



Evaluation of Hand Anthropometric Measurements and Grip Strength in Healthy Kitchens Workers

Published online on 22nd January 2016@www.eternalpublication.com

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Received: 31st December 2015; Accepted: 12th January
2016

How to cite this article: Gajbhiye V, Jiwane R, Choudhary AK. Evaluation of hand anthropometric measurements and grip strength in healthy kitchens workers. International Journal of Anatomy Physiology and Biochemistry 2016;3(1):1-5.

Abstract:

Hands are important tool to perform various works. Strength of hand is measure by hand grip strength which determines physical health and muscle function of an individual. Sixty female workers of 25-45 years of age working in the kitchen of People's hospital, hostels were selected for the study. They were divided into two groups according to their nature of work .Study group-Group I (n=30) and Control group-Group II (n=30). Hand width, hand length, palmar length, palmar width, and 3rd digit length were measured following standard techniques. From these hand-anthropometric variables i.e. the shape index, digit index, 2D:4D ratio, palmar length/width ratio and right handgrip strength (kg) were calculated. The palmar length, palmar width, palmer length/palmar width ratio and 2D/4D ratio was similar among all control group females and study group female workers. However, hand length, hand width, digit index and shape index showed significant variation in study group when compare to control group. Hand grip strength of the study group is more as compare to control group. Also there is significant positive correlation between right shape index and right hand grip strength [r(58)=0.85; P=0.01] and between left shape index and left hand grip strength [r(58)=0.90; P=0.01] in the study group female workers. Study group female workers show significant variation in hand anthropometry and have significantly high hand grip strength.

Keywords: hand grip strength, hand length, hand breath, hand grip dynamometer

Introduction:

Hand is a very complex structure capable of not only a multitude of motor tasks but also of relaying sensory information about the temperature, the shape and texture of objects to the brain. The hand does not function in isolation and is dependent on the integrity of the shoulder and elbow complexes to allow the appropriate positioning of the hand in space to complete the desired task.¹ Its effectiveness in these activities is due to particular configuration

of the bones and muscles which permits opposition of the pulp surface of the thumb to the corresponding surfaces of the other four finger tips in a firm grasp, together with a highly elaborated nervous control and sensitivity of the fingers.²

Hand grip strength is a measure of strength of several muscles in the hand and the forearm.³ It was found to be a significant determinant of bone mineral content and bone area at the forearm sites and had a positive correlation with lean body mass

and physical activity. It determines the muscular strength of an individual and it is an easily obtainable measure of physical health and muscle function.⁴ Hand grip strength is a physiological variable that is affected by a number of factors including age, gender and body size. Strong correlations between HGS and various anthropometric measurements (weight, height, hand length etc.) were reported earlier.⁵⁻⁷ In a present study we are studying different hand anthropometric measurements and comparing grip strength in healthy workers who worked in different kitchens of hostels and the hospital of Peoples Institute, Bhopal. Hands are the major tool for cooking its morphology and functional properties could be important for the performance.

Material and Method:

Sixty female workers of 25-45 years of age working in the kitchen of Peoples hospital, hostels were select for the study. They are divided into two groups according to their nature of work .Study group Group I (n=30) workers cooking large quantity of food like kneading dough, rolling chapattis, sauté the vegetables and dish washing. . Control group Group II (n=30) dusting, cleaning floor, vegetables cutting. Exclusion criteria were set upon the knowledge of some genetic, psychological, neurological or chronic diseases affecting hand function and anthropometric characteristics.^{8,9} The study protocol was approved by the Institute's Ethical Committee. A written consent was obtained from the subjects prior to participation. The data were collected under natural environmental conditions in the morning between 8am to 12 noon. Hand anthropometric measurements were performed in order to evaluate the physical characteristics of the hand and the grip strength was chosen as the indicator of hand function.

Body weight was measured using a standard scale with light clothing on and without any footwear. Height was measured with the individual in upright position in front of a wall looking ahead and heels

touching one another. For each hand, parameters related with hand dimensions and ratios were evaluated. Hand width, hand length, palmar length, palmar width and 3rd digit length were measured following standard techniques. From this hand-anthropometric variables, i.e. the shape index, digit index, 2D:4D ratio, palmar length/width ratio and right handgrip strength (kg) were calculated.

