

Original empirical article

AN ASSOCIATION OF HAND GRIP STRENGTH WITH SOME ANTHROPOMETRIC VARIABLES IN INDIAN CRICKET PLAYERS

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Abstract. *The purpose of this study was of two-fold, firstly, to compare the hand grip strength (both right and left) and twelve anthropometric variables of cricketers with their control counterparts and, secondly, to search the correlation of hand grip strength with those anthropometric variables in cricketers. To solve this purpose, a total of 103 district and state level male cricketers from Amristar, Punjab, India, aged 17 – 21 years (mean 18.29 ± 2.21) were selected purposively as the samples of the study along with an adequate control group ($n = 101$). The findings of the present study indicate that cricketers have higher mean values in six variables and lesser mean values in seven variables than their control counterparts, showing statistically significant differences ($P \leq 0.05$) in all the variables (except arm muscle area) between them. In cricketers, right and left hand grip strength have significantly positive correlations with all the variables studied except percent lean body mass. From the findings of the present study, it may be concluded that, hand grip strength might be an acceptable indicator for the excellent performance in cricket as well as a useful selection criterion for this sport.*

Key words: *Hand grip strength; Anthropometric variables; Indian Cricketers.*

INTRODUCTION

Hand grip strength is a general term used by strength athletes, referring to the muscular strength and force that they can generate with their hands. The strength of a hand grip is the result of forceful flexion of all finger joints, thumbs, and wrists with the

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maximum voluntary force that the subject is able to exert under normal biokinetic conditions. Hand grip strength is a physiological variable that is affected by a number of factors including age, gender and body size among others. Strong correlations between grip strength and various anthropometric traits, (weight, height, hand length etc.) were reported earlier by Malina, Zavaleta, & Little (1987) and Ross & Rosblad (2002). In fact, the grip strength was reported to be higher in the dominant hand with right handed subjects, but no such significant differences between sides could be documented for left-handed people (Incel, Ceceli, Durukan, Erdem, & Yorgancioglu, 2002). Dopsaj, Koropanovski, Vukovic, Blagojevic, Marinkovic & Milijus (2007) confirmed that men showed significantly greater maximal hand grip force in both dominant and non-dominant hands than women. Right and left hand grip strength was positively correlated with weight, height and body surface area (Chatterjee & Chowdhuri, 1991). 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. Hip/waist circumferences measurement is a good marker of fat distribution, bone mineral content and lean mass which are strongly correlated with maximum isometric grip force (Brozek, 1984). 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, Karni & Nicklin, 1990). It is also of use as a functional index of nutritional status (Brozek, 1984; JeeJeebhoy, 1998 and Vaz, Thangam, Prabhu, & Shetty, 1996).

Hand grip strength is a significant predictor of performance in various sports activities, viz. lawn tennis (Lucki & Nicolay, 2007), club volleyball (Melrose, Spaniol, Bohling, & Bonnette, 2007), ten-pin bowling (Tan, Aziz, Teh, & Lee, 2001), rock climbing (Watts, Newbury & Sulentic, 1996). To the best of our knowledge, the information regarding the association of hand grip strength and various anthropometric variables in cricketers is lacking. So the present study was planned.

MATERIALS AND METHODS

Participants

The present study is based on a sample of 103 male cricketers (61 district level and 42 state level) aged 17 – 21 years (mean age 18.29 ± 2.21 years) of Amritsar, collected from Gandhi Ground, Amritsar, Punjab, India during March, 2008 – January, 2009. An adequate number of control participants ($n = 101$) was also taken for comparison from the same place matching age, sex, socio-economic status, ethnicity, except the playing condition. In this cross-sectional study, the subjects were selected purposively and the age of the subjects were recorded from the records of their respective educational institutions. The subjects were divided in such a way that "age 17", for instance, refers to the children aged 16 years and 6 months through 17 years and 5 months and 29 days. The study was approved by the local ethics committee.

