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EDITORIAL

Utilization of new anthropometric indicators in the diagnosis of obesity: a focus on the body roundness index

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Open acess

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Abstract

Obesity, considered a severe global epidemic, is increasing worldwide and has negatively impacted public health, leading to a rise in non-communicable chronic diseases. In this epidemiological scenario, anthropometric indicators capable of early identification of general and abdominal obesity, as well as predicting the risk of other health complications, are essential. The Body Roundness Index emerges as an alternative to the Body Mass Index, as it is a useful tool for identifying abdominal obesity and fat distribution, which are directly associated with cardiometabolic complications and mortality. Therefore, the Body Roundness Index is considered a promising tool for developing epidemiological population studies, clinical obesity diagnosis, and future risk prediction.

Keywords: anthropometry, abdominal obesity, cardiometabolic risk factors.

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Obesity is recognized as a serious public health issue, exhibiting high prevalence rates worldwide and resulting in negative impacts on the overall health of the population[1,2]. Considered a global epidemic, the World Health Organization, through the classification of Body Mass Index (BMI) ≥30 kg/m^2, estimates that one in eight people in the world live with obesity and that approximately 890 million adults face this condition[3]. Data from the Global Burden of Disease (GBD) 2021 study indicate that the prevalence of obesity has more than doubled among adults and tripled among children and adolescents between 1990 and 2021, and these rates are expected to continue growing over the next 30 years[4,5].

According to GBD, 3.7 million deaths and 128.5 million disability-adjusted life years (DALYs) were attributed to elevated BMI in 2021, particularly reflecting its association with cardiovascular diseases and diabetes[6]. With increasing rates of overweight and obesity, a projected 40% rise in the disease burden attributable to these risks is expected by 2030[7]. Given this scenario, the importance of tracking and monitoring overweight and obesity, as well as their adverse health effects, for the well-being of the global population is undeniable. These actions are fundamental for the early identification of cases, to support public policies, and for coordinated actions focused on promoting a healthy weight and assessing the effectiveness of interventions.

Historically, BMI has been the most widely used method for screening overweight and obesity, being considered simple, easy to apply, and low-cost[8]. However, BMI has significant limitations as it does not differentiate between fat mass and lean mass nor consider the distribution of body fat, which are fundamental factors in assessing the risks associated with overweight and obesity[8]. Moreover, a person with a high BMI but a high level of fat-free mass may be erroneously categorized as overweight or obese, while a person with a larger fat mass may be identified as healthier than they actually are[9]. As a result, other indicators may be used for a more accurate assessment[10].

Given the limitations of BMI, new anthropometric indicators are gaining prominence for being more precise in diagnosing obesity, body fat distribution, and predicting the risk of developing other conditions such as cardiovascular disease and metabolic syndrome[11-13]. Among these new indicators, waist circumference (WC), waist-to-hip ratio (WHR), waist-to-height ratio (WHtR), Conicity Index (CI), A Body Shape Index (ABSI), and Body Roundness Index (BRI) stand out for offering a different perspective on body fat composition and distribution[14-18].

WC is a simple and effective method for assessing obesity and predicts the risk of cardiometabolic diseases and mortality better than BMI[19,20]. Measuring WC allows an evaluation of visceral fat, which is considered more harmful to human health[21]. Its limitation lies in its sensitivity to weight, height, and body fat distribution[22]. In other words, WC alone may indicate a high risk for tall and athletic individuals, even with a healthy body composition, due to greater muscle mass. Conversely, short individuals with abdominal fat may have a normal WC but a higher risk of disease. Thus, WC does not consider factors such as height, muscle mass, and fat distribution, limiting its accuracy in health risk assessment. However, according to the WHO, WC can be used as an alternative to BMI[23].

Among these new indicators, BRI has gained prominence for its ability to provide a comprehensive assessment of body shape and composition[16]. Several studies indicate that BRI is a more accurate predictor of health risks related to obesity, such as cardiovascular diseases[11], metabolic syndrome[24], kidney disease[25], cancer[26], and mortality[27] compared to BMI and other indicators.

