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ORIGINAL ARTICLE

THE RELATIONSHIP BETWEEN HAND DIMENSIONS AND HAND GRIP STRENGTH AMONG UNIVERSITY TENNIS PLAYERS A CROSS-SECTIONAL STUDY.

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ABSTRACT

Handgrip strength is important for overall physical ability and is often measured in clinics and workplaces. It can even indicate the effects on other systems like the endocrine system. **Objective:** The purpose of this study is to inquire at the relationship between hand grip strength and hand dimensions in collegiate tennis players. **Methods:** A cross-sectional study was conducted on 153 university students using a non-probability convenient sampling technique. The data was collected from the University of Lahore, Punjab University, and the University of Central Punjab. The questionnaire contains demographic data age, height, weight, BMI, lifestyle, hand dimensions by anthropometric measurements, and grip strength by dynamometer will be used to collect data. **Results:** The average age of the study subjects was 21.73, ±1.97 years. The minimum age was 19 years, and the maximum age was 25 years. Out of 153 university tennis players (52.9%) were male and (47.1%) were females. The result shows that 13.2% of students were underweight and 70.6% were normal weight according to their BMI. About 51.5% of females performed exercise twice a week and 25.0% performed more than three times a week with a value of r (r=0.27 - r=0.86). **Conclusion:** Hand dimensions (finger spread, finger length, and hand perimeter) have a highly significant relationship with hand grip strength. Hand grip strength improves as the value of hand measurements increases.

Keywords: Hand grip strength, hand dimensions, dynamometer, Body mass index, little finger length, Thumb length

INTRODUCTION

Handgrip strength is an indication of total physical aptitude and an assessment of upper extremity functioning. It has been proven to be an important factor in predicting impairment in musculoskeletal disorders, bone mineral density, and the likelihood of osteoporosis falls and fractures[1]. The amount of static force that the hand can exert around a dynamometer can be used to determine hand grip strength. The most common units of force measu-re ment have been kilograms and pounds[2,3].

The amount of muscular strength and power that athletes can generate with their hands is referred to as handgrip strength. Some sports rely substantially

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on handgrips, such as rock climbing, tennis, volleyball, and baseball[4]. Tennis is a popular sport with an estimated 75 million players worldwide[5]. The power grip assignment is completed by subjects flexing their digits in palmar opposition around an object. Athletes that do handgrip motions may have different handgrip strength and hand size[6,7].

Among all muscle function tests, assessing hand grip strength has gained prominence as a simple, non-invasive indicator of upper extremity muscular strength that is excellent for clinical use[8,9]. Handgrip strength and wrist stability are essential to hold the racket firmly, move the racket in line with the ball, and create an effective stroke during these high-speed actions. This is especially important in sports requiring a lot of external rotation in the shoulder and forehand strokes, like tennis[10]. Despite the fact that cumulative strength training can lead to large increases in maximal strength and muscle mass, muscular strength loss is the most major physiologic change that happens with aging[9, 11] varied nations have varied hand sizes[12].

Handgrip strength (HGS) testing is commonly used in clinic and occupational settings to determine the clinical consequences of operations, regulate the rehabilitation process, and provide practical information regarding muscles, nerves, articular, and heart problems[13, 14]. Handgrip strength has been discovered as a biomarker for various systems, including the endocrine system[15, 16]. Grip strength may be seen as a measure of strength independent of resistance training[17,18]. Relationship between hand grip strength and height, weight, arm circumferences, and subcutaneous skin folds, men had higher anthropometric factors and hand grip strength values than females[19,20].The purpose of this research is to investigate the association between handgrip strength and hand dimensions.

MATERIALS AND METHODS

It was a cross sectional study design. Data were collected from 153 tennis players of University of Lahore Teaching Hospital, "Punjab University" and "University of Central Punjab" Lahore through nonprobability convenient sampling technique. Study was completed within six months after the approval of synopsis from February 2022 to July 2022[21].

Subjects were screened out for the eligibility criteria before entering them to study and ethical approval was also granted from Institutional Review Board, University of Lahore. All tennis players with the age between 18 to 25 years[4] who played tennis regularly at least for one year and practice covers a regular physical conditioning training including co-ordination, speed and strength exercises[4] were checked in after taking tan informed consent and rest of players were excluded from the study, mainly the ones with having systemic diseases like diabetes and hypertension, having history of facture in upper extremity. Each participant filled out a survey which consists of demographic data age, gender, height, weight, BMI, duration of practice tennis, duration of exercise per week, dominant hand, hand dimensions by anthropometric measurements and grip strength by dynamometer was used to collect data.

