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# Body mass index and body adiposity index in relation to percent body fat: A study in adult men of three endogamous groups of South Bengal

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ABSTRACT

Body adiposity index (BAI), based on height and hip circumference data from Mexican-Americans and African-Americans established its relation to body fat (BF). The aim of our study was to compare body mass index (BMI) and BAI in relation to BF%. Participants were adult men of three endogamous social groups (Brahmin, Muslim and Namasudra) in a village of South 24 Parganas district in West Bengal, India. Height, weight and hip circumference of 952 individuals (370 Brahmins, 307 Muslims and 275 Namasudras) were recorded. The BMI-based nutritional status and bioelectrical impedance-based BF% were evaluated. Namasudras (33.8%) and Muslims (33.6%) had high frequency undernutrition compared to Brahmins (7.3%). High prevalence (46.22%) of excess weight (overweight + obesity) was recorded only among Brahmins. There was significant social group difference in rates of nutritional status ($\chi^2 = 93.10$, $p < 0.0001$). The BF% had higher correlation with BMI than BAI. A cut-off value of BAI (22%) was determined by binomial logistic regression analysis (BLRA). The value had best estimated relation to BF% and also coincided with WHO standard mean BF

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(22%) for overweight adults at BMI ($\geq$25 kg/m$^2$). However, greater area under the receiver operating characteristic curve, higher correct prediction rate, and other results of BLRA for the cut-off value of BMI-based overweight ($\geq$25 kg/m$^2$) showed its better relation to BF% than that observed for BAI cut-off at 22%. The BMI was observed to be a better indicator of adiposity compared to BAI in relation with body fat (%).



## Introduction

There are available anthropometric indices and other techniques to evaluate adiposity and body fat in humans. In epidemiological studies, the commonly used surrogate anthropometric measures of adiposity and body fatness include body mass index (BMI), skinfold thickness, waist circumference, waist-hip ratio etc. However, these variables do not precisely characterize persons by body composition (percentage of body fat or muscle mass), and there is reported substantial variation across age, sex and population background (Camhi et al., 2011; Nooyens et al., 2007; Rahman and Berenson, 2010; Rush et al., 2006, 2009; Wang et al., 2000). More sophisticated and expensive techniques to estimate body fat include bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DXA), magnetic resonance imaging (MRI), and underwater weighing (densitometry).

Anthropometric evaluations are relatively inexpensive, non-invasive and can be used for large scale surveys, on a routine or regular basis (WHO, 1995). On the other hand, sophisticated techniques are precise but complex and time consuming (Pateyjohns et al., 2006) and therefore, not very practical in large epidemiological and field studies. In addition, BMI and other modern techniques are often difficult to use in places where accurate measure of body weight is not available. However, BIA is a precise, non-invasive and considered to be a validated and reliable technique to estimate body fat with minimal intra and inter-observer variability (Buchholz et al., 2004).

A new index of adiposity, namely the body adiposity index (BAI) was developed with an equation: ((hip circumference)/((height)$^{1.5}$) – 18) (Bergman et al., 2011). Based on correlation and regression analysis of anthropometric measurements of hip circumference and height; body fat (%) estimated by DXA, the authors suggested that unlike BMI, the BAI could be used to reflect percent body fat for adult men and women of differing ethnicities without numerical correction. It could be used in the clinical setting even in remote locations with very limited access to reliable scales where accurate measurement of body weight is difficult. In their study (Bergman et al., 2011), BAI exhibited high correlation with body fat. Further, correlation between BAI and body fat (%) was higher than BMI in pooled sample of men and women. There were, of course, drawbacks. One issue was that the BAI calculation was based on data from Mexican-American and African-American populations in the USA, so more research on other ethnic groups might be useful before they could determine if it was useful for a wide range of populations. The authors further suggested that BAI had an advantage over BMI since hip circumference in BAI indicates better sexual dimorphism in adiposity measure. Advantages of BAI over BMI in estimating adiposity were tested in samples representing different populations including European adults (López et al., 2012; Schulze et al., 2012; Vinknes et al., 2013) and American blacks and whites (Barreira et al., 2011), and in a mixed sample of adult men represented by the individuals of white, black, Hispanic, Asian, and other descents in the USA (Freedman et al., 2012). However, inconsistencies were observed in the results. Therefore, it was important to verify and compare BAI and BMI in relation with body fat in other sample(s) representing different population backgrounds and nutritional status. Our objectives were to:

(1) Evaluate nutritional status based on conventional BMI of adult men Brahmin, Muslim and Namasudra, three endogamous social groups of the southern part of West Bengal, India.