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Abstract

The body mass index (BMI) had been the most measured to characterize body composition in an individuals. However, BMI has been criticized as being an inaccurate measured of body fatness among active individuals. Therefore, the aim of this study was to identify the relationship between BMI and waist to hip ratio (WHR), percentage body fat (PBF) and visceral fat (VF) among active individuals. The design used in this study was descriptive correlation design. Subjects (n = 242) were students from Faculty of Sports Science and Recreation, UiTM Shah Alam. BMI, WHR, PBF and VF measurements was using Bio Impedance Analysis (BIA). There was a positive relationship between BMI and WHR, PBF and VF. Results showed high relationship between BMI and WHR (r = 0.615, p = 0.000). Whereas, moderate relationship between BMI and PBF (r = 0.421, p = 0.000). Besides, there was high relationship between BMI and VF (r = 0.529, p = 0.000). Based on results, BMI was moderate to high relationship between WHR, PBF and VF. Therefore, BMI can be considered accurate and appropriate measurement to determine body fatness among active individuals.

Keyword: *Body Mass Index (BMI), WHR, PBF, VF*

INTRODUCTION

As the country already in the edge of urbanization there are a lot of health problems identified, one of these major health problems is obesity (Yousif,Kaddam,& Humeda, 2019). Nowadays, obesity has become a severe worldwide public health problem. As predicted, by 2030 about 573 million and 1.35 billion adults would have problems with obesity respectively (Kelly, Yang, & Chen, 2008). As obesity is a global issue, it represents a rapidly growing threat to the health of populations in an increasing number of countries. As reported the prevalence of obesity has reached epidemic levels in many developing countries, and Malaysia is of no exception (Chan,2009). Malaysia is ranked as the fattest country in Asia (NHMS,2015). In addition, recently informed Malaysian was ranked the second highest in the number of obese people in the Southeast Asian Region. Almost half of Malaysian adult populations made up of 9.9 million citizens are either obese (Foo, 2017).

Overweight and obesity has become a major public health concern to the world because obesity has far reaching negative effects on health (Finkelstein et al.,2012; Wiklund, 2016). As reported in recent years, body composition anomalies are closely related to lipid metabolic disorder diseases, such as obesity (Liang, Chen, Li, Yan, & Yang, 2018). Obesity is usually related with a higher risk of developing diabetes mellitus, metabolic syndrome, stroke, hypertension, atherosclerosis, cardiovascular disease, cancer and other clinical conditions, such as sleep apnea, gallstones and also osteoarthritis (Donnelly et al.,2003; Fogelholm, Stallknecht, & Van Baak, 2006; Hallal, Victora, Azevedo, & Wells, 2006; Hopps & Caimi, 2011; Paul Poirier & Després, 2001; Wiklund, 2016). As said by Ramires et al. (2016). Obesity also highlight as factor raises the risk of early mortality and other chronic diseases and these associated increased health care costs, and placing a large financial burden. This epidemic disease clearly needed to be countered as it becomes more worst and be- coming a lifestyle disease.

The body mass index (BMI) is commonly used to characterize obesity in active individual. From previous study stated that BMI are among the most popular methods to measure obesity due to their simplicity, ease of execution and low cost (Kopelman,2002). Besides, BMI also acts as an indicator to predict disease incidence and mortality it is a simple

to use scale, as it provides a standardized cut-off value to classify obesity in the adult population (Ofei,2005). However, there was a limitation of using BMI to classify obesity are particularly exemplified when examining young adults with varying levels of physical activity (Zanovec,2014). Besides, limitation of using BMI as an index of obesity was that it failed to account for the composition of body weight, which was comprised mainly of fat, and lean tissues (Dinger et al., 2006; Han 2006). BMI is unable to distinguish between lean and fat mass: a muscular athlete may have a high BMI because of extra lean mass (Okorudu,2010). There was difference interpretation regarding BMI as a predictor of body fatness. Therefore, the aim of this study was to identify the relationship between BMI and Waist to Hip (WHR), Percentage Badi Fat (PBF) and Visceral Fat (VF) among students from Faculty of Sports Science and Recreation, UiTM Shah Alam.

