A cross sectional study on correlation of handgrip strength with various anthropometric indices in north Indian male population

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Abstract

Background: A reliable handgrip strength assessment is important as it is an objective index for functional integrity of upper extremity. It is found to be influenced by factors like age, weight, height, BMI, life style and occupation. There are various sports activities which need high level of forearm and hand muscle strength. Various studies have been performed to evaluate handgrip strength in different geographical locations. Present study was undertaken to provide the normative data for handgrip strength and to correlate the effects of various anthropometric indices on it.

Objective: To measure the hand grip strength and correlate it with anthropometric parameters in adult male population.

Material and method: Four hundred fifty young healthy adult males were selected for the study in MMIMSR, MMDU, Mullana, Amabala . A Jammar dynamometer was used for measuring handgrip strength in both dominant and non dominant hand.

Result: The handgrip strength was found to be greater in dominant than non-dominant side. It was observed that handgrip strength increases with increase in BMI in both the hands. Positive correlation was also found with weight, height and BMI. There was highly significant association of handgrip strength with weight (r=.244; p<0.001),height (r=.251; p<0.001) and BMI (r= .155; p<0.001).

Conclusion: Our study provides reference values of handgrip strength and its correlations with anthropometric indices which is useful in screening of talented players in sports.

Keywords: anthropometric indices, BMI, handgrip strength, Jammar dynamometer.

Introduction

Upper extremity plays a colossal character in performing daily life activities. Handgrip strength is an objective index for functional integrity of upper extremity. (1) It is of paramount importance to physiotherapists, for measuring hand muscle power and to ascertain progress during rehabilitation and its future outcomes. (2)Its evaluation is of crucial importance for assessment of upper limb impairment and effectiveness of various treatments modalities. It is an important tool

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for evaluating work capacity of patients with local hand injuries and systemic clinical conditions such as arthritis and muscular dystrophy. The utility of handgrip strength in the overall management of hand injuries is immense. (3) Koley etal reported that major aspects of the game i.e. swing and pitch speed are affected by the handgrip strength of the sports personnel. Sports activities requires muscular coordination in upper body. The ability of hand to perform function, grasping the objects, sports activities , baseball, judo, badminton, tennis, etc is a unique feature to human being.(4)

S.M. Adodo et al. stated that factors including age, height, weight & BMI, handedness all affects handgrip strength performance. (5)

As reported by Khalid et al. handgrip strength estimation is imperative in determining the efficiency of treatment strategies & rehabilitation. Handgrip strength is also a predictor of heart disease, general health, cerebrovascular disease, disability, cognitive decline, future risks & mortality. It is also being evaluated that the dominant hand has approximately 10% stronger grip strength than non dominant hand. This is also stated in the well known 10% rule. (6).The different extrinsic factors affecting muscle strength are motivation, time of day, type of training & anabolic steroids. Intrinsic factors include, muscle hypertrophy, muscle cross- sectional areas, range of motion and muscle fiber type. (7). It is also being observed in previous studies that longer fingers & larger hand span have stronger grip strength. Ngee et al. stated that for each standard deviation increase in handgrip strength, there is an association with significant reduction in the relative risk of mortality rate. (8). Previous studies also stated that the muscle of obese individual have fatty infiltration & alteration in the distribution of type I & type II muscle fibers which is also going to influence muscle strength & endurance.(9) Hand grip strength is also accepted indicator for assessment of bone mineral density. (10)

Baseline data for handgrip strength depending on age, height, weight are available in different populations and are used for reference purpose but these data are useful for the particular population from which the sample is taken. Reference values are many from the western world but it would not be right to extrapolate them on Indian population due to the various factors which affect handgrip strength. A very few studies undertaken in India are also there. Present study was conducted to find out the reference values of handgrip strength in healthy young adult North Indian male population.

Procedure/Material and method:

Participants

The current study was conducted in MMIMSR, MMDU (Mullana), Ambala after ethical clearance from IEC committee during the period 2016-2019. Four fifty healthy young North Indian males lying in age group 18-26 yrs were included in the study. The subjects with neurological and musculoskeletal impairment of upper limb, cardiovascular or systemic illness were excluded.

Measurements

Prior informed consent were taken from all the subjects after being narrated with a brief description of the study. Jammar dynamometer (Saehan corp. Masan, Korea, Model No.SH5005) was used for quantification of handgrip strength .The subject was in sitting position with shoulder adducted with arms hanging by the sides elbow 90 ^{o} forearm midprone position, wrist 0 to 30 degree outstretched, ulnarly deviated for taking the measurement. The grasping of the dynamometer was carried out by the subject executing three successions grating one minute interval between the quantification

to minimize fatigue effect. Mean of three trials of grip strength was taken as the maximum hand grip strength. The handle position was selected for on the basis of maximum voluntary force and comfort. For handgrip strength, the measurements were performed in both dominant and non dominant hands. Weight was measured by caliberated electronic scale.

Height was measured with stadiometer with head aligned in Frankfurt's plane. Reading were recorded at the end of normal breathing to precision of half a centimetre by dividing the reading by 100.Waist circumference was measured closer to 0.5, at the level of umblicus by using a elastic tape.

Hip circumference was measured at the widest portion of buttocks girth at the level of greater trochanter with the subject wearing minimal clothing.

Waist hip ratio was measured by dividing the waist circumference by hip circumference.

