ORIGINAL ARTICLE

EFFECT OF RECREATIONAL SPORTS ON HANDGRIP STRENGTH AND ANTHROPOMETRY IN ADOLESCENT BASKETBALL AND VOLLEYBALL PLAYERS

Husnain Ahmad Khan, Khadijah Junaid, Irha Jamshed, Mohammad Azeem Khaliq, Huma Saeed Khan*, Madiha Ahmad*, Shahid Hasan*

Students of 4th Year, *Department of Physiology, CMH Lahore Medical College, Lahore, Pakistan

Background: Human hand has given humans their survival advantage and because of it, they have evolved better through the ages. Grasping is the feature that surpasses all functions that the human hand can perform. The objective of this study was to compare hand anthropometry in adolescent basketball and volleyball players. **Methods:** Seventy-four participants, 18–23 years were recruited after informed consent. Purposive sampling was used to include 45 volleyball (26 males, 19 females) and 29 recreational, basketball players (19 males, 10 females). Anthropometric measurements done were Height, Weight, Body Mass Index (BMI), Dominant hand length, hand span, upper extremity length and upper extremity bulk. Handgrip strength was performed with Biopac (SS2LB) bilaterally. **Results:** Dominant hand length was 19.81±1.01 Cm in basketball players and 19.30±1.01 Cm in volleyball players (p=0.016). Difference between the two groups for dominant hand span was insignificant. Dominant upper extremity bulk for basketball players was more than volleyball players (31.75±3.5 Cm and 30.22±2.28 Cm respectively), (p=0.03). Comparison between dominant and non-dominant handgrip strength within volleyball players revealed significant differences; mean handgrip strength for dominating hand was more than non-dominating hand. Same comparison was done for basketball players and no significant differences were seen. Categorical analysis showed non-dominating handgrip strength significantly different between volleyball and basketball players. There were no participants among basketball players, and 5 (11.1%) among volleyball players, with handgrip strength <15 Kg. Similarly, 6 (20.7%) among basketball players, and 3 (6.7%) among volleyball players had handgrip strength >45 Kg. Similar differences were observed for dominating upper extremity bulk. Non-dominating handgrip strength depended on hand length. Differences between the players for dominating and non-dominating handgrip strength were insignificant. **Conclusion:** Anthropometric data collection of limbs helps design specific sports training. It aids establishing treatment and rehabilitation protocols in kinesiology.

Keywords: Hand dimensions, handgrip strength, basketball, volleyball

Pak J Physiol 2019;15(1):37–40

INTRODUCTION

The human hand is the defining feature that gives our species its specific dominance in improving on daily tasks. It has given humans their survival advantage and because of it, they have evolved better through the ages. Grasping is the feature that surpasses all functions that the human hand can perform. The opposition of the thumb to the four digits and the complexity of the nervous regulation to control such a unique anatomy has not only evolved the reflex but enabled our species to devise manoeuvres and skills that aid our day-to-day activities.[1]

Grasping through the ages has been a symbol of overall strength and power in the form of arm wrestling competitions. Arm wrestling has been the ultimate sport since times unknown that suggests that the overall built of an individual is reflective of the power and force generation of the upper arm muscles. The grip strength or grasping force is reflective of this and lean body mass of the arm muscles is a strong indicator of total strength of an individual.[2,3] A decrease in lean body mass of arms is strongly correlated to overall body strength. This also leads to conclusion that handgrip strength is reflective of the nutritional status of an individual.

Based on this single function of gripping, sports physiologists classify the various varieties of sports into gripping and non-gripping sports. Basket ball, volley ball, softball, wrestling, rock climbing, tennis, and javelin throw are some of the examples of gripping sports. Hand dimensions which include individual digit span, hand length, hand width as well as overall body strength all are inter-related and contribute significantly to the techniques applied in all of these sports.[4] The force with which the mountain climber will grip the rocks determines the agility of his climb, the strength of throwing and hitting the ball or the grasp of a wrestler, all give a good graphic image in relation to handgrip strength.

Sports physiology is not only about training for physical strength in addition to specifying the 'do's' it also emphasizes the 'don'ts'. Preventing injury is one of the outcomes of research in kinesiology. The swing velocity, pitching speed and the force with which a ball is hit or thrown contributes to muscle and joint injury drastically. This may result because of imbalance of upper arm to forearm muscle strength ratios and may cause lateral epicondylitis commonly known as tennis elbow.[5] Taking such injuries and their treatment protocol a step further, understanding of optimal muscle function and prevention of injury significantly contributes to rehabilitation medicine and principles of physiotherapy.

