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Reliability of BMI as an index for fattiness and obesity in active population in comparison to Endomorphy component as an index

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Abstract

Aim: The aim of the present study was to find out whether BMI is a reliable index for fattiness and obesity compare to endomorphy component as index. **Methods:** 439 males and 475 females from different countries across the world were measured over an extended period of years to 2020 for . Stretched stature, Body weight, Skinfold Thicknesses (Biceps, Triceps, Supraspinale and Calf), Girths (Arm Flexed and Tensed and Calf) and Bi-epicondylar breadth (Humerus and Femur). **Results:** Very low correlation (r = 0.18) was observed between BMI and fat % whereas high correlation (r = 0.61, p< .05) was observed between BMI and Fat Free Mass (FFM). correlation coefficient (r) between BMI and Mesomorphy component was 0.79 (p<.05). Correlation coefficient (r) between Endomorphy and fat % was 0.86(p<.05). **Conclusion**: Thus from the above study, it can be concluded that, for individuals, BMI is more associated with muscularity than it is with fatness.

Keywords: BMI, Fat %, FFM, Endomorphy, Mesomorphy

Resumen

Objetivo: El objetivo del presente estudio fue averiguar si el IMC es un índice confiable de gordura y obesidad en comparación con el componente de endomorfia como índice. **Métodos:** se midieron 439 hombres y 475 mujeres de diferentes países de todo el mundo durante un período prolongado de años hasta 2020 para. Estatura estirada, peso corporal, grosor de los pliegues cutáneos (bíceps, tríceps, supraespinal y pantorrilla), circunferencia (brazo flexionado y tenso y pantorrilla) y amplitud bi-epicondilar (húmero y fémur). **Resultados:** Se observó una correlación muy baja (r = 0.18) entre el IMC y el% de grasa, mientras que se observó una alta correlación (r = 0.61, p <.05) entre el IMC y la Masa libre de grasa (FFM). El coeficiente de correlación (r) entre el IMC y el componente Mesomorfia fue de 0,79 (p <0,05). El coeficiente de correlación (r) entre la endomorfia y el% de grasa fue de 0,86 (p <0,05). **Conclusión:** Por lo tanto, del estudio anterior, se puede concluir que, para los individuos, el IMC está más asociado con la musculatura que con la gordura.

Palabras Clave: IMC, % de grasa, FFM, endomorfia, mesomorfia.

Introduction

Body Mass Index (BMI) is a simple anthropometrical method to classify the human body according to its nutritional status in terms of degree of fattiness and obesity. The basis of Body Mass Index (BMI) was the Quetelet index, which was first introduced by Lambert Adolphe Jacques Quetelet (1830-1850) as a simple measure to classify body weight relative to an ideal for height (Eknoyan 2008). Later on, Body Mass index (BMI) became a simple index of weight-for-height that is commonly used to classify overweightness and obesity in adults

Overweightness and obesity are defined as excessive fat accumulation in the body. A body mass index (BMI) over 25 is considered overweight, and over 30 is obese. Obesity has turned into an epidemic over the last few decades irrespective of whether a country is developed or developing. According to the Global Burden of Disease, over 4 million people die every year as a result of being either overweight or obese (WHO 2017). Though BMI has been regarded as a reliable index of health for the last 170 years, it may not be an accurate predictor because BMI does not distinguish between muscle and fat, nor between body lean mass and body fat mass. This can lead to confusion and misinformation about fattiness and obesity (Strain GW, Zumof 1992, Wellens et al. 1996, Flegal et al. 2009, Nuttal 2015).

The Endomorphy component describes the fattiness of a person as a part of a three-component Somatotype that describes the shape and size of the human body. Other two components of somatotype are mesomorphy and ectomorphy where mesomorphy indicates the muscularity and ectomoprhy describes the linearity (Carter and Heath 1990).

The aim of the present study was to find out whether BMI is a reliable index for fattiness and obesity compare to endomorphy component

Material and Methods

Participants:

439 males and 475females from different countries across the world were measured over an extended period of years to 2020. At the time of measurement, all participants were physically active at their profession which had to involve significant physical labour, e.g. farming, hunting, professional sport and personal training.

Anthropometric measurements:

Stretched stature, Body weight, Skinfold Thicknesses (Biceps, Triceps, Supraspinale and Calf), Girths (Arm Flexed and Tensed and Calf) and Bi-epicondylar breadth (Humerus and Femur) were measured by an ISAK Criterion Anthropometrist according to the methods described in ISAK Manuals (International Standards for Anthropometric Assessment), 2011 and 2019 editions.

Somatotype

The Heath-Carter (1967) method was followed for somatotype rating. The following equations were used for calculating somatotype:.

