Original Research Article

Influence of body composition on handgrip strength and handgrip endurance in adult females aged 22-40 years

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Abstract

Background: Physical inactivity has become a serious problem all over the world. Handgrip strength (HGS) and handgrip endurance (HGE) are the important parameters to assess the upper extremity muscular strength. Handgrip Strength (a form of isometric static contraction test), is an important test to evaluate the physical fitness and nutritional status of an individual. The study helps to assess the Handgrip strength and handgrip endurance in obese and non obese individuals. **Aims and objectives:** To study the influence of body composition on handgrip strength and handgrip endurance in adult females. **Materials and Methods:** The study included 60 subjects comprising of 30 non obese and 30 obese females in the age group of 22-40 years. Handgrip strength and handgrip endurance was performed using handgrip dynamometer. **Result:** The observed values of the handgrip strength and handgrip endurance among the obese females were less when compared to the non obese females. **Conclusion:** The obese females showed poor handgrip strength and handgrip endurance compared to the non obese.
Key Word: Body composition, handgrip strength, handgrip dynamometer, physical fitness,

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INTRODUCTION

Obesity is becoming prevalent worldwide in the developing and developed countries for the past decades. The excess body fat has been accumulated in our body, and this condition is known as obesity in medical terms.[1] In most cases, obesity is caused by a combination of excessive intake of food and lack of physical activity, and in some cases, it may be due to genetic susceptibility.[2,4] Obesity has been leading to several risks in both the physical and mental conditions. Obesity has become a common health problem and is considered important risk factor for many of the disease condition.[5] Obesity leads to several conditions particularly such as the obstructive sleep apnea, osteoarthritis, asthma, cardiovascular diseases, diabetes mellitus, and even sometimes cancer.[6] 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.[7] Muscular endurance is known as the ability of a muscle or some group of muscles to sustain contractions that are repeated against a resistance for over an extended time period. The components of muscular fitness include the muscle endurance along with the muscle power and muscle strength.[8] Various studies were carried out to assess the cardiovascular component of physical fitness but very few studies were done to assess the muscular strength and endurance component of physical fitness, so the present study was planned to observe the influence of body composition on handgrip strength and endurance in females of age group 22-40 years. Handgrip strength (HGS), a form of isometric (static contraction) test is a reliable clinical measure to assess the physical fitness and

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nutritional status of an individual. It is the most common assessment method to measure the upper extremity muscle strength.[9] Muscle strength is impaired in overweight/obese persons and this impairment may be a consequence of both obesity and low physical fitness. HGS is a good indicator of health status based on the incidence of disability, morbidity, and mortality in adult population.[10] The power of handgrip is the result of forceful flexion of all finger joints with the maximum voluntary force that the subject is able to exert under normal biokinetic conditions.[11] Handgrip strength, a physiological variable, is affected by a number of factors like age, gender, body size, effort, skeletal muscle bulk and contractility.[12] Handgrip endurance (HGE) is the ability of a muscle to sustain a muscular force produced during activity. It is significantly correlated with the strength of a brief maximum effort. Endurance, to a great extent depends on the nutritive support for the muscle.[13] It is also affected by factors like cardiorespiratory fitness, skeletal muscle function, blood flow and temperature of the muscle.

MATERIALS AND METHODS

It is a population based cross-sectional study. A set of 30 obese and 30 non obese females in the age group of 22-40 years were selected as study subjects. All the subjects had regular 28 days menstrual cycle for at least 6 months prior to the study. The study was conducted in the Research lab, Department of physiology, Chamarajanagar institute of medical sciences, Chamarajanagar after obtaining the Ethical clearance (CIMS/IEC/-04/2018-2019) and informed consent was obtained from the participants. The duration of the study was 4 months. The following are the inclusion and exclusion criteria.

Inclusion criteria

For obese

- The inclusion criteria for obese were as follows:
- Individuals with the age group of 22-40 years
- Individuals with body mass index (BMI) above 30kg/m^2

For non obese

- The inclusion criteria for non obese were as follows:
- Individuals with the age group of 22-40 years
- Individuals with body mass index (BMI) above 18.5 – 24.9kg/m^2

Exclusion criteria

The following criteria were excluded from the study: Individuals who had undergone surgery in their upper limbs. No other history of cardiovascular disorder, muscular disorder or neurological disorder. The study was conducted after keeping the subject at physical rest for at least 10 mins. Height was measured with an anthropometer and weight was measured with Krups flat type of weighing machine. BMI was then calculated by using Quetlet index. According to WHO classification, BMI of 18.5-24.9 kg/m2 were categorized as non obese and BMI≥ 30 kg/m2 were categorized as obese.

