# Assessing the accuracy of BMI and Body Fat Percentage in Identifying Obesity: A Comparative Study Examining the Influence of Socio-Economic and Lifestyle Factors

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#### Abstract

Obesity has become a significant public health issue in India, largely driven by lifestyle and dietary changes. This study aimed to assess the nutritional status of adults using key indicators such as Body Mass Index (BMI), body fat percentage, and waist-to-hip ratio.

The study sought to examine the relationship between BMI, body fat percentage, and lifestyle factors in adults aged 20-50 years. Additionally, it aimed to explore the impact of demographic factors like education, occupation, and dietary habits on body composition.

A cross-sectional study was conducted with 117 adults recruited from two obesity clinics and two fitness centers. BMI and body fat percentage were measured using bioelectrical impedance analysis (BIA), and data were collected through a pretested questionnaire.

The study found discrepancies between BMI and body fat percentage, with individuals in the "normal" BMI range often having high fat percentages. Significant correlations were found between BMI and educational level, occupation, and dietary habits. No direct effects were observed from physical activity, sleep patterns, smoking, or alcohol consumption on body composition.

The findings highlight the limitations of BMI as a sole measure of obesity and its associated health risks. The study emphasizes the importance of including additional measures like body fat percentage and fat distribution in obesity assessments.

Key words : Adult, bioelectric impedance, demographic, health risk, obesity.

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Global public health faces a significant threat from obesity, a complex and multifaceted condition characterized by an excessive accumulation of body fat. Traditionally, obesity is diagnosed using the Body Mass Index (BMI) scale, with individuals having a BMI of 25 kg/m<sup>2</sup> or higher classified as obese. This classification underscores the interplay of environmental and genetic factors that influence individual risk assessments and obesity thresholds (WHO 2021). The World Health Organization (WHO) reported that by 2016, over 1.9 billion adults aged 18 and older were overweight, with more than 650 million classified as obese, indicating a troubling rise in the obesity epidemic globally (WHO 2021).

In India, the situation mirrors global trends, with adult obesity rates reaching 11.8%, and variations across age groups can see figures soar to as high as 36.3%. This increase is primarily attributed to shifting lifestyles that encompass dietary habits, physical activity levels, and socioeconomic factors<sup>1,15</sup>. Obesity prevalence in India also varies by region and state, influenced by geography and lifestyle choices. For instance, states with higher socioeconomic status such as Tamil Nadu report elevated obesity rates among women due to sedentary lifestyles and the consumption of calorie-dense foods.

Social and environmental factors play a critical role in the rising obesity rates. Demographic characteristics such as sex and socioeconomic status significantly impact obesity prevalence, with low-income areas often having greater access to affordable highcalorie foods<sup>2</sup>. Lifestyle modifications including diet, physical activity, stress management, and sleep patterns—are essential for effective weight management<sup>16</sup>.

The health implications of obesity are severe; it is associated with increased risks of metabolic diseases, hypertension, dyslipidemia, and various cancers. Excess body fat puts additional strain on the heart and blood vessels, elevating blood pressure and leading to abnormal cholesterol levels. This creates a vicious cycle where hypertension further increases the risk of heart attacks and strokes. Research indicates that the pro-inflammatory state associated with obesity may also facilitate cancer progression by altering cell growth pathways (National Institutes of Health, 2013). While BMI remains the standard metric for diagnosing obesity, its limitations are evident as it does not differentiate between muscle and fat or account for fat distribution. Consequently, individuals with identical BMI scores can have vastly different health risks based on their body composition. More precise methods for assessing body fat distribution include air displacement plethysmography, underwater weighing, dual-energy X-ray absorptiometry (DEXA), and bioelectrical impedance analysis (BIA)<sup>8</sup>. Each method offers unique advantages; for instance, BIA is cost-effective and quick while DEXA provides comprehensive insights into regional fat distribution. Emerging research is also exploring imaging techniques such as MRIs and CT scans to better assess visceral fat and predict obesity-related health outcomes<sup>15</sup>. Addressing the obesity epidemic necessitates a multifaceted approach that considers genetic predispositions alongside environmental influences. Understanding these interactions is crucial for developing effective prevention

and treatment strategies tailored to individual needs within diverse populations.

