# Grip Strength among College Youth and its Relation to Body Postures

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Abstract: Many daily functions and sporting events require high activity levels of the flexor musculature of the forearms and hands. These are the muscles involved in gripping strength. Sports like tennis, football, basketball, and daily activities such as carrying laundry, turning a doorknob, and vacuuming, some degree of grip strength is necessary to be successful. A study was conducted to understand the grip strength among college youth in relation to gender, dominant and non dominant hands, postures and upper arm positions and grip span. A standard isometric grip strength protocol with 3 replications was administered on 12 sample divided equally by gender to examine the observational variations. Results indicated that the gender significantly made a difference in grip strength, as boys were found demonstrating higher grip strength for both the hands. Between right and left hand, irrespective of gender, right hand was found showing higher grip strength. A significant variation in the grip strength was confirmed due to grip span when compared among postures and varied spans.

Keywords: Grip strength, grip span, postures, college youth

## 1. Introduction

Hand grip strength is widely considered as an objective index of functionality of upper extremity (Balogun et al., 1991, Lagerstrom, 1998). Hand functionality is considered to be vital in most of the daily activities involving upper limb be it to perform daily life activities, such as holding objects, using a handrail or bus supports, carry out domestic tasks, self-care activities, that is, to maintain functionality and independence. There are 35 muscles involved in movement of the forearm and hand, with many of these involved in gripping activities. During gripping activities, "the muscles of the flexor mechanism in the hand and forearm create grip strength while the extensors of the forearm stabilize the wrist.

Muscular fitness has been defined as "muscular strength and power and other properties of muscle that contribute to its mass and quality" (McCartney, et al., 2007). Now a day's most of the young adults are leading sedentary life and work styles. They spent their time in studying, social networking and fast food indulging is more compared to their attention to sports, games etc among college going youth to build up and maintain their muscle strength. Grip strength was one of the techniques for the measurement of muscle strength, and was the simplest method for assessment of muscle function (Bohannon, 2008). It is a strong and consistent predictor of morbidity and mortality in middle aged and elderly subjects (Gale et al., Sasaki et al., 2007 and Bohannon, 2008) and of disability in older populations. (Rantanen, 2003). It is widely accepted indicator of nutritional status, bone mineral content, muscular strength and functional integrity of upper extremity. Overall, hand grip strength can be a measure to evaluate the fitness among young adults. An experimental study was to examine the grip strength among college going youth with the following objectives

- To understand the variability in grip strength as per gender
- To understand the variability as per hand preference and
- To understand the variability as per postures and position of arm and span.

#### 2. Review of Literature

Murugan et al. (2013) conducted a study to assess grip strength changes in relation to different body postures, elbow and forearm positions. 40 healthy students from department of Physiotherapy and School of Nursing (20 male and 20 female) volunteered to be a part of this study. Hand grip strength was evaluated using SAEHANS Dynamometer at different test positions. Statistically significant results were observed when comparisons were made using ANOVA, between male and female participants and between postures. The elbow flexion and forearm supination produced better grip strength than other positions. Differences in mean of grip strength between postures and positions showed little variations.

Aadahl et al. (2011) conducted a healthy survey to assess muscular fitness by hand grip strength and lower limb extension power and explored association with age (19-72 years), leisure time physical activity and body composition among old men and women. HGS was measured in the dominant hand using a Jamar dynamometer. A sample of 3471 was selected. The results of the study revealed that large inter-individual variation in hand grip strength and lower limb extension power was found. Hand grip strength and lower limb extension power declined with age and highly correlated. Physical activity was positively associated with hand grip strength in both genders, but it was not associated with lower limb extension power.

Koley and Melton (2010) conducted a study to investigate age related changes in hand grip strength among healthy Indian males and females aged 6-12 years from different schools in Punjab. Three anthropometric measurements viz. height, weight and BMI were carried out with standard techniques. Hand grip strength was measured by using a standard adjustable digital handgrip dynamometer at standing position with shoulder adducted and neutrally rotated and elbow in full extension. The findings of the study indicated a gradual increment of both right and left handgrip strength from 6 to 23 years in males and from 6 to age 21 years in females. Statistically highly significant sex differences (p<0.001) were found in right dominant (t=12.84) and non-dominant (t=13.46) handgrip strength, where males had higher mean values in all the anthropometric variables than females.

## 3. Methodology

A sample of 12 Home science college youth divided equally by gender, age in the range of 17-25 years was selected for the study. The variables selected were gender, hand domination, posture variation (Standing, Sitting and squatting), elbow to forearm positions (forearm and elbow in full extension and forearm in full extension and elbow  $90^{\circ}$ flexed horizontally), grip span variations (4cm, 5cm, 6cm and 7cm). Experiment was conducted by using a calibrated Cranley digital hand grip dynamometer.

