

Correlation between Body Mass Index and Body Fat Percentage

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Abstract

Background: Body mass index (BMI) has been used to determine the nutritional status which is classified into low, normal, overweight or obese. The BMI only shows a comparison of height and weight instead of body composition which consists of fat mass and fat-free mass. Most of people assumed that BMI average means fat mass average as well, yet it does not occur in all cases. This study was conducted to measure the correlation between BMI and body fat percentage.

Methods: An analytical study was conducted to 100 male and female students respectively from Universitas Padjadjaran Jatinangor batch 2009 to 2013. The body weight was measured using scales, whereas the body height was measured using stature meter. The body fat percentage was measured using Bioelectrical Impedance Analysis (BIA). The BMI was calculated by dividing the body weight in kilogram divided by body height in meter square. Data was collected from September to October 2013 and analyzed by Pearson's correlation test.

Results: The mean of BMI in male students and female students were 22.56 and 21.35 respectively. The body fat percentage was 16.44 for men and 28.09 for women. Correlation score between BMI and fat mass in male students were 0.853 and female students are 0.834.

Conclusions: There is a strong and positive correlation between BMI and body fat percentage both in male and female students in Universitas Padjadjaran Jatinangor. Among this population, BMI can still be used to determine body fat percentage. [AMJ.2015;2(4):575-8]

Keywords: Bioelectrical impedance analysis, body fat percentage, body mass index.

Introduction

Human body consists of fat mass and fat free mass. The fat free mass consists of total body protein stored in the muscle mass, total body water, and total bone mineral. Level of fat mass varies between 13–21% in male and 23–31% in female.¹⁻³ Recently, the common method used to categorize overweight or obesity is body mass index (BMI), which is calculated by using a formula that consists of body weight in kilogram divided by body height in meter square.¹ However, someone who uses BMI cannot determine his body composition of fat and muscle precisely.^{2,4,5}

Most of people assumed that a higher BMI means a higher composition of body fat mass as well, yet it does not occur in all cases. People who have active physical activity relatively possess less fat percentage than who do not do it.^{7,8} For example, an athlete will have solid bone

and well-developed muscle resulting an over body weight based on standard of body weight, but have less body fat mass.^{1,2,3,7,8} Therefore, it can be concluded that a higher BMI does not represent a higher body fat percentage. This study was developed to identify whether there was correlation between BMI and body fat percentage

Methods

Population and subjects of this study were students of Universitas Padjadjaran Jatinangor, selected using stratified random sampling method. Criteria of inclusion in the study were academically active students batch 2009 until 2013 and age of respondents from 18 to 22 years old. Pregnant, in lactation, menstruated female students, athlete students, foreign students, students who were in strict diet, and did hard exercise before the measurement

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Table 1 Characteristic of the Respondents

Characteristic	Male (n=100)	Female (n=100)
Age (years)		
18	13	20
19	32	28
20	25	27
21	20	20
22	10	5
BMI		
Mean	22.56	21.35
Sd	0.40422	0.31629
Body Fat Percentage:		
Mean	16.44	28.09
Sd	0.62923	0.55762

Note: BMI=body mass index, Sd=standard deviation

were excluded from the study. One hundred male and female respectively gathered from 14 faculties in Universitas Padjadjaran Jatinangor. This study was carried out from September to October 2013 in Universitas Padjadjaran Jatinangor.

This study was approved by Health Research Ethics Committee Faculty of Medicine Universitas Padjadjaran. Body height measurement in this study used stature meter tool, while body weight measurement and body composition determination used Bioelectrical Impedance Analysis (BIA). The BIA is known as rapid, non-invasive and relatively precise tool to measure body composition.^{4-6,12}

Respondents who were eligible in the study were asked to fill informed consent form before the measurements were done. The measurements were BMI (score of body weight divided by body height in meter square), and the percentage of body fat. The measurement used BIA was established by inserting age, gender, and body height of respondent into the BIA tools, then respondent stood on the BIA to generate result of the measurement that

would be showed in the tool screen.

After data were collected, statistical data analysis was established. Normality of data was tested using logistic Kolmogorov-Smirnov method before being analyzed the correlation. Data was separated based on gender and showed in numerical data for BMI and body fat percentage. The statistic result showed that data obtained from both male and female samples for BMI and body fat percentage were not normally distributed. Moreover, data transformation was performed using logistic test and resulted normally distributed data. Then, data were analyzed used Pearson's correlation test to define significant correlation between BMI and body fat percentage.

