

A Descriptive Study to Assess Relationship between Body Fat Percentage and Obesity at a Tertiary Level Health Facility

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Abstract:

Introduction: The prevalence of obesity is increasing in Indian adults at alarming rate and causing high burden of chronic diseases due to relatively high Body Fat Percentage (BFP) compared to other ethnic groups. There is a dearth of studies on assessment of obesity by using BFP measurement. This study was undertaken to strength the reliability of BFP in assessment of obesity. **Objective:** To find out the relationship between body fat percentage and obesity among adults aged 18-59 years. **Method:** A total of 228 subjects were included in the study from the in-patients admitted to tertiary care hospital by systematic random sampling method. In the interview, socio-personal characteristics were collected using pre-tested, semi-structured questionnaire. Anthropometric measurements were conducted to calculate BMI based on Asia-Pacific classification and waist circumference based on International Diabetes Federation guidelines along with body fat percentage was measured using standard guidelines. The t- test, ANOVA and correlation was used to determine the relationship between obesity and BFP. **Results:** A significant association between Body Fat Percentage (BFP) and obesity measured by Body Mass Index (BMI) and Waist Circumference (WC) was observed across the categories and sex. Positive correlation was observed between BMI and waist circumference ($p < 0.001$), BMI and body fat percentage ($P < 0.001$) and waist circumference and body fat percentage ($P < 0.001$). **Conclusion:** The study shown significant association and positive correlation between body fat percentage and obesity measured by BMI and waist circumference at lower cut-off among Indian adults indicating BFP is a reliable measure for assessment of obesity.

Key words: Anthropometry, Body fat percentage, Body mass Index, Obesity, Waist circumference.

Introduction:

Obesity is an accumulation of excess fat which may leads to impairment of health and reduction in life expectancy.^[1] Global Burden of Disease (GBD) study estimated that number of obese individuals has increased from 921 million in 1980 to 2.1 billion in 2013. Globally, obesity leading to 3.4 million deaths and 3.8% of Disability Adjusted Life Years annually. The global obesity prevalence is predicted to reach 18% in men and over 21% in women by 2025 indicating

obesity is a major public health concern in the world.^[2-3]

In India, NFHS – 4 (2015-16) shown that the prevalence of obesity was 19.6% in men and 20.7% in women and prevalence is doubled in the past 15 years. The reason behind rapid increase in the prevalence is mainly due to modern lifestyle such as increase in sedentariness and consumption of energy rich food.^[4]

It is clear that obesity plays a major role in causing chronic diseases such as type II diabetes mellitus,

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hypertension, dyslipidemia, cancers and related cardiometabolic complications and the cost of medical care for obese patients is 30% higher compared to normal weight peers.^[5]

The evidence shows that South Asians (Indians) are having relatively high body fat percentage (BFP), lesser lean muscle and skeletal mass compared to other ethnic groups and prone for relatively higher risk of cardiovascular complications and premature death at lower cut-off for body mass index and waist circumference.^[6]

Majority of the studies in obesity used indirect measures of fat mass in the body such as BMI and waist circumference. Whereas, body fat percentage measurement using bio-electrical analysis is a simple, quick and non-invasive method for assessment of fat mass in defining obesity and finding the relationship between obesity and BFP will definitely strength the reliability of BFP in assessment obesity.^[7]

In the Indian adults, published data on relationship of BFP with obesity is limited. Such study act as a guidepost for future studies on assessment of obesity based on BFP. Because, the burden of obesity in India is increasing at faster rate compare to world average and needs urgent attention. In this context, the present study was undertaken to investigate the relationship between body fat percentage and obesity based on BMI and waist circumference

Method:

The present descriptive study was undertaken in a medical college hospital, Kempegowda Institute of Medical Sciences Hospital and Research Centre (KIMSH&RC) at Bengaluru by involving 228 adult in-patients (18 years to 59 years) from September to November 2016.

