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Original empirical article

THE RELATION BETWEEN HANDGRIP STRENGTH AND SELECTED HAND-ANTHROPOMETRIC VARIABLES IN INDIAN INTER-UNIVERSITY SOFTBALL PLAYERS

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Abstract. *The purpose of this study was to estimate the grip strength of the dominant (right) hand and its associations with selected hand-anthropometric variables in Indian inter-university softball players. The study deals with randomly selected 243 Indian inter-university softball players (121 males and 122 females) aged 18–25, from six Indian universities. The research was carried out in Guru Nanak Dev University, Amritsar, Punjab, India. An adequate number of controls (n = 200; 98 males and 102 females) were also taken from the same place for comparisons. Three anthropometric variables, viz. height, weight and BMI, six hand-anthropometric variables, viz. the shape index, digit index, 2D:4D ratio, palmar length, palmar width, palmar length/width ratio and right handgrip strength were measured using the following standard techniques. The one-way ANOVA showed significant differences ($p \leq .02$ - $.000$) in all of the studied characteristics, except age, height and palmar length among the male and female Indian inter-university softball players and the controls. Highly significant ($p \leq .000$) gender differences were also determined for softball players in all of the studied variables except age, the digit index and the 2D:4D ratio. The right handgrip strength has significantly positive correlations ($p \leq .03$- $.000$) with all of the studied variables.*

Key words: *hand-anthropometric variables; handgrip strength.*

INTRODUCTION

Softball is a direct descendant of baseball. It requires speed, strength and endurance (Terbizan, Waldera, Seljevold & Schwigert, 1996). It is a game where the handgrip plays a crucial role. The main basic aspects of the game swing velocity and pitch speed are

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greatly influenced by the grip strength of the player (Giardina, Leslie, Raridon & Zimmer, 1997). Softball players require a significant amount of upper body muscle balance due to the specificity of underarm activity. Many athletes and coaches believe that the forearm plays a significant role both in hitting and throwing the ball (Brylinskyl & Melanie, 1992).

The power of the handgrip is the result of forceful flexion of all the finger joints with the maximum voluntary force that the subject is able to exert under normal biokinetic conditions (Bohannon, 1997; Richards, Olson & Palmiter-Thomas, 1996), which requires several muscles in the hand and the forearm. The estimation of handgrip strength is of immense importance in sports such as wrestling, tennis, handball, basketball, volleyball, baseball and softball where a sufficient degree of grip strength is necessary for success. For example, without an adequate grip and forearm strength, tennis players may run the risk of developing lateral epicondylitis, commonly known as tennis elbow. Often overlooked or taken for granted, the strength of one's grip plays a key role in injury prevention and overall strength development (Budoff, 2004; Fry, Ciroslan, Fry, LeRoux & Schilling, 2006; Yasuo, Daisaku, Nariyuki, Junya, Toshihiko, Masahiko & Yashiyuki, 2005). In many cases, strengthening of the grip has been a prescription for rehabilitation from injuries such as golfers and tennis elbow (Budoff, 2004). These ailments are often caused by improper strength ratios between the elbow muscles and the forearm muscles. If the elbow flexors, such as the biceps and brachialis, are too strong for the forearm flexors, uneven tension accumulates in the soft tissue and results in elbow pain (Poliquin, 2006).

Grip strength determines the handedness of an individual. It is often used as an indicator of overall physical strength (Foo, 2007), hand and forearm muscles performances (Nwuga, 1975) and as a functional index of nutritional status (Jeejeebhoy, 1998; Jurimae, Hurbo & Jurimae, 2009; Kaur & Koley, 2010; Pieterse, Manandhar & Ismail, 2002; Tsunawake, Tahara, Moji, Muraki, Minowa & Yukawa, 2003; Watters, Haffejee, Angom & Duffy, 1985) and physical performance (Samson, Meeuwsen, Crowe, Dessens, Duursma & Verhaar, 2000). Handgrip strength is a physiological variable that is affected by a number of factors including age, gender and body size. Strong correlations between grip strength and various anthropometric traits, (weight, height, hand length etc.) were reported earlier (Jurimae, Hurbo & Jurimae, 2009; Koley & Singh, 2009; Koley & Kaur, 2009; Ross & Rösblad, 2002).