Data collection

All anthropometric measurements, viz. height, weight, BMI, triceps skinfold, subscapular skinfold, percent of body fat, percent of lean body mass, arm muscle girth, arm

muscle area, arm area, arm fat area and arm fat index were calculated for each subject by the MKY using standard methodologies (Weiner & Lourie, 1969; Womersley & Durnin, 1977). All variables except height and weight were measured on the right side of the body in triplicate with the median value used as the criterion.

The height was recorded during inspiration using a stadiometer (Holtain Ltd., crymych, Dyfed, UK) to the nearest 0.1 cm, and weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. Triceps and subscapular skinfolds (to the nearest 0.1 mm) were measured by Harpenden skinfold calipers (British indicators Ltd., West Sussex, UK). The BMI was then calculated using the formula $\text{weight (kg)}/\text{height (m)}^2$. Percent body fat and percent lean body mass were calculated using the formula (Wormersley & Durnin, 1977): for men (17 – 76 years) percent body fat = $1.34 \times \text{BMI} - 12.47$, percent lean body mass = $100 - \text{percent body fat}$. The grip strength of both right and left hands was measured using a standard adjustable digital battery-operated automatic hand grip dynamometer (Takei Scientific Instruments Co., LTD, Japan) at standing position with shoulder adducted and neutrally rotated and elbow in full extension, after Mathews (1973). All of the subjects were given 3 minutes of independent warm-up. Then the subjects were instructed to squeeze the dynamometer as tightly as possible, using the musculature of the hand. No part of the subject's upper or lower arm or hand may push against any object or against any other part of the body. The force exerted was read from the dial of the dynamometer in kilograms and the data was recorded for the best one, after three successful attempts with one minute rest between trials. All anthropometric equipment and hand grip dynamometer were calibrated before the assessment.

Data analysis

Descriptive statistics (mean \pm standard deviation) were determined for all directly measured and derived variables. Comparisons between cricketers and controls for all the measured variables were made using an independent t-test. Pearson's correlation coefficients were used for correlation coefficient 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

The descriptive statistics of Indian male cricketers and the control group are presented in Table 1. The cricketers were taller (1.24%), having greater values for triceps skinfold (34.57%), percent lean body mass (3.38%), arm muscle area (3.26%), and both right and left hand grip strength (9.67% and 11.97% respectively) and were lighter (8.10%) with lesser values in lesser mean values in BMI (10.76%), subscapular skinfold (37.60%), percent body fat (25.19%), arm muscle girth (28.02%), arm area (13.59%), arm fat area (53.76%) and arm fat index (34.10%) than their control counterparts, showing statistically significant differences ($P \leq 0.05$) in all the variables (except muscle mass area).

Table 1. Descriptive statistics of district and state level Indian male cricketers and controls

Variables	Cricketers (n=103)		Controls (n=101)		t - value	P
	Mean	S.D.	Mean	S.D.		
Height (cm)	172.41	6.20	170.26	8.03	2.118	0.035
Weight (kg)	59.13	11.58	63.92	12.50	2.810	0.005
BMI (kg/m ²)	19.79	3.42	21.92	3.40	4.403	0.000
Triceps skinfold (mm)	31.41	5.27	20.55	6.65	8.416	0.000
Subscapular skinfold (mm)	14.52	5.67	19.98	7.12	6.002	0.000
Percent body fat	14.05	4.58	17.59	7.43	4.054	0.000
Percent lean body mass	85.98	4.62	83.07	4.57	4.487	0.000
Arm muscle girth (cm)	20.91	2.10	26.77	3.15	15.493	0.000
Arm muscle area (cm ²)	35.19	7.24	34.04	6.97	1.144	0.254
Arm area (cm ²)	51.12	12.62	58.07	13.76	3.722	0.000
Arm fat area (cm ²)	15.94	7.51	24.51	9.21	7.197	0.000
Arm Fat Index	30.32	9.17	40.66	9.10	8.000	0.000
Right hand drip strength (kg)	35.86	7.07	32.39	7.91	3.276	0.001
Left hand grip strength (kg)	35.41	6.68	31.17	7.85	4.117	0.000