Keeping in view the objectives of the study, questionnaire was developed and pretested. Appropriate changes were made in consultation with subject experts. A total of 117 subjects were studied from two obesity clinic and two fitness centres. Adults, both men and women of age 20 -50 were assessed for their body weight, BMI, body fat per cent using BCA (Omron HBF 362) respectively. Height was measured in cm using the standard height measuring rod. Consent from the clinics was taken. The participants were briefed about the study through one-to-one session. Only the

participants who themselves volunteered were included in the study. Subjects with health complications were excluded. Subjects who did not provide complete information were also excluded from the study and thus the final data was available for 117 subjects. The collected data were analysed and tests of significance were applied. The software SPSS was used for statistical analysis.

### BMI vs Fat %

The study examined the relationship between Body Mass Index (BMI) and body fat percentage revealed interesting results.

	Fat %					Total		
	Normal		Obese		Overweight			
	Number	%	Number	%	Number	%	Number	%
Normal	12	10	4	3	5	4	21	18
Obese	1	1	65	56	15	13	81	69
Overweight	2	2	3	3	10	9	15	13
Total	15	13	72	62	30	26	117	100

Table-1. Relationship between Body Mass Index (BMI) and Body Fat

Out of 117 participants, 21 (18%) had a normal BMI, with 12 (10%) exhibiting a normal fat percentage. In contrast, 81 (69%) individuals fell into the Obese BMI category, with a staggering 65 (56%) displaying an Obese fat percentage. The Overweight BMI group consisted of 15 (13%) respondents, with 10 (9%) having an Overweight fat percentage. These findings suggest that BMI is a useful measure for general weight classification but may not always accurately reflect an individual's body fat percentage. Some people with a Normal BMI may still have high fat percentages, while some with a higher BMI may not have excessive body fat. A more accurate understanding of health and body composition might require additional measurements, such as fat percentage, to complement BMI data. Overall, the study found a significant discrepancy between BMI and body fat percentage, highlighting the importance of considering multiple metrics when assessing health and weight status.

A study goes on pars with BMI serves as a general indicator of nutritional health, but it has limitations, as it does not differentiate between fat, lean muscle mass, or bone

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density. It simply provides a numerical measure of body weight in relation to height, which may not fully reflect an individual's body composition. While BMI can be useful for assessing overall trends in populations, it does not provide a complete picture of a person's health or weight-related risks<sup>12</sup>.

Demographic Factors and its nutritional impact (BMI and Fat percentage) :

The study included 117 participants, with a majority (60.7%) aged less than 30 years. The sample consisted of 31.6% females and 68.4% males.

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General Information		Number	Percent	BMI	Fat %
				P value; Sig	P value; Sig
Age	31 to 40 yrs	25	21.4		19.980; 0.002
	41 to 50 yrs	13	11.1		
	Above 50 yrs	8	6.8	18.839; 0.003	
	Less than 30 yrs	71	60.7		
	Total	117	100.0		
	Female	37	31.6		12.831; 0.005
Gender	Male	80	68.4	14.075; 0.004	
	Total	117	100.0		
	Diplomo	7	4.5		13.371; 0.004
	Graduate	55	47.0		
	Higher secondary	1	.9	15.124; 0.002	
Education	No	2	1.7		
	Post graduate	44	37.6		
	Secondary	9	7.7		
	Total	117	100.0		
	Business	27	23.1		16.26; 0.003
	Government sector	1	.9		
Occupation	Private sector	71	60.7	18 056 0 002	
	Student	5	4.3	18.050, 0.002	
	Unemployed	13	11.1		
	Total	117	100.0		
Income	2-3 lakhs	45	38.5		1.896; 0.441
	Above 3 lakhs	38	32.5	1 979 0 271	
	Less than 1 lakh	21	17.9	] 1.979, 0.271	
	No	13	11.1		

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	Total	117	100.0		
	Daily	67	57.3		
	Monthly	2	1.7		
Physical	Never	16	13.7	12.616; 0.004	18.598; 0.003
Activity	Rarely	15	12.8		
	Weekly	17	14.5		
	Total	117	100.0		
	5 to 6	44	37.7		
Sleeping	7 to 8	59	50.4		
hours	Less 5 hours	8	6.8	12.703; 0.002	13.642; 0.001
	More than 8 hours	6	5.1		
	Total	117	100.0		
	No	100	85.5		
Smoking	Yes	17	14.5	2.091; 0.215	1.095; 0.231
	Total	117	100.0		
	No	94	80.3		
Alcohol	Yes	23	19.7	4.603; 0.137	0.639; 0.431
	Total	117	100.0		
	Nv	103	88.0		
Dietary	Ov	4	3.4	14.396; 0.002	18.655; 0.000
Pattern	Veg	10	8.6	]	
	Total	117	100.0		

The results showed significant associations between BMI and body fat percentage with various socio-demographic and lifestyle factors.