Some literature related to the morphological and anthropometric characteristics and handgrip strength of softball players are available (Brylinskyl & Melanie, 1992; Giardina, Leslie, Raridon & Zimmer, 1997; Tsunawake, Tahara, Moji, Muraki, Minowa & Yukawa, 2003; Werner, Deryk, Guido & Brunet, 2006). But, the information related to the correlations of hand-anthropometry and grip strength in softball players is scanty. In the present study, an attempt has been made to estimate the handgrip strength of inter-university softball players, and also its relationship to various hand-anthropometric characteristics.

THE METHOD

The participants

The present cross-sectional study is based on randomly selected 243 Indian inter-university softball players (121 males and 122 females) aged 18–25 from Punjabi University, Patiala, Punjab University, Chandigarh, Guru Nanak Dev University, Amritsar, Kurukshetra University, Kurukshetra, Himachal Pradesh University, Himachal Pradesh and

Delhi University, Delhi, and was organized in Guru Nanak Dev University, Amritsar, Punjab, India. An adequate number of controls (n = 200; 98 males and 102 females) with no particular athletic background were also collected from the same place for comparison. The age of the participants were recorded from the date of birth registered in their respective institutions. Written consent was obtained from the participants. The data were collected under natural environmental conditions in the morning (between 8 AM. to 12 noon). The study was approved by the local ethics committee.

Anthropometric measurements

Three anthropometric variables, viz. height (cm), weight (kg) and BMI (kg/m^2), six hand-anthropometric variables, i.e. the shape index, digit index, 2D:4D ratio, palmar length, palmar width, palmar length/width ratio and right handgrip strength (kg) were measured following standard techniques (Lohmann, Roche & Martorell, 1988; Barut, Demirel & Kiran, 2008) and were measured in triplicate with the median value used as the criterion.

Height was recorded during inspiration using a stadiometer (Holtain Ltd., Crymych, Dyfed, UK) to the nearest 0.1 cm, and weight was measured using digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. The BMI was then calculated using the formula weight (in kg)/height^2 (in m)^2.

Shape index was calculated by hand width divided by hand length and multiplied by 100. Hand length was measured by a Vernier slide caliper (Starrett, 123 Series, U.S.A.) in centimeters from the creases of the wrist to the dactylion of the participant. Hand width was measured by a Vernier slide caliper from the metacarpal radiale to the metacarpal ulnare in centimeters. The digit index was calculated by the 3rd digit length divided by hand length and multiplied by 100. The length of the 3rd digit was measured from the dactylion to the crease of the metacarpal by a Vernier sliding caliper in centimeters. The 2D: 4D ratio was measured by dividing the length of the second digit by the length of the fourth digit. The length of the second digit (index finger) was measured from the tip of the second finger to the crease of the metacarpal by a Vernier sliding caliper in centimeters and the length of the fourth digit (ring finger) was measured from the tip of the fourth finger to the crease of the metacarpal by a vernier sliding caliper in centimeters. Palmar length was calculated from the midpoint of the distal wrist crease to the midpoint of the proximal digit crease in centimeters, with the formula hand length minus the 3rd digit length. Palmar width was measured from the metacarpal radiale to the metacarpal ulnare (same as hand width). The palmar length/width ratio was calculated as palmar length divided by palmar width.

Handgrip strength measurement

The grip strength of both the right and left hand was measured using a standard adjustable digital handgrip dynamometer (Takei Scientific Instruments Co., LTD, Japan) in a standing position with the shoulder adducted and neutrally rotated and the elbow in full extension. The dynamometer was held freely without support, not touching the participant's trunk. The position of the hand remained constant not in the downward direction. The participants were asked to put maximum force on the dynamometer thrice from both sides of the hands. The maximum value was recorded in kilograms. The anthropometric equipment and handgrip dynamometer were calibrated before each assessment. All of the participants were tested after 3 minutes of independent warm-up. Thirty-second time intervals were maintained between each handgrip strength testing.

Statistical analysis

Standard descriptive statistics (mean ± standard deviation) were determined for directly measured and derived variables. The one-way ANOVA (analysis of variance) was tested for the comparison of data among both the sexes of softball players and controls, followed by a post hoc Bonferroni test (in the case of significant differences). The results of the independent variables (height, weight, BMI and six hand-anthropometric variables) as well as the dependent variable (right handgrip strength) proved to be normally distributed as per skewness tests. Simple correlation coefficients were used to establish the correlations of right handgrip strength with other hand-anthropometric variables of the softball players. The individual contributions of the independent variables to the total variability of the dependent variable were calculated by standard techniques (Stupnicki, Tomaszewski & Milde, 2007). Data were analyzed using SPSS (Statistical Package for Social Science) version 17.0. A 5% level of probability was used to indicate statistical significance.