Subjects were explained about grip dynamometer, the way to hold it in different body postures and arm positions. When the subject was ready, they squeezed the dynamometer using with maximum isometric effort maintained for about 5 seconds and the readings were recorded. Grip strength experiment was repeated for both hands for all the subjects in selected postures and positions. A total of 96 observations were compared to examine grip span and 120 observations were compared to examine the variations due to postures and hand positions. Height was measured without shoes to the nearest centimetre, weight was measured without shoes to the nearest 0.1 kg and body mass index (BMI) was calculated as kg/cm. According to NNMB (2006), BMI classified into very severely underweight (less than 15), severely underweight (from 15 to 16), underweight (from 16 to 18.5), Normal (from 18.5 to 25), overweight (from 25 to 30), obese class I i.e., moderately obese (from 30 to 35), obese class II i.e., severely obese (from 35 to 40) and obese class III i.e., very severely obese (over 40)

#### 4.1 Physical characteristics of the subjects

The height, weight and Body Mass Index were presented in Table -1.

Table 1:	Physical	characteristics	of the	subjects
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Gender N = 12	Mean Height (cm)	Mean Weight (kg)	Mean BMI (kg/cm)	Percentage
Girls	153.8	56	23.6	50%
Boys	174.6	59.5	19.5	43%

Mean height and weight of the girls was 153.8cm and 56kg and mean height and weight of the boys was 174.6 cm and 59.5kg respectively. Only fifty percent of the girls and forty three percent of boys were found to be within the category of normal body mass index. Others were found to be nutritional risk of either in energy deficient category or over weight.

#### 2. Grip strength of Girls

Grip strength of girls recorded as per span for the right and left hand was presented in Table 2. Highest grip strength was found to be 17.9kg for the right hand for when subjects were in squatting posture and fore arm is in extension and elbow in 90<sup>0</sup> flexion. Lowest grip strength of 12.32kg was found in standing posture and when forearm and elbow in full extension position. But the difference was not statistically significant between postures indicating no influence of posture on grip strength of right hand for girls. When grip strength was observed among 4 different spans, highest was found as 17.63kg at grip span of 5cm and lowest was 13.9kg at grip span of 7cm. The mean grip strength of youth in Hyderabad was much less when compared to a study of Ghosh, S; 2012 on Biomechanical studies on various aspects of strength of Indian youth conducted in North Eastern India, which indicated a mean value of 20.7kg grip strength for girls. The test of ANOVA (Table -3) conducted to find source of variation among observations between spans and postures indicated significant variation due to spans. About 77% of variation in grip strength was found due to grip span of 4cm. This may be due to low resistance effort between the palm and thumb at the span of 5 cm. Even for left hand, it was observed that the grip strength was highest as 17kg in squatting posture and lowest as 13.5 kg in standing posture when elbow in  $90^{\circ}$ flexion position

## 4. Results

			0 0				-		0		/		
		Right hand						Left hand					
Span/	Stan	ding	Sitt	ing	Squatting	Average	Standing		Sitting		Squatting	Average	
Postures	Fore arm	Fore arm	Fore arm	Fore arm	Fore arm	1	Fore arm	Fore	Fore arm	Fore	Fore arm		
	and	in	and elbow	in	in		and	arm in	in	arm in	in		
	elbow in	extension	in full	extension	extension		elbow in	extension	extension	extension	extension		
	full	and	extension	and	and		full	and	and	and	and		
	extension	elbow in		elbow in	elbow in		extension	elbow in	elbow in	elbow in	elbow in		
		90 <sup>0</sup> flexion		90 <sup>0</sup> flexion	$90^{0}$			$90^{0}$	90 <sup>0</sup> flexion	$90^{0}$	90 flexion		
					flexion			flexion		flexion			
Span 1	12.32	14.82	17.38	16.9	16.9	15.66	13.86	13.5	15.58	14.3	16.08	14.66	
(4cm)													

Table 2: Grip strength of girls at varied grip span in different postures for right and left hands, N-12

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Span 2 (5cm)	17.46	17.24	17.66	17.9	17.9	17.63	14.74	15.8	16.52	15.3	14.92	15.46
Span 3 (6cm)	16.86	15.9	16.48	16.5		16.45	14.48	15.56	16.14	15	17	15.64
Span 4 (7cm)	14.74	13.26	14.54	13.7	13.7	13.99	14.26	14.2	13.78	14.46	16.24	14.59
Average	15.35	15.31	16.52	16.25	16.25	15.93	14.34	14.77	15.51	14.77	16.06	15.09

