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Percent Body Fat and Body Mass Index in Assessing Obesity: A Cross-Sectional Study Among the College Going Young Females of Lucknow

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Abstract:

Background : Body Mass Index (BMI) has limited diagnostic performance due to its inability to discriminate between Fat Mass(FM) and Fat Free mass(FFM).

Objectives: The study was conducted to study the correlation between BMI and Percent Body Fat(PBF) among college going young females of (18-21 years) residing in the city of Lucknow.

Materials and Methods : This was a cross-sectional study conducted in the city of Lucknow. 10 colleges from five regions namely North, West, East, South and Central were randomly chosen. BMI using standard techniques and PBF using skinfold measurements was used. Data was collected, tabulated and analyzed using SPSS 16.0 Karl Pearson (2. tailed) test was used to assess correlation.

Results : Mean age of participants was 19.41±1.17 years. Mean BMI (±SD) was 21.79 (±2.79) kg/m². whereas mean PBF was 30.66(±4.01)% and mean fat mass was 16.38 (±3.90). BMI & FM AND BMI & PBF were positively correlated with the Correlation Coefficient of 0.754 and 0.338 respectively, it was statistically highly significant with a P value < 0.001. Percent Body Fat is categorized as athletes with %fat of 14-20%, fitness 21-24%, acceptable 25-31% and obese>32% body fat. and the study concluded that maximum sample (49%) came under the category of obese when their PBF was compared with standards despite being under the normal BMI category

Conclusions : In this population we have found strong correlation between PBF and BMI but even falling under a normal BMI the subjects have excess PBF.

Keywords : Body Mass Index, Present Body Fat, Skinfold measurement

1. INTRODUCTION

Overweight and obesity defined as having body mass index (BMI) has a significant impact on health and has reached epidemic proportions, globally. Global Burden of Disease (GBD) 2013 study estimated that number of overweight and obese individuals has increased from 921 million in 1980 to 2.1 billion in 2013.[1] Worldwide, overweight and obesity is attributed to 3.4 million deaths and 3.8% of Disability Adjusted Life Years.[2] High BMI, both directly

and mediated through high blood pressure and cholesterol, is a major risk factor for cardiovascular deaths.[3]

BMI has been used traditionally as an anthropometric means of measuring generalized obesity due to its ease to use, low cost, and convenience. However, BMI does not reflect the adiposity or PBF. Central adiposity as measured by waist height ratio. Waist circumference, and PBF are known to be better predictor of diabetes and cardiovascular events than BMI.[4,5,6] Moreover, at same level of BMI, south Asians are believed to have high BF% (both central and generalized) and lesser lean, muscle and skeletal mass than Caucasians and thus being at a higher risk of cardiovascular events and deaths.

Despite the utility of measuring body composition to predict metabolic syndrome and cardiovascular diseases, data showing relationship between BMI and PBF in India and other similar South Asian countries is scarce.[7,8] In this context, it is important to understand the relationship between BMI and PBF in Indian population. This is of more importance among females as they have relatively higher PBF on a corresponding BMI as compared with males.[9] Since PBF is a better predictor of metabolic disorder than BMI alone, women are likely to be at more risk of metabolic disorders than men having similar BMI. However no study has been conducted in India to study this relationship specifically for young female adults (18-21 years). Knowledge regarding the relationship between BMI and PBF can be used to understand the utility of BMI as a predictor of cardiovascular morbidity among Indian female population.

There are various methods of assessing Percent Body Fat but in the current study, Skinfold Thickness measurements have been used to estimate Percent Body Fat, Fat mass and Fat Free Mass. College going girls of (18 to 21 years) residing in the city of Lucknow have been studied to calculate the mean PBF and to identify the relationship of BMI and PBF across various stratas of BMI.

2. MATERIALS AND METHODS

Study design and population

This was a cross-sectional study done on college going girls of (18-21 years) residing in the study area. The data was gathered from 5 different regions of Lucknow, namely North, South, East, West and Central and from each region 2 colleges were chosen from where 40 participants from each college were taken from the study.

Sample Size

The required sample size was calculated assuming unknown prevalence of 50% with 95 % confidence interval and 80% power. The required sample size was calculated to be of 400.