METHOD

Study Population

Subject of 242 students from Faculty of Sports Science and Recreation, UiTM Shah Alam, age between 18 to 30 years. Each gender was included in this study which male (n = 134) and female (n = 108). The characteristics of the subject are listed in the table 1. This study excluded subjects diagnosed with chronic diseases. This research was approved by the UiTM ethic committee: 600-IRMI (5/1/6).

Table 1: Subject Characteristic (n =242)

Variables	Mean (SD)
Number of subjects	242
Sex (M/F)	134/108
Age	22.89 ± 1.68
BMI (kg.m^2)	23.88 ± 3.10
WHR	1.74 ± 0.72
PBF	17.53 ± 1.68
VF	7.46 ± 1.62

Study Design

The design used in this study was descriptive correlation designed to identify relationship between BMI, WHR, PBF and VF among students Faculty of Sports Science and Recreation. First, the recruitment of the students selected based on the inclusion and exclusion criteria that was set by researcher. Students were recruited during September 2019 to January 2020

academic session from Faculty of Sports Science and Recreation. After that, students were well brief by researcher about the test benefits and procedures and given a consent form to complete. Then, the students were explained regarding the body composition measurement procedures.

Body Composition Measurement

In Body 720 device used a direct segmental multi-frequency bioelectric analysis method, a patented technology to precisely measure body composition by sending multiple electrical voltages through the inner body, resulting in up to six different impedance readings for the trunk and four limbs. All measurement was collected by researcher during a single laboratory session in clinic of Faculty of Sports Science and Recreation that lasted approximately two hours.

The detail of the student filled in Bio Impedance Analysis (BIA) machine recorded digitally by researcher before the body composition assessment took place. Students also asked to wear lightweight, loose- fitting clothing, free of metal and to remove all jewelry and shoes during measurement. Standing height was measured without shoes to the nearest 0.5cm using a portable stadiometer, with the student head positioned in the Frankrut's horizontal plane. Researcher give instruction on the BIA assessment. Printed results kept by researcher as confidential information.

Statistical Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS 2.0). Descriptive analysis used to describe the demographic data. The Pearson correlation was used to identify the relationship between BMI and WHR, PBF and VF. All data was presented in mean and standard deviation with significant level set at $p < 0.05$.

RESULTS AND DISCUSSION

Body fatness was measured using BMI, WHR, PBF and VF. Normal BMI classification among students of Sport Science and Recreation was 46.7%. Meanwhile, overweight, pre-obese and obese was 22.7%, 26.4% and 4.13% respectively. Furthermore, results showed excellence WHR was 40.5%, good 47.1%, average 11.6% and at risk 0.8%.

Results for PBF was excellence (16.5%), good (52%), average (25.6%) and at risk (5.8%). For VF, results showed standard was 74.4%, high 24% and very high 1.6%. There were a positive and significance relationship between BMI and WHR, PBF and VF (Table2). Finding for correlation between BMI and WHR was $r\ (242) = 0.615$, $p < .000$ (Figure1. p.164). High association between BMI and WHR, which increase the BMI, positively increase the waist to hip ratio measurement. Meanwhile, moderate correlation between BMI and PBF $r\ (242) = 0.421$, $p < .000$ (Figure 2. p. 165). There was significance association between BMI and PBF among active individual. Furthermore, finding for correlation between BMI and VF $r\ (242) = 0.529$, $p < .000$ (Figure 3. p.165). It means, high reading of BMI showed high level of VF among active individuals.

Table 2: Correlation between Body Mass Index with WHR, PBF and VF

Variables	Correlation	*P* value
BMI (Kg.m²) and WHR	0.615	0.000
BMI (Kg.m²) and PBF	0.421	0.000
BMI (Kg.m²) and VF	0.5	0.000