RESULTS

Descriptive statistics of the hand-anthropometric characteristics and grip strength of Indian inter-university softball players and controls are shown in Table 1.

Table 1. Descriptive statistics of handgrip strength and some selected hand-anthropometric characteristics of Indian inter-university softball players.

Variables	Softball males (n=121)		Control males (n=98)		Softball females (n=122)		Control female (n=102)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (yr)	20.65	1.50	21.36	2.74	20.11	1.64	23.30	1.51
Height (cm)	172.4	7.00	172.31	6.42	159.64	5.29	159.19	5.43
Weight (kg)*	63.87	9.98	65.8	10.3	51.39	6.36	53.97	7.34
BMI (kg/m^2)**	21.44	2.88	22.13	3.01	20.15	2.16	21.3	2.75
Shape index**	44.49	1.97	43.76	2.12	43.76	2.12	42.78	1.92
Digit index**	43.13	1.37	42.71	1.82	43.25	1.72	42.35	1.20
2D/4D ratio**	0.97	0.03	0.99	0.04	0.97	0.05	0.98	0.02
Palmar length (cm)	10.75	0.52	10.64	0.60	9.75	0.56	9.93	0.48
Palmar width (cm)**	8.41	0.41	8.12	0.43	7.51	0.43	7.36	0.35
Palmar length/width ratio**	1.28	0.06	1.31	0.09	1.30	0.08	1.35	0.07
Right handgrip strength (kg)*	41.35	6.21	40.31	6.16	26.62	4.52	23.78	4.18

* Significant at 0.05 level; ** Significant at .000 level

Statistically significant differences ($p \leq .05$ - $.000$) were noted between male softball players and their control counterparts (not shown in the table) in the shape index, digit index, 2D:4D ratio, palmar width and palmar length/width ratio, whereas highly significant differences ($p \leq .000$) were found between female softball players and controls in all of the studied variables, except, age, height and 2D:4D ratio. Highly significant gender differences ($p \leq .000$) were found in softball players in all the studied variables, except, age, the digit index and 2D:4D ratio. The one-way ANOVA showed significant differences ($p \leq .02$ - $.000$) in all the studied characteristics, except age, height and palmar length among these four sets of data.

Table 2. Simple correlation coefficients, multiple correlations (R^2) and percentage contributions of independent variables to the total variance of the right handgrip strength in Indian inter-university male softball players.

Variables	HT	WT	BMI	SI	DI	2D:4D	PL	PW	PL/PW	HGS	%
Age	.135	.111	.057	-.024	.012	.090	.161*	.133	.023	.132	2
HT		.505**	-.013	-.257*	.068	.093	.578**	.368**	.194*	.251**	6*
WT			.855**	.186*	.120	.013	.289**	.508**	-.221*	.501**	20***
BMI				.372**	.104	-.043	-.009	.375**	-.376**	.445**	5*
SI					-.029	-.153*	.332**	.563**	-.875**	.214*	1
DI						-.065	-.425**	.047	-.456**	.195*	1
2D:4D							.072	-.097	.165*	-.075	0
PL								.475**	.499**	.167*	2
PW									-.525**	.452**	0
PL/PW										-.282**	0
											R^2 = .368; ***

* Significant at 0.05 level; ** Significant at .01 level

Table 3. Simple correlation coefficients, multiple correlations (R^2) and percentage contributions of independent variables to the total variance of the right handgrip strength in control males.

Variables	HT	WT	BMI	SI	DI	2D:4D	PL	PW	PL/PW	HGS	%
Age	-.284**	.051	.218*	.156	-.074	.111	-.077	.012	-.162	.062	0
HT		.493**	.020	-.181*	-.003	.078	.555**	.417**	.239**	.364**	16***
WT			.878**	.005	.046	.110	.393**	.445**	-.004	.383**	4*
BMI				.114	.058	.177*	.145	.290**	-.135**	.246**	1
SI					.323**	.141	-.468**	.607**	-.584**	.182*	4*
DI						.071	-.563**	.264*	-.323**	.140	1
2D:4D							-.108	.065	-.090	.058	0
PL								.276**	.442**	.193*	2
PW									-.259**	.447**	0
PL/PW										-.174*	2
											R^2 = .299, P< .000

* Significant at 0.05 level; ** Significant at .01 level; *** Significant at .000 level

Table 4. Simple correlation coefficients, multiple correlations (R^2) and percentage contributions of independent variables to the total variance of the right handgrip strength in Indian inter-university female softball players.