Age: Participants aged 31-40 years had significantly higher BMI (p=0.003) and body fat percentage (p=0.002) compared to other age groups. Our result confirmed the significant effect of age in the relationship which was consistent with studies which did the same. Similar research was found to determine the determine the relationship between BMI and BF% in this group of Indians aged 17-84 years, the influence of age and gender on this relationship. Several studies have investigated the relationship between BMI and BF% across diverse Asian population groups.<sup>3</sup>

**Gender:** Males had significantly higher BMI (p=0.004) and body fat percentage (p=0.005) compared to females. According to a study by Muscogiuri, Men often have higher BMI than women, with men having more abdominal fat.

Education: Participants with a

graduate degree had significantly higher BMI (p=0.002) and body fat percentage (p=0.004) compared to those with lower education levels.

**Occupation:** Participants working in the private sector had significantly higher BMI (p=0.002) and body fat percentage (p=0.003) compared to those in other occupations.

**Physical Activity:** Participants who engaged in daily physical activity had significantly lower BMI (p=0.004) and body fat percentage (p=0.003) compared to those with lower physical activity levels. These findings align with research, which carried out comparative analysis of dietary habits and obesity prediction. The results suggest that increased physical activity plays a crucial role in reducing body fat percentage and BMI.

A study goes on pars with engaging in regular physical activity plays a significant role in maintaining a healthy Body Mass Index (BMI) and body fat percentage. For example, individuals who participate in physical exercise tend to have a more balanced BMI and healthier body fat levels, as compared to those who lead sedentary lifestyles<sup>7</sup>.

**Sleeping Hours :** Participants who slept for 7-8 hours had significantly lower BMI (p=0.002) and body fat percentage (p=0.001) compared to those with shorter or longer sleep durations. These findings are consistent with the results of studywhich examined the relationship between sleep duration and obesity.

**Smoking Habits :** The majority of participants (85.5%) did not smoke, while 14.5% were smokers. The association

between smoking habits and BMI (p=0.215) and body fat percentage (p=0.231) was not statistically significant.

Alcohol Consumption : Most participants (80.3%) did not consume alcohol, while 19.7% did. The association between alcohol consumption and BMI (p=0.137) and body fat percentage (p=0.431) was not statistically significant.

**Dietary Patterns :** The majority of participants (88.0%) followed a nonvegetarian diet, while 3.4% followed an omnivorous diet, and 8.6% followed a vegetarian diet. The association between dietary patterns and BMI (p=0.002) and body fat percentage (p=0.000) was statistically significant. The same findings were obtained in a study that demonstrated that while vegetarian diets often contain fewer calories and fat, those who follow vegetarian diet typically have lower body fat percentages and BMI.

A similar study was found to be a wellbalanced vegetarian diet may be linked to a lower body mass index (BMI) compared to other types of diets. This diet, typically rich in fruits, vegetables, whole grains, and plantbased proteins, tends to be lower in calories and unhealthy fats, which can contribute to maintaining a healthier weight. As a result, individuals following a vegetarian diet often experience a more favourable BMI, potentially reducing the risk of obesity and related health conditions<sup>5</sup>.

This study investigated the associations between socio-demographic and lifestyle factors with BMI and body fat percentage. The result showed significant associations between BMI and body fat percentage with age, gender, education, occupation, physical activity, sleeping hours, and dietary patterns.

The findings suggest that individuals aged 31-40 yrs, males, those with a graduate degree, and those working in the private sector are more likely to have higher BMI and body fat percentage values. Additionally, daily physical activity, sleeping for 7-8 hours, and following a vegetarian diet were associated with lower BMI and body fat percentage values.

Overall, this study contributes to the existing literature on the determinants of nutritional status and highlights the importance of considering socio-demographic and lifestyle factors in the development of effective interventions aimed at promoting healthy lifestyle habits.

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