Results

The average BMI in male was greater than average BMI in women, while the average body fat percentage was higher in women than men. Most research subjects were aged 19 years old in men and women, while respondents aged 22 years were the least.

Table 2 Pearson's rho Test result for correlation between BMI and body fat percentage

Pearson's rho test	Male	Female
Correlation coefficient	0.853	0.834
Sig. (2-tailed) (p)	0.000	0.000
n	100	100

Note: $p < 0.05$ = data was significant, $p > 0.05$ = data was not significant

Result from the correlation of the study had a significant score with p score = 0.000 either in male respondent or female respondent. From the Pearson test table above, Pearson's correlation value was 0.853 for male students and 0.834 for female students. This result indicated that positive correlation with high power of correlation because the score was range between 0.80–1.00. Result of this study stated that the correlation between BMI and body fat percentage was positive, the higher BMI, the higher body fat percentage.

Discussion

This study discovered that the mean of BMI and body fat percentage in male was higher than in female. The study conducted by Flegal *et al.*¹³ among U.S public research subjects showed a similar results. The average BMI in male was of 27.9 kg/m² while in women was of 28.2 kg/m². Subsequently, the percentage of body fat average was 28.1% in men and 39.9% in women.

Daud *et al.*⁷ in Malaysia conducted a study that divided the respondents into three groups, namely: athlete, people who exercise regularly and those with sedentary activity. The study showed that the average BMI was higher in subjects sedentary activity (24.3 kg/m²), and the athlete has average BMI was lower than the other two groups (22.6 kg/m²). The body fat percentage on sedentary activities group (20.6%) was higher than the exercise group (18.9%) and the athlete group (15.7%). From these data, it can be concluded that the average of BMI and body fat percentage was influenced by age, race, and activities.

From this study, there was a strong correlation between the BMI and body fat percentage either in male or female students. This results were similar with the study performed by Ranasinghe *et al.*¹⁰ In the study in Sri Lanka, the body fat percentage in adult people was measured by BIA and the subjects of the study were classified based on gender and age interval, young (18–39 years), middle aged (40–59 years), and elderly (>60 years). Based on the study, age and gender influenced the score correlation significantly.

Another study performed by Rao *et al.*⁹ in South India showed that there was a strong correlation between BMI and body fat percentage. It was held in various socioeconomic conditions and ranged between 20 to 60 years old of India people. The study resulted 0.73 score of correlation in male and 0.70 in female. To obtain body fat percentage

in the study, skin-fold method was established. It was concluded that the correlation between BMI and body fat percentage was various and was interfered by gender and age.

Moreover, study performed by Ode *et al.*⁸ reported that there was a significant correlation in both groups of students, athlete students and unathlete students. Unathlete respondents had more significant correlation than athlete respondents. ($r = 0.70$ in non-athlete; $r = 0.65$ in athlete). Furthermore, female students had more significant correlation than male. Inversely, study by Meeuwsen *et al.*⁴ showed less power correlation in the BMI (less than 27 kg/m²). The result were interfered by age of subject. From the previous researches, it could be concluded that the power correlation was influenced by some factors such as race, gender, age, and life style like as physical activity. The difference of mean in BMI from some studies also contributed to the different correlation result.^{4,10} According to Rush *et al.*^{11,14} there was different relationship between body fat mass and BMI in Asian, Indian, European, Maori, and Pacific Island people. On the contrary, Asian Indian people had higher body fat percentage than European, Maori, and Pacific Island people. That study was held in New Zealand with European, Maori, and Pacific Island race as subjects.

There are several limitations in this study. Many of respondents were measured shortly after eating might be interfere result of study, whereas respondents should be fasting at least for 3 hours before the measurement. Other limitations of the study might be from several factors that could influence subjects' body composition and result such as eating style, socioeconomic and various physical activities which were not considered in selecting the subject of study.

Based on the result of study, it can be concluded that there is a strong correlation between BMI and body fat percentage either in male or female students. The BMI data from male students and female students in Universitas Padjadjaran can still be used to describe body fat percentage score.

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