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RESEARCH ARTICLE

Comparison of fat percentage with muscle strength/endurance and blood pressure response in young adults

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ABSTRACT

Background: Obesity and hypertension comprise an important worldwide epidemic that has been linked to the metabolic syndrome. Leading a sedentary lifestyle can promote weight gain, increase body fat; a loss of lean muscle mass could eventually lead to obesity. **Aims and Objectives:** This study was designed to investigate the correlation between fat percentage with muscle strength/endurance and blood pressure response in young adults. **Materials and Methods:** This cross-sectional study was conducted after the approval from Institutional Ethical Committee. 40 subjects having general obesity among staff and student community, between the age group of 18 and 40 years of either sex was recruited for the study. The fat percentage was measured based on the Deurenberg's equation body mass index (BMI) was measured using the formula, BMI = weight (kg)/height (m^2). The muscular strength/endurance was assessed by hand grip exercise using hand dynamometer. **Results:** The result showed that there was a significant difference between the fat percentage in male and female obese subjects ($P = 0.004$), but the difference was insignificant with respect to BMI ($P = 0.398$). The result also showed a significant correlation between hand grip performance at different interval of time and fat percentage in both right hand ($P < 0.05$) and left hand ($P < 0.005$). The association between BMI and fat percentage was found to be significant ($r = 0.349$, $P = 0.027$). **Conclusion:** This study concluded that the association between BMI and fat percentage was found to be significant, whereas the correlation between fat percentage and blood pressure response was insignificant.

KEY WORDS: Obesity; Hypertension; Fat Percentage; Muscle Strength/Endurance; Blood Pressure Response

INTRODUCTION

Obesity and hypertension comprise an important worldwide epidemic that has been linked to the metabolic syndrome.[1] Leading a sedentary lifestyle can promote weight gain, increase body fat; a loss of lean muscle mass could eventually lead to obesity.[2] Body mass index (BMI) appears to be the best index of obesity, as it approximates adiposity and fat distribution in adults.[3]

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Scientific evidence has suggested a significant relationship between a sedentary lifestyle and hypertension.[4] Increased weight gain which is associated with increased lean and fat mass, along with the associated increase in total blood volume may be accompanied by an increase in stroke volume, cardiac output and circulatory preload and afterload that can lead to left ventricular hypertrophy and sustained rise in blood pressure.[5]

Individuals who do not participate in daily structured exercise are more at risk for developing obesity and hypertension thus is important to promote a physically active lifestyle across

the lifespan. Weight reduction in obesity brought about by physical training has been associated with numerous metabolic adaptations including preservation of lean body mass, improved muscle endurance, increased insulin sensitivity, improved high-density lipoprotein cholesterol, low-density lipoprotein cholesterol ratio, and improved ability of the muscle cell to take up glucose and metabolize fat.[6]

Although there is significant evidence suggesting that physical activity leads to weight loss and decrease blood pressure, many adults still do not achieve the recommended amount of daily exercise.[7] Although it was reported that body fat percentage enhances fatigability, data regarding the blood pressure response in obese individuals with varying body fat percentage were not well documented. Therefore, this study was undertaken to compare the fat percentage with muscle strength/endurance and blood pressure response in young adults.

MATERIALS AND METHODS

A total of 40 subjects having general obesity among the staff and student community, between the age group of 18 and 40 years of either sex were recruited for the study. It is a cross-sectional type of study conducted after the approval from Institutional Ethical Committee. Subjects recruited for the study had BMI more than 25. Subjects with any organic diseases, smokers and having medication for diabetes and renal dysfunctions were not included in the study.

Measurement of Fat Percentage

The fat percentage was measured based on the Deurenberg's equation (age and gender specific equation). % Body fat = (1.2 × BMI) + (0.23 × age) - (10.8 × sex) - 5.4 (Substitute sex by 1, if male and 0 if female; age in years).