Authors measured the lengths of the fingers by starting from the wrist (W) and going to the tips of each finger, including the thumb (TL), index finger (IFL), middle finger (MFL), ring finger (RFL), and little finger (LFL)[22]. From the W joint (WTIW, P1); from the W joint (WTMW, P2); from the W joint to the tips of I and M fingers and the W joint (WIMW, P3); from the W joint to the tips of R and L fingers and the W joint (WMRLW, P4); and from the W joint to the tips of all fingers (WTIMRLW). After taking informed written consent data was collected through a Questionnaire.

The amount of muscular strength and power that athletes can generate with their hands is referred to as handgrip strength. Some sports rely substantially on handgrips, such as rock climbing, tennis, volleyball, and baseball[4]. Tennis is a popular sport with an estimated 75 million players worldwide[5]. The power grip assignment is completed by subjects flexing their digits in palmar opposition around an object. Athletes that do handgrip motions may have different handgrip strength and hand size[6,7].

Statistical Analysis

SPSS version 22 was used to analyze data. Percentages and Frequencies were reported for categorical variables and mean ± standard deviation was reported for non-normal continuous data. Person correlation is used to assess the relationship between hand grip strength and hand dimensions among university tennis players.

RESULTS

As sown in Table 1, there were 153 university tennis players mean age of 21.74±1.973 years. 81 (52.9%) were male and 72 (47.1%) were females. Out of 153 university tennis players 20(13.1%) were underweight, 108(70.6%) were normal and 25(16.2%) were overweight.

On asking about the how many times do you exercise in a week 36 (23.5%) university tennis players did once in a week, 79 (51.6%) did twice in a week and 38 (25.8%) did three times in a week. 32 (20.9%) university tennis players practiced for about 1 year, 48 (31.8%) were practiced for about 2 years, 42 (27.4%) for about 3 years and 31 (20.3%) were practiced for about more than 3 years as shown in Table 2.

Table 3 summarized key statistics on hand dimensions, including finger spans, finger lengths, and hand perimeters. Mean values with standard deviations and ranges are provided for each parameter, offering insights into the variability and average measurements of different aspects of the hand. This information is valuable for applications such as ergonomic design and understanding hand anatomy in diverse populations.

Table 1. Statistics of demographic variables

Age		
Mean±Std.	21.74±1.973 years	
Gender		
	Frequency	**Percentage**
Male	81	52.9%
Female	72	47.1%
BMI		
	Frequency	**Percentage**
Underweight	20	13.1%
Normal range	108	17.6%
Overweight (pre-obese)	25	16.3%

Table 2. Statistics of Exercise Duration

How many times do you exercise daily	Frequency	Percentage
once in a week	36	(23.5%)
twice in a week	79	(51.6%)
three times in a week	38	(24.8%)
Total duration of practicing tennis	**Frequency**	**Percentage**
1 year	32	(20.9%)
2year	48	(31.4%)
3 years	42	(27.5%)
more than 3 years	31	(20.3%)

Table 3. Statistics of hand dimensions (finger span, finger length and hand perimeter)

Variable	Construct	Mean ± Std.	Minimum	Maximum
Finger spans	FS1	10.97±1.82	8.50	14.0
	FS2	14.32±1.74	12.0	17.0
	FS3	15.75±1.94	13.0	19.5
	FS4	16.94±2.00	13.0	20.5
	Fs5	26.63±3.65	20.0	32.0
Finger length	TL	13.10±.89	12.0	15.0
	IFL	1IFL6.55±1.18	15.0	19.0
	MFL	17.64±1.27	16.0	20.0
	RFL	16.70±1.29	15.0	19.0
	LFL	14.44±.955	30.0	16.0
Perimeters of hand	P1	39.94±2.98	36.0	45.9
	P2	44.64±2.59	41.0	49.0
	P3	43.93±3.02	41.0	51.0
	P4	43.96±3.56	39.0	49.0
	P5	54.29±4.18	45.0	60.0

Table 4. Individual association between hand size and hand grip strength in university tennis players