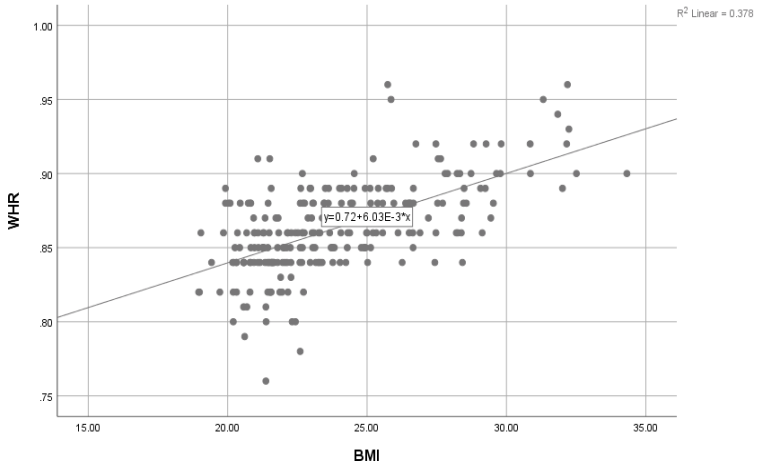

Figure 1: Scatter plot of BMI and WHR

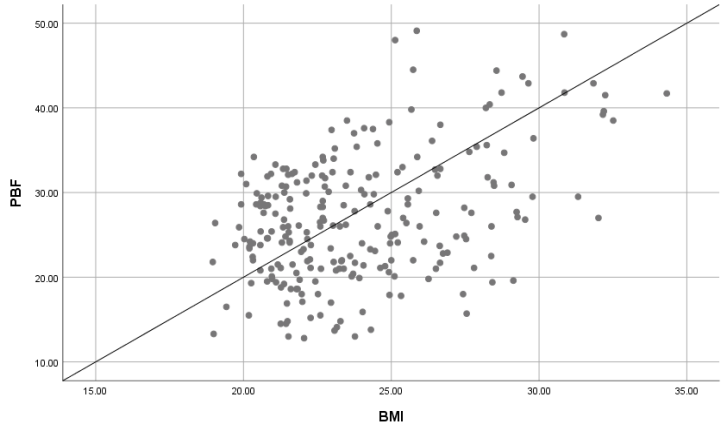

Figure 2: Scatter plot of BMI and PBF

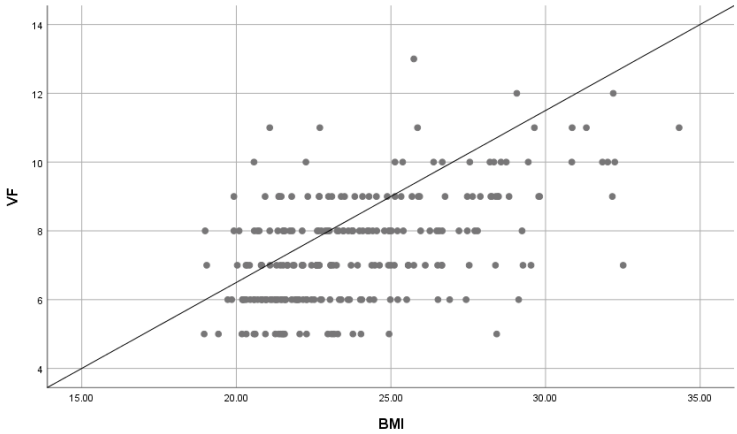

Figure 3: Scatter plot of BMI and VF

Body mass index, weight kg/height m² is presently the most often used and widely satisfactory methods of distribution of body weight and classification of medical risk (Lietzmann, 2011). As reported in this study, 46.7% students were in normal BMI classification while 53.3% were abnormal BMI. Somehow, 87.6% in good range classification in WHR and 68.5% reported as good range in PBF.

In addition, 74.4% students also reported in a good VF. Briefly, more than 65% of students were reported in a good classification in WHR, PBF and VF. Thus, this contradict with the BMI results. The BMI result reported were quite less expected because Sports Science and Recreation Students should have more number than 46.7% as their social environment itself able to engage students with physical activity. Social environment plays a major role in order to enhance physical activities (Zanovec,2014). As Faculty of Sports Science and Recreation

include the fit ness programs and aerobic dance classes this helped students to develop the active lifestyle and able to maintain healthy BMI.