Variables	HT	WT	BMI	SI	DI	2D:4D	PL	PW	PL/PW	HGS	%
Age	-.030	.130	.180*	.068	-.048	-.135	-.078	.048	-.027	.000	0
HT		.507***	-.037	-.076	-.072	.031	.523***	.491***	.031	.422**	18***
WT			.841***	.075	-.053	.023	.438**	.466**	-.033	.457**	8*
BMI				.137	-.102	.012	.176*	.233**	-.062	.260*	1
SI					.176*	-.047	-.365**	.568***	-.877***	.064	0
DI						.000	-.494***	.177*	-.622***	-.016	0
2D:4D							-.066	.108	.034	-.147	2
PL								.432**	.526***	.507***	14***
PW									-.538***	.559***	5*
PL/PW										-.048	0
											R^2 = .483 ***

* Significant at 0.05 level; ** Significant at .01 level; *** Significant at .000 level

Table 5. Simple correlation coefficients, multiple correlations (R^2) and percentage contributions of independent variables to the total variance of the right handgrip strength in control females.

Variables	HT	WT	BMI	SI	DI	2D:4D	PL	PW	PL/PW	HGS	%
Age	-.154	.053	.139	-.005	.006	.062	-.058	-.060	-.004	.121	1
HT		.368**	-.147	-.181*	-.103	-.185*	.580***	.379**	.194*	.273**	9*
WT			.865***	.186*	-.040	.031	.249**	.406**	-.153	.240**	2
BMI				.298**	.018	.132	-.055	.225**	-.271**	.101	2
SI					.128	-.005	-.390**	.583***	-.921***	-.011	0
DI						.012	-.518***	.022	-.499***	-.009	0
2D:4D							-.253**	-.259**	-.001	-.006	0
PL								.437***	.534***	.432***	21***
PW									-.525***	.434***	1
PL/PW										.000	1
										R^2 = .368, P< .000	

* Significant at 0.05 level; ** Significant at .01 level; *** Significant at 0.000 level

Tables 2-5 highlighted the simple correlation coefficients, multiple correlations (R^2) and percentage contributions of independent variables (height, weight, BMI and all hand-anthropometric variables) to the total variance of the right handgrip strength in Indian inter-university softball players and their control counterparts. The coefficient of multiple correlations of height, weight, BMI and hand-anthropometric variables was lower in male softball players (R^2 = .368) than their female counterparts (R^2 = .483), but higher than their control counterparts (R^2 = .299 and .368 respectively). The right handgrip strength had significantly positive correlations ($p \leq .01$- .000) with almost all the variables studied in all the four sets of data.

DISCUSSION

Anthropometric dimensions and morphological characteristics play an important role in determining the success of an athlete (Keogh, 1999). Quite naturally, the interest in anthropometric characteristics and body composition of athletes from different competitive sports has increased tremendously over the last decades. All ball games require comprehensive abilities including physical, technical, mental and tactical (Terbizan, Waldera, Seljevold & Schwigert, 1996; Werner, Deryk, Guido & Brunet, 2006).

In the present study, both male and female players have higher mean values for right handgrip strength than their control counterparts, though statistically significant differences ($p \leq .000$) were found only between female players and controls. The reasons behind these differences might be due to regular physical exercise and practice. Highly significant gender differences ($p \leq .000$) were determined for softball players for right handgrip strength and these differences might be due to physical and physiological differences between the two genders. In male softball players, the partition of R^2 into the contributions of individual independent variables revealed that weight (20%), height (6%) and BMI (5%) contributed significantly ($p \leq .05$ - .000) to the total variables (37%) of the right handgrip strength, whereas in female softball players, height (18%), palmar length (14%), weight (8%) and palmar width (5%) contributed significantly ($p \leq .05$ - .000) to

the total variables (48%) of the right handgrip strength. It was also reported that strong correlations existed between handgrip strength and height, weight, BMI and all the six hand-anthropometric studied characteristics (except age and 2D:4D ratio in male players and age, shape index, digit index, 2D:4D ratio and palmar length / width ratio in female players). In fact, all the flexor muscles of the hand and forearm responsible for grip strength are closely related anatomically, physiologically and biomechanically to each other to perform the task, showing close affinity to each other. It has previously been reported, also, that handgrip strength had strong correlations with various anthropometric characteristics (Benefice & Malina, 1996; Koley & Kaur, 2009; Koley & Yadav, 2009; Koley, Kaur & Sandhu, 2009; Koley, Singh & Sandhu, 2010) and males attained a stronger handgrip than their female counterparts (Benefice & Malina, 1996). Right and left handgrip strength was positively correlated with weight, height and body surface area (Chatterjee & Chowdhuri, 1991). The limitation of the study was that the national level players would have to be taken into account to validate these correlations.

