# ASSESSMENT OF BODY COMPOSITION AND MUSCLE STRENGTH AMONG UNDERWEIGHT, NORMAL AND OVERWEIGHT/OBESE FEMALE STUDENTS OF IIUM KUANTAN

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ABSTRACT

**Introduction:** Muscle strength is a useful parameter of individual body strength and health and is influenced by many factors including sex, age, physical activity as well as body composition. The main objective of this study was to assess hand grip strength (HGS) among different BMI classes as well as to examine the correlation between body composition and HGS in a representative sample of young healthy adults. **Methods:** A total of 102 female students were recruited from the International Islamic University Malaysia (IIUM) Kuantan Campus Kuantan. The subjects were then divided into three groups based on their BMI (34 underweight, 34 normal and 34 overweight/obese). The anthropometry and body composition were measured using the SECA stadiometer and OMRON body fat analyzer, respectively. The HGS was assessed using Takei hand grip dynamometer. **Results:** The findings showed that the HGS was significantly lower in underweight as compared to the overweight/obese subjects (21.47 + 3.23 kg vs 23.31 + 3.32 kg; $p<0.05$). A fair positive correlation was found between BMI and HGS ($p<0.05$). However, in this study there was no correlation between HGS and body fat percentage or skeletal muscle mass. **Conclusion:** In this study, higher HGS was associated with higher BMI, but not body fat percentage and muscle mass. However, the influence of other factors such as physical activity, sex and age, on HGS should be investigated.

**KEYWORDS:** Muscle strength, BMI, Handgrip strength, Body fat percentage

## NTRODUCTION

The prevalence of overweight and obesity in all age groups have reached an alarming level in many countries. Globally, in 2016, there were more than 1.9 billion adults (18 years and older) were overweight. From this number, 650 million were obese (World Health Organization, 2018). In Malaysia, the National Health and Morbidity Survey 2019 revealed that 30.4% of our adults were overweight while 19.7% were obese (Institute of Public Health,

2020). This means half of Malaysian adults were overweight or obese as of last year. While overweight or obese is the major risk factor for many health diseases, underweight is also associated with health concerns such as frequent sickness, disrupted hormone regulation especially for woman, malnutrition e.g anemia or easy fatigue (Rachel, 2018). Muscular strength can be defined as the maximum amount of force a muscle can produce in a single effort. It is a component of physical fitness and essential in improving the quality of life as it provides various health benefits (Corbin & Lindsey, 1994). Strong muscles are associated with low mortality and mobility of individuals. A study conducted by Rantanen and his team (2000), concluded that increasing risk of all-cause mortality had been related to poor muscle strength measured in mid-life. On the other hand, strong muscular strength provides direct and indirect health benefits such as enabling functional movement, easier performance of works in daily life, contributing to stronger tendons, ligaments, and bones. Research indicates that the rate of strength and muscle gains tend to be greater at the age of 10 to 20 years old, as it is the phase of rapid growth and development. Muscle improvements appear to be slower after reaching normal physical maturity (Tackett, 2014). However, people of all groups of ages can increase the muscle strength following a safe and effective training program. Researchers agreed that one of the major determinants of muscle strength was the body size, where thinner people often have lower strength compared to those with normal body weight (Rantanen, 2000). Lower muscle strength also affects muscle quality, leading to weak and non-fit muscles. The main organ that affects strength is the skeletal muscle fiber while adipose tissue is used to store energy. It is very important to have a strong muscular strength and endurance as it leads to healthier, stronger muscles and bones. A cross-sectional study was conducted to compare the muscle strength and BMI between underweight, normal and overweight/obese female students of IIUM Kuantan. Hand-grip dynamometer was used to measure the force generated the muscles (muscle strength).

## METHODS

A total of 102 female students in IIUM Kuantan were recruited in this research where their body composition, BMI and muscle strength were measured. Informed consent was obtained from the participants and ethical approval was obtained from the IIUM Research Ethics Committee. Height was measured by using the SECA stadiometer while weight was measured by using OMRON body fat analyzer following the correct procedures. For height measurement, subjects looked straight ahead with both arms at the side and the headboard lowered enough to compress the hair. Measurement was taken to the nearest 0.1 centimeter (cm). As for weight, subjects were barefoot, all the accessories were removed and were requested to stand still on the base plate. Measurement was taken to the nearest 0.1 kilogram (kg). The BMI were calculated using the formula: BMI = weight (kg)/ height$^2$ (m). Fat mass including visceral fat and fat free mass was measured using OMRON body fat analyzer. Firstly, the profile settings of the subject such as gender, age and height were entered. Then, the subject stepped on the body fat analyzer barefooted while holding the head of body fat

analyzer scale to the front with both hands straight and stand still. Values such as fat percentage, skeletal muscle mass, visceral fat, weight, and BMI were recorded. Muscle strength of the subjects was measured by using Takei Digital Grip Strength Dynamometer (Model T.K.K.5401). The proper position of handling the hand grip dynamometer was emphasized, where subject's elbow was straight and fully extended at the side. Head and eyes looked straight ahead. The wrist was not flexed or extended, and the feet were hip width apart and even. The measurements were taken for dominant hand and the values obtained were recorded. The result was analyzed by using SPSS version 12.0.1. The Pearson correlation test was used to evaluate the correlation of muscle strength and BMI, body fat percentage and skeletal muscle mass. ANOVA was applied to compare the differences between muscle strength and BMI among underweight, normal, and overweight/obese. The significance level was set at $p < 0.05$.