Measurement of BMI

The BMI was measured using the formula weight (kg)/height (m^2). The height was measured using measuring tape fixed to the wall, with barefoot, hands hang freely by the side, heels together, scapula and buttocks in contact with the measuring wall, and recorded nearest to 0.1 cm. The weight was measured using weighing scale, zeroed before taking weight, without shoes.

Assessment of Muscular Strength

The muscular strength/endurance was assessed using hand grip exercise. This test evaluates the maximum isometric muscular strength of the flexor muscles of the hands. There is a strong correlation between hand grip strength and upper body strength. The muscular strength/endurance was assessed. Instruct the subject to towel dry the hand. Place dynamometer in subject's hand. Ensure that the handle rests on middle phalanges and base on the 1st metacarpal. Before commencing the assessment, set the dynamometer to "zero." Evaluation includes six trials, three for each hand. Position: Stand upright, adduct shoulder and place hand in neutral grip position, flexion of elbow at 90°, slight extension at wrist (0-30°). Subject should squeeze the device with maximum force for 3 s while exhaling. Subject should release the grip. Note down the reading. Measure both hands, alternating between right and left, completing 3 trials per hand. Allow a 1-min rest between trials. Reset the peak-hold needle to zero before obtaining new readings. Record the scores for each trial in each hand to the nearest kilogram. Record the highest score for each hand.

The blood pressure was measured using sphygmomanometer before starting, during, and after 5 min of hand grip exercise.

Statistical Analysis

The data were analyzed using independent samples *t*-test for finding out the equality of means of fat percentage and BMI between males and females. The Pearson correlation test was performed for finding out the statistical significance of fat percent, with muscle strength/endurance and BP responses in obese individuals using SPSS Version-16. $P < 0.05$ will be considered the level of significance.

RESULTS

In this study, 40 subjects having general obesity among the staff and student community between the age group of 18-40 years of either sex were recruited. The BMI of the recruited subjects was measured. The fat percentage, blood pressure at different interval of isometric exercise and the muscle strength/endurance of the recruited subjects were recorded.

The number of subjects recruited in this study was shown in Figure 1. The number of subjects was 18 between the age group of 18 and 24 years and 16 between the age group of 25 and 31 years and 6 between the age group of 32 and 38 years of age (Figure 2). This indicates that all the subjects were young adults. The results showed that there was a significant difference between the fat percentage in male and female obese subjects ($P = 0.004$). Whereas, the difference was insignificant ($P = 0.398$) with respect to BMI (Table 1). The results also showed a significant correlation between handgrip performance at different interval of time and fat percentage in both right hand ($P < 0.05$) and left hand ($P < 0.005$) as shown in Table 2. The result showed a no significant correlation between fat percentage and blood pressure responses, whereas the association between BMI and fat percentage was significant (Table 3, $r = 0.349$, $P = 0.027$).

Table 1: Descriptive statistics showing the mean values of fat percentage and BMI in male and female obese subjects *n*=40

Parameter	Gender	Number	Mean±SD	95% confidence interval of the difference		*P* value
				Lower	Upper	
Fat percentage	Female	28	33.37±4.95	4.10099	12.37258	0.004**
	Male	12	25.14±7.80	3.03556	13.43801	
BMI	Female	28	28.06±2.45	−2.46919	0.98062	0.398^{NS}
	Male	12	28.81±2.52	−2.54101	1.05244	

**Highly significant, NS: Non-significant, BMI: Body mass index, SD: Standard deviation

Table 2: Correlation between the muscle strength and fat percentage at different point of time with fat percentage in obese individuals n=40

Hand grip test trials in the right and left hand	Correlation with fat percentage	
	r value	*P* value
Right hand		
Hand grip trial-1	−0.360*	0.022*
Hand grip trial-2	−0.381*	0.015*
Hand grip trial-3	−0.363*	0.022*
Left hand		
Hand grip trial-4	−0.451**	0.003**
Hand grip trial-5	−0.483**	0.002**
Hand grip trial-6	−0.428**	0.006**

*Significant, **Highly significant

Table 3: Correlation between blood pressure responses at different point of time with fat percentage in obese individuals. *n*=40

