Original Article

Normative measurement of hand grip strength and its correlation with hand dimensions among healthy Maharashtrian females

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Abstract

Background: Hand grip strength is a physiological variable affected by a number of factors including age, gender, body mass index and dimensions of forearm and hand. There are many studies done to find grip strength among children and athletic population but there are less study done among the normal female population. To our knowledge there is no study done to find normative data of grip strength among healthy females. **Aims:** To obtain normal reference value for grip strength in Maharashtrian female population. **Objective:** To establish normative data of hand grip strength and to determine whether correlation between hand grip strength with hand width, hand length, forearm length and forearm circumference. **Design:** Cross-sectional study was performed to study the association between hand dimensions. **Methods:** 140 healthy females between age group of 10 to 79 years was divided into 7 groups (10 – 19, 20 – 29, 30 – 39, 40 – 49, 50 – 59, 60 – 69, 70 – 79) of age were recruited for the study, hand dominance was determined, every female were asked to exert maximum grip strength was measured by using hand dynamometer **Results and Conclusion:** The normal reference value for grip strength in Maharashtrian female population is 21.94 ± 6.23. There is a negative correlation between BMI and grip strength and positive correlation between Hand Width, Hand Length, and Forearm length and hand circumference and grip strength.

Keywords: Grip strength, Jamar hand dynamometer, Hand width.

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INTRODUCTION

Many daily activities involve interaction with the objects that are grasped in the hand.[1] The manipulative ability of the human hand requires effective force and dexterity.[1] Hand grip strength is a physiological variable that is affected by a number of factors including age, gender and body size.[2] Although strength is one of the important characteristic of normal hand this fact is not given enough attention in reconstructive surgeries as compared to other parameters of motion and sensibility.[3] The estimation of hand grip strength is of immense importance in determining the efficacy of different treatment strategies of hand and also in hand rehabilitation.[2] Hand grip strength can be quantified by measuring the amount of static force that the hand can squeeze around a dynamometer.[4] The power of hand grip is the result of forceful flexion of all finger joints with the maximum voluntary force that the subject is able to exert under normal biokinetic conditions.[2] The synergistic action of flexor and extensors muscles and the interplay of muscle group is an important factor in the strength of the resulting grip. For overall hand function, grip strength plays a very important role.[5] Assessment of hand grip strength is simple, inexpensive and is frequently performed to evaluate outcomes following upper extremity injuries.[5] In hand injury the strength of the contra lateral non-injured hand serves as a control. [5] Health status and level of physical activity of a person has

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a great effect on grip strength.[5] A recent study in the Chinese and Korean population has found a correlation between grip strength and anthropometric factors such as forearm circumference, body height, and weight.[5]However there are not many Indian studies available in the literature to form a baseline reference values for hand grip strength. There is also dearth of literature comparing the anthropometric values with the hand grip strength in the Indian population. Hence this study aimed to establish a normative value for hand grip strength in normal Indian population based on age stratification as well as to do a correlation with anthropometric values. Consequently, strength assessments in postoperative hand patients are subjective at best. Thus, this study was designed to characterize and establish baseline hand strength values and to determine what patient-related factors might influence hand strength in the healthy Indian population. The purpose of the study was **t**o obtain normal reference value for grip strength in Maharashtrian female population. The objective of the study was to establish normative data of hand grip strength and to determine whether correlation between hand grip strength with hand width, hand length, forearm length and forearm circumference.

MATERIAL AND METHODS

The subjects in this study were recruited from patients who were visiting MGM's Hospital OPD, Aurangabad in 2013 for health problems other than upper extremity injuries, their care takers, relatives and students from MGM Institute of physiotherapy. The subject were included with females older than 10 years and less than 80 years of age and those having no history of any upper extremity injury. They were excluded in case of any history of inflammatory disease, any history of neurologic disease, traumatic event to the upper extremity requiring medical management or leading to restrictions of daily activity.

PROCEDURE

A sample of 140 females meeting the inclusion criteria was evaluated. Their anthropometric values were noted as follows:[5]

1. hand width = measured at the level of the distal palmar crease.
2. hand length = distal wrist crease to the tip of the longest finger.
3. forearm length = lateral humeral epicondyle to radial styloid process.
4. forearm circumference = measured to include the midpoint of the forearm length.
5. Total body weight and height were measured with standard scales.

Grip strength was measured with a Jamar hand dynamometer (Fig 1) whose reliability and validity is already well established. For each of the strength assessment all subjects were asked to sit on a chair with straight back without armrest with the feet flat on the floor, shoulder adducted and neutrally rotated, elbow flexed at 90 degree, forearm in neutral position and wrist between 0-30 degrees extension and 0-15 degree of ulnar deviation.[1] The subjects were instructed to initiate optimal handgrip strength usually about 3 seconds sustained grip. The subjects were given one trial after which they rested for 10 minutes. The instruction was given in the same tone and volume in order to discourage the overload of instruction. To get maximum reliability of data collected, every subject was asked to squeeze the dynamometer three times and the best reading was noted. A rest of sixty seconds was given between each squeeze. The dynamometer was set to zero before each trial.[1]

Figure 1: Jamar Hand dynamometer

Figure 2: Grip strength position

DATA ANALYSIS

Descriptive analysis was performed to find out the mean and S.D for all 140 subjects overall and also after categorizing in individual groups depending upon age criteria considering the best grip strength value obtained. Data was analysed using SPSS 11.5 version. The

correlation was determined using pearsons correlation coefficient test.

RESULT

A total of 140 females between age group of 10 to 79 years of age were recruited for the study. They were classified into different age groups considering the age criteria. Mean was obtained for all 140 subjects as well as in the different age groups.