Body mass index was calculated by using formula: weight (kg) / height (m²).

Statistical analysis

Mean and standard deviation were calculated for the variables considered in the study. Pearson correlation ® was used to provide better understanding of relation between the independent variables. Independent t- test was used for comparison of grip strength tests, hand dominance. The data was analyzed using SPSS version 20. P values were calculated for all the variables so as to predict the statistical significance (p value<.05). The study received the ethical clearance from the MMIMSR Ethical Committee.

Results

Baseline data for handgrip strength is presented in table no.1. It is found that 335 out of total 450 subjects (74%) were right handed and 115 (26%) were left handed. As analysed from fig 1, Handgrip strength in

the dominant side were found to be greater than those of the non-dominant side. As observed from table no.2, significant association of handgrip strength with weight, height and BMI is seen. Positive correlation was observed with all the anthropometric parameters under consideration as seen from table no2 in present study.

It can be observed from comparison table no.3 that study conducted on Asian population and Nigerian population had hand grip strength values lesser than the present study both in dominant and non dominant side with age of the subjects on the slightly higher side. But as the age group increases in years in the different studies of European countries, the hand grip strength values also increases proportionately in both dominant and non dominant sides.

Discussion

According to the table no 2, we found that handgrip strength is related linearly with BMI which means as the body fat decreases there is a simultaneous decrease of muscle power and hence handgrip strength decreases. This is similar with previous studies correlating handgrip strength with BMI. As stated in table number 2, there was a positive correlation of handgrip strength with all the anthropometric indices. Highly significant association of hand grip strength was observed with weight, height and BMI. (p value < 0.001)

Thus it becomes important to measure the handgrip strength so as to assess performance of sports personnel. The handgrip strength of the dominant side was 3.1% greater than of non dominant side in both right and left hand dominant subjects. (11) Previous studies have reported dominant hand to be 10% stronger than non dominant hand in random sampling. Handgrip strength is an important parameter to

quantitatively assess these hand functions. Hand grip strength is assessed by forcefully flexing the fingers to the maximum by a subject under normal environmental conditions. Adebisi et al. has shown that there is strong correlation with anthropometric indices like weight, height and BMI. It is also been stated that handgrip strength in the dominant side of adult is found to be higher than non dominant hand.

In our study the most of the subjects were in the age group of 18 to 26 years of age and hence no correlation was found with hand grip strength while in the study of Khalid et al. there was a wide variation in the age of the subjects included. (Age range 20 to 74 years) with mean age 42.55 years.

In the study conducted by B .Chittibabu (12) in department of physical education and sports sciences Annamalai University, Chidambaram, India. 144 male players were selected in the age range of 18-28 years. The right handgrip strength showed a significant relationship with weight. In a cross sectional study conducted by Bansode et al. (13) on 121 healthy 1st year students at department of physiology Dr. Ulhas Patil Medical College Jalgaon, Maharashtra. The aim of study was to evaluate the association of dominant handgrip strength of both adult genders with age, height, weight, BMI, WC and WHR. As a result it was analysed that the dominant hand grip strength in both males and females had a significant   positive correlation with body height p<0.05 to 0.001) (r=0.245 in males), (r=0.379 in females), body weight r=0.497 in males, r=0.484 in females whereas hand grip strength have non-significant positive correlation (p<0.05) with waist circumference (r=0.180 in males); (r=0.102 in females) and waist height ratio (r=0.05 in males) and (r=0.101 in females).

Findings of above study were similar to our study but the reference values of hand grip strength are from a different geographical location and cannot be extrapolated to north Indian population.

Conclusion

It is concluded from our study that overweight subjects having more muscle mass will have higher handgrip strength in them. The parameters like hip circumference, waist circumference, waist to hip ratio, waist to height ratio, becomes relevant than the BMI in the overall assessment of these variables. The measurement of handgrip strength is a convenient way to predict the forearm and hand muscle function. Handgrip strength is very significant indication for future performance of players in ball sports. Reference values of handgrip strength and its correlations with these anthropometric indices will be very useful in the screening of talented players in sports .Almost all the sports played worldwide require the use of a very good amount of handgrip strength, for there better performance.

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Table 1: Baseline data of handgrip strength in subjects under the study.

Variables	Handedness	Mean± SD (Right Handed Dominant Subjects) (335)	Mean± SD (Left Handed Dominant Subjects (115)
Grip Strength (Kg) Grip Strength (Kg)	Right Left	40.734 ±7.71 37.692 ±7.64	38.00 ±7.38 41.27±7.47

Table 2: Correlation of Handgrip strength with various anthropometric indices

Variables	N	r-value	p-value
Age(years)		.090	0.58
Weight (kg)		.244	<0.001**
Height (cm)		.251	<0.001**
Hip Circumference (cm)	450	.073	.121
Waist Circumference (cm)		.102	.030
WHR		.092	.051
WHtR		.024	.608
BMI (Kg/m²)		.155	<0.001**

*p<0.05;significant;**<0.001;highly significant

Table 3: Comparison of handgrip strength in present study with other previous studies at different age groups

Population	Age (Year)	Dominant Grip Strength (kg)	Non Dominant Grip strength (kg)
Swiss	40-44	55.9	53.4
German	30-39	54	52
U.K	35-44	48.6	44.8
Nigerian	20-29	36.6	32.2
Asian	25-34	31	28
Present Study	18-26	42	39