Section: Physiology

Original Research Article

EFFECT OF BODY MASS INDEX ON HANDGRIP STRENGTH OF MEDICAL STUDENTS IN JORHAT MEDICAL COLLEGE, JORHAT, ASSAM

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Abstract

Background: Handgrip strength (HGS) has evolved as an important tool for the assessment of the upper extremities muscle strength of an individual. Body Mass Index (BMI) is an acceptable measure for the thinness (underweight) and fatness (overweight) and there may be a change in the muscle quality. The aim of the study is to demonstrate the effect of BMI on HGS in medical students of Jorhat Medical College. **Materials and Methods:** This is a cross-sectional and observational study which includes 234 numbers of medical student participants from Jorhat Medical College, Jorhat. BMI is calculated by using the Quetlet index. HGS is obtained by using a Labotech handgrip dynamometer. The results were done by using Microsoft Excel. The statistical correlation is done by using a paired t-test and Pearson's correlation coefficient. **Result:** HGS is higher in males as compared to females. A significant positive correlation was seen between female BMI and HGS ($p= 0.0257$; $r= 0.06260$) and a negative correlation was seen between male BMI and HGS ($p= <0.001$ and $r = -0.2226$). The mean values of the HGS declined from normal BMI to overweight and underweight. **Conclusion:** Males have more HGS than females. This shows gender plays an important factor in affecting HGS. Positive correlation was seen between female BMI and HGS. A negative correlation was seen between male BMI and HGS. With a larger population and taking multiple factors, a further study is required.

INTRODUCTION

Health, according to the World Health Organization, is "a state of complete physical mental and social well-being and not merely the absence of disease and infirmity"[1]. Health is a thing that we always take for granted until it is compromised. A healthy life includes not only physical well-being but also mental and emotional stability. So, maintaining good health is very important for leading a healthy and fruitful life. Almost one-quarter of the global burden of disease could be prevented by a healthy environment. The covid-19 pandemic is a further reminder of the delicate relationship between people and our planet where the pandemic has highlighted the importance of preventive measures and overall health maintenance. The virus has disproportionately affected individuals with pre-existing health conditions, such as obesity, diabetes, and cardiovascular diseases.[1]

Physical activity refers to any bodily movement by skeletal muscle that causes energy expenditure while physical fitness comprises it is the well-being and overall fitness of an individual. Physical activity is a behavior while physical fitness is an attribute which includes cardiorespiratory fitness, muscular endurance, muscular strength, body composition, and flexibility. Physical activity levels below those required to induce fitness gains are known to produce health gains, but both physical activity and cardiorespiratory fitness are related to health promotion and disease prevention in adulthood.[2]

Obesity can have a negative impact on handgrip strength where excess body fat can lead to reduced muscle strength and impair grip strength. Handgrip strength is measured by using a Jamar handgrip dynamometer. The history of measuring handgrip strength dates back to the early 20th century. In the 1920s, a device called the Jamar dynamometer was developed by Samuel Jamar and his colleagues. Handgrip strength is a simple and non-invasive measure that provides valuable information about muscle strength and overall health. The easy way to estimate skeletal muscle strength is the handgrip

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strength test (HGS)[3]. HGS test is widely recognised as a reliable objective indication of body muscle strength.[3,4] Simplicity, reliability and ability to provide valuable information about muscle strength and overall health has contributed to its continued use in various settings. The dominant HGS has been used to predict skeletal muscle strength.[5]

Aim

To find out the effect of Body Mass Index (BMI) on the HGS of medical students

Objectives

- To obtain the BMI of medical students.
- To demonstrate the effect of BMI on HGS of medical students.

MATERIALSANDMETHODS

Research/study design: For any successful research, research design plays an important role where it decides the outcome of the study. The study design depends on the purpose of the research and the findings of the data collection. The present study will be an institution-based cross-sectional study.

Sample Size: A total no. of 234 healthy medical students from both sexes, aged 18-25 years were selected.

Inclusion Criteria

- Students who gave consent to participate in the study.
- Students within the age group of 18 to 25 years.
- Students who were available for HGS tests.
- Both male and female students were selected.

Exclusion Criteria

Students who didn't consent for the study

Students who weren't present during the time of the test.