Table 2 shows the correlation coefficient between the right and left hand grip strength with other anthropometric variables in cricketers and the control group. Figs 1-12 also show the linear regression for the right hand grip strength and other anthropometric variables in cricketers. In cricketers, the right and left hand grip strength have significantly positive correlations with height, weight, BMI, triceps skinfold, subscapular skinfold, percent body fat, arm muscle girth, arm muscle area, arm area, arm fat area and negative correlation with percent lean body mass, and negative correlation with percent lean body mass ($r = -0.347$ and -0.247 respectively).

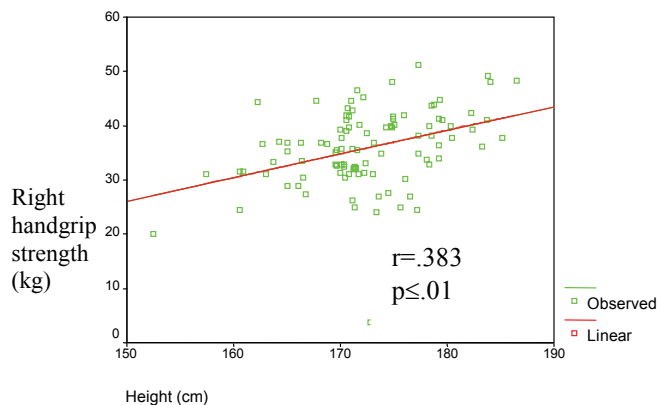


Fig. 1. Scatter plot of hand grip Strength (right) of Indian Cricketers by height

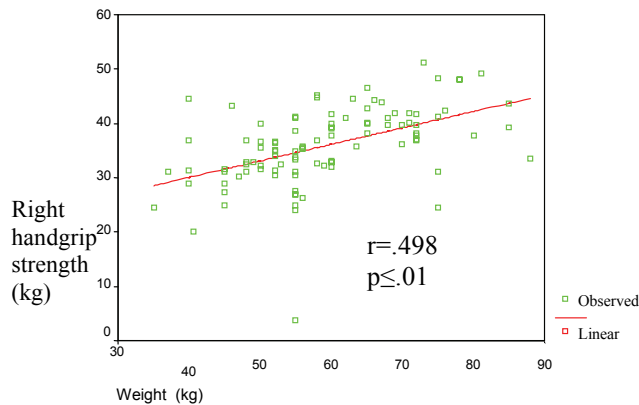


Fig. 2. Scatter plot of hand grip strength (right) of Indian Cricketers by weight