This study is an attempt to contribute to the evidence available on muscle physiology, specifically upper limb muscle mechanics. To achieve this, anthropometric data regarding the various aspects of muscle physiology needs to be explored so that sports training, exercise and muscle workout can be specified to the needs of a specific sport. Anthropometric and electrical measurements in healthy, young athletes who played different sports for recreation but were consistently and actively pursuing these sports was collected and analyzed. The data collected is a contribution to sports physiologists to help them justify specific sports training. Moreover, it may help establish and improve treatment and rehabilitation protocols in cases of sports/muscle injury. The study was conducted with a view to compare handgrip strength in adolescent basketball and volleyball players at a local college in relation to anthropometry.

MATERIAL AND METHODS

Ethical Review Committee of CMH Lahore Medical College, Lahore granted permission for undertaking the study. Participants were explained the procedure to be done, and written informed consent was obtained. It was a cross-sectional comparative study conducted from November 2016 to January 2017. A group of 74 students who had been playing in their respective school and college teams for the last 3−4 years off and on were included. Forty-five of them (26 males, 19 females) played volleyball, and 29 (19 males, 10 females) were recreational basketball players.

In addition to height and weight, upper limb measurements included dominant hand length, dominant hand width[6], dominant upper extremity length and dominant upper extremity bulk. Electrical measurements of handgrip strength on both dominant and non-dominant hands were performed using Biopac™ (SS2LB) System.

Figure-1: Measurement of Height and Weight

Figure-2: Measurement of Hand length

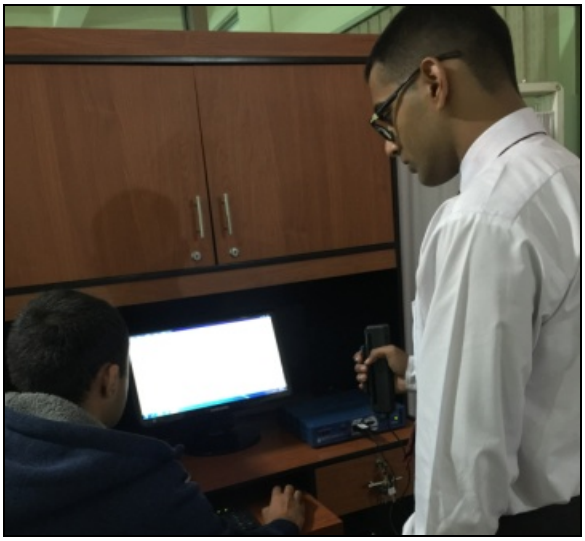

Figure-3: Measurement of hand grip strength

RESULTS

Table-1 shows various variables recorded during the study. The dominant hand length (mostly right hand in our study) of basketball players was 19.81±1.01 Cm, while for volleyball players it was 19.30±1.01 Cm, with a significant statistical difference (p=0.016). The difference between the two groups for dominant hand span was insignificant (p=0.232). The dominant upper extremity bulk for basketball players was greater than that for volleyball players and the differences were statistically significant (p=0.030).

Table-1: Comparison of handgrip strength between dominating and non-dominating handgrip strength for volleyball and basketball players

	type of exercise			*p*-value by *t*-test
	Volleyball n=45	Basketball n=29	Total n=74	
Hand length (Cm)				
Mean±SD	19.30±1.01	19.81±1.01	19.55±1.01	0.016
Q1	19.05	19.05	19.05	
Median	19.05	20.32	19.05	
Q3	20.32	20.32	20.32	
Hand span (Cm)				
Mean±SD	20.82±0.7	21.33±0.8	21.08±0.7	0.232
Q1	19.55	19.81	19.81	
Median	21.08	21.33	21.08	
Q3	21.84	22.60	22.09	
Dominant hand grip strength (Kg)				
Mean±SD	32.0±11.5	35.5±13.2	33.4±12.2	0.234
Q1	21.1	23.9	22.2	
Median	34.2	38.8	35.2	
Q3	41.4	44.6	42.1	
Right upper extremity length (Cm)				
Mean±SD	30.3±2.3	30.8±2.4	30.5±2.3	0.330
Q1	29.0	30.0	29.3	
Median	30.0	31.5	30.5	
Q3	31.5	32.1	32.0	
Dominant upper extremity bulk (Cm)				
Mean±SD	30.22±0.9	31.75±1.4	30.73±1.2	0.030
Q1	28.19	28.95	28.70	
Median	30.48	30.73	30.48	
Q3	31.75	34.29	32.66	

Categorical analysis showed that non-dominating handgrip strength was significantly different between volleyball and basketball players (p=0.011). There was no case with strength <15 Kg among basketball players while there were 5 (11.1%) among volleyball players. There were 6 (20.7%) among basketball with strength >45 Kg while 3 (6.7%) of volleyball players had strength >45 Kg. A similar difference was also observed for the dominating upper extremity bulk (p=0.001) (Table-2).

