Does body adiposity index evaluate percentage of body fat?

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Received; 5/09/2019 revised; 30/09/2019 accepted; 8/10/2019

Abstract

Introduction: The purpose of the present study was to determine whether the novel marker, body adiposity index (BAI), is accurate to measure percentage of body fat (PBF).
Materials and methods: Seventy-eight males were undergone anthropometric examination. PBF was calculated by BAI and measured using InBody 3.0.
Results: Significant correlation was found between BAI and PBF ($r = 0.751$; $P < 0.001$).
Conclusion: PBF can be measured by BAI, which is calculating from hip circumference and height and we validated this novel index. Therefore, it can be widely used in the clinical settings.

Keywords: Body adiposity index, Hip circumference, Height, Body fat percent

Introduction

The prevalence of overweight and obesity is rapidly increasing in developing as well as in industrialized countries (1, 2). Previous research has consistently shown that both absolute total body fat and central distribution of body fat are closely associated with the risks of diabetes, hypertension, hyperlipidemia and cardiovascular disease (CVD) (3). Treating obesity and obesity-related conditions costs billions of dollars a year. Thus, establishing intervention programs to manage and prevent obesity-related disorders is necessary (4). Although computed tomography (CT) or magnetic resonance imaging may more accurately reflect body fat distribution and dual-energy X-ray absorption (DXA) is most accurate for quantifying adiposity to predict metabolic risks, the inherent high cost and radiation hazard prevent their use in large-scale epidemiological studies or self-assessments (4). Surrogate methods are necessary to be used in epidemiological studies or self-assessments. Therefore, the purpose of the present study was to determine if the novel marker of body adiposity index (BAI) is accurate to measure percentage of body fat.

Material and methods

Participants

In this study, 78 males were recruited through a notice on a board of university (Table 1). The study individuals were invited to a physical fitness center of the university to undergo anthropometric examination. All the subjects were volunteers and gave their consent for participation into the study, whose protocol

was in accordance with the Declaration of Helsinki.

Table 1. Physical characteristics of subjects under study (n=78).

Variable	Value
Age	44.66 ± 8.96
Height	174.76 ± 6.06
Body Mass	83.19 ± 11.92
Hip Circumference	101.98 ± 5.80
Body Mass Index	27.19 ± 3.21
Body Adiposity Index	26.18 ± 2.48
PBF from InBody 3.0	26.73 ± 4.74

Data are shown as mean ± standard deviation.

Procedures

The following anthropometric variables were evaluated in all individuals: body mass, height, waist circumference (WC), hip circumference (HC), body mass index (BMI), waist to hip ratio (WHR) and waist to height ratio (WHtR). Circumferences were measured to the nearest millimeter using a flexible tape. WC was taken at the end of normal expiration, with the measuring tape positioned at the midway between the lower rib and the iliac crest. HC was measured at the level of maximal protrusion of the gluteal muscles. BMI was calculated as weight/height squared (as kg/m^2). WHR was calculated as WC (as cm) divided by HC (as cm) and WHtR was calculated as WC (as cm) divided by height (as cm) (4). PBF was calculated by BAI (HC / height $^{1.5}$–18) (5) and measured using InBody 3.0 (Biospace Co, Ltd., Seoul, Korea).

Statistical analysis

All variables are presented as mean and standard deviation. The Kolmogorov–Smirnov test was used to test the normality of the distribution. Bivariate correlation coefficient was calculated to investigate the association between two values of PBF. All tests for statistical significance were two-tailed and performed assuming a type I error probability of < 0.05. All data were analyzed by the SPSS software package (SPSS for Windows; SPSS Inc., Chicago, IL, USA; Version 16.00).

Results

Correlation coefficients among anthropometric measures are presented in Table 2. A highly significant correlation was found between BAI and PBF. In addition, BAI was strongly correlated with all anthropometric measures except WHR.

Table 2. Bivariate correlation among anthropometric measures.

	BAI	PBF from InBody 3.0	WC	BMI	WHR	WHtR	Height	HC
Body Adiposity Index	1							
PBF from InBody 3.0	0.751 P<0.0001	1						
Waist Circumference	0.502 P<0.0001	0.782 P<0.0001	1					
Body Mass Index	0.784 P<0.0001	0.866 P<0.0001	0.863 P<0.0001	1				
Waist/Hip Ratio	0.164 P=0.152	0.457 P<0.0001	0.711 P<0.0001	0.468 P<0.0001	1			
Waist/Height Ratio	0.731 P<0.0001	0.833 P<0.0001	0.901 P<0.0001	0.882 P<0.0001	0.754 P<0.0001	1		
Height	-0.461 P<0.0001	-0.043 P=0.724	0.315 P=0.005	0.029 P=0.803	-0.026 P=0.820	-0.121 P=0.292	1	
Hip Circumference	0.568 P<0.0001	0.735 P<0.0001	0.799 P<0.0001	0.812 P<0.0001	0.149 P=0.194	0.623 P<0.0001	0.466 P<0.0001	1

BAI, body adiposity index; PBF, percent body fat; WC, waist circumference; BMI, body mass index; WHR, waist-to-hip-ratio; WhtR, waist-to-height ratio; HC, hip circumference.

Discussion

Public health monitoring needs easily applicable index to evaluate adiposity. Measuring skinfold thickness requires skills and complex mathematical calculations to obtain the value and DEXA is expensive and not accessible for all. This issue demands hard efforts to establish new index to estimate the adiposity. Bergman et al. (2011) introduced BAI as a new and more applicable anthropometric measure of adiposity (5).

The present study demonstrated that BAI could directly estimate the percentage of body fat by height and hip circumference in males. BAI was positively correlated with hip circumference, and negatively correlated with height. Initial study by Bergman et al. compared DXA-derived % adiposity and the BAI and reported that BAI was a strong predictor of %fat in Mexican-American subjects. They also confirmed the result in a study of African-Americans (5). In another study, Sun et al. validated the accuracy of BAI to estimate adiposity among a large number of Caucasian men and women. They indicate that the BAI method is a better estimate of adiposity than BMI in non-obese Caucasian subjects. They found strong correlations between BAI and body fat percentage measured by DEXA in men (r = 0.67) and women (r = 0.74) (6).

Conclusion

In conclusion, we validated BAI, which can only be calculated from hip circumference and height. Therefore, it can widely be used in the clinical settings. However, it remains to be investigated if the BAI is a more useful predictor of health outcome than other indexes of body adiposity.

Acknowledgment

The authors give special thanks to the Ilam University for their support.

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