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BODY MASS INDEX AND BODY FAT PERCENTAGE: A COMPARATIVE ANALYSIS IN THE ASSESSMENT OF OVERWEIGHT AND OBESITY

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ABSTRACT

Introduction: Obesity is a global public health problem associated with high metabolic and cardiovascular risk. Body Mass Index (BMI) is widely used for obesity screening, but it has limitations because it does not consider body composition. Body Fat Percentage (BFP) emerges as a more specific complementary metric.
Objectives: To evaluate the relationship between high BFP and BMI in the classification of overweight and obesity, identifying discrepancies between the metrics and their clinical implications. Materials and Methods: This was a retrospective, descriptive and analytical cross-sectional study, carried out with secondary data from body composition assessments obtained through bioelectrical impedance analysis in an outpatient setting, specialized in nutrology. The classification followed WHO criteria for BMI and scientific literature for BFP.
Results: The sample of 1,792 individuals revealed significant discrepancies between BMI and BFP in the classification of obesity. The findings reinforce the need for the complementary use of both metrics for greater diagnostic accuracy.
Discussion: BMI has limitations as an isolated tool for assessing obesity, especially due to its inability to differentiate between lean mass and body fat. BMP, obtained by methods such as bioelectrical impedance, presents an alternative that allows a more detailed assessment of body composition and better stratification of metabolic risk10,12. Physiological differences between genders and age groups reinforce the need for personalized approaches.
Conclusion: The combination of both tools can provide a more accurate and personalized approach, not only improving diagnostic accuracy but also facilitating the implementation of more effective therapeutic strategies, aligned with international guidelines and contemporary health demands.

Keywords: Obesity, Overweight, Body mass, Assessment, Body Fat.

INTRODUCTION

Obesity is considered one of the major global public health problems, with a significant impact on morbidity, mortality, and quality of life worldwide. According to the World Health Organization

(WHO), the global prevalence of obesity has increased substantially over recent decades, posing a major challenge to public health policies due to its clinical and economic implications.[1,2,3] In Brazil, epidemiological studies indicate a progressive rise in overweight and obesity rates, highlighting the need for more accurate and efficient diagnostic approaches.[4,5,6]

Body Mass Index (BMI) is widely used as a tool for classifying nutritional status in adults.[1] For population-level screening and classification purposes, the WHO recommends BMI, a simple metric calculated as body weight divided by height squared (kg/m²).[1] BMI values ≥25 kg/m² indicate overweight, while obesity is defined as BMI ≥30 kg/m². Despite its low cost and ease of use, BMI has important limitations, as it does not differentiate between lean mass, fat mass, or fat distribution. This limitation may lead to inaccurate assessments, particularly in individuals with atypical body composition, such as athletes or older adults.[7,8]

In contrast, Body Fat Percentage (BFP), which can be obtained through methods such as bioelectrical impedance analysis, has emerged as a relevant alternative to complement the diagnosis of overweight and obesity. This metric allows for a more detailed assessment of body composition by providing specific information on the proportion of fat relative to total body mass.[9] These associations are clinically relevant, as elevated BFP is directly related to insulin resistance, systemic inflammation, and endothelial dysfunction, all of which are predictors of cardiovascular risk.[10–12]

The use of BFP in conjunction with other clinical indicators enables more accurate identification of individuals at increased metabolic risk[12]. Cutoff values above 30% for women and 25% for men, particularly in young and middle-aged adult populations, are associated with a significantly higher likelihood of developing cardiovascular diseases[10–12]. From this perspective, BFP is emphasized as a more specific marker of metabolic health than metrics based solely on weight or height. Its integration into clinical assessment may improve cardiovascular risk stratification and therapeutic management in patients with overweight and obesity.[8,10,13]

In this context, the present study aims to comparatively analyze BMI and BFP in the assessment of overweight and obesity among patients treated in an outpatient setting. The objective is to explore the concordances and discrepancies between these diagnostic tools, evaluating their accuracy and clinical relevance, with the goal of contributing to improved strategies for obesity management and prevention.