Hand length was measured by a tailor measuring tape in centimeters from the creases of the wrist to the dactylion of the participant. **Hand width** was measured by a tailor measuring tape from the metacarpal radiale to the metacarpal ulnare in centimeters. **Palmar length** defined as the distance between the midpoint of the distal wrist crease and the midpoint of the proximal digit crease, was calculated according to the formula hand length minus 3rd digit length, determines palmar type without the digits were also assessed.^{9,10} **Palmar width** was measured from the metacarpal radiale to the metacarpal ulnare. **Digit index (phalangeal index)** calculated as 3rd digit length x 100/hand length determines grasping capability.^{10,11} **Palmar length/width ratio:** Palmar length/Palmar width (Palmar width = Hand width).^{9,10} **Shape index** was calculated by hand width divided by hand length and multiplied by 100. **2D:4D ratio** was measured by dividing the length of the second digit by the length of the fourth digit. **Hand grip strength** was determined by using hand grip dynamometer as the maximum voluntary contraction (kg) sustained for at least 3 seconds. Each subject will be given the verbal instruction and demonstration before being tested and further instructions are provided at the time of test. Subject stand upright holding dynamometer in the dominant hand, with the shoulder abducted and elbow in full extension and will be encouraged to exert the maximal grip. Three trials with brief pauses of 10-20 seconds will be allowed and best result will be chosen for analysis.

Statistical analysis:

Data are expressed as Mean \pm Standard deviation (SD) and each parameter had six observations. All data were analyzed with the SPSS for windows

statistical package (version 20.0, SPSS Institute Inc., Cary, North Carolina. Statistical significance between the different groups was determined by the independent student 't' test and the significance level was fixed at $p \leq 0.05$. Finally, Pearson correlation was used between two variables.

Result:

The comparison of BMI on the basis of Asian population among control and study group female workers was done.

Table:1 The comparison of body mass index (BMI) among control and study group female workers.

	Control females (n=30)	Study group females (n=30)
Age (years)	26.25 ±5.67	28.80±6.40
Height (cm)	170.38±20.83	165.24±23.84
Weight (Kg)	60.72±8.24.	62.56±10.23
BMI (kg/m ²)	18.89±1.70	19.46±2.80

Table:2 The comparison of anthropometric measurements among control and study group female workers.

Anthropometric measurements	Side	Control females (n=30)	Study group females (n=30)
Hand length(cm)	Right	17.58±1.83	22.30±2.44*
	Left	16.82±1.62	21.27±2.30*
Hand width(cm)	Right	6.80±0.42	7.85±0.37*
	Left	6.57±0.34	7.49±0.46*
Shape index	Right	38.20±2.18	44.35±2.80*
	Left	36.54±1.72	42.10±2.54*
Palmar length(cm)	Right	9.37±0.72	10.15±0.83
	Left	9.12±0.55	9.76±0.68
Palmar width(cm)	Right	8.02±0.28	8.15±0.40
	Left	7.84±0.25	8.12±0.38
Palmer length/palmar width	Right	1.17±0.008	1.75±0.01
	Left	1.164±0.007	1.17±0.009
Digit index	Right	41.39±3.62	53.15±4.23*

	Left	40.85±3.24	51.39±4.40*
2D/4D ratio	Right	0.89±0.03	0.92±0.04
	Left	0.85±0.04	0.88±0.05
Hand grip strength (Kg)	Right	19.80±2.44	26.30±2.57*
	Left	17.75±2.28	24.19±2.20*

The data is summarized in (Table 1) with mean ±SD. Among all control females and kitchen female workers there was not any significant variation of body mass index (BMI) and their age groups.

The data is summarized in (Table 2) with mean ±SD. The palmar length, palmar width, palmer length/palmar width, and 2D/4D ratio was similar among all control group females and kitchen group female workers. However hand length, hand width, digit index and shape index showed significant variation in kitchen group worker females when compare to control group females workers.

The data are summarized in (Figure 1 & 2) with mean ±SD. Among all control group females and kitchen group female workers significant positive correlation between right shape index and right hand grip strength [$r(58) = 0.85$; $P= 0.01$] and between left shape index and left hand grip strength [$r(58) = 0.90$; $P= 0.01$] is shown by kitchen group female workers.

Figure:1 The correlation of right hand among shape index and hand grip strength of control group and study group female workers.