Endomorphy = $-$ 0.7182 + 0.1451 × ΣSF $-$ 0.00068 × ΣSF2 + 0.0000014 × ΣSF3

where ΣSF = (sum of triceps, subscapular and supraspinale skinfolds) multiplied by (170.18/height in cm). This was called height-corrected endomorphy and was preferred method for calculating endomorphy)

Mesomorphy = 0.858 × humerus breadth + 0.601 × femur breadth + 0.188 × corrected arm girth + 0.161 × corrected calf girth $-$ height × 0.131 + 4.5

Three different equations were used to calculate ectomorphy according to the height -weight ratio (HWR):

If HWR was greater than or equal to 40.75 then, Ectomorphy = 0.732 × HWR $-$ 28.58

If HWR was less than 40.75 and greater than 38.25 then, Ectomorphy = 0.463 × HWR $-$ 17.63

If HWR was equal to or less than 38.25 then, Ectomorphy = 0.1

Body Mass Index(BMI)

Body Mass Index (BMI) was calculated using the equation where BMI = Weight (kg) / Height(m)2.

Body Fat %: Body fat % was calculated using the equation of Siri (1956).

Body fat % = (495/Body density) - 450.

The Durnin and Womersley (1974) calculation was followed for Body density.

Statistical analysis: The SPSS 15 (IBM SPSS Statistics) software package was used for statistical analysis.

Results

Table 1. Average Age, Height, Weight, somatotype components, BMI, Fat %, Fat free Mass (FFM) and Fat Mass of 801 male and female participants.

Variables	Male & Female (n= 801) Mean ±SD (Range)	Male (n=442) Mean ±SD (Range	Female(n= 359) Mean ±SD (Range)
Age (year)	23.8±7.5(17-70)	23.7±6.1(17-63)	24±8.6(18-70)
Height(cm)	166.7± 11.0 (130.8-201.6)	172.4±8.8(152.4-201.6)	159.7±9.3(130.8-194.9)
Weight(kg)	65.5±14.6 (31.3-131.7)	72.3±15.2(39.1-167.1)	57.6±11.5(31.3-95.0)
Endomorphy	4.2±2.0 (0.7-11.2)	3.6±1.7(0.7-11.2)	5.0±2.0 (1.0-11.2)
Mesomorphy	4.4±1.6(0.7-9.8)	4.8±1.7(0.7-9.8)	3.9±1.3(0.8-7.8)
Ectomorphy	2.1±1.4(0.1-8.3)	2.1±1.4(0.1-6.8)	2.1±1.4(0.1-8.3)
BMI	23.4±3.9 (12.5-42.2)	24.1±4.1(15.7-42.2)	22.5±3.4(12.5-34.8)
Fat %	21.3±8.2(2.1-45.2)	15.4±5.8(2.1-37.2)	27.3±6.4(2.5-45.2)
Fat Free Mass(FFM)	51.7±13.3(21.3-93.8)	60.3±12.2(32.7-144.7)	41.7±8.2(21.3-70.8)

Table 2. Correlation coefficients (r) of BMI and Endomorphy component with Body Fat % , FFM, Somatotype components

		BMI	Fat %	FFM	Endomorphy	Mesomorphy
Male & Female n= 801	BMI	1	0.18	0.61	0.31	0.79
	Endomorphy	0.31	0.86	-0.35	1	0.10
Male n=442	BMI	1	0.38	0.61	0.41	0.79
	Endomorphy	0.41	0.92	.09	1	0.51
Female n=359	BMI	1	0.52	0.56	0.44	0.81
	Endomorphy	0.44	0.91	-0.30	1	0.28

Discussion

In the present study, correlation between BMI and fat % was very low (r = 0.18). On the other hand, relationship between BMI and Fat Free Mass (FM) was significantly (r = 0.61, p< .05). This was also reflected when the relationship between BMI and Mesomorphy component was considered. The correlation coefficient (r) between BMI and Mesomorphy for males was 0.79 (p <.05) and that for females was 0.81 (p<.05).

The correlation coefficient (r) between BMI and Fat % was only 0.38 for males and that for females was 0.52. Good positive correlations were observed between BMI and FFM for both groups (r=0.61 for males and r=0.56 for females). The poor correlations between BMI and Fat % of the present study indicated that BMI did not necessarily reflect Fat % or fattiness, nor the degree of obesity. However, good positive correlations between BMI and FFM as well as between BMI and Mesomorphy (Muscularity) indicated that BMI values reflected Fat Free Mass (FFM).

The correlation coefficients (r) between Endomorphy and Fat % for men and women of 0.92 (p<.01) and 0.91 (p<.01) respectively (Table 2).

Conclusion

Thus from the above study, it can be concluded that, for individuals, BMI is more associated with muscularity than it is with fatness.

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Conflict of interest

The Author do not have any conflicts of interest to declare.

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