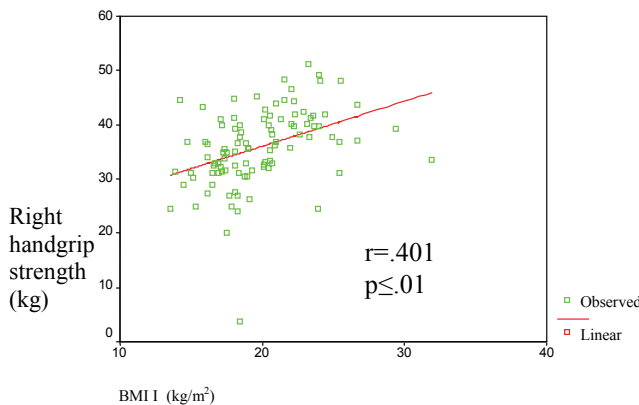


Fig. 3. Scatter plot of hand grip strength (right) of Indian Cricketers By BMI

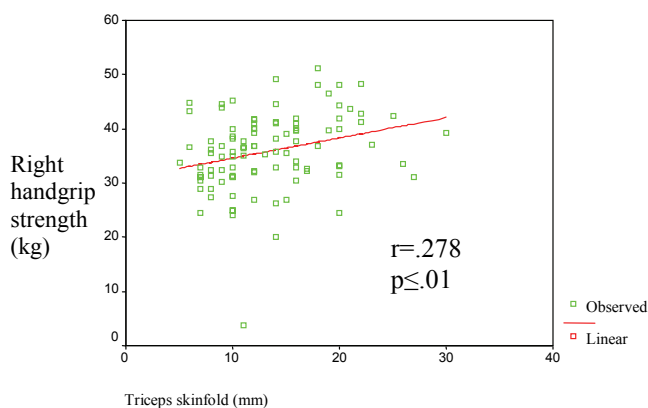


Fig. 4. Scatter plot of hand grip strength (right) of Indian Cricketers by triceps skinfold

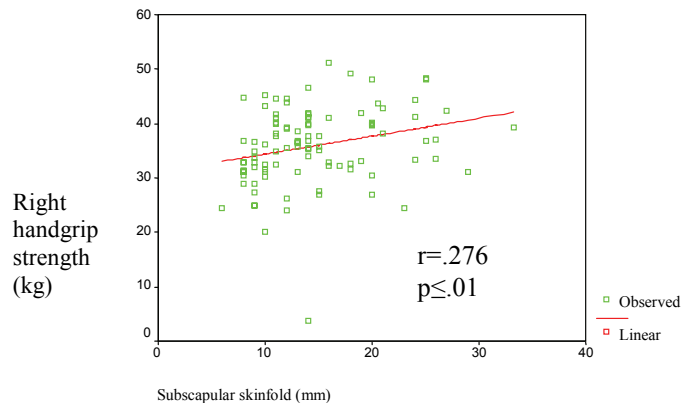


Fig. 5. Scatter plot of hand grip Strength (right) of Indian Cricketers By subscapular skinfold

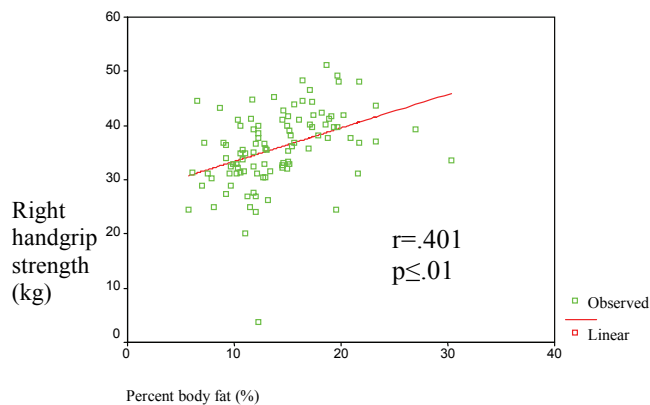


Fig. 6. Scatter plot of hand grip strength (right) of Indian Cricketers by percent body fat

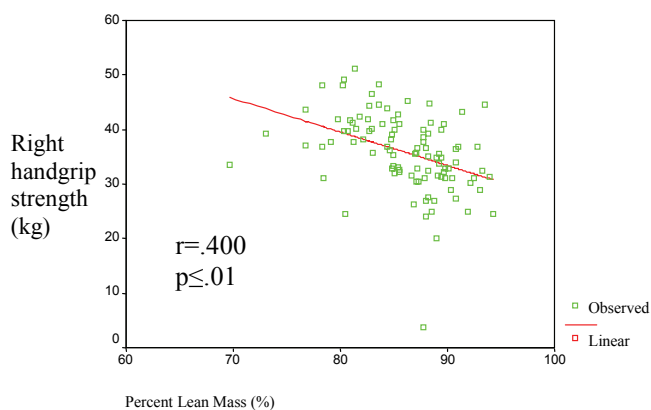


Fig. 7. Scatter plot of hand grip Strength (right) of Indian Cricketers By percent lean mass

