diet can induce dyslipidemia. Lipoprotein A level can be increased when there is more consumption of diet rich in trans fatty acids. Elevation of Lipoprotein A level can lead to development of CHD[28].

VI. LIMITATION

The study sample size could have been larger which could help in generalizing the results of our current work.

VII. CONCLUSION

In the present study, significant association was found between BMI and body fat%, visceral fat and skeletal muscle fat% in both male and female volunteers. When there is increase in body fat%, visceral fat and skeletal muscle fat%, BMI will be increased and this may lead to higher risk for development of obesity and other metabolic syndrome. We can also conclude that the association between BMI and VF level with serum lipids profile is stronger in males as compared to female volunteers in this study, which can increase the risk of insulin resistance, diabetes, hypertension, dyslipidemias and atherosclerosis. Thus, the need for early identification of obese individuals with excess visceral fat, which may help in the prevention and management of obesity related health risks.

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