$$BMI = \frac{\text{weight (kg)}}{\text{height}^2\ (m^2)}$$

Handgrip strength (HGS) was determined by using a handgrip dynamometer (INCO, ambala) as the maximal voluntary contraction (MVC in kg) sustained for at least 3 secs. Prior to the test each subject was given verbal instruction and demonstration of the test. Subject stood upright by holding the dynamometer in dominant hand, with the shoulder abducted and elbow in full extension. Three readings with brief pauses of 10-20 seconds were taken and then the best result was chosen for analysis. Handgrip endurance (HGE) was determined by asking the subject to sustain 1/3rd of maximal voluntary contraction for as long as she could. Subject was made to sit with the forearm placed on a table, flexed at 90^0 and was asked to maintain a grip of 1/3rd of MVC and then the time recording was noted in seconds. Statistical analysis was done after obtaining the recordings. Correlation between BMI and handgrip strength and handgrip endurance was assessed by calculating Karl Pearson's Correlation Coefficient. Mean ± standard deviation was used to present the descriptive data.

RESULTS

Our study consisted of 30 non obese and 30 obese adult females in the age group of 22-40 years. Table 1 shows statistical analysis of height, weight and BMI of non obese and obese female subjects expressed as mean and standard deviation. The average height, weight and BMI of non obese females was 1.62±9.16 m, 63.14±9.94 kg and 23.8±2.73 kg/m^2 respectively. The average height, weight and BMI of obese females was 1.71±8.14 m, 86.16±6.52 kg and 30.8±4.83 kg/m^2 respectively.

Table 1

Parameters	Non obese females (Mean ±SD)	Obese females (Mean±SD)
Height	1.62±9.16	1.71±8.14
weight	63.14±9.94	86.16±6.52
BMI	23.8±2.73	30.8±4.83

BMI: Body Mass Index, SD: Standard Deviation

Table 2 shows HGS and HGE in non obese and obese female participants. The HGS in non obese females was 34.64±7.52 kg and in obese females was 24.18±5.67 kg. There was a highly significant difference in HGS between non obese and obese females, $p<0.0001$. The HGE in non obese females and obese females was 79.77±39.56s and 54.35±22.98s respectively. The HGE was also highly significant in non obese females as compared to obese females, $p<0.0001$.

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Table 2: comparison of HGS and HGE in non obese females and obese females.

Parameters	Non obese females (Mean ±SD)	Obese females (Mean±SD)	P value
HGS (Kg)	34.64±7.52	24.18±5.67	<0.0001
HGE (sec)	79.77±39.56	54.35±22.98	<0.0001

Both HGS and HGE in non obese females were highly significant compared to obese females (p<0.0001). HGS: Handgrip Strength, HGE: Handgrip Endurance, SD: Standard Deviation

DISCUSSION

Statistically significant negative correlation between BMI and HGS was observed in obese females. This impairment of muscle strength in obese females may be a consequence of both obesity and reduced physical fitness. Moreover significant positive correlation was observed between BMI and HGE in non obese females. From the previous studies taken up by Janne Sallinen, he stated that the need of muscle strength for mobility-related activities increases along with body mass index, particularly in men.[14,15,16] From the previous studies taken up by Massy, he stated that "The chronically undernourished groups have significantly lower handgrip strength than the underweight groups," both being significantly less strong than the "well-nourished" groups of BMI higher than 18.5.[17] Furthermore, with the increase in age of the person, the muscular endurance was seen to reduce.[18]Physically, inactive individuals are more likely to be obese compared to other individuals.[19] From the previous study taken up by Monica Antony, she stated that there was no significant change in the muscle endurance of security people with that to normal people.[20] However, some of the sample participants may not have had a proper intake that day and because of that there may be difference in results obtained. The muscle function is not significantly different between lean and obese participants when adjusted for their age, height, physical activity, pain, depression, and appendicular skeletal muscle mass.[21] Obese women have lower muscle strength of both upper and lower extremities when compared to lean women, which is explained by their lower degree of activity.[22]

One limitation may be addressed in this study is that it was a cross-sectional study; therefore, a causal effect among variables is difficult to be identified.

CONCLUSION

The obese people performing less physical exercises and having less muscular fitness perform a poor handgrip strength than the nonobese individuals. The obese people can improve their muscle strength by taking up endurance training exercises.

A further study in a larger population is required with multiple factors taken into consideration such as gender, waist circumference, waist to hip ratio, abdominal fat, and skin fold thickness, in addition to BMI for better conclusions.

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