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Relationship of Handgrip Strength and Endurance Time With Body Mass Index in Medical Students

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ABSTRACT

Introduction

The sedentary lifestyle, unhealthy eating habits and obesity are major health problems of current generation. High body mass index is directly related with high mortality rate, cardiovascular diseases, mental issues and difficulty in physical functioning. Normal weight and strength of muscle are indications of good health. Handgrip strength and endurance are the important parameters to assess the upper extremity muscular strength.

Methods

This is a descriptive cross-sectional study in 400 medical students in Kathmandu Medical College, Bhaktapur (October 2021 to March 2022) with Institutional Review Committee approval (Reference no. 0106202102). The sample was collected by simple random sampling method. Height and weight were measured by Prestige stadiometer and body mass index was calculated. Student's dominant hands grip strength and endurance time was measured by manual Grip Dynamometer. Data was analyzed by Statistical Package of Social Science (SPSS) software version 16 with Chi-square test.

Results

Among 400 samples, female 217 (54.25%) and 183 (45.75%) were males. Female students with normal, overweight and pre-obese BMI had maximum and highly significant (p value = 0.00, 0.001 and 0.003 respectively) relationship with grip strength. Normal, pre-obese and obese male had highly significant relation with grip strength (p = 0.004, 0.00 and 0.002 respectively). Normal body mass index samples had maximum endurance time along with overweight male.

Conclusions

The normal body mass index samples had significant relation with hand grip strength and highest endurance time.

Keywords: body mass index (BMI); endurance time (ET); hand grip strength

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INTRODUCTION

High BMI and related risk factors like cardiovascular diseases, mental issues, neuro-muscular diseases and high mortality rate are major health problems of current generation .[1] WHO (World Health Organization) data shows, in 2016, >1.9 billion adults of 18 years and older population were overweight and > 650 million were obese. The rate of obesity is escalating every year [2] Asian Criteria for BMI cut off point, <18.5 is underweight, 18.5-22.9 normal, 23-24.99 overweight, pre- obese ≥25-29.9 and obese is ≥ 30.[3]

Hand grip strength test is a maximum voluntary forceful flexion of the fingers. It gives the idea about hand muscle strength and activities.[4] Hand grip strength and endurance time of muscle are used to evaluate the muscle strength and nutritional status.[5,6] The hand muscle strength can be assessed by hand grip dynamometer with grip strength test.[7]

This study aims to find relation of handgrip strength, endurance time with body mass index in medical students.

METHODS

A descriptive cross-sectional study was carried out among 400 medical students at Kathmandu Medical College, Duwakot, Bhaktapur. The sample was collected by simple random sampling method. The study was started from October 2021 to March 2022 with approval Institutional Review Committee (IRC) of Kathmandu Medical College and Teaching Hospital (Reference no. 0106202102).

The sample size was calculated by using the following formula:

$n = 4pq/ E^2$

n = number of samples, p = prevalence

p = 50%= 0.5

E (allowable error) = 5%=0.05

q = (1-p %) = 0.5

n = 400

Based on the above formula, the minimum samples size was 400.

Anthropometric measurements including height and weight was recorded as per WHO criteria. Height in meter and weight in kilogram (kg) of students was measured to calculate Body Mass Index (BMI) by Prestige height and weight measuring scale (Stadiometer). The formula, weight in kg divided by height in meter square was used to calculate the BMI and unit is kg/m^2. According to WHO (World Health Organization), "Asian Criteria" for BMI cut off point <18.5 is underweight, 18.5-22.9 normal, 23-24.99 is overweight, pre- obese ≥25-29.9 and obese ≥ 30 were considered.

Students dominant hand grip strength was measured for three times manually by Grip Dynamometer in standing posture. The mean strength was calculated. The weight for Endurance time was calculated by formula 60% of T_{max} in Kg. Here, T_{max} is maximum sustained voluntary contraction of muscle. So, maximum reading was considered for calculation of T_{max} among three readings. Then endurance time was measured for three times and mean was calculated.

Data was analyzed by using Statistical Package of Social Science (SPSS) software version 16. Relationship was analyzed by Chi-square test and ≤ 0.05 was considered statistically significant, < 0.001 was considered highly significance

RESULTS

In present study, total 400 sample, female 217 (54.25%) and 183 (45.75%) were males. The mean age was 19 ±1.36**.** Among 217 females, maximum 70 students showed excellent (>38 kg) grip strength. Normal BMI showed highly

significant relation (p value = 0.00) with grip strength. The overweight and pre-obese females showed p value 0.001 and 0.003 respectively. Underweight female students did not show any statistically significant relation. BMI with hand grip strength relation in dominant hand are tabulated below (Table 1).

Table 1. Strength of dominant hand with body mass index in females.