Blood pressure response at different time interval	Correlation with fat percentage	
	r value	*P* value
Before handgrip test		
Systolic blood pressure	−0.112	0.493^{NS}
Diastolic blood pressure	−0.074	0.651^{NS}
During handgrip test		
Systolic blood pressure	−0.212	0.190^{NS}
Diastolic blood pressure	−0.258	0.108^{NS}
After handgrip test		
Systolic blood pressure	−0.128	0.432^{NS}
Diastolic blood pressure	−0.128	0.430^{NS}

NS: Non-significant

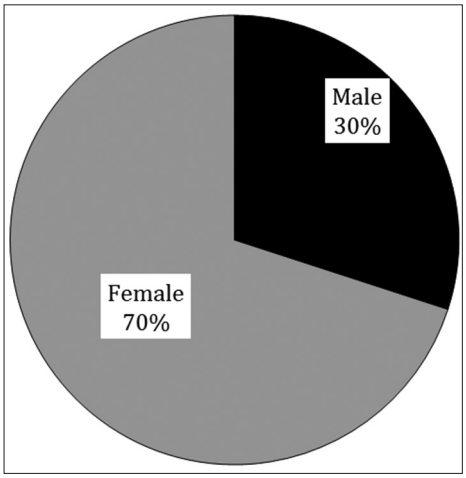

Figure 1: Percentage of male and female obese subjects recruited for the study. Total number of subjects was 40

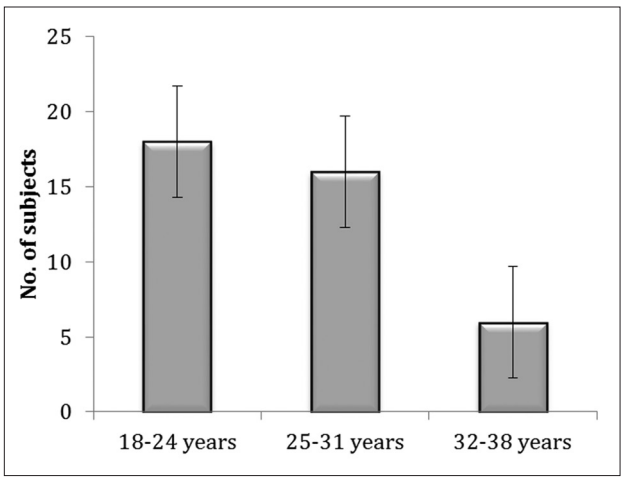

Figure 2: Bar diagram showing the number of subjects recruited in the different age group out of a total 40 subjects

DISCUSSION

Obesity is associated with functional limitations in muscle performance and increased likelihood of developing a functional disability such as mobility, strength, postural, and dynamic balance limitations. According to Tomlinson et al., obese adult females belong to 18-49 years old, have significantly greater plantar flexor strength that their age-matched normal and underweight counterparts.[7] This study was the first to control for both antagonist contraction and agonist muscle activation during maximal isometric contraction in any age classification.

The results of our study showed that there was a significant difference between the fat percentage in male and female obese subjects, whereas the difference was insignificant with respect to BMI. These results are in accordance with the previous reports.[8-10] It was also observed in our study that

a significant correlation between handgrip performances at different interval of time with fat percentage. The association between BMI and fat percentage was found to be significant, whereas the correlation between the fat percentage and blood pressure response was insignificant.

It was reported that in older obese women have a 3-4 times increased risk of developing functional limitations, where their BMI was higher than 30.[11] However, individuals who had Class II sarcopenia had a similar risk of functional limitations as the females who were only characterized as obese.

CONCLUSION

This study concluded that handgrip performances were correlated with fat percentage. The association between BMI and fat percentage was found to be significant, whereas the correlation between the fat percentage and blood pressure response was insignificant which was not as expected. Therefore, a large sample size with a wide range of age group and belonging to wider range of fat percentage is required to establish or to confirm the association between the muscle strength/endurance in general obese subjects is warranted.

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