After obtaining institutional ethics committee clearance, study subjects were enrolled from the department of medicine by using systematic random sampling technique where every 5th ambulatory in-patient willing to participate were included and seriously ill patients were excluded. The sample of 228 was arrived at by considering prevalence of 17.17% with absolute precision of 5% and 95% confidence limits using the formula $n = 4 pq/L^2$.^[8]

The interview method was used to collect data on socio-personal characteristics by using a pre-tested, semi-structured questionnaire after obtaining

informed written consent from the subjects. Assessment of anthropometric measurements such as height, weight, waist circumference and percentage body fat were conducted using standard procedures and guidelines by trained medical investigator. The generalised obesity was assessed by using BMI based on WHO Asia-Pacific guidelines (overweight $>23\text{kg/m}^2$ and obesity $>25\text{kg/m}^2$) and an International Diabetes Federation (IDF) guideline was adopted to assess central obesity ($>90\text{ cm}$ for males and $>80\text{ cm}$ for females).^[9]

Body fat percentage was assessed by using Bio-electrical impedance analysis (BIA) method. In this method, body fat percentage was calculated by feeding details such as age, sex and height of each subject into the instrument OMRON body fat monitor (HBF-306) by undertaking required precautions.^[10]

The data was analysed using SPSS version 21.0, IBM Corp, Armonk, NY, USA. The ANOVA and t test were used to compare mean body fat percentage among different groups of BMI and WC. The t-test was used to compare mean body fat percentage of both sex with their BMI and waist circumference and correlation was used to find out the relationship between BMI, waist circumference and body fat percentage.

Results:

Out of 228 study subjects, 130 (57%) were males and 98 (43%) were females. The mean age of the study population was 36.9 ± 13 years, mean BMI and waist circumference was $23.8 \pm 4.7\text{ kg/m}^2$ and $83.1 \pm 10.2\text{ cm}$. Mean body fat percentage was 30.2 ± 7.9 . (Table 1)

Table 1: Baseline information of study subjects

| Variable | Mean \pm SD | |
|--------------------------|----------------|----------------|
| | Men | Women |
| Age (years) | 37.4 ± 7.2 | 36.1 ± 5.7 |
| Height (cm) | 167 ± 6.6 | 160 ± 4.5 |
| Weight (kg) | 67.4 ± 5.7 | 59.9 ± 5.6 |
| BMI (kg/m ²) | 24.1 ± 4.7 | 23.3 ± 4.4 |
| Waist circumference (cm) | 85.0 ± 6.2 | 79.5 ± 5.3 |
| Percentage body fat | 29.6 ± 4.9 | 31.0 ± 5.1 |

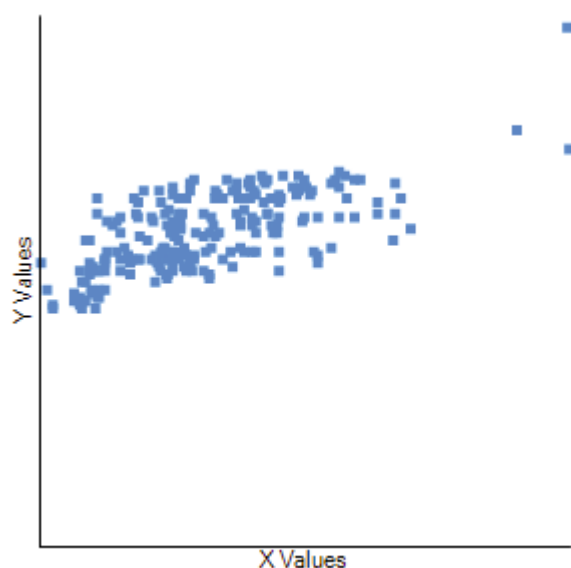
The mean body fat percentage was significantly higher across the categories of BMI and mean values were increasing with increase in BMI among subjects ($F=87.7$, $p<0.01$). Similarly, BFP was significantly