Students who had a history of or clinical evidence of any medical illnesses.

Place of the study: The study was conducted at the Department of Physiology.

The Parameters Studied are:

Height

Body weight

Body mass index (BMI)

Handgrip strength

Height was measured by using a stadiometer. It was measured without shoes while the student was standing against a wall on which a measuring scale was placed. The student was asked to stand erect, feet parallel & and heels, buttocks, shoulder and occiput touching the vertical rod of the stadiometer. Head was held erect, eyes aligned horizontally & ears vertically without any tilt. The horizontal bar which is at right angle to the vertical rod was placed touching the vertex. Height was measured to the nearest of 0.5 cm.

Bodyweight was recorded without shoes and with light clothes on a bathroom type of weighing machine.

Body mass index was calculated by dividing weight in kilograms by square of height of the subject in metres. Hence it is represented by: BMI= Body mass (kg) / (Height (m)). It is often used to express overweight and obesity.

Handgrip dynamometer: Muscle strength was measured via hand grip test using hand grip dynamometer. During measurement, the subject was allowed to sit with their feet touching the ground, their elbow was flexed to 90˚ and forearm in the neutral position. All the subjects performed 3 grips with their dominant hand and highest values were analysed.

RESULTS

This study was done on 234 no. of student participants out of which 117 were male and 117 were female medical students. The results were analyzed results by using Microsoft Excel. Statistical analysis was done by using paired student "t-test" and Pearson's Correlation Coefficient. [Table 1] shows the mean and SD of height weight and BMI of males and females. [Table 2 and 3, Figure 1,2] show the BMI of both males and females under the BMI category. [Table 4,Figure 3] shows the effect of female BMI on HGS where underweight BMI females have an insignificant negative correlation (p= 0.1309 and r = - 0.3403) and normal BMI females have a significant positive correlation (p=<0.0001 and r = 0.05329) and overweight female has significant negative correlation (p = 0.0015 and r= - 0.4222). [Table 5,Figure 4] shows the effect of BMI male on HGS where underweight BMI male shows a significant positive correlation (p= 0.0271and r= 0.4807) and normal BMI shows a significant negative correlation (p= <0.0001 and r= -0.04033) and overweight BMI male have significant negative correlation (p= 0.0392 and r= - 0.3860). [Table 6,Figure 5-7] shows the male BMI is negatively correlated (r= -0.2226) with HGS and female BMI is positively correlated (r= 0.06260) with HGS.

Table 1: Mean and SD of height and weight of study subjects according to age

Gender	HT.(MEAN±SD)	WT.(MEAN±SD)	BMI (MEAN±SD)
Male	174.20±6.32	68.68±8.89	22.63±2.893
Female	162.634±6.309	58.12±8.042	21.982±2.716

Table 2: BMI of Male

	MEAN BMI in kgs.
Underweight	17.73±0.44
Normal	22.074±1.609
Overweight	27.67±1.860

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Table 3: BMI of Female

	In Kgs.
Underweight	17.815±0.7822
Normal	21.6954±2.020
Overweight	26.67±1.613

Table 4: Effect of BMI female on HGS

	HGS	p	r
Underweight	15.37±3.701	0.1309	-0.3403
Normal	24.34±6.092	<0.0001	0.05329
Overweight	21.0769±4.010	0.0015	-0.4222

Table 5: Effect of BMI male on HGS

	HGS	p	r
Underweight	26±8.602	0.0271	0.4807
Normal	34.623±6.683	<0.0001	-0.04033
overweight	25.5±3.034	0.0392	-0.3860

Table 6: Overall HGS of Male and Female.

