ORIGINAL ARTICLE

CORRELATION OF HAND DYNAMOMETRY WITH BODY MASS INDEX AND WAIST HIP RATIO IN MEDICAL STUDENTS

Erum Afaq, Syed Hafeez ul Hassan, Madiha Rehman Khan*, Daania Aman Zaidi, Haisum Baktashi****

Department of Physiology, *Anaesthesia, **Student, Liaquat National Hospital and Medical College, Karachi, Pakistan

Background: Hand grip strength is a non-invasive measure of physical health that is positively correlated with body fitness. The objective of this study was to determine the correlation between hand grip strength and anthropometric measures including waist hip ratio and body mass index in students. **Methodology:** This was a cross-sectional study conducted in the Department of Physiology Liaquat National Hospital and Medical College, Karachi. A total of 109 medical students studying in 1st and 2nd year MBBS were evaluated and 91 who met the inclusion criteria were included in this study. Anthropometric variables including weight, height, BMI, waist and hip circumferences and waist hip ratio (WHR) were measured. Right and left handgrip strength was measured by standard techniques. Mean and standard deviation was calculated for numeric data. Independent sample *t*-test was used to compare the means of two groups. To find out the correlation of hand grip vs BMI and WHR, Pearson correlation coefficient was applied. **Results:** Out of 91, 32 (35%) male and 59 (65%) female students participated in the study. Significant mean differences were found for height, weight, waist circumference, hip circumference, WHR, right hand grip and left hand grip in both genders. Significant and positive correlation was observed for right hand grip in male students with weight, BMI and waist hip ratio. In female students, no significant correlation was observed for right hand grip. Height showed significant and positive correlation with left hand grip in both genders while waist and hip circumference showed negative but significant correlation with left hand grip in males. **Conclusion:** Dominant handgrip strength had positive correlations with some variables. The findings may be valuable in anthropology as some positive correlations with the variables carry practical application for the diagnosis and treatment of upper limb musculoskeletal deformities, talent identification and player selection.

Keywords: Hand dynamometry, Medical students, BMI, WHR

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INTRODUCTION

To accomplish daily activities, proper fitness and wellbeing of musculoskeletal system is one of the essential factors.[1] Handgrip strength is a common clinical evaluation done for various pathologies as it is a physiological variable that is influenced by multiple factors including body size, sex, age, fat percentage, body mass index (BMI) and hand perimeters. Grip strength is a standard criterion for assessment of hand grip function. As grip strength estimation using hand dynamometer is easy and economical, it is generally used in upper limb injuries for outcome assessment.[2–4] It is a functional index of nutritional status in hospital patients who need nutritional intervention as a part of assessing the effectiveness, as well as for maltreatment and impairment determinations.[5,6]

The handgrip strength is determined by usage of various muscles in the hand and the forearm along with powerful flexion of wrist, thumb and all finger joints with the maximum voluntary force that the subject is able to apply under standard biokinetic state.[7] The handgrip strength estimation is of great importance in various sports like arm wrestling, baseball, handball, football, basketball, tennis, volleyball and wrestling where adequate amount of grip strength is essential to be successful.[8–10] Various health conditions are related to change in hand grip strength, although causative relationship was not found.[10–12] Normal bone mineral density is positively related to normal hand grip strength in women of postmenopausal age.[13–15]

When factors associated with body mass index and muscle mass are adjusted, poor hand grip predicts high mortality from cancer and from cardiovascular diseases.[16] Hand grip strength is negatively associated with physical frailty although the effects of BMI and arm muscle circumference are removed. It has been indicated by researchers that in the manner in which muscles are used is the factor related to frailty, disability and weakness in later life and this can be assessed by hand dynamometry.[17,18] The objective of the present study was to find out the correlation between hand grip strength and anthropometric measurements including waist hip ratio (WHR) and BMI in medical students.

METHODOLOGY

This cross-sectional comparative study was conducted in the Department of Physiology, Liaquat National Hospital and Medical College after taking approval from Ethical Review Committee of the institution. Written informed consent was also obtained from all participants. A

sample size of 91 was calculated considering the correlation coefficient value as 0.29, alpha as 0.05, and beta as 0.2. The study was completed in 3 months from September to November 2016. Healthy right-handed medical students studying in 1st and 2nd year MBBS were included in our study. Left handed students, those who refuse to participate and students having any musculoskeletal or neurological impairment in upper limbs or systemic illness affecting musculoskeletal function were excluded. Non-probability convenience sampling technique was used to select the subjects.

Electronic Hand Dynamometer (Deyard EH101) was used to assess the grip strength of the participants. Each participant was asked to sit on a chair with the elbow flexed at 90 degrees and the forearm in semi-pronated position lying on an arm rest. The participants were instructed to compress the dynamometer with their hand, the grip strength was recorded thrice and the best value was taken for further analysis. Measurement of waist and hip was taken in centimetres using stretch-resistant measuring tape. The waist circumference was measured approximately midpoint between the lower margin of last palpable rib and the top of the iliac crest,[19] at the end of a normal expiration. The circumference around the widest portion of the buttocks was taken as hip circumference. Waist hip ratio was calculated by dividing the circumference of the waist to that of the hips in centimetres. Body weight was measured using a standard scale, light clothing on with bare foot. Height was measured in upright position looking ahead and heels touching one another. Body mass index of the participants was calculated by using standard formula, i.e., the measurements of the weight in Kg divided by the square of the height in meters (Kg/m^2).