MATERIALS AND METHODS

This is a retrospective, cross-sectional, descriptive and analytical study, conducted using secondary data from body composition assessments obtained through electrical bioimpedance analysis (InBody 230 device) in an outpatient setting specialized in nutrology. The analytical data were collected from anonymized records stored and exported directly into spreadsheet format (.xlsx) via the Lookin'Body data management software. This study does not involve clinical interventions or direct contact with patients and therefore poses no risk to their physical or psychological integrity.

The sample consisted of individuals of both sexes aged 18 to 60 years, evaluated at the nutrology outpatient clinic between March 2015 and September 2024. Only data from the first body composition assessment were included, in accordance with standardized protocols for electrical bioimpedance analysis. The variables analyzed were Body Mass Index (BMI), Body Fat Percentage (BFP), and sex, with the objective of correlating these parameters in the assessment of overweight and obesity. The selected age range aimed to ensure greater sample homogeneity, considering the significant

differences in body composition observed among children, adults, and older individuals.[8,12]

BMI was calculated using the formula weight (kg) divided by height (m) squared, and classified according to World Health Organization (WHO) criteria.[1] The classifications adopted were: underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25–29.9 kg/m²), and obesity (≥30 kg/m²), the latter further stratified into three grades: obesity class I (30–34.9 kg/m²), obesity class II (35–39.9 kg/m²), and obesity class III (≥40 kg/m²).

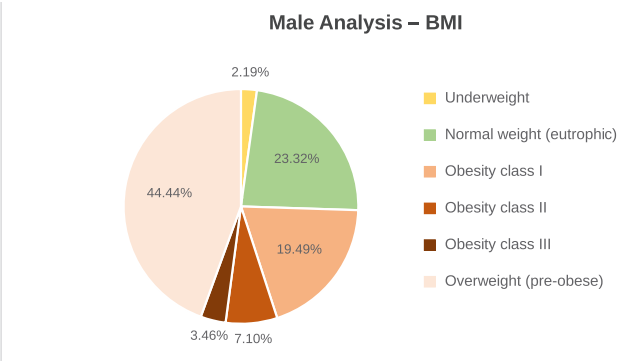
The cutoff points for Body Fat Percentage classification were defined as values above 25% for men and above 35% for women, as described in the literature as indicative of overweight and obesity. These thresholds are associated with a significant increase in metabolic and cardiovascular risk, reinforcing their relevance as a complementary diagnostic criterion to BMI.[10–13]

Data were organized and analyzed using Microsoft Excel. Descriptive statistics (comparisons, means, and percentages) were performed to characterize the sample. Comparative charts (pie and bar graphs) were generated to illustrate the distribution of BMI and BFP data, separately for men and women. A cross-analysis between BMI and BFP classifications was conducted to identify potential discrepancies between these diagnostic tools.

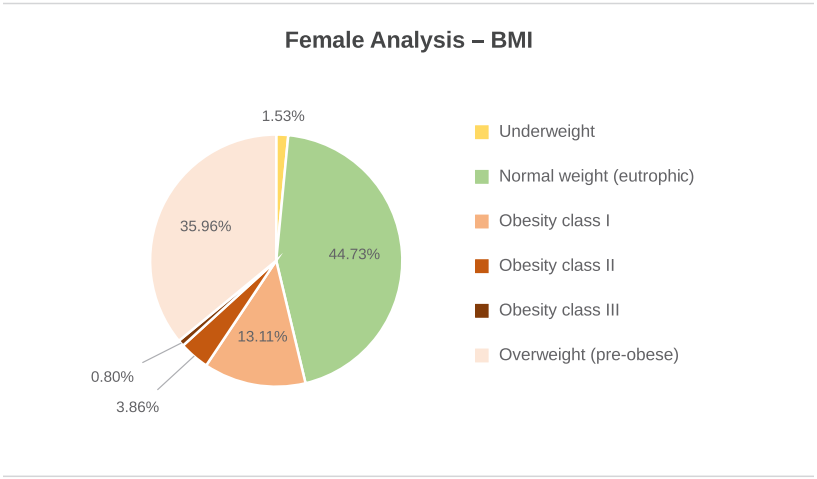
RESULTS

The sample consisted of 1,792 individuals, including 549 men (30.65%) and 1,243 women (69.35%), with ages ranging from 18 to 60 years. The results indicate significant differences in the classification of overweight and obesity when comparing Body Mass Index (BMI) and Body Fat Percentage (BFP). Sex-stratified analysis revealed discrepancies that underscore the limitations of BMI as a standalone tool for obesity assessment, particularly in populations with heterogeneous body composition.