Comparison made between dominant and non-dominating handgrip strength within volleyball players revealed significant differences (p=0.003); the mean handgrip strength for dominating hand was more than non-dominating hand within this category of players. When the same comparison was done for basketball players, no significant differences were seen (p=0.078) (Table-3).

The regression analysis showed that per Cm increase in hand length increases handgrip strength by 0.55 Kg in the dominant hand. The difference between two types of players for dominating and non-dominating handgrip strength was insignificant (Table-4).

Table-2: Gender distribution and categorical presentation and comparison of all variables between volleyball and basketball players

	Type of exercise						
	Volleyball n=45		Basketball n=29		Total n=74		
	n	%	n	%	n	%	*p*
Gender							
Male	26	57.8	19	65.5	45	60.8	0.673
Female	19	42.2	10	34.5	29	39.2	
Hand length (Cm)							
≤17.80	7	15.6	2	6.9	9	12.2	0.193
17.80–20.32	37	82.2	24	82.8	61	82.4	
20.32+	1	2.2	3	10.3	4	5.4	
Hand span (Cm)							
≤19.05	10	22.2	4	13.8	14	18.9	0.439
19.05–23.36	34	75.6	23	79.3	57	77.0	
23.36+	1	2.2	2	6.9	3	4.1	
Non-dominant hand grip strength (Kg)							
≤15.00	6	13.3	0	0.0	6	8.1	0.011
15.00–25.00	10	22.2	9	31.0	19	25.7	
25.01–35.00	7	15.6	8	27.6	15	20.3	
35.01–45.00	19	42.2	6	20.7	25	33.8	
45.00+	3	6.7	6	20.7	9	12.2	
Dominant hand grip strength (Kg)							
≤15.00	5	11.1	0	0.0	5	6.8	0.083
15.00–25.00	9	20.0	9	31.0	18	24.3	
25.01–35.00	9	20.0	4	13.8	13	17.6	
35.01–45.00	17	37.8	9	31.0	26	35.1	
45.00+	5	11.1	7	24.1	12	16.2	
Right upper extremity length (Cm)							
≤63.5	0	0.0	1	3.4	1	1.4	0.302
63.5–82.55	41	91.1	24	82.8	65	87.8	
82.55+	4	8.9	4	13.8	8	10.8	
Dominant upper extremity bulk (Cm)							
≤27.94	11	24.4	6	20.7	17	23.0	0.001
27.94–30.48	20	44.4	8	27.6	28	37.8	
30.48–33.02	12	26.7	3	10.3	15	20.3	
33.02–35.56	2	4.4	8	27.6	10	13.5	
35.56+	0	0.0	4	13.8	4	5.4	

Table-3: Comparison of hand dimensions and grip strength between volleyball and basketball players

	Type of exercise		
	Volleyball n=45	Basketball n=29	Total n=74
Non-dominant hand grip strength (Kg)			
Mean	30.2	33.1	31.4
SD	11.3	11.7	11.5
Q1	21.6	21.5	21.5
Median	31.2	33.8	32.8
Q3	39.5	43.9	40.2
Dominant hand grip strength (Kg)			
Mean	32.0	35.5	33.4
SD	11.5	13.2	12.2
Q1	21.1	23.9	22.2
Median	34.2	38.8	35.2
Q3	41.4	44.6	42.1
***p*-value by paired *t*-test**	0.003	0.078	0.002

Table-4: Regression analysis (backward elimination method) presenting significant factors contributing in non-dominating handgrip strength

Variable	Non-standardized Coefficients		Standardized Coefficients		
	B	SE	Beta	*t*	*p*
Constant	-1.30	12.42		-0.10	0.917
Hand length (Cm)	8.10	1.47	0.11	2.16	0.034
Dominant handgrip strength (Kg)	0.55	0.08	0.59	7.33	<0.001
Gender	-7.25	1.887	-0.31	-3.84	<0.001