A few studies concluded that was shortfall of BMI as a measurement to estimate fatness. The limitations of using BMI to classify obesity were particularly exemplified when examining young adults with varying levels of physical activity (Zanoec,2014). As the some of the students in Faculty of Sports Science and Recreation were very active in sport that may cause them to weigh muscle. Therefore, BMI would inevitably class muscle, athletic people as fatter than they really were. Consequently, limitation of using BMI as an index of obesity was that it failed to account for the composition of body weight, which was comprised mainly of fat, and lean tissues (Liang et al., 2018; Han 2006) was accepted. BMI is unable to distinguish between lean and fat mass: a muscular athlete may have a high BMI because of extra lean mass (Okorudu,2018).

The active students might be mis-categorized for having an extra weight or obese. WHR also concluded slightly better performance than BMI (Hajian-Tilaki, K., & Heidari, B., 2015). Besides, PBF was reported as superior measure of obesity to BMI better at differentiating between lean mass and adipose tissue in those mildly obese or overweight (Goonagesaran,2012). Thus, possibly WHR and PBF played a more important role in distinguishing between healthy and obese individuals, as it has a greater ability to differentiate between lean mass and fat mass compared to BMI.

Interestingly, the result showed positive significance relationship between BMI and WHR ($r\ (242) = 0.615$, $p < .000$). It means, higher BMI reading was resulted higher WHR among students in Faculty of Sports Science and Recreation. Another finding also state there was a correlation between BMI and WHR (Rufai et al., 2019). This study agreed with those findings. Therefore, the limitations of using BMI to classify obesity were not exist among active individuals. Particularly, BMI can be considered as effective tools to estimate body fatness among active individuals as it was high correlation between WHR.

Furthermore, the result showed positive significance relationship between BMI and PBF ($r\ (242) = 0.421$, $p < .000$). It means, higher BMI reading was resulted higher PBF among students in Faculty of Sports Science and Recreation. In addition, high correlation reported

between BMI and PBF which high BMI, increased the potential high PBF (Pham et al., 2015; Misra, 2019).

Besides, the degree of correlation among BMI and PBF was found to be positive and highly significant (Bano et al.2015). This study was in line with those findings. Therefore, the limitations of using BMI to classify body fatness were not occur among active individuals. Explicitly, BMI can be considered as an effective tool to predict body fatness among active individuals as it was moderate correlation between PBF.

Moreover, the result showed positive significant relationship between BMI and VF ($r\ (242) = 0.529$, $p < .000$). Higher BMI reading was resulted higher VF among students in Faculty of Sports Science and Recreation. There was positive and high correlation between BMI and VF. Next, also reported, there was correlation between BMI and VF (Hong et al., 2015). This study had confirmed the direction of correlation between BMI and VF. Hence, BMI should not be abandoned in the clinical evaluation of people with obesity as there was correlation between VF.

In conclusion, there were positive and significance correlation between BMI and WHR, PBF as well as VF. Though our results were in alignment with the already available evidences. The possible factors that lead to high correlation between BMI and other indexes were method of assessment of body composition. Few studies also showed positive correlation between BMI and PBF measured using BIA machine (Raimi et al.,2017; Ranasinghe, 2016).Therefore, BIA machine was one of the effective method of assessment that able to measure WHR, PBF and VF. Besides, BIA offer a cheaper, hazard-free accessible way to estimating body fatness.

As well, BIA was a valid method of body fatness, showed excellent correlation between BMI and DXA machine (Tilaki et al., 2015). Therefore, BMI is a practical measure, but it needs to be interpreted cautiously based on study population. The contradict finding may because of the population characteristics. BMI was unable to distinguish between lean and fat mass: a muscular athlete may have a high BMI because of extra lean mass (Okorudu et al., 2010). Probably, our population considered as moderately active, thus the finding was differences. Therefore, BMI can be used as one of the indicators of body fatness among active individual. But, assuming, BMI was not a valid measurement to apply on high

performance athlete populations. This study was limited by the small sample size. A larger study is necessary to confirm the findings in this study. In addition, future study should be conduct to high performance athlete population to test whether BMI was a practical measure to use on them.

CONCLUSION

There was positive significant correlation between BMI and WHR, PBF and VF. BMI can be considered as a valid measurement as others index of obesity to estimate body fatness among active individuals.

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