Table 2: Comparison of mean body fat percentage values across different BMI and WC categorise

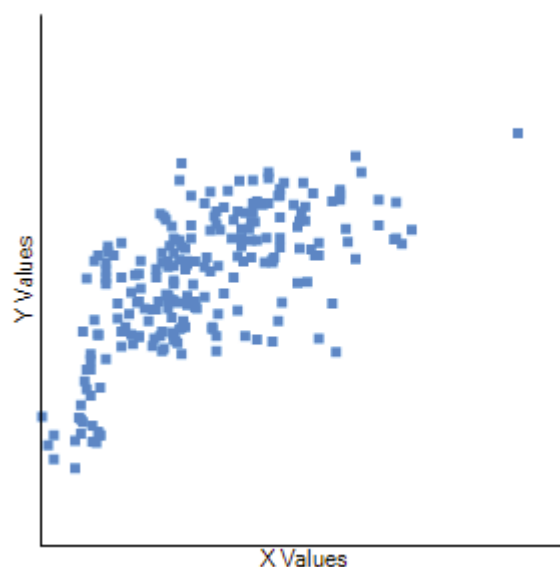
| Variable | n (%) | BFP (Mean±SD) | F value/t-value | p-value |
|---------------------------|------------|---------------|-----------------------------|---------|
| Generalized obesity (BMI) | | | | |
| Underweight | 33 (14.5) | 18.1± 6.8 | F (one way ANOVA) =87.7 | p<0.01 |
| Normal | 89 (39.0) | 28.9± 4.7 | | |
| Overweight | 23 (10.1) | 32.3± 5.4 | | |
| Obesity | 83 (36.4) | 35.8 ± 5.5 | | |
| Central obesity (WC) | | | | |
| Obese | 99 (43.4) | 35.1±5.8 | t (independent t- test)=9.6 | p<0.001 |
| Non-Obese | 129 (56.6) | 26.5±7.3 | | |

Table 3: Gender distribution of generalised obesity, central obesity and body fat percentage

| Variable | | Male (n=83) | | | | Female (n=146) | | | |
|---------------------|---------|-----------------------|------------|------------|--------------------|------------------------|------------|---------|-------------------|
| | | n | Mean+SD | t-value | p-value | N | Mean+SD | t-value | p-value |
| Generalized obesity | Present | 70 (53.9) | 34.0+ 5.2 | 9.2 | p< 0.001 | 36 (36.7) | 37.2+ 5.9 | 6.6 | p<0.001 |
| | Absent | 60 (46.2) | 24.5 + 6.5 | | | 62 (63.3) | 27.5 + 7.5 | | |
| | | Males (n= 130) | | | | Females (n= 98) | | | |
| Central obesity | Present | 71 (54.6) | 34.1 + 5.1 | 7.5 | p<0.001 | 58 (59.2) | 36.5+ 6.4 | 6.3 | p<0.001 |
| | Absent | 59 (45.4) | 25.9+ 7.1 | | | 40 (40.8) | 27.3+ 7.5 | | |