DISCUSSION

The parameters related to upper limb anatomy and physiology aid in assessing the performance criteria in various games in which use of the upper limbs is the main focus. The length of the dominant hand and the dominant upper extremity bulk being more in basketball players as compared to volleyball players in this study indicates the different techniques of playing the two games. Gripping the ball for shooting or passing and dribbling are skills in which basketball players need to be proficient.[7] Hence for these activities holding of the ball and strength to manoeuvre it while throwing, clearly indicate the parameters effected in these players. Different set of skills are needed by volleyball players which include more of passing the ball, blocking, vertical jumps and spiking (jumping and hitting the ball).[8] Agility tests, jump levels, counter movement jump levels, height, weight, have been shown to be more specific and relevant to volleyball players as these assess the techniques relevant to this game.[9]

Based on these differences it is seen that upper limb anthropometry is strongly associated with the strength of muscles and force generation by the respective hands as shown in this study and supported by others.[10] Such studies support the idea of early talent identification in younger and recreational players to get a better understanding regarding their training in future.

The results of this study regarding handgrip strength in the subjects show variation in terms of the sports played as well. In volleyball players the hand grip strength of the dominant hand is greater than of the non-dominant hand, being statistically significant. This is basically because the volleyball players use the dominant hand to hit the ball as compared to basketball players who as previously mentioned use both hands more symmetrically. Hence, such being not the case in basketball players in whom there is no difference between handgrip strengths of the two hands.[11] Dominant and non-dominant hands vary in grip strengths. Studies have shown greater values for the dominant hand and further research has led to the conclusion that the values are significantly greater in right handed dominance rather than in left handed dominance.[12] In a world where most gadgets are made for right-handed people, the dominance for this hand surpasses that for the left one.[13]

CONCLUSION

Anthropometric data collection of limbs helps design specific sports training. It aids establishing treatment and rehabilitation protocols in kinesiology.

REFERENCES

1. Barut C, Demirel P, Kiran S. Evaluation of hand anthropometric measurements and grip strength in basketball, volleyball and handball players. Anatomy 2008;2:55–9.
2. Roemmich JN, Sinning WE. Sport-seasonal changes in body composition, growth, power and strength of adolescent wrestlers. Int J Sports Med 1996;17(2):92–9.
3. Leyk D, Gorges W, Ridder D, Wunderlich M, Rüther T, Sievert A, *et al*. Hand-grip strength of young men, women and highly trained female athletes. Eur J Appl Physiol 2007;99(4):415–21.
4. Fallahi AA, Jadidian AA. The effect of hand dimensions, hand shape and some anthropometric characteristics on handgrip strength in male grip athletes and non-athletes. J Hum Kinet 2011;29:151–9.
5. Koley S, Kumaar SB. The relation between handgrip strength and selected hand-anthropometry variables in Indian inter-university softball players. Phys Educ Sports 2012;10:13–21.
6. Cakit E, Durgun B, Cetik O, Yoldas O. A survey of hand anthropometry and biomechanical measurements of dentistry students in Turkey. Hum Factor Ergon Manuf 2014;24(6):739–53.
7. Apostolidis N, Emmanuouil Z. The influence of anthropometric characteristics and handgrip strength on technical skills of young basketball players. J Phys Educ Sports 2015;15(2):330–7.
8. Smith DJ, Roberts D, Watson B. Physiological and performance differences between Canadian national team and Universiade volleyball players. J Sports Sci 1992;10(2):131–8.
9. Pena J, Moreno-Doutres D, Coma J, Cook M, Busca B. Anthropometric and fitness profile of high level basketball, handball and volleyball players. Rev Andal Med Deporte 2018;11(1):30–5.
10. Chahal A, Kumar B. Relationship of hand anthropometry and hand grip strength in junior basketball boys. Intl J Health Sci Res 2014;4(11):166–73.
11. Bohannon RW. Grip strength: a summary of studies comparing dominant and non-dominant limb measurements. Percept Mot Skills 2003;96(3 pt 1):728–30.
12. Pizzigalli L, Micheletti Cremasco M, LA Torre A, Rainoldi A, Benis R. Hand grip strength and anthropometry characteristics in Italian female national basketball teams. J Sports Med Phys Fitness 2017;57(5):521–8.
13. Incel NA, Ceceli E, Durukan PB, Erdem HR, Yorgancioglu ZR. Grip strength: effect of hand dominance. Singapore Med J 2002;43(5):234–7.

Address for Correspondence:

Prof. Dr. Madiha Ahmad, 97/A, Block-B, Revenue Employees' Co-operative Housing Society, Lahore, Pakistan.
Cell: +92-308-4510200
Email: ahmad13madiha@gmail.com

Received: 21 Aug 2018 **Reviewed: 12 Sep 2018** **Accepted: 5 Feb 2019**