BMI	Very poor (<20kg)	Poor (20-22kg)	<Average (23-25kg)	Average (26-29kg)	>Average (30-33 kg)	Very Good (34-38 kg)	Excellent (>38 kg)	Total	P value
Underweight (<18.5 kg)	0	0	0	0	2	5	8	15	0.18
Normal (18.5-22.9 kg)	1	3	4	20	15	19	70	132	**0.000**
Overweight (23-24.99 kg)	2	0	0	0	2	10	25	39	**0.001**
Pre-obese (≥25-29.9 kg)	0	0	0	0	3	9	19	31	**0.003**
Obese (≥ 30 kg)	0	0	0	0	0	0	0	0	
Total	3	3	4	20	22	43	122	217	

Among 400 samples, maximum normal BMI female and overweight male had 0 – 10 seconds endurance time. The highest 51 – 60 seconds endurance time was found in normal BMI female. The highest 71 to 80 seconds endurance time was seen in normal BMI (2) and overweight (1) male.

Among 183 males, normal, pre-obese and obese BMI students had highly significant grip strength and overweight male had no significant relation with grip strength. BMI with hand grip strength relation in dominant hand in males are tabulated below (Table 2).

Table 2. Strength of dominant hand with body mass index in male.

BMI	Very poor (<40 kg)	Poor (40-43 kg)	<Average (44-47 kg)	Average (48-51/>50 kg)	Total	P value
Underweight (<18.5 kg)	0	0	0	13	13	0.017
Normal (18.5-22.9 kg)	0	0	0	53	53	**0.004**
Overweight (23-24.99 kg)	0	1	3	59	63	**1.44**
Pre-obese (≥25-29.9 kg)	0	1	2	42	45	**0.00**
Obese (≥ 30 kg)	0	0	0	9	9	**0.002**
Total	0	2	5	176	183	

Relation of endurance time with BMI in both male and female are tabulated below (Table 3).

Table 3. Relation of endurance time and body mass index.

BMI	Gender	0-10 sec	11-20 sec	21-30 s	31-40s	41-50 sec	51-60sec	61-70 sec	71-80s	Total
Underweight (<18.5 kg)	M	3	1	3	5	0	0	1	0	13
	F	12	1	2	0	0	0	0	0	15
Normal (18.5-22.9 kg)	M	15	18	16	2	0	0	0	2	53
	F	84	38	6	3	0	1	0	0	132
Overweight (23-24.99 kg)	M	28	17	7	6	4	0	0	1	63
	F	22	9	2	6	0	0	0	0	39
Pre-obese (≥25-29.9 kg)	M	14	10	9	10	2	0	0	0	45
	F	20	10	1	0	0	0	0	0	31
Obese (≥ 30 kg)	M	1	2	5	1	0	0	0	0	9
	F	0	0	0	0	0	0	0	0	0
Total		199	106	51	33	6	1	1	3	400

DISCUSSIONS

The current study aimed to find the grip strength and endurance time in students with their BMI. The normal, overweight and pre-obese BMI females, and normal, pre-obese, obese male showed highly significant relation with hand grip strength. Normal BMI samples had maximum endurance time along with overweight male. A study by Lad UP et. al showed similar result that normal BMI male samples had highest grip strength. But contrast result showed in case of female with underweight had highest grip strength.[8] A study by Hammed A.I. had showed significant relationship of hand grip strength and BMI. Contrast to current study this article had no categorization of BMI.[9] An article by Nakandala P. showed similar result to current study, normal BMI had highest grip strength.[10] Another study by Gupta M. showed normal BMI samples had maximum grip strength and endurance time. But this study overall correlation of BMI with endurance time and grip strength insignificant.[11] A study by Heidy H. no significant correlation grip strength with BMI.[12] Feng Q. et al. reported hand grip strength was decrease with advancing age. But current study was included certain age group students only.[13] Another study by Oseloka I.A. et.al showed positive correlation of grip strength with BMI in secondary school students.[14] Roshan PSB et al study showed significant relation of BMI with hand grip strength, but endurance time had no significant relation.[15]

This current study has some limitations, the sample size was relatively small, and data was taken from only one medical college. So, the sample is based on healthy young population. The larger sample size in different sites and age groups might have greater values. The hand grip used during this research was manual which was very hard, and the graduation was also limited maximum up to 50 kg. So, the samples having strength more than 50 kg was included within 50 kg grading. In addition,

relation with ethnicity, nutritional and exercise habits might have greater and more significant values.

CONCLUSIONS

The normal, overweight, pre-obese BMI females, and normal, pre-obese, obese male showed highly significant relation with hand grip strength. Normal BMI samples had maximum endurance time along with overweight male.

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Conflict of Interest: None.

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