Analysis of BMI-related results shows that in the male group (Figure 1), 44.44% of individuals were classified as overweight, 19.49% as obesity class I, 7.10% as obesity class II, and 3.46% as obesity class III, while 23.32% were classified as having normal weight. In the female group (Figure 2), 35.96% were classified as overweight, 13.11% as obesity class I, 3.86% as obesity class II, and 0.80% as obesity class III, with 44.73% classified as having normal weight. These findings demonstrate that a substantial proportion of the evaluated individuals fall into excess-weight categories, highlighting the relevance of BMI as an initial screening marker for overweight and obesity in the studied population.



Source: author.



Source: author.

In the case of BMI, although both men and women showed substantial prevalence of overweight and obesity, the mean values of body fat percentage (BFP) indicated a greater number of individuals classified as obese, especially among women. More than 50% of women presented a BFP above the cutoff point of 35%, whereas 40.3% of men exceeded the 25% threshold (Figure 3). This disparity reinforces that BMI, as it is based solely on weight and height, does not distinguish body composition and is therefore unable to identify individuals with metabolically significant obesity, such as those with a high percentage of body fat but a BMI within the normal range. This finding is supported by previous studies highlighting BFP as a more sensitive and specific metric for the assessment of overweight and obesity, particularly in women.

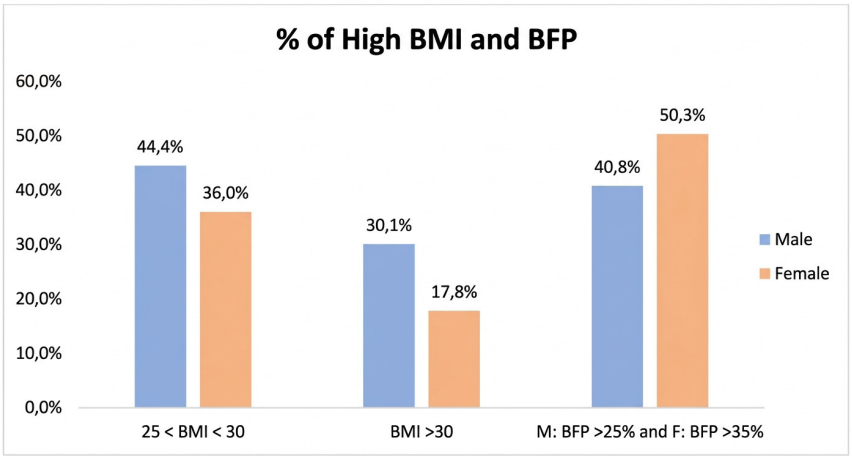
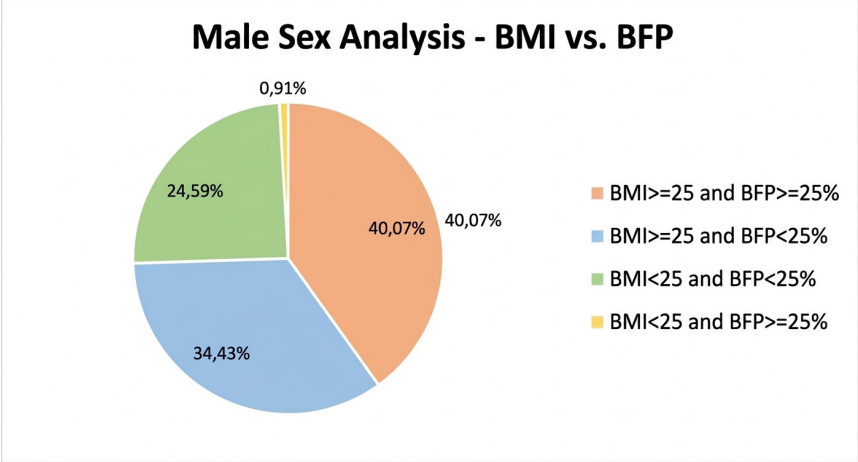
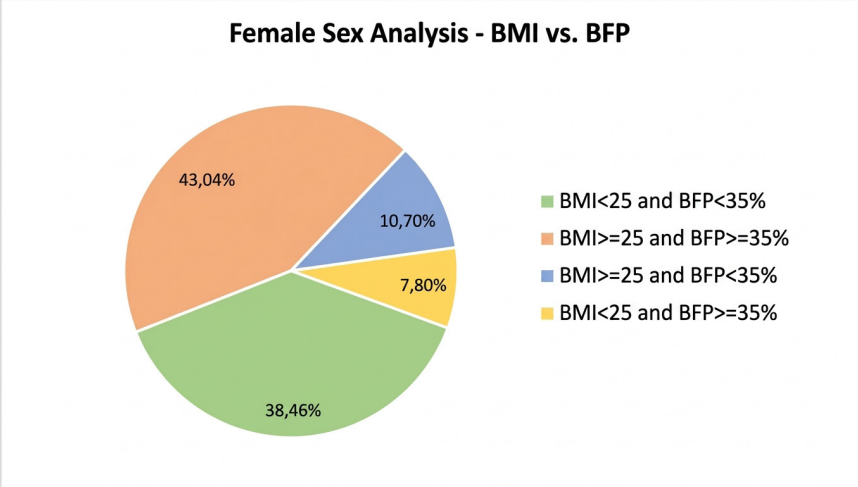