BRI was developed by Thomas *et al*.,[16] through the analysis of data from three major databases: the National Health and Nutrition Examination Survey (NHANES III), data gathered from various studies conducted at St. Luke's/Roosevelt Hospital New York Nutrition Obesity Research Center (NORC), and studies conducted at Christian Albrecht's University in Kiel[16]. In its calculation, BRI considers abdominal circumference and height, and through an elliptical geometric model, it reflects total body fat and eccentricity to estimate visceral fat[16,25].

The mathematical formula for BRI involves the ratio between WC and height, which is a fundamental measure for estimating body fat distribution. Its derivation is based on an idealization of the human body as a geometric figure (ellipse) that considers the major axis as height and the minor axis as the width of the ellipse. Additionally, the values 364.2 and 365.5 are constants derived from population study databases that adjust the index to provide estimates of body fat and physical shape[16].

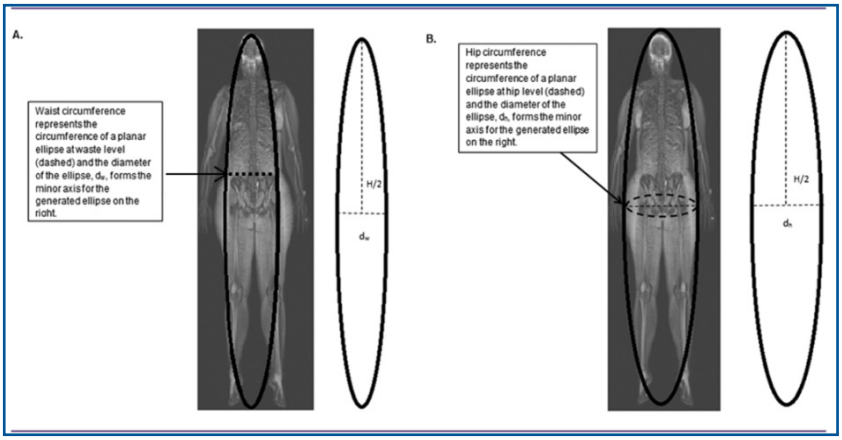

Figure 1. A schematic diagram of the body describing how body circumference can be equated to an ellipse

Source: Thomas et al., 201316. Panel A depicts an ellipse generated from height (H) in cm and WC (cm). Waist circumference represents the distance around an ellipse at the waist level. The diameter of this ellipse (dw) is equal to the waist circumference divided by 3.14. Similarly, Panel B describes an ellipse arising from HC (cm).

The mathematical constants used (values 364.2 and 365.5) were defined through statistical analyses, allowing the index to accurately represent the percentage of body fat and the distribution of visceral fat. The value 364.2 establishes the starting point of the scale, while 365.5 adjusts the impact of the square root to ensure sensitivity to anthropometric variations. Meanwhile, the value 1, present in the root, functions as a fixed mathematical point inspired by the geometry of a circle, ensuring coherence between the measurements and preventing negative results that would invalidate the formula[16].

Thus, for the calculation of BRI, the following formula is considered[16]:

$$BRI = 364.2 - 365.5 \times \sqrt{1 - \left(\frac{WC \div (2\pi)}{Height}\right)^2}$$

BRI: Body Roundness Index; WC: Waist circumference; pi π: constant with a value of approximately 3.1416

One of the main advantages of BRI is its ability to provide detailed information about body shape and fat distribution, as it includes waist circumference (WC) in its calculation[16]. This factor is crucial since visceral fat is one of the main risk factors for cardiovascular and metabolic diseases[28].

Another advantage is related to the strong correlation between the increase in BRI and cardiometabolic risk markers, where the cutoff points identified in the literature show high sensitivity and specificity for predicting such risks[29]. This suggests that BRI may be a valuable tool for identifying individuals at risk for obesity-related complications and for monitoring the effectiveness of interventions aimed at weight loss and reducing visceral fat.