Table 1: Average mean for indian female population

For 140 subjects	Mean ± S.D
	21.94±6.23

Table 2: Average grip strength in different age groups

AGE GROUPS	MEAN+- S.D
10-19	22.45±6.23
20-29	27.60±5.17
30-39	23.95±6.36
40-49	24.05±4.68
50-59	22.50±4.34
60-69	17.40±4.72
70-79	15.65±2.81

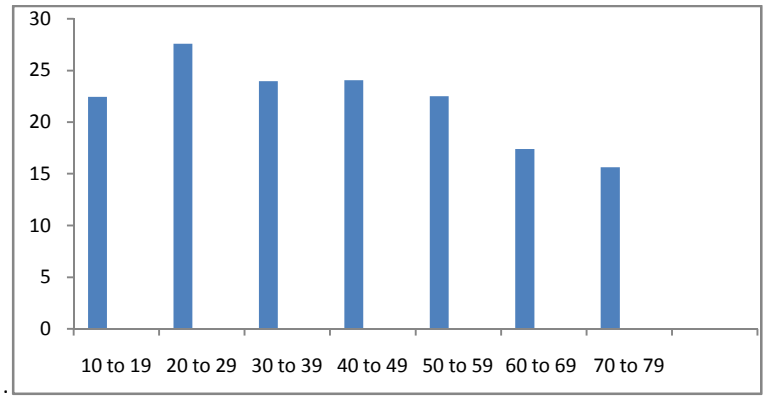

Table 3: Correlation was done between grip strength and bmi, hw, hl,fal, fac. The result are shown in the table below

	R	p
BMI	-0.04	0.963
HW	0.270	0.001
HL	0.359	0.000
FAL	0.242	0.004
FAC	0.352	0.000

DISCUSSION

Total of 140 subjects was taken for studies. Their hand width, hand length, forearm length, forearm circumference, BMI was noted. Grip strength was measured with a Jamar hand dynamometer. For each of the strength assessment all subjects were asked to sit on a chair with straight back without armrest with the feet flat on the floor, shoulder adducted and neutrally rotated, elbow flexed at 90 degree, forearm in neutral position and wrist between 0-30 degrees extension and 0-15 degree of ulnar deviation.[1] The subjects were instructed to initiate optimal handgrip strength usually about 3 seconds sustained grip. To get maximum reliability of data collected, every subject was asked to squeeze the dynamometer three times and the best reading was noted. A rest of sixty seconds was given between each squeeze. The dynamometer was set to zero before each trial.[1] To analyze data further divide into 7 different age groups ranging from 10 to 79 years. Each group had 20 subjects. Mean and standard deviation was noted for all 140 subjects and all group wise analysis was done. The overall mean and standard deviation was 21.94±6.23. For the Indian population this can be taken as normal reference value for grip strength in female patient. This is less as compared to the study done in Korean population which was found to be 26.54.5. This might be due to the different lifestyle and cultural variations of Indian and Korean population. In India females prefer household work or even if they are employed they prefer lighter jobs whereas Korean counterparts are hardworking people who can take up any kind of strenuous jobs. Moreover their food habits are different from Indians. They are more health and diet conscious. This might also contribute to their general fitness. They use chopsticks while eating on daily basis. This could have led to a better intrinsic muscles strength as compared to Indians. In the individual group mean, it was found that female between age group 20 to 29 had greater grip strength as compared any other group (.27.60±5.17) and the least grip strength was found in the population between 70 to 79 years (15.65±2.81). 20 to 29 is the age where most of the females have active life styles and thus they develop better muscle strength. Degenerative changes are not usually found in this age group. This outcome most obviously reflects the variation of muscular mass which peaks during this period in the normal course of human

development which is consistent in age related pattern as reported by OH, SCHMIDD and POEWS.[5] Whereas after 70 years they are more prone to develop degenerative changes and muscle wasting Further we tried to find out the correlation between Body mass Index (BMI), Hand Width (HW), Hand length (HL), Forearm length (FAL), Forearm circumference (FAC) with the grip strength. It was found that there was negative correlation between BMI and grip strength(r=-0.004). There are very few studies which support this result. A recent study done in school children in rural area of Maharashtra concluded that there is positive correlation between hand grip and BMI.[1] more study done in Indian female volleyball players proved that there is positive correlation BMI and grip strength.[5] There is scarcity in the literature which supports negative correlation between BMI and grip strength. Most of the studies say that there is no association or very weak association between BMI and grip strength. One Australian study says that BMI is inversely proportional to grip strength which supports our result. Probably reason could be that as BMI increases the person may fall into obese or overweight. In such patient overall muscle mass is reduced and fat percentage is more hence the strength could be decreased.[4] We analyze the correlation between hand width and grip strength the r value was 0.270. Correlation between HL and grip strength was done and r value was 0.359. Correlation between FAL and grip strength was done and r value was 0.242. Correlation between FAC and grip strength was done and r value was 0.352. Out of all these HL and FAC has a strong positive correlation. The association between HW and FAL has a weak correlation. Longer the hand length better would be the pull of the muscles while attempting forceful flexion of all the finger joints due to a longer lever. Greater FAC means that muscle mass is more which can result in a better grip strength. However, the study was limited in various ways. The sample size could have been more. In the future study more sample size can be taken.In this study only females were included and males were not taken. In future studies even males can be taken as a subject.In this study only dominant hand was taken due to time constraints. Study can be done in the future by comparing both dominant and non-dominant hand.

CONCLUSION

The normal reference value for grip strength in Maharashtrian female population is 21.94 ± 6.23. There is a negative correlation between BMI and grip strength and positive correlation between Hand Width, Hand Length, and Forearm length and hand circumference and grip strength.

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