PRACTICAL APPLICATIONS

The data presented in the present study carry immense practical applications. To excel the performance of the players as well as to avoid sport-specific injuries, sports authorities can use the data to design gender specific training program. As softball players require a significant amount of upper body muscle balance due to the specificity of the underarm activity, specific muscle(s) of the hand and arm would be strengthened for the specific purpose of the game. The data might be useful in future investigation on player selection and talent identification in the game.

REFERENCES

Barut C., Demirel, P. & Kiran, S. (2008). Evaluation of hand anthropometric measurements and grip strength in basketball, volleyball and handball players. *Anatomy*, 2: 55-59.

Benefice, E. & Malina, R. (1996). Body size, body composition and motor performances of mild-to-moderately undernourished Senegalese children. *Annals of Human Biology*, 23:307-321.

Bohannon, RW. (1997). Reference values for extremity muscle strength obtained by handheld dynamometer from adults aged 20 to 79 years. *Archives of Physical Medicine & Rehabilitation*, 78, 26-32.

Brylinskyl, J. & Melanie, MJCF. (1992). The effect of using a weighted softball on pitching velocity, wrist strength and handgrip. *Journal of Strength & Conditioning Research*, 6 (3), 170-173.

Budoff JE (2004). The prevalence of rotator cuff weakness in patients with injured hands. *Journal of Hand Surgery*, 29, 1154-1159.

Chatterjee, S. & Chowdhuri, BJ. (1991). Comparison of grip strength and isometric endurance between the right and left hands of men and their relationship with age and other physical parameters. *Journal of Human Ergology*, 20, 41-50.

Foo, LH. (2007). Influence of body composition, muscle strength, diet and physical activity on total body and forearm bone mass in Chinese adolescent girls. *British Journal of Nutrition*, 98, 1281-1287.

Fry, AC., Ciroslan, MD., Fry, CD., LeRoux, CD. & Schilling, BK. (2006). Anthropometric and Performance Variables Discriminating Elite American Junior Men Weightlifters. *Journal of Strength & Conditioning Research*, 20, 861-866.

Giardina, D., Leslie, H., Raridon, L. & Zimmer, D. (1997). Relationship of grip strength and forearm size to bat velocity in college female softball players. *IAHPERD Journal*. 30 (2).

Jeejeebhoy, KN. (1998). Nutritional assessment. *Gastroenterology Clinics of North America*, 27, 347-369.

Jurimae, T., Hurbo, J. & Jurimae, J. (2009). Relationship of handgrip strength with anthropometric and body composition variables in prepubertal children. *Journal of Comparative Human Biology*, 60, 225-238.

Kaur, N. & Koley, S. (2010). An association of nutritional status and handgrip strength in female laborers and sedentary women of Jalandhar, Punjab, India. *Anthropologist*, 12, 237-243.

Keogh, J. (1999). The use of physical fitness scores and anthropometric data to predict selection in an elite under-18 Australian rules football team. *Journal of Sports Science & Medicine,* 2, 125–133.

Koley, S. & Singh, AP. (2009). An association of dominant hand grip strength with some anthropometric variables in Indian collegiate population. *Anthropologischer Anzeiger*, 67, 21-28.

Koley, S. & Kaur, N. (2009). A study on handgrip strength and some anthropometric variables in younger and older female labourers of Jalandhar, Punjab, India. *Internet Journal of Biological Anthropology*, 3 (2).

Koley S. & Yadav, MK. (2009). An association of handgrip strength with some anthropometric variables in Indian cricket players. *Facta Universitatis series Physical Education & Sports*, 7, 113-123.

Koley, S., Kaur, N. & Sandhu, JS. (2009). Association of hand grip strength and some anthropometric traits in female laborers of Jalandhar, Punjab, India. *Journal of Life Sciences*, 1:57-62.

Koley, S., Singh, J. & Sandhu, JS. (2010). Anthropometric and physiological characterictics on Indian inter-university volleyball players. *Journal of Human Sport & Exercise*, 5, 389-399.