## RESULTS

### Comparison of hand grip strength according to BMI classes

One-way ANOVA analysis was conducted to compare the HGS between different categories of BMI. The HGS of underweight, normal and overweight/obese subjects were 21.47 + 3.23 kg, 22.89 + 3.49 kg and 23.31 + 3.32 kg, respectively (Figure 1). The result shows that there was a significant difference in terms of HGS between the BMI classes (P=0.037). Post-hoc test revealed that the difference was between underweight and overweight classes (P<0.05).

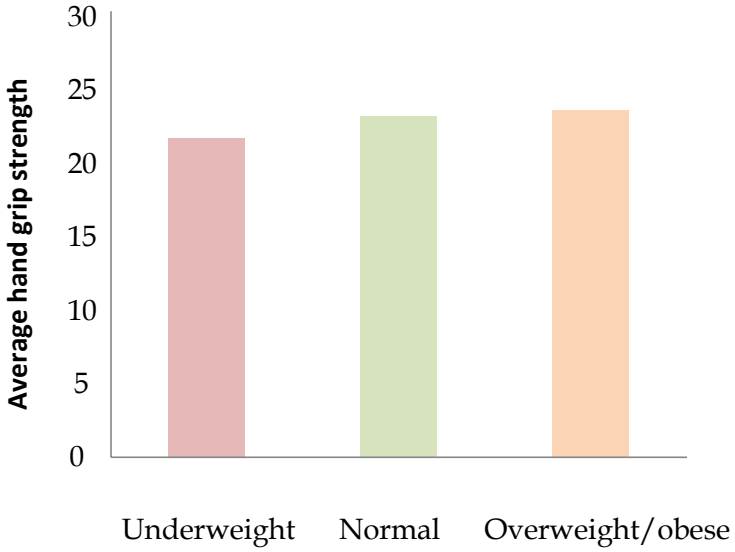


Figure 1 Hand grip strength (kg) according to BMI categories (n=102)

### Correlation between body mass index and hand grip strength

The relationship between BMI and HGS was assessed using Pearson correlation coefficient. A preliminary analysis was performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity. Figure 2 shows a fair positive correlation between the two variables with r = 0.2251 (p = 0.012) between BMI ($kg/m^2$) and HGS (kg).

**Hand grip strength and body composition**

In this study, it was revealed that there was no linear correlation between body fat percentage and HGS (r=0.035, p=0.46). This non-association explained that increase or decrease in body fat percentage does not affect HGS. Similarly, there was no significant relationship between skeletal muscle mass and HGS (r=0.007, p=0.95).

## DISCUSSION

In this study, we found that overweight/obese group had significantly stronger HGS than underweight group. These findings support the studies of Liao (2015) and Shin et al (2012). Basically, underweight individuals have less muscle mass and therefore have less muscular strength. The relationship between BMI and low HGS was explored in a study and it was revealed that poor nutritional status, expressed by low BMI and low arm muscle area, was a significant determinant of impaired HGS (Pieterse et al, 2002). Besides, a significant positive correlation between HGS and BMI implying that higher BMI represented higher strength and power of hand grip. This finding is in line with Anupi and Marami (2015) who also found a statistically significant correlation between BMI and HGS in female subjects. Surprisingly, there was no correlation found between HGS and body fat or muscle mass. These findings were not in agreement with several other studies that found a correlation between body composition and HGS (Ingrova et al, 2017, Lad et al, 2012, Bindiya et al, 2017). It is believed that this could be due to the differences in the subjects' age and gender between our study and the studies above. Another possible reason is the time when measurement was conducted. It is possible that some of the subjects did not have any meals before the assessment, thus affecting the potential strength in gripping the hand grip dynamometer. In contrast, the subjects who already had their meals might perform better during the assessment. Other confounders might also have contributed to the findings such as physical activity. Students with lower body fat percentage might have a good muscle mass whereas students with higher body fat percentage might have more muscle mass than fat. The current study found no correlation between HGS and skeletal muscle mass the variable. It was unclear as to why there was no effect of skeletal muscle mass on HGS observed in the current study. However, the reasons for these inconsistent results were believed to be because of the environment during the data collection itself as well as the condition of subjects such as their health. The HGS assessment was conducted in front of other students. Therefore, it may be possible that some of them got a little bit enthusiastic to show their strength to the others, and

this might have affected the HGS measurement. Another possible reason was some of the subjects might had not eaten any meals before the assessment, thus they did not have as much energy to give their fullest potential in gripping the hand grip dynamometer. In contrast, the subjects who already had their meals might perform better during the assessment. In addition, although it was confirmed that none of the subjects were having any kind of diseases or illness or hand deformity, some of the respondents might be experiencing acute health conditions that were not revealed such as experiencing menstruation cramp or just recovered from a fever. All of these can affect the hand grip measurement. Most of other studies that correlated HGS and skeletal muscle mass found a positive correlation between the two variables. However, those studies were conducted among elderly, thus aging and physical performance might be the factors that affect the results (Sekarsari et al, 2018, Shin et al,2017 and Ma et al, 2017).

## CONCLUSION

There was a positive correlation between HGS and BMI indicating that the higher BMI of a person, the stronger her or his HGS would be. However, HGS was not associated with body fat or skeletal muscle mass. Factors such as age, gender and physical activity level may play a role in the muscle strength and warrant further investigation.

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