Figure 3. M: Male sex F: Female sex BMI: Body Mass Index BFP: Body Fat Percentage.
Source: author.

Joint analysis of BMI and BFP revealed relevant discrepancies. Among men (Figures 4), 40.07% had BMI ≥ 25 associated with BFP ≥ 25, indicating agreement between the two metrics, whereas 24.59% had BMI < 25 but BFP ≥ 25, demonstrating underestimation by BMI. In the female group (Figure 5), 43.04% had BMI ≥ 25 and BFP ≥ 35, while 7.8% had BMI < 25 and BFP ≥ 35 and 10.8% had BMI ≥ 25 and BFP < 35, highlighting cases in which BMI failed to reflect excess body fat. This can be attributed to BMI's inability to differentiate lean mass from body fat, particularly in populations with atypical body composition, such as individuals with high muscle mass or with sarcopenic obesity, a phenomenon already described in the literature.[11-14]



Source: author.



Source: author.

DISCUSSION

The BMI has important advantages, such as simplicity, low cost, and wide applicability at the population level, making it a practical and well-established method for diagnosing overweight

and obesity; however, it presents limitations when used as a standalone tool.[15–17] The results indicate that BMI underestimated the prevalence of obesity, particularly among women, due to its inability to account for body composition. Body Fat Percentage (BFP) serves as a complementary diagnostic tool, allowing for a more accurate and individualized approach by providing detailed information on the proportion of body fat.

Sarcopenic obesity, characterized by the coexistence of high body fat and low muscle mass, is a condition frequently underdiagnosed by BMI alone.

The Brazilian Obesity Guidelines emphasize the need for a combined approach in the diagnosis of obesity. It is recommended that BMI be used alongside waist circumference measurements or body composition analysis for initial assessment. For specific populations, such as older adults - who are at greater risk of sarcopenia - multifrequency bioelectrical impedance analysis is particularly useful. The guidelines also suggest the waist-to-height ratio (<0.5) as an additional valid metric for estimating cardiometabolic risk, reinforcing the need to integrate different diagnostic methods.[17]

Differences in fat distribution between sexes are also evident. Women tend to have a higher proportion of subcutaneous fat, whereas men accumulate more visceral fat, which is associated with increased cardiovascular risk[16–17]. These physiological characteristics underscore the need for sex-specific approaches in body composition assessment. Furthermore, hormonal changes throughout life, such as menopause, influence fat accumulation in women[18,19], further highlighting the importance of specific and sensitive metrics.