Lohmann, TG., Roche, AF. & Martorell, R. (1988). *Anthropometric Standardization Reference Manual*. Champaign, IL: Human Kinetics Books.

Nwuga, V. (1975). Grip strength and grip endurance in physical therapy students. *Archives of Physical Medicine & Rehabilitation*, 56, 296-299.

Pieterse, S., Manandhar, M. & Ismail, S. (2002). The association between nutritional status and hand grip strength in older Rwandan refugees. *European Journal of Clinical Nutrition*, 56, 933-939.

Poliquin, C. (2006). *The Poliquin International Certification Program Theory II Manual*. East Greenwich, RI. Pp 2-42.

Richards, L., Olson, B. & Palmiter-Thomas, P. (1996). How forearm position affects grip strength. *American Journal of Occupational Therapy*, 50,133 –139.

Ross, CH. & Rösblad, B. (2002). Norms for grip strength in children aged 4–16 years. *Acta Paediatrica*, 91, 617-625.

Samson, MM., Meeuwsen, BI., Crowe, A., Dessens, JE., Duursma, SA. & Verhaar, HJ. (2000). Relationships between physical performance measures, age, height and body weight in healthy adults. *Age and Ageing*, 29, 235-242.

Stupnicki, R., Tomaszewski, P. & Milde, K. (2007). Contributions of age, body height and body mass to the total variance of an example physical fitness variable. Paper on Anthropology XVI. Pp. 266-272.

Terbizan, DJ., Waldera, M., Seljevold, P. & Schwigert, DJ. (1996). Physiological characteristics of masters women fastpitch softball players. *Journal of Strength & Conditioning Research*, 10 (3), 157-160.

Tsunawake, N., Tahara, Y. Moji, K., Muraki, S., Minowa, K. & Yukawa, K. (2003). Body composition and physical fitness of female volleyball and basketball players of the Japan inter-high school championship teams. *Journal of Physiological Anthropology & Applied Human Science*, 22, 195-201.

Watters, D.A., Haffejee, AA., Angom, IB. & Duffy, KJ. (1985). Nutritional assessment by hand grip dynamometry. *South African Medical Journal*, 68, 585-587.

Werner, SL., Deryk, GJ., Guido, JA. & Brunet, ME. (2006). Kinematics and kinetics of elite windmill softball pitching. *American Journal of Sports Medicine*, 34 (4), 597-603.

Yasuo, G., Daisaku, T., Nariyuki, M., Junya, S., Toshihiko, O., Masahiko, M. & Yashiyuki, M. (2005). Relationship between grip strength and surgical results in rotator cuff tears. *Shoulder Joint*, 29, 559-562.

POVEZANOST SNAGE STISKA ŠAKE SA ODABRANIM ANTROPOMETRIJSKIM VARIJABLAMA ŠAKE KOD INDIJSKIH UNIVERZITETSKIM IGRAČA SOFTBOLA

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Ciljevi istraživanja bili su procena snage stiska dominantne šake (desne) i povezanost utvrđene snage sa odabranim antropometrijskim varijablama šake kod Indijskih univerzitetskih igrača softbola. Nasumičnom selekcijom izabrano je 243 igrača oba pola (121 muškog i 122 ženskog pola), starosti između 18-25 godina, sa šest Indijskih Univerziteta. Istraživanje je sprovedeno na Univerzitetu Guru Nanak Dev, Amritsar, Punjab, India. Odgovarajući broj ispitanika kontrolnog subuzorka (n = 200; 98 muškog i 102 ženskog pola) služio je za upoređenje rezultata. Tri antropometrijske varijable, tj., visina, težina i BMI, šest antropometrijskih varijabli šake, tj., oblik šake, kažiprst, 2D: 4D odnos, dužina dlana, širina dlana, odnos dužine/širine dlana i snage stiska desne šake, merene su primenom standardnih tehnika. Analiza varijanse (One way ANOVA) pokazala je značajne razlike ($p \leq .02$ - .000) u svim istraživanim varijablama, osim kod starosti, visine i i dužine šake ispitanika oba subuzorka i pola. Statistički značajne razlike ($p \leq .000$) po polu utvrđene su i kod igrača softbola, osim u varijablama starost, drugi prst (kažiprst) i 2D:4D odnos. Snaga stiska desnom šakom značajno je pozitivno povezana ($p \leq .03$- .000) sa svim istraživanim varijablama.

Ključne reči: *antropometrijske varijable šake; snaga stiska šake*