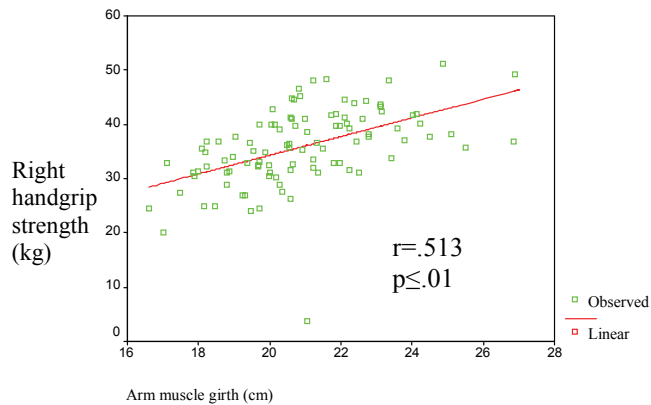


Fig. 8. Scatter plot of hand grip strength (right) of Indian Cricketers by arm muscle girth

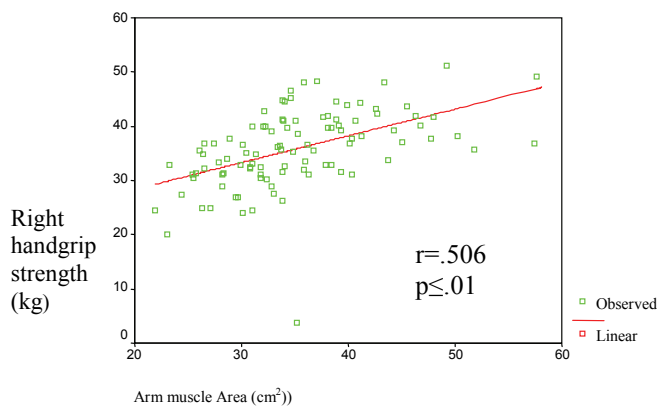


Fig. 9. Scatter plot of hand grip Strength (right) of Indian Cricketers By arm muscle area

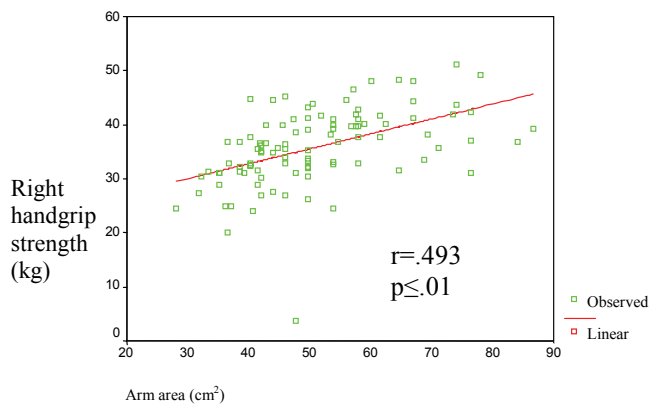


Fig. 10. Scatter plot of hand grip strength (right) of Indian Cricketers by arm area

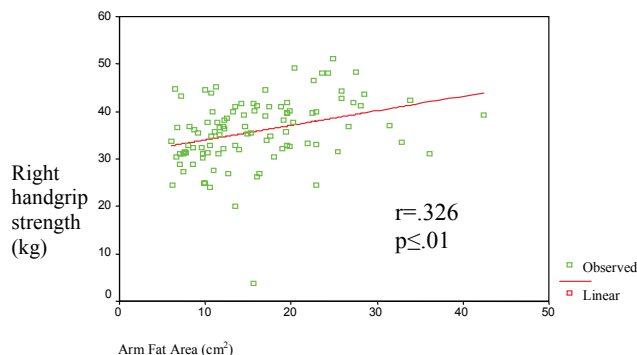


Fig. 11. Scatter plot of hand grip Strength (right) of Indian Cricketers By arm fat area