On the other hand, challenges related to the use of BFP in clinical practice must be considered. Although methods such as bioelectrical impedance analysis are accessible due to their practicality, affordability, and noninvasive nature, they are subject to variability influenced by factors such as hydration status, body temperature, and environmental conditions[20,21]. This technique is based on the conduction of a low-amplitude electrical current through the body, with tissue resistance (impedance) used to estimate body compartments such as water, lean mass, and fat mass[22]. Lean tissues, rich in water and electrolytes, exhibit low resistance, whereas adipose tissue, with lower water content, offers greater electrical resistance.

Other alternative methods are widely used, offering varying degrees of accuracy, cost, and clinical applicability. Anthropometric methods, such as skinfold thickness measurements, stand out for their accessibility and low cost. This technique uses calipers to measure skinfold thickness at standardized sites, such as the triceps, abdomen, and thigh, allowing estimation of BFP through predictive equations. However, its accuracy depends directly on equipment calibration and evaluator expertise, making it more suitable for population-based or low-resource settings.[19,21]

Among densitometry-based methods, hydrostatic weighing was considered the gold standard for many years. This method estimates body density by submerging the individual in water and calculating lean and fat mass based on displaced volume. Despite its high accuracy, it is uncomfortable and requires complex infrastructure. Air displacement plethysmography emerged as a less invasive alternative, using air displacement to determine body density. Although more comfortable, both techniques are costly, limiting their large-scale applicability.[21,23]

Advanced imaging methods, such as dual-energy X-ray absorptiometry (DEXA), are widely recognized for their high accuracy in assessing body composition. In addition to providing detailed BFP measurements, DEXA can evaluate fat distribution, including visceral fat. However, its high cost and need for specialized infrastructure restrict its use. Computed tomography (CT) has the drawback

of radiation exposure, and both methods are limited by cost and execution time.[21,23]

The choice of the most appropriate method for assessing BFP should be guided by clinical objectives, specific population characteristics, and available resources.[24]

These considerations reinforce the need for personalized approaches capable of more accurately reflecting body composition across different groups.[25]

This study has limitations due to its reliance on secondary data, including the lack of information on other relevant variables such as physical activity level and metabolic history. Future studies could benefit from the inclusion of additional measures, such as imaging-based visceral fat assessment and behavioral variables. Furthermore, the sample composed of individuals attending a nutrology outpatient clinic may limit the generalizability of the findings to other populations.

CONCLUSION

The clinical implications of this study are relevant both for clinical practice and for public health as a whole. The results demonstrated a moderate correlation between BMI and BFP, while also highlighting significant discrepancies in the classification of overweight and obesity. These discrepancies are attributed to BMI's inability to differentiate between lean mass and fat mass, reinforcing the need for complementary metrics to achieve a more accurate assessment. BFP, obtained through bioelectrical impedance analysis, proved to be more sensitive and specific for detecting obesity, particularly among women, in whom subcutaneous fat accumulation is more pronounced.

Despite the inherent limitations of the study and the challenges in establishing universally applicable BFP cutoff values, the findings contribute meaningfully to the ongoing discussion regarding the use of more precise tools in obesity assessment. Future studies may explore the combination of additional body composition assessment methods, stratification by different age groups, and further expansion of the understanding of the clinical and epidemiological implications of these metrics.

Overall, this study contributes to a better understanding of the limitations and strengths of BMI and BFP in the evaluation of overweight and obesity. The combined use of both tools may provide a more accurate and personalized approach. The complementary application of these metrics may not only improve diagnostic accuracy but also facilitate the implementation of more effective therapeutic strategies, aligned with international guidelines and contemporary healthcare demands.

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