A systematic review and meta-analysis[24] demonstrated that BRI has good discriminative power for predicting metabolic syndrome (MetS) in adults from different populations (AUC > 0.7). Its performance was superior to other indices, such as Body Mass Index (BMI), Waist-to-Hip Ratio (WHR), Body Adiposity Index (BAI), and A Body Shape Index (ABSI) in predicting MetS. Although it showed equivalent results to waist circumference (WC) and slightly lower results to Waist-to-Height Ratio (WHtR), these differences were not statistically significant. This reinforces the relevance of BRI as a valuable and effective tool for MetS screening in various populations, especially non-Chinese populations where it demonstrated higher accuracy and clinical utility.

Another study[30] investigated the application of BRI in a population with type 2 diabetes. In the cross-sectional evaluation of 585 individuals, BRI showed a strong association with the presence of MetS in both men and women, even after adjustments for variables such as age and BMI. The cutoff points identified for BRI were 3.85 for men and 4.05 for women, with AUCs of 0.824 and 0.775, respectively. These findings reinforce the potential of BRI as an effective indicator for screening MetS in higher-risk contexts, such as type 2 diabetes, with high sensitivity and specificity (men: sensitivity 76.5%, specificity 82.1%; and women: sensitivity 76.4%, specificity 70.3%).

Other authors[31,32] expanded the evaluation of the relationship between BRI and cardiometabolic risk factors in different populations. Li *et al.,*[31] reported that BRI is an independent risk factor for MetS and has a non-linear relationship with its prevalence, while Xu *et al.,*[32] confirmed that BRI has greater predictive ability compared to other traditional anthropometric indicators (WC, BMI, WHR, WHtR) with AUC > 0.70. Both studies highlighted that BRI can be used as an important tool to identify individuals at risk and enable early interventions that can improve health outcomes.

Finally, in this context, the relationship between the increase in BRI and the risk of MetS has been widely discussed, especially due to the association of the index with the accumulation of visceral fat, a relevant marker of metabolic risk. The distribution of body fat, calculated by BRI, reflects the impact of excess abdominal fat, one of the main components of MetS and a significant contributor to insulin resistance. Therefore, elevated BRI levels not only indicate a higher likelihood of developing MetS but also highlight the importance of its use for screening and early management of these conditions.

In this context, the adoption of indicators such as the BRI not only represents a methodological advancement in the diagnosis of obesity but also encourages broader perspectives on the topic. This view aligns with the editorial mission of the Journal of Human Growth and Development (JHGD), which supports the articulation of diverse fields of knowledge in the analysis of health and human development processes[33-48]. The integration of insights from public health, clinical practice, education, social sciences, and public policy enhances the understanding of complex phenomena such as obesity and underscores the need for approaches that move beyond disciplinary boundaries. By fostering this expanded dialogue, the JHGD consolidates itself as a strategic space for the production of innovative knowledge, responsive to the multiple dimensions of care and the complexity of contemporary health challenges.

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Resumo

A obesidade, considerada uma grave epidemia mundial, é crescente em todo o mundo e tem causado impactos negativos na saúde da população, como aumento das doenças crônicas não transmissíveis. Neste cenário epidemiológico, são essenciais indicadores antropométricos capazes de identificar precocemente a obesidade geral, obesidade abdominal e especialmente prever o risco de outros agravos. O índice de redondeza corporal, surge como uma alternativa ao índice de massa corporal, por ser uma ferramenta útil na identificação de obesidade abdominal e distribuição da gordura corporal, que está diretamente associada a complicações cardiometabólicas e mortalidade. Desta forma, o índice de redondeza corporal, é considerado promissor no desenvolvimento de estudos epidemiológicos populacionais e no diagnóstico clínico da obesidade, e predição de riscos futuros.

Palavras-chave: antropometria; obesidade abdominal; fatores de risco cardiometabólico.