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ORIGINAL ARTICLE

SKELETAL MUSCLE FUNCTION IN A SAMPLE POPULATION OF 1ST YEAR MBBS STUDENTS AT CMH LAHORE MEDICAL COLLEGE

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ABSTRACT

Background and Aims: Hand dynamometry is a predictor of surgical outcome and old age disability whereas peak expiratory flow rate (PEFR) has been used as an index of respiratory function. This study was designed to measure and compare the skeletal muscle strength and anthropometric markers of upper limb in healthy adults in a sample population of first year MBBS students and to study the correlation between lung function parameters such as PEFR and hand grip strength.

Methods: Sixty three medical undergraduate students (33 male and 30 female) between the age of 19 – 21 years were included. Anthropometric measurements were performed according to published guidelines. Hand grip strength was measured by Biopac Hand dynamometer and PEFR was performed by using a Wright's Peak flow meter. Data was analyzed by Student t test and Pearson's correlation test.

Results: There was a significant correlation between hand grip strength in the dominant hand and PEFR (correlation coefficient = 0.694, p = 0) across both genders. Hand grip strength was significantly correlated with upper arm length (correlation coefficient = 0.417, p = 0.001) and mean arm circumference (correlation coefficient = 0.307, p = 0.014). PEFR was also significantly correlated with BMI (correlation coefficient = 0.39, p = 0.002), upper arm length (correlation coefficient = 0.294, p = 0.02) and mean arm circumference (correlation coefficient = 0.396, p = 0.001).

Conclusion: There is a positive correlation between skeletal muscle function as depicted by hand grip strength and PEFR with anthropometric measurements of upper arm such as mean arm circumference and upper arm length in healthy adults recruited in the study.

Key words: Hand dynamometry, hand grip strength, peak expiratory flow rate.

INTRODUCTION

Hand grip strength can be quantified by measuring the amount of static force that a person's hand can squeeze around a dynamometer.[1] Hand grip strength is a very strong predictor of functional limitation and disability[2] especially in old age.[3] It can be affected by local disorders of hand as well as by degenerative changes occurring in the cervical spine.[4] It has been reported that hand grip strength decreases with age[5] and shows a difference between dominant and non dominant hand.[6] Establishment of norms for hand strength is emerging worldwide and is both important and necessary in public health and hand surgery.[7] It is being used as a validated tool for nutritional assessment of patients along with adductor polices muscle.[8] Measurement of skeletal muscle function in relation to lung function is very important[9] as various mechanisms have been postulated for deteriorated skeletal muscle function in respiratory disorders.[10] These include systemic hypoxia, which causes a change in the muscle metabolic phenotype from oxidative metabolism to anaerobic metabolism as an adaptive process, and increased circulating levels of inflammatory mediators such as interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α) and C-reactive protein (CRP).[11] These changes have been studied widely in large muscle groups such as the quadriceps but a very less emphasis has been given to investigate changes occurring in other peripheral muscles especially the muscles of the upper extremity such as wrist and intrinsic muscles of the hand.[12] Hence this study was aimed at determining whether hand grip strength in healthy adults is correlated with measurement of lung function such as peak expiratory flow rate and with other anthropometric markers such as height, weight, BMI and specific markers of upper limb muscle mass such as mean arm circumference and upper arm length.

METHODOLOGY

The study was performed in the Department of Physiology, CMH Lahore Medical College, from May 2013 till June 2013. The study was approved by the ethical

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review committee of the institution. Sixty three study participants were selected randomly from first year MBBS class, 33 male and 30 female. The exclusion criteria included smoking, known medical illnesses, obesity (BMI >30 kg/m^2) and isometric exercises. A written informed consent was taken from the participants. The data was recorded on a predesigned proforma. The anthropometric measurements performed included height, weight, mean arm circumference and upper arm length. Height and weight were recorded by using a standard stadiometer and weighing scale in the Physiology laboratory. BMI was calculated by using the formula BMI = Weight in kg / Height in meters.^{2} Mean arm circumference and upper arm length were recorded by using a measuring tape. For upper arm length, subjects were asked to stand straight, with the elbow flexed at 90° and the distance between the acromion and olecrenon processes was measured.[13] The midpoint between these two processes was marked, and the subject was then asked to let the arm hang loosely by his side. Mean arm cir-

Table 1: *Comparison of variables among males and females.*

	Males n=33	*Females n= 30*	*p-value*
Age (years)	19.27 ± 0.94	19.07 ± 0.74	0.342
Height (cm)	172.81 ± 4.6	160 ± 5.23	0.001*
BMI (kg/m^2)	18.98 ± 3.31	30 ± 2.50	0.002*
Mean arm circumference (cm)	27.30 ± .87	25.1 ± 3.29	0.006*
Upper arm length (cm)	34.65 ± 2.26	32.45 ± 1.89	0.001*
Hand grip strength (kg)	38.49 ± 8.42	17.74 ± 5.87	0.001*
Peak expiratory flow rate (L/min)	497 ± 85.83	302.66 ± 55.58	0.001*

*p-value < 0.05 = statistically significant.

Table 2: *Comparison of study variables in two groups depending upon exercise.*

	Isotonic Exercise n = 39	*No Exercise n = 24*	*p-value*
Height (cm)	168.93 ± 7.27	163.62 ± 7.97	0.009*
BMI (kg/m^2)	18.17 ± 2.64	17.35 ± 3.88	0.32
Mean arm circumference (cm)	26.70 ± 2.88	25.52 ± 3.71	0.16
Upper arm length (cm)	34.15 ± 2.54	32.70 ± 1.72	0.017*
Hand grip strength (kg)	32.76 ± 11.69	21.87 ± 11.57	0.001*
Peak expiratory flow rate (L/min)	436.15 ± 112	328.75 ± 83.47	0.001*

*p-value < 0.05 = statistically significant.

