

Effect of Hand Dominance in Grip Strength in Collegiate Population of Amritsar, Punjab, India

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ABSTRACT The aim of the present study was to evaluate the grip strength between the two sides for the right and left handed male and female collegiate Indian population, as grip strength provides an objective index for the functional integrity of upper extremity. The study is based on 151 males (103 right handed and 48 left handed) and 152 females (129 right handed and 23 left handed) collegiate population of Amritsar, Punjab, India, aged 18-25 years. Hand grip strength was measured by hand grip dynamometer. The findings of the present study indicate that statistically significant differences ($p < 0.05$) were found for hand grip strength both in males and females between right hand dominant and non-dominant groups ($t=3.13$ and 2.78 respectively) and left hand dominant and non-dominant groups ($t=2.66$ and 3.13 respectively). When comparisons were made between dominant right and left hand groups and non-dominant right and left hand groups, both in males and females, statistically no significant differences were noted in any case.

INTRODUCTION

Hand grip strength is a physiological variable that is affected by a number of factors including age, gender and body size among others. 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. 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. Strong correlations between grip strength and various anthropometric traits, (weight, height, hand length etc.) were reported earlier (Malina et al. 1987; Ross and Rosblad 2002). In fact, the grip strength is reported to be higher in dominant hand with right handed subjects, but no such significant differences between sides could be documented for left handed people (Incel et al. 2002). Right and left hand grip strength was positively correlated with weight, height and body surface area (Chatterjee and Chaudhuri 1991). In case of relationships of hand grip strength with stature, weight, arm and calf circumferences and various subcutaneous skinfolds, it is found that males attained greater values for those anthropometric variables and also have greater hand grip strength values than their female counterparts (Benefice and Malina 1996). It is found too, that age dependent increase of hand grip strength in

boys and girls as well as inter-gender differences are strongly associated with changes of fat free mass during their childhood (Sartorio et al. 2002). Hand grip strength is found to be a significant determinant of bone mineral content and bone area at the forearm sites and has a positive correlation with lean body mass and physical activity. It determines the muscular strength of an individual (Foo 2007). Hip/waist circumferences measurement is a good marker of fat mass, bone mineral content and lean mass which are strongly correlated with maximum isometric grip force (Rasid and Ahmed 2006). The assessment of hand grip strength assumes importance in a number of situations. It may be used in the investigation and follow – up of patients with neuromuscular disease (Wiles et al. 1990). It is also of use as functional index of nutritional status (Brozek 1984; Vaz et al. 1996; Jeejeebhay 1998) and can predict the extent of complications following surgical intervention in hospitalized patients (Klidgian et al. 1980). The information regarding the association of hand grip strength and handedness is scanty, especially from north India, so the present study was planned.

MATERIALS AND METHODOLOGY

The present study is based on the sample of 303 unrelated, healthy individuals (151 males and 152 females) aged 18–25 years selected randomly

from Guru Nanak Dev University, Amritsar, Punjab, India. For male and female students, the mean age was calculated 21.48 years (S.D. ± 2.29) and 21.5 years (S.D. ± 2.30) respectively. So far height is concerned, right and left hand dominant males have the means 172.05 cm (S.D. ± 6.89) and 173.69 cm (S.D. ± 6.37) respectively and right and left hand dominant females have the means 157.40 cm (S.D. ± 5.72) and 157.87 cm (S.D. ± 5.34) respectively. The age of the subjects were recorded from the records of their respective institutes, the subjects were divided in such a way that "age 18", for instance refers to the individuals aged 17 years and 6 months through 18 years and 5 months and 29 days. The study was approved by the local ethics committee.

The grip strength of both right and left hands was measured using a standard adjustable digital hand grip dynamometer (Takei Scientific Instruments Co. Ltd., Japan) at standing position with shoulder adducted and neutrally rotated and elbow in full extension. The subjects were asked to put maximum force on the dynamometer thrice from both dominant and non-dominant hands. The average value was recorded in kilograms. Descriptive statistics (mean $\pm$ standard deviation) were determined for the directly measured variable. Comparisons between the hand grip strength of dominant and non-dominant hands of two sexes were made using an independent t-test. Data were analyzed using SPSS (Statistical Package for Social Science) version 7.5. A 5% level of probability was used to indicate statistical significance.