	HGS	p	r
Male	32.63±7.383	<0.001	-0.2226
Female	23.367±6.218	0.0257	0.06260

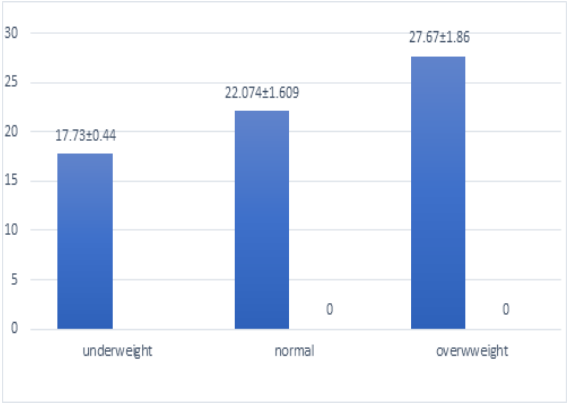

Figure 1: BMI of Males

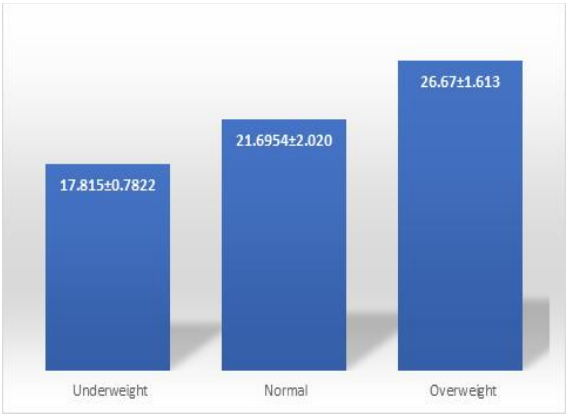

Figure 2: BMI of Female

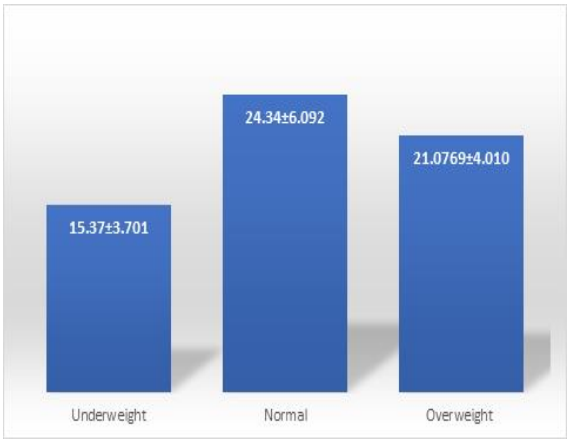

Figure 3: Effect of BMI female on HGS

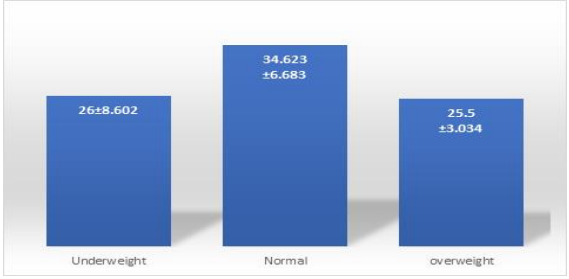

Figure 4: Effect of BMI male on HGS

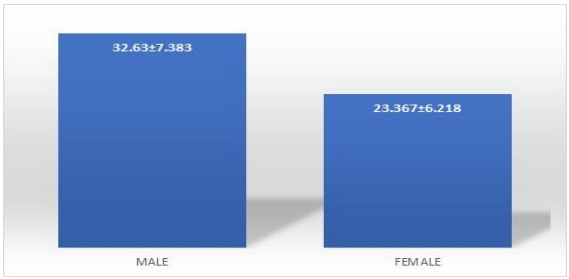

Figure 5: Overall HGS of Male and Female

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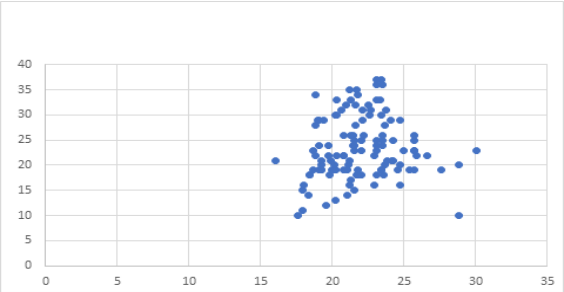

Fig. 6 Pearson correlation coefficient between BMI and HGS in female

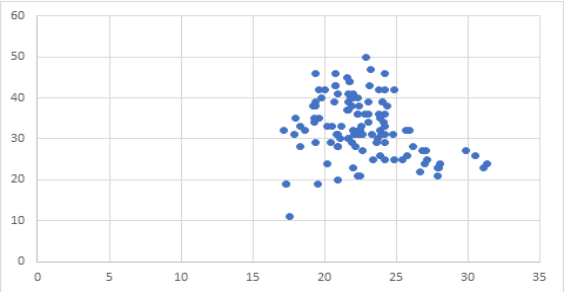

Figure 7: Pearson coefficient correlation between BMI and HGS male

DISCUSSION

The main objectives of the study were to find out the BMI and examine the HGS of the medical students. To demonstrate the effect of BMI on HGS of the medical students. The mean values of the HGS declined from normal BMI to overweight and to underweight.