Table 3: *Correlation among variables in the study participants.*

		BMI	*Upper Arm Length*	*Mean Arm Circumference*	*Hand Grip Strength*	*Peak Expiratory Flow Rate*
BMI	Pearson correlation		0.35	0.756	0.258	0.39
	p-value		0.005*	0.001*	0.041*	0.002*
Upper arm length	Pearson correlation	0.35		0.394	0.417	0.294
	p-value	0.005*		0.001*	0.001*	0.02*
Mean arm circumference	Pearson correlation	0.756	0.394		0.307	0.396
	p-value	0.001*	0.001*		0.014*	0.001*
Hand grip strength	Pearson correlation	0.258	0.417	0.307		0.694
	p-value	0.041*	0.001*	0.014*		0.001*
Peak expiratory flow rate	Pearson correlation	0.39	0.294	0.396	0.694	
	p-value	0.002*	0.02*	0.001*	0.001*	

*p-value < 0.05 = statistically significant.

cumference was measured across the midpoint. Peak expiratory flow rate was measured in a standing position, by using Wright's Peak Flow Meter (MicroPeak, Cardinal Health, UK). The subjects were instructed to take a deep inspiration and then blow out as fast and as forcefully as possible into the peak flow meter. Before starting PEFR, the mouth pieces were washed in soapy water and disinfected with 70% ethanol to prevent contamination. A total of three readings were recorded and the single best was selected for using in the study. Hand grip strength was performed by using BIOPAC Hand dynamometer (SS25 LA S/N 12013156) in the Physiology laboratory. At the start of each session, the dynamometer was calibrated. Participants were instructed to hold the dynamometer in the dominant hand and to exert a maximum clench force in the beginning of the recording. This was to be continued as a sustained force of contraction till the value dropped down to approximately half of the initial clench force. The data was recorded by using BIOPAC data acquisition unit MP36E (S/N 1109002523, BSLPHY-W). Hand grip strength was calculated by using the BIOPAC Student Lab Software (BSL R version 4.0.0). The data was entered into and analyzed by using SPSS version 20 (IBM SPSS Inc., Chicago, USA). Frequencies and percentages were used for descriptive data and Student t test was used to compare group means. Pearson Correlation test was used to correlate variables within the groups.

RESULTS

The anthropometric characteristics of the subjects and the measurements of their muscle function are summarized in Table 1. It was shown that mean ± SD arm circumference, upper arm length, hand grip strength and PEFR were significantly different between males and females. For the purpose of analysis, the participants were divided into two groups, one not performing any exercise and one performing isotonic exercise such as swimming, walking, drill etc. The comparison of variables is summarized in Table 2. It was shown that hand grip strength and PEFR were significantly higher in subjects performing isotonic exercise. The results of Pearson correlation are shown in Table 3. These show that hand grip strength was positively correlated with BMI, upper arm length, mean arm circumference and peak expiratory flow rate and all these were statistically significant.

DISCUSSION

Hand grip strength is one of the most commonly used tests for assessing muscular fitness in adults and is reported to be a strong predictor of morbidity and life expectancy.[14] It is also used in sports physiology as an indicator of sports efficiency.[15] In this study we found a strong correlation between hand grip strength of the dominant hand with BMI, upper arm length, mean arm circumference and PEFR. This study provides a strong foundation for further studies in large sample size and gives a base line data regarding hand grip strength in a sample population of first year MBBS students in CMH Lahore Medical College.

Hand grip strength varies with gender and level of physical activity as depicted by the results of our study. It also shows a variation if our results are compared with the values obtained in the Western population. In our study the hand grip strength was 38.49 ± 8.42 Kg in males and 17.74 ± 5.87 kg in females. In a study conducted by Hornby et al in the adult population of The United Kingdom, the hand grip strength for males was 41.2 (38 – 44.4) kg and for females it was 26.7 (24.9 – 28.5) kg.[10] This may be attributed to a difference in overall body build and a better nutritional status of the subjects in the West as compared to our local population. If the results are compared with other studies done in the local subcontinent regions then our results are comparable with the results shown by various studies in India. In a study conducted by Shah et al in Puna, India, the results showed a mean grip strength of 31.24 ± 4.3 kg in healthy adult males and 23.0 ± 1.9 kg in healthy adult females.[11]

However, in our study we found a strong positive correlation between hand grip strength and other study parameters such as PEFR, BMI, upper arm length and mean arm circumference. In a study conducted by Sirguroh and Ahmed (2012), it was shown that there was a weak negative correlation between PEFR and hand grip strength in patients suffering from COPD.[12] The researchers attributed this to the fact that the muscles of upper extremities may not be subjected to the effects of physical inactivity which is present in patients suffering from COPD. As opposed to this, the study conducted by Hornby et al, (2005), shows a good positive correlation between hand grip strength and PEFR, which is similar to our results.[10] This study was conducted in forty six males and fifty two females with a mean age of 45.9 years.

When the study participants were divided into two groups depending upon whether they perform any isotonic exercise or not, it was observed that height, upper arm length, hand grip strength and PEFR were significantly higher in the group performing isotonic exercise. This may be attributed to the fact that exercise affects the height and length of the long bones as demonstrated by Bradney et al (1998)[17]. Height of an individual in turn affects the chest proportions and hence affects the pulmonary function of the body.[16]

It is ***concluded*** that this study provides a baseline of normative data in a sample population of first year MBBS students at CMH Lahore Medical College, Lahore. The study showed that measures of skeletal muscle function such as hand grip strength and pulmonary function as depicted by PEFR are positively correlated

with one another. Markers of anthropometric measurements such as height, weight, BMI, upper arm length and mean arm circumference are also positively correlated with hand grip strength.

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