Study Procedures

From the five different regions of Lucknow namely North, South, East, West and central, a total of 10 colleges (2 colleges from each region were selected and 40 subjects from each college were randomly chosen who were of (18-21 years). Eligibility was assessed using following exclusion criteria; married girls living in hostel or PG, Girls on reducing diet. Eligible participants who consented for the study, their socio demographic information we

obtained using the interview schedule, then their anthropometric and body composition measurement were undertaken. Weight, height and PBF were measured using standardized equipment. Height was measured using a stadiometer (Seca) to the nearest 0.1 cm in standing position with no footwear. Weight was measured using an electronic scale (Seca 808 Germany). BMI was, thus, calculated using standard definition of weight (kg)/square of height (m) PBF was estimated using 4 sites skinfolds namely Triceps, Biceps, Subscapular and Suprailiac. The measurements were done using Harpenders Callipers. This was done during morning hours after ensuing that participants have not indulged in any vigorous physical activity.

Statistical analysis

Participants were classified as underweight (<18.5 kg/m^2), normal weight (18.5-24.9kg/m^2), overweight (25.0-29.9 kg/m^2), and obese (>30kg/m^2) based on consensus guidelines for diagnosis of obesity among Asian Indians.[10] Descriptive statistics was reported as mean±SD. Correlation between PBF and BMI and total body fat and BMI were calculated using Pearson's correlation coefficient (r) across various BMI categories. Along with BMI, PBF, Fat mass and Fat free mass were assessed. Statistical analysis of data was carried out using the SPSS-16 software for windows.

3. RESULTS

Descriptive Characteristics

A total of 400 college going girls were taken as samples

BMI	Frequency	Percent
Underweight	24	6.0
Normal weight	332	83.0
Pre obesity	40	10.0
Obesity class I	4	1.0
Total	400	100.0

Table 1: BMI categories and its frequency

Table 1 shows the different categories of BMI along with their frequency and percentages. 83% of the sample were found to be in the normal category amd only 10% were in preobese category.

Percent Body Fat	Frequency	Percent
Athletes	4	1
Fitness	20	5.0
acceptable	180	45.0
obese	196	49.0

Table 2: PBF category and its frequency

Table 2 depicts Percent Body Fat is categorized as athletes with %fat of 14-20%, fitness 21-24%, acceptable 25-31% and obese>32% body fat. this table shows that maximum sample (49%) came under the category of obese.

PARAMETERS	Mean	Standard Deviation
AGE	19.41	1.17
HEIGHT (cm)	156.05	7.77
WEIGHT (Kg)	53.21	8.72
BMI (Kg/mt2)	21.79	2.79
TRICEPS (cm)	2.03	.53
BICEPS (cm)	1.23	.43
SUPRAILIAC (cm)	2.39	.59
SUBSCAPULAR(cm)	1.98	.67
PERCENT BODY FAT	30.66	4.01
FAT MASS (kg)	16.38	3.90
FAT FREE MASS(kg)	36.83	5.76

Table 3: Consolidated table for Anthropometric and Body composition n=400

Mean age of participants was 19.41±1.17. Table 3 shows anthropometric and body composition of participants. Mean BMI was 21.79±2.79 whereas Mean Fat Mass and Percent Body Fat were 16.38 kg ±3.90 and 30.66% ±4.01 respectively.

Analysis of anthropometric and Body Composition characteristics with respect to BMI category revealed a highly significant (p value <0.001> increase in fat mass, and PBF with an increment in BMI category.

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	Body Mass Index								p-value
	Underweight		Normal weight		Pre obesity		Obesity class I		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Percentage BODY FAT	27.54	2.06	30.55	3.90	32.57	4.10	38.60	.00	<0.001

Applied one way ANOVA for significance. considered highly significant.

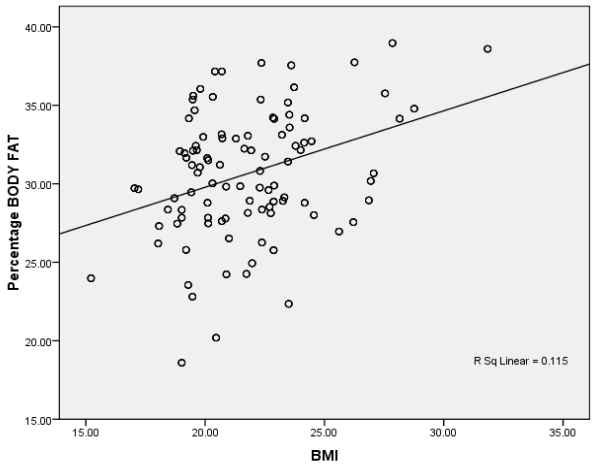
Table 4: Analysis of Anthropometric and Body Composition Characteristics with respect to BMI Category. It reveals a highly significant (P value<0.001) increase in percent body fat with an increase in BMI category.