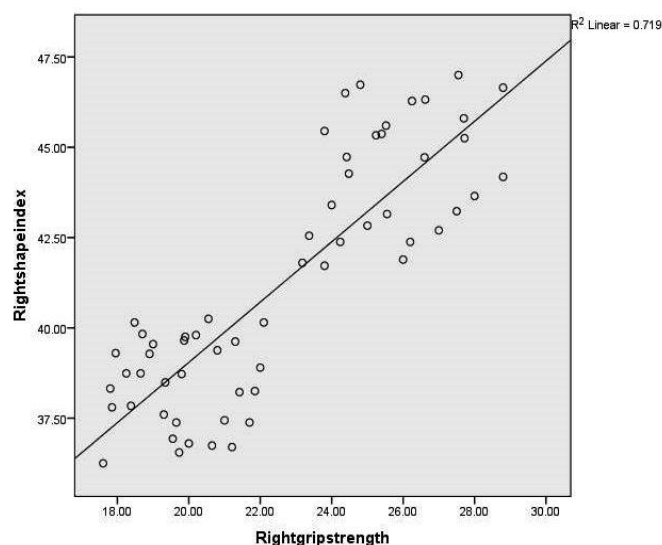
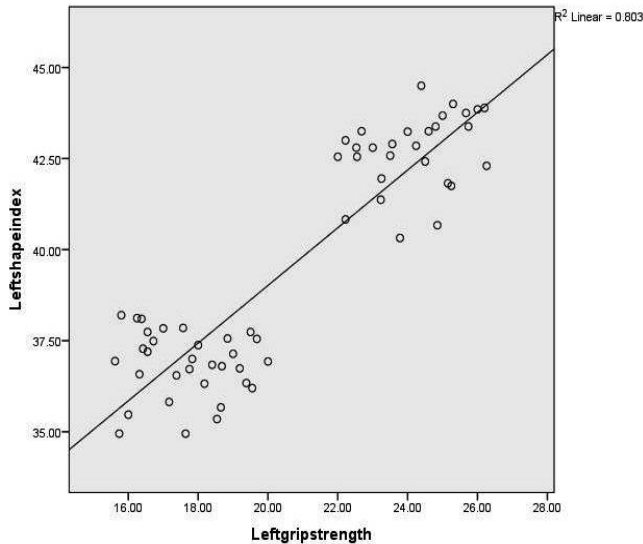


Figure:2 The correlation of left hand among shape index and hand grip strength of control group and study group female workers.



Discussion:

A total of 35 muscles are involved in movement of the forearm and hand. Many of these are involved in gripping activities. In gripping activities, the flexor muscles in the hand and forearm create the grip strength, while the extensor muscles of the forearm stabilize the wrist.¹² All the flexor muscles of the hand and forearm responsible for grip strength are closely related anatomically, physiologically and biomechanically to each other to perform the task, showing close affinity to each other. Grasping ability is made possible by the fact that the thumb can be opposed to the fingers. The fingers and the thumb act as a versatile pair of pliers. They need the palm of the hand as a flat base, on which the object grasped can be held, so that the anatomy of the hand is more geared toward flexion than extension.¹³ In the present study the palmar length, palmar width, palmer length/palmar width and 2D/4D ratio was similar among all control group females and study group female workers.

The findings of the present study indicate that grip strength is directly proportional to hand anthropometric parameters, hand length, hand width, digit index and shape index. It was

significantly higher in study group worker females when compare to control group females workers. Study done by Shah UN et al¹⁴ (2012) show that height, weight, hand length, hand span, wrist circumference and forearm girth positively correlate with hand grip strength. Grip strength has long been thought of as a possible predictor of overall body strength. Smith et al¹⁵ (2005) found a direct correlation in grip strength and overall body strength in elderly female populations. In 2006, Fry et al¹⁶ found a correlation between grip strength and performance in American junior male weightlifters. It is also reported that hand grip strength determines the muscular strength of an individual.⁴

According to Klausen K¹⁷ (1990) the maximum force or tension produced by a muscle depends on the cross-sectional area of all the muscle fibers within the muscle- considered as the physiological cross-sectional area. Number of muscle fiber, length of muscle fiber is more when muscle mass is more. Thus, a muscle with a large cross sectional area is able to produce greater maximal force than a muscle with a small cross-sectional area.¹⁷ This may lead to positive correlation of digital index and hand grip strength. Better hand grip strength lead to better performance of work in the kitchen workers. So proper and specific diet plans, nutrition factors, should be given to the workers for their better performance.

Conclusion:

In this present study we concluded that hand grip strength of the study group is more as compare to control group. Some of the hand anthropometric variables are significant in study group (hand length, hand width, digit index and shape index). Also there is significant positive correlation between shape index and hand grip strength in the study group female workers.

Acknowledgement: The authors gratefully acknowledge the people's University and RKDF Medical College and Research Centre for their financial support.

Conflict of interest: The authors declared no conflict of interest.

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