Cross tabulation of hand span (FS1, FS2, FS3, FS4 and FS5) and hand grip strength					
Hand grip strength	Fs1	Fs2	Fs3	Fs4	Fs5
Pearson Correlation (r)	0.48	0.60	0.69	0.50	0.46
p value	0.00	0.00	0.00	0.00	0.00
Cross tabulation of hand length (TL, IFL, MFL, RFL and LFL) and hand grip strength					
Hand grip strength	TL	IFL	MFL	RFL	LFL
Pearson Correlation (r)	0.28	0.78	0.86	0.87	0.83
p value	0.00	0.00	0.00	0.00	0.00
Cross tabulation of hand perimeter (P1, P2, P3 P4 and p5) and hand grip strength					
Hand grip strength	P1	P2	P3	P4	P5
Pearson Correlation (r)	0.60	0.72	0.42	0.73	0.40
p value	0.00	0.00	0.00	0.00	0.00

Shown in Table 4, there is a substantial relationship between hand dimensions (finger spread, finger length, and finger perimeter) and hand grip strength (correlation coefficient $r < 0.9$). Hand grip strength improves as the value of hand measurements increases.

DISCUSSION

In this study 153 university tennis players have participated with the mean age was 21. 74±1.973 years. The minimum age was 19 years, and the maximum age was 25 years. In this study, we look at the association between hand measurements and

grip strength in Lahore university tennis players. Age, height, BMI, question duration of tennis practice was asked. They were also asked about exercise duration in a week. In hand dimensions, finger span, finger length and hand perimeters were also measured. Hand grip strength was measured by a hand dynamometer.

The result shows that 13.1% of students were underweight, 70.6% were normal weight and 16.2% were overweight according to their BMI. 23.5% of university tennis players performed exercise once a week, 51.6% performed twice in a week and 24.8% performed more than three times in a week hand grip strength has been connected to overall anthropometric (body weight, height, and BMI) as well as hand measurements (hand perimeters, finger lengths, and finger spans)[23,24].

Visnapuu and Jürimäe's criteria were used to evaluate certain anthropometric aspects of the hand. The finger spans, finger lengths, and hand perimeters were all measured. The results shows that person correlation (r=0.46, r=0.69) value for figure span and hand grip strength, according to another comparable study, in our investigation, all three general anthropometric parameters were positively associated to handgrip strength (r=0.35-0.42), with body height being the best correlated variable. Body height was shown to be the most important general anthropometric measure, accounting for up to 76.1 percent of prepubertal children's handgrip strength[25].

The study should be conducted on a larger population and with extensive study designs. Other factors like body span, height and BMI associated to hand grip strength also study by further study. The effect of BMI and body span and height on hand grip strength was not assessed in my research. A study was conducted on a specific Lahore population.

CONCLUSION

Hand dimensions (finger spread, finger length, and hand perimeter) have a highly significant association with hand grip strength. Hand grip strength improves as the value of hand measurements increases. Hand grip strength is reduced as hand dimensions are reduced.

DECLARATION

Conflicts of interest: The authors declared no conflict of interest.

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REFERENCES

1. Unal M, Kose O, Arik HO, Guler F, Acar B, Yuksel HY. Hand grip strength: Age and gender stratified normative data in Anatolian population. Hand and Microsurgery. 2018;7 (1):16-.

2. Shah UN, Sirajudeen MS, Somasekaran PK, Mohasin N, Shantaram M. The association between hand grip strength and hand dimensions in healthy Indian females. International Journal of Current Research and Review (IJCRR). 2012;4:36-42.

3. Rostamzadeh S, Saremi M, Fereshteh T. Maximum handgrip strength as a function of type of work and hand-forearm dimensions. Work. 2020;65(3):679-87.

4. Hazar Z, Eker L, Yüksel İ. Demographic and anthropometric factors predicting the grip strength and endurance in adolescent tennis players. Turkiye Klinikleri Journal of Sports Sciences. 2015;7(1):24-8.

5. Hernández-Davó JL, Moreno FJ, Sanz-Rivas D, Hernández-Davó H, Coves Á, Caballero C. Variations in kinematic variables and performance in the tennis serve according to age and skill level. International Journal of Performance Analysis in Sport. 2019;19(5):749-62.