The result of our study was highly significant in the males as compared to the females, the same study was conducted by Shetty et al,[6] Manjunath et al,[7] Rolland et al,[8] Ravisankar et al,[9] and Leyk et al.[10] This may be due to the study population who were healthy adolescents and none of them were extremely underweight or obese. The underweight population might have had a good muscle mass and the overweight population might have had more muscle mass than fat.[11] Hand grip strength is a physiological variable that is affected by several factors including age, gender.[12,13] Hand grip strength was more in males as compared to the females and this could be due to physiological differences between them.[14,15] As muscle strength is determined largely by muscle girth; muscle with larger cross-sectional area have the tendency to lift more weight than muscle with smaller cross-sectional area. As the male hormone testosterone enlarges muscles, men tend to be stronger than women.[16] The greater muscle strength in males has been to a large extent attributed to differences in muscle mass.[17]

Some studies also suggest that testosterone increases type II fibres,[18] which are the fast fibres with high glycolytic enzyme activity. In males, the portion of type 2 muscle fibres is high as compared to females. Increased strength in males is also attributed to increased bone mineral density in males,[19] thus males have higher HGS than females in our study. Males also showed a higher mean value for Hand grip strength and this agrees with the study conducted by Shyamal and Sartinder (2011),[20] which showed that females have lesser mean values of all the anthropometric parameters than males. Also, it has been reported earlier that men possessed considerably greater strength than women for all muscle groups tested (McArdle et al. 2001; Bohannon et al., 2006; Shyamal and Satinder, 2011).[21-20]

McArdle et al, Foo LH; Prakash et al also suggested that the existence of a greater percentage of muscularity among male students than their female counterparts may be due to lesser accumulation of fat in males because of regular exercise.[21-24]

When the BMI is categorized, we found that there is a significant negative correlation between BMI and HGS (r= -0.04033 and p = <0.0001) in the normal male BMI category. In overweight too, there is a significant negative correlation between male BMI and HGS (r= -0.3860 and p= 0.0392) and female BMI and HGS (r= -0.4222 and p= 0.0015). Dhananjaya et al. suggested that BMI and HGS are negatively correlated among normal and overweight BMI male participants. Massy-Westropp et al. in their study noted a very weak positive relationship between higher BMI and right HGS in the youngest and oldest age groups in the sample. They also noted that BMI was negatively correlated with HGS in age groups of the 4th, 5th, and 6th decades. Apovian cm et al,[27] Koley S. et al,[28] and Vaz M et al,[29] noted that there is some sort of conflict between the BMI and HGS where many claimed to have a positive correlation in both male and female and all age groups, while others found no relationship. Umesh Lad et al,[30] mentioned in their studies that there were a correlation between the body fat percentage and the handgrip strength which was significantly positive in the underweight and normal-weight males as well as in the overweight females.

In male underweight BMI, there is a significant positive correlation between BMI and HGS (p = 0.0271 and r= 0.4807). Our results are supported by Hulen et al., who also explain that an increase in the body fat percentage does not have a detrimental effect in the overweight and normal weight females.[31]

CONCLUSION

We have analysed the effect of BMI with HGS in healthy young medical students. We have found that males have more handgrip strength as compared to females irrespective of their BMI. In male with normal and overweight BMI there is a significant negative correlation with HGS and a significant positive correlation was found in male with underweight BMI. In female with normal BMI, we found a significant positive correlation with HGS

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and overweight females there is a significant negative correlation. In case of underweight females we found an insignificant negative correlation between BMI and HGS. A further study is required with a larger population by including body circumference to assess for adiposity and skinfold thickness into consideration to provide the effectiveness and clinical aspects of HGS testing in the evaluation and prediction of critical conditions.

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