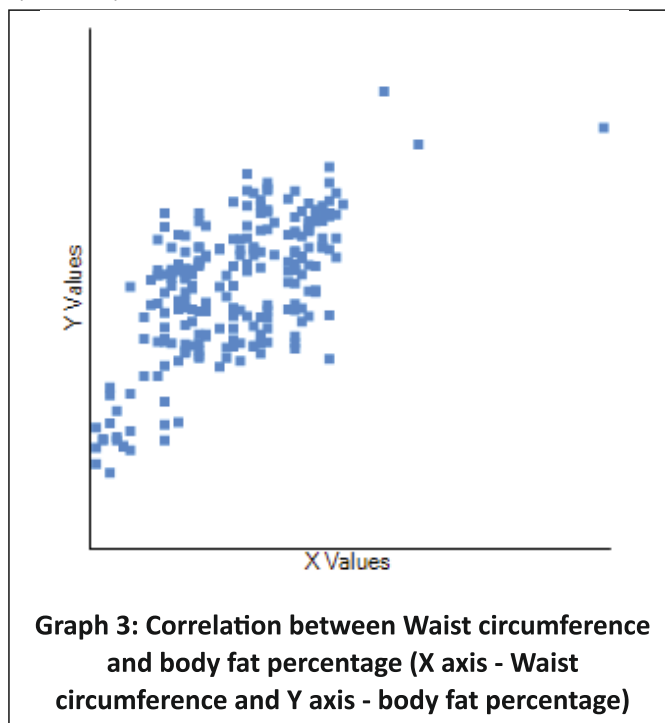


Graph 1: Correlation between BMI and Waist circumference (X axis - BMI and Y axis - Waist circumference)



Graph 2: Correlation between BMI and body fat percentage (X axis - BMI and Y axis - body fat percentage)

higher among subjects with central obesity compared to those without central obesity ($t=9.6$, $p<0.001$). (Table 2)



Body fat percentage (BFP) was significantly higher among subjects with generalised obesity compared to normal subjects among males ($t=9.2$, $P<0.001$) and females ($t=6.6$, $P<0.001$). Similarly, BFP was significantly higher among subjects with central obesity compared to normal subjects among males ($t=7.5$, $P<0.001$) and females ($t=6.3$, $P<0.001$) (Table 3).

The present study observed moderate positive correlation of BMI with waist circumference ($r=0.68$, $p<0.001$), BMI with body fat percentage ($r=0.69$, $P<0.001$) and waist circumference with body fat percentage ($r=0.64$, $P<0.001$). All these were found to be statistically significant (Figures 1, 2 and 3).

Discussion:

Obesity is a serious concern due to its involvement in causing high cardiovascular morbidity and mortality among Indian adults. Hence, present study was aimed to investigate relationship between body fat percentage and obesity in Indian adults. So that obesity can be measured accurately by using body fat percentage.

The present study observed that the mean body fat percentage was significantly higher across the categories of BMI among adult subjects. This is

consistent with previous study by Liang X in Chinese population.^[11] This indicates that as BMI increases there is a proportional increase in the mean body fat percentage. Similarly, mean body fat percentage was significantly higher among subjects with central obesity. This could be due to more number of subjects having combined obesity (both generalised and central obesity) in the study which can increase the future risk of adverse metabolic and cardiovascular events. This needs to be addressed in further studies.

In both sex, BFP was significantly higher in both generalised and central obesity. Particularly in women BFP was higher compared to men. Similar findings were noticed in study undertaken by Akindele MO and Amin F.^[12,13] These observations support that BFP increases with increase in BMI and waist circumference in both sex. Hence, BFP can be used for the assessment of obesity.

In this study BMI, waist circumference and BFP were all shown positive correlation with each other. Similarly, Okafor I C et al and Ranasinghe C observed correlation of BMI with WC and BFP and, Kim H C observed correlation between WC and BFP.^[14,15] All these evidences strengthen the relationship between body fat percentage and obesity. Hence, body fat percentage can be used to assess obesity in resource limited settings and epidemiological studies.

This study was limited by small sample size and lack of generalization of results. All the measurements were undertaken by trained medical professional and use of simple and reliable bioelectrical impedance analysis (BIA) for the measurement of BFP after taking required precautions are the potential strengths.

Conclusion:

In Indian adults, significant association of BFP and obesity was found across the categories and sex. Positive correlation was observed between body fat percentage with BMI and waist circumference at lower cut-off, thus indicating relationship between BFP and obesity. Hence, BFP is a reliable measure of obesity.

Recommendations:

The present study recommends that the body fat percentage is suitable for assessment of obesity among Indian adults and calls for similar research in different settings by involving large sample to confirm the study findings.

Declaration:

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Conflict of Interest: Nil

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