 Table 3: ANOVA for right hand grip strength of girls

 with grip span and posture

Source of Variation	SS	Df	MS	F	P-value	F-crit
Grip Span	35.04	3.00	11.68	9.25*	0.00	3.49
Posture	5.12	4.00	1.28	1.01	0.44	3.26
Error	15.15	12.00	1.26			
Total	55.30	19.00		*Signi	ificant at 5	5%

 Table 4: ANOVA for Left hand grip strength of girls with grip span and posture

Source of Variation	SS	df	MS	F	P-value	F crit
Grip Span	4.33	3.00	1.44	2.48*	0.11	3.49
Posture	7.58	4.00	1.89	3.25*	0.05	3.26
Error	6.99	12.00	0.58			
Total	18.90	19.00	*Sign	ificant	at 1 %	

#### Grip strength of boys

Grip strength of boys recorded as per span for the right and left hand was presented in Table 5. Highest grip strength was observed to be of 36.7kg for the right hand for boys when subject's forearm in extension and elbow in 900 flexion and was seated in squatting posture. Lowest grip strength of variation due to spans. Even for left hand, it was observed that the grip strength was highest as 34.38kg in standing posture and lowest 24.78 kg in sitting posture when elbow in 900 flexion position. The grip strength 26.6kg, of the youth of North East region in India for boys was compared, boys demonstrated higher. The test of ANOVA as per (Table-7) indicated significant variation due to span. Figure 2 compared the grip strength between left and right hand of boys. Higher grip strength was noticed for right hand compared to left hand in all the postures and the difference was significant at 5 % level when observations were seen one tailed.

Table 5: Grip strength of boys at varied grip span in different postures for right and left hands, N-12

Right hand L						Left hand						
Span/	Star	nding	Sitti	ng	Squatting	Average	Stand	ling	Sitt	ing	Squatting	Average
Postures	Fore arm	Fore arm	Fore arm	Fore arm	Fore arm in		Fore arm	Fore arm	Fore arm	Fore arm	Fore arm	
	and	in	and elbow in	in	extension		and elbow	in	in	in	in	
	elbow in	extension	full	extension	and		in full	extension	extension	extension	extension	
	full	and	extension	and	elbow in		extension	and	and	and	and	
	extension	elbow in		elbow in	90 <sup>0</sup> flexion			elbow in	elbow in	elbow in	elbow in	
		90 <sup>0</sup> flexion		90 <sup>0</sup> flexion				$90^{0}$	90 <sup>0</sup> flexion	$90^{0}$	90 flexion	
								flexion		flexion		
Span 1	27.06	28.66	26.88	25.22	26.95	26.95						
(4cm)							27.14	25.58	25.08	24.78	25.64	25.64
Span 2	36.7	35.38	34.1	33.14	34.83	34.83						
(5cm)							33.36	34.38	32.7	32.1	33.13	33.13
Span 3	36.66	35.86	34.36	30.4	34.32	34.32						
(6cm)							34.1	32.48	32.7	31.62	32.72	32.72
Span 4	35.3	33	34.02	32.86	33.79	33.79						
(7cm)							31.88	31.7	29.2	29.46	30.56	30.56
Average	33.93	33.23	32.34	30.41	32.47	32.47	31.62	31.04	29.92	29.49	30.51	30.52

 Table 6: ANOVA for Right hand grip strength of boys with

 grip span and posture

	8P -	Pan an	re post						
Source of Variation	SS	Df	MS	F	P-value	F critical			
Grip Span	205.86	3.00	68.62	67.33*	0.00	3.49			
Posture	27.93	4.00	6.98	6.85*	0.00	3.26			
Error	12.23	12.00	1.02						
Total	246.02	19.00	*significant at 5% level						

**Table 7:** ANOVA for Left hand grip strength of boys with grip span and posture

		-	-						
Source of Variation	SS	df	MS	F	P-value	F crit			
Grip Span	177.34	3.00	59.11	183.89*	0.00	3.49			
Posture	11.58	4.00	2.90	9.01*	0.00	3.26			
Error	3.86	12.00	0.32						
Total	192.78	19.00	*S	*Significant at 5% level					

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Figure 1: Mean grip strength for Right and Left hand of girls



Figure 2: Mean grip strength for Right and Left hand of boys

### 5. Conclusions

The study concluded that the gender made a variation in grip strength, when compared both boys and girls. Boys were found to have higher grip strength in both the hands than girls. Right hand was found to have more strength compared to left hand in all the postures and the difference was significant at 5% level. As per ANOVA, significant variation was found due to grip spans.

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