Data were analysed using SPSS-21. For numeric data mean and standard deviation, and for categorical data frequency and percentage were calculated. Independent sample *t*-test was used to compare the means of two groups. To find out the correlation of hand grip with BMI and WHR, Pearson correlation coefficient was applied, and $p \leq 0.05$ was considered significant.

RESULTS

There were 32 (35%) male and 59 (65%) female students with the age ranging from 18 to 20 years. Significant mean difference was found for height, weight, waist circumference, hip circumference, WHR, right hand grip and left hand grip with gender. Detailed results of anthropometric profile according to gender are shown in Table-1.

Significant and positive correlation was observed for right hand grip in male students with weight, BMI and WHR. In female students, no significant correlation was observed. Detailed results of correlation of right hand grip strength with several anthropometric measures for males and females are shown in Table-2.

Significant and positive correlation was also observed for left hand grip in male and female students with height. Result of correlation of left hand grip strength with several anthropometric measures for males and females are shown in Table-3.

Table-1: Anthropometric profile in male and female students (Mean±SD)

Parameters	Overall (n=91)	Male (n=32)	Female (n=59)	*p*
Height (Cm)	161.55±9.93	172.55±5.37	155.59±5.90	0.000
Weight (Kg)	57.53±11.78	66.06±9.57	52.91±10.22	0.000
BMI(Kg/m^2)	22.04±3.71	22.24±3.49	21.93±3.85	0.708
Waist circumference (Cm)	47.73±22.27	36.00±13.74	54.10±23.48	0.000
Hip circumference (Cm)	55.79±26.15	41.37±16.05	63.61±27.32	0.000
WHR	0.859±0.08	0.871±0.050	0.85±0.09	0.000
Right hand grip strength (Kg)	25.96±10.17	37.14±8.57	19.90±3.89	0.000
Left hand grip strength (Kg)	23.43±10.18	35.01±8.00	17.14±3.53	0.000

Table-2: Correlation coefficient (*r*) of Right Hand grip strength with anthropometric measures for males and females

	Male (n=32)		Female (n=59)	
Parameters	*r*	*p*	*r*	*p*
Height (Cm)	0.17	0.352	0.24	0.07
Weight(Kg)	0.45	0.009	0.24	0.074
BMI (Kg/m^2)	0.34	0.05	0.14	0.308
Waist circumference (Cm)	-0.32	0.072	0.05	0.716
Hip circumference (Cm)	-0.38	0.033	0.01	0.945
WHR	0.36	0.041	0.12	0.361

Table-3: Correlation coefficient (*r*) of Left Hand grip strength with anthropometric measures for males and females

	Male (n=32)		Female (n=59)	
Parameters	*r*	*p*	*r*	*p*
Height (Cm)	0.36	0.041	0.36	<0.01
Weight (Kg)	0.29	0.107	0.2	0.119
BMI (Kg/m^2)	0.12	0.519	0.06	0.646
Waist circumference (Cm)	-0.36	0.041	-0.16	0.216
Hip circumference (Cm)	-0.41	0.021	-0.15	0.248
WHR	0.28	0.122	-0.03	0.824

DISCUSSION

Measurement of handgrip strength is a simple, non-invasive easily administrable yet effective measure which provides useful information about strength and disabilities related to it.[20,21] Adult population of younger age group has greater muscle strength and in turn works effectively so they are considered as the backbone of a nation. Dominant hand is used more in routine life. Muscles of forearms and hands are used for everyday activities and sporting events providing gripping power.[1]

Males in this study had higher mean values in all anthropometric variables with significant *p*-value except BMI. It was in agreement with the study conducted by Shyamal *et al*[10]. It is due to the fact that men possess physiologically better strength than women for all muscle groups.[10]

We found significant positive correlation for right hand grip in male students with weight (r=0.45), BMI (r=0.34) and WHR (r=0.36). This is in accordant with Baskaran[2] who found excellent correlation to hand grip with weight, BMI and age. This suggests greater muscles bulk in males and differences in muscle mass proportions with fat and bone in both genders.

Left hand grip showed significant and positive correlation with height in both genders (r=0.36). Increase in height may influence better hand grip, depends upon a variety of factors like longer arms, with greater lever arm for force generation leads to effective amount of force.[2] Similarly these findings are in concordant with Shyamal and Sherithat showing positive correlation with handgrip strength and height.[22]

Waist and hip circumference is negatively correlated with right hand grip in males (r= -0.32 and -0.38 respectively) and left hand grip in both male and females (r= -0.36 and -0.41 in males, and -0.16 and -0.15 in females). As far as WC and HC are concerned with obesity, more fat content, lower skeletal muscle and fascicular levels lead to lower skeletal muscle contractile capacity.

CONCLUSION

Our findings may help anthropology researches as some positive correlations with the variables carry vast practical application and may be valuable in talent identification, player selection and to the diagnosis of different upper extremities musculoskeletal deformities and for their treatment and rehabilitation, the knowledge of handgrip strength and its association with physical and physiological traits is important.

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Address for Correspondence:
Dr. Erum Afaq, Assistant Professor, Department of Physiology, Liaquat National Hospital and Medical College, Stadium Road, Karachi, Pakistan. **Cell:** +92-300-2248447
Email: doc_erum@yahoo.com

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