Correlation between Body Mass Index and Percent Body Fat

		BMI	Percentage BODY FAT	FAT MASS	FAT FREE MASS
BMI	Pearson Correlation	1	.338**	.754**	.689**
	Sig. (2-tailed)		<0.001	<0.001	<0.001
	N	400	400	400	400

Table 5: Table 5 reports the Pearson's correlation coefficient for the relationship between BMI and PBF. There was a positive correlation between BMI and body composition factors with correlation coefficient of 0.338, 0.754 and 0.689; it was statistically highly significant with P value <0.001. Visual inspection of scatter plot of relationship between BMI and PBF is shown in Figure 1 and relationship between BMI and FM is shown in Figure 2

Figure 1: Scatter plot showing distribution of PBF with respect to BMI (overall)



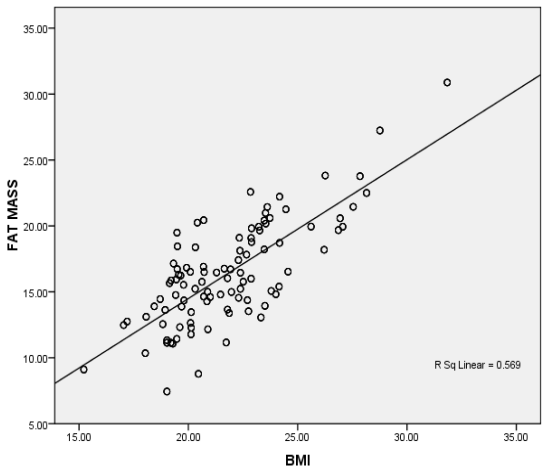


Figure 2; Relationship between BMI and Fat Mass

Figure 1 and Figure 2 shows the scatter plot for better visualization of percent body fat with different categories of BMI and Fat Mass with different BMIcategories respectively

4. DISCUSSION

The study mainly intended to assess the BMI and PBF and also understand the correlation between PBF and BMI measured by skinfold thickness of four sites. among college going girls of (18- 21 years) residing in the city of Lucknow. The correlation between BMI and PBF has been studied across various ethnic groups; particularly in Western countries.[11,12,13,14,15,16,17]. Thus, it is needed to understand the correlation between BMI and PBF in Indian Population, especially the targeted sample as they are future mothers and so the responsibility of bearing and nurturing the babies lies on their shoulders. Their health needs to be good for the purpose mentioned above.

In a study done among young adults of Sri Lanka, a strong and significant positive correlation was observed between BMI and PBF overall ($r= 0.82$, $P< 0.01$ among females). Similarly, the Pakistan study showed a positive correlation between BMI and PBF with $r= 0.74$, $P<0.01$. Other studies done among Caucasians and Blacks have also confirmed similar relationships. In the present study also, the relationship was significant across all the BMI categories. It was also reported that the relationship of BMI and Fat Mass was almost similar to the relation between BMI and PBF.

it was found that with the increase in BMI categories the PBF increases, on the contrary the sample group though falling under normal BMI category has PBF higher than the acceptable range and thus falling under the category of obese which makes a topic which need to be paid attention. Despite being of the normal BMI, their PBF is not normal. the participants fall under the category of preobese and obese when their PBF is taken into account. This was to be penned down in the present study that their diet and lifestyle need to be checked and monitored for more precise information.

5. CONCLUSION

Our results demonstrate a significant positive correlation between BMI and BF% using skinfold measurements among the college going girls of Lucknow. We could also establish the effect of age and level of BMI on the magnitude of correlation with maximum positive correlation of BMI and BF% in the youngest (18 years) age group and in individuals with high BMI, that is, obese (≥25 kg/m2). Our findings provide initial information on the relationship of BMI and BF% in the Lucknow city, which may be different from individuals of other ethnic groups and geographical regions. However, it is important to see whether assessment of BF% will be a feasible screening tool than BMI as a predictor of metabolic disorder. This study provides a platform for further research to provide more understanding in this context through prospectively planned longitudinal studies.

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