6. Fallahi A, Jadidian A. The effect of hand dimensions, hand shape and some anthropometric characteristics on handgrip strength in male grip athletes and non-athletes. Journal of

Human Kinetics. 2011;29(2011):151-9.

7. Innes EV. Handgrip strength testing: a review of the literature. Australian Occupational Therapy Journal. 1999;46(3):120-40.

8. McGrath RP, Kraemer WJ, Snih SA, Peterson MD. Handgrip strength and health in aging adults. Sports Medicine. 2018;48:1993-2000.

9. Norman K, Stobäus N, Gonzalez MC, Schulzke JD, Pirlich M. Hand grip strength: outcome predictor and marker of nutritional status. Clinical Nutrition. 2011;30(2):135-42.

10. Li FX, Fewtrell D, Jenkins M. String vibration dampers do not reduce racket frame vibration transfer to the forearm. Journal of Sports Sciences. 2004;22(11-12):1041-52.

11. Vianna LC, Oliveira RB, Araújo CG. Age-related decline in handgrip strength differs according to gender. The Journal of Strength & Conditioning Research. 2007;21(4):1310-4.

12. Imrhan SN. Comparison of hand dimensions among various nationalities. Proceedings of the Human Factors and Ergonomics Society Annual Meeting. 2000;44(33):6-284.

13. Dias JA, Wentz M, Külkamp W, Mattos D, Goethel M, Júnior NB. Is the handgrip strength performance better in judokas than in non-judokas?. Science & Sports. 2012;27(3):e9-14.

14. Taekema DG, Gussekloo J, Maier AB, Westendorp RG, de Craen AJ. Handgrip strength as a predictor of functional, psycho-logical and social health. A prospective popu-lation-based study among the oldest old. Age and Ageing. 2010;39(3):331-7.

15. Cheung CL, Nguyen US, Au E, Tan KC, Kung AW. Association of handgrip strength with chronic diseases and multimorbidity: a cross-sectional study. Age. 2013;35:929-41.

16. Alonso AC, Ribeiro SM, Luna NM, Peterson MD, Bocalini DS, Serra MM, Brech GC, Greve JM, Garcez-Leme LE. Association between handgrip strength, balance, and knee flexion /extension strength in older adults. PLoS One. 2018;13(6):e0198185.

17. Buckner SL, Dankel SJ, Bell ZW, Abe T, Loenneke JP. The association of handgrip strength and mortality: what does it tell us and what can we do with it?. Rejuvenation Research. 2019;22 (3):230-4.

18. Newman DG, Pearn J, Barnes A, Young CM, Kehoe M, Newman J. Norms for hand grip strength. Archives of Disease in Childhood. 1984;59(5):453-9.

19. Incel NA, Ceceli E, Durukan PB, Erdem HR, Yorgancioglu ZR. Grip strength: effect of hand dominance. Singapore Medical Journal. 2002;43(5):234-7.

20. Alahmari KA, Silvian SP, Reddy RS, Kakaraparthi VN, Ahmad I, Alam MM. Hand grip strength determination for healthy males in Saudi Arabia: a study of the relationship with age, body mass index, hand length and forearm circumference using a hand-held dynam-ometer. Journal of International Medical Research. 2017;45(2):540-8.

21. Koley S, Kaur SP. Correlations of handgrip strength with selected hand-arm-anthropometric variables in Indian inter-university female volleyball players. Asian Journal of Sports Medicine. 2011;2(4):220-230.

22. Yoldaş A, Demir M, Çalişgan E, Emre AT, Geçgil E, Çiçek M, Ertekin T, Doğaner A. The comparison of measurements of the wrist, hand and finger parameters between female and male. Kahramanmaraş Sütçü İmam Üniversitesi Tıp Fakültesi Dergisi. 2020;15(1):6-10.

23. Fallahi A, Jadidian A. The effect of hand dimensions, hand shape and some anthropometric characteristics on handgrip strength

in male grip athletes and non-athletes. Journal of Human Kinetics. 2011;29(2011):151-9.

24. Fraser A, Vallow J, Preston A, Cooper RG. Predicting'normal'grip strength for rheumatoid arthritis patients. Rheumatology (Oxford, England). 1999;38(6):521-8.

25. Jürimäe T, Hurbo T, Jürimäe J. Relationship of handgrip strength with anthropometric and body composition variables in prepubertal children. Homo: Journal of Comparative Human Biology. 2009;60(3):225-38.