RESULTS AND DISCUSSION

Table 1 shows the hand dominance and grip strength in boys and girls of collegiate population of Amritsar, Punjab, India. In males, 68.21% and 31.79% were reported to be right handed and left handed respectively, whereas, in females, these percentages were 84.87% and 15.13%, respectively. Right hand dominant males have the mean hand grip strength 41.31 kg as compared to non-dominant males (38.14 kg) and the grip strength differences were statistically significant ($p < 0.05$) among them ($t = 3.13$). Conversely, left hand dominant males have the mean grip strength 41.12 kg than their non-dominant counterparts (37.79 kg), exhibiting statistically significant differences ($p < 0.05$) among them ($t = 2.66$). When comparisons were made between dominant and

Table1: Hand dominance and grip strength in two sexes

Right (n=103)	Mean	S.D.	S.E.	t-value
Males (n=151)				
Right (n=103)				
Dominant	41.31	± 6.00	0.59	
Non-dominant	38.14	± 6.20	0.61	3.13*
Left (n=48)				
Dominant	41.12	± 6.88	0.99	
Non-dominant	37.79	± 7.34	1.06	2.66*
Females(n=152)				
Right (n=129)				
Dominant	23.82	± 3.71	0.33	
Non-dominant	21.03	± 3.49	0.31	2.78*
Left (n=23)				
Dominant	23.48	± 3.29	0.69	
Non-dominant	21.46	± 3.37	0.70	3.13*

*Significant at 0.05 level.

non-dominant right and left hands of males, on significant differences were found in any case (t-values 0.16 and 0.29, respectively).

Right hand dominant females have the mean hand grip strength 23.82 kg than non-dominant females (21.03 kg), showing, once again, statistically significant differences ($p < 0.05$) between them ($t = 2.78$). Left hand dominant females have the mean hand grip strength 23.48 kg as compared to non-dominant females (21.46 kg), exhibiting statistically significant differences ($P < 0.05$) between them ($t = 3.13$). When comparisons were made between the dominant and non-dominant hands of right and left sides of the females, once again, no significant differences were noted in any case (t values 0.44 and 0.57 respectively).

When comparisons were made between males and females for the grip strength of dominant and non-dominant hands of both right and left sides, highly significant differences ($P < 0.001$) were found in all the cases (t values = 25.87, 25.01, 14.61 and 12.86, respectively).

Assessment of hand grip strength is an important component in hand rehabilitation. It is essential for the evaluation of patient's initial limitation and also to assess the efficacy of the treatment strategy for the progress of the patients. Handedness is an important factor for the forceful flexion of all finger joints and subsequently generates the hand grip strength. 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 (Waldo 1996). Anatomically, there are four major joints in the hand, namely carpometacarpal, intermetacarpal, metacarpophalangeal, and interphalangeal joint, with nine extrinsic muscles that cross the wrist and ten intrinsic muscles with both of their attachments distal to the wrist (Hall 2007). Grip strength has long been thought of as a possible predictor of overall body strength (Foo 2007). But little information is available regarding this. Smith et al. (2005) found a direct correlation in grip strength and overall body strength in very old and oldest females. Fry et al. (2006) also found a correlation between grip strength and performance in American junior male weightlifters. So, an increase in hand grip strength determines the physical strength of an individual.

Handedness inherits genetically, but hand grip strength is affected greatly by nutritional status of an individual. That's why hand grip strength has been considered as a functional index of nutritional status (Brozek 1984; Vaz et al. 1996; Jeejeebhoy 1998).

Incel et al. (2002) reported that percentage of stronger non-dominant hand grip was 10.93% and 33.33% for right and left handed groups respectively. Instead of segregating data into two sexes, they pooled all the data in to left and right handed groups. The findings of the present study strongly criticized the findings of Incel et al. (2002). In fact, marked hand grip strength differences exist between the two sexes. It was reported that men possessed considerably greater strength than women for all muscle groups tested. Women scored about 50% lower than men for upper body strength and about 30% less for leg strength (McArdle et al. 2001). In the present study, females with right hand dominance have grip strength scores 13.86% greater than their non-dominant left hands and with left hand dominance have grip strength 9.92% greater than their non-dominant right hands. In males, right hand dominant have grip strength 8.82% greater than their non-dominant left hands and dominant left hands have grip strength 9.87% greater than their non-dominant right hands. A general rule often used suggests that the dominant hand is approximately 10% stronger than the non-dominant hand (Petersen et al. 1989; Armstrong and Oldham 1999). Hence this rule has also been confirmed in our study (differences of grip strength in dominant and non-dominant hands ranged from 8.82% to 13.86%). While interpreting these results the fact should be

taken into account that the world we live in is mostly designed for right handedness. Most tools and daily appliance are designed for the right hand. As a result, the right hand of both right and left handed people is exercised more often than left on a daily basis (Crosby et al. 1994). The findings of the present study would certainly help the health professionals to diagnose various musculoskeletal deformities especially related to hands and to plan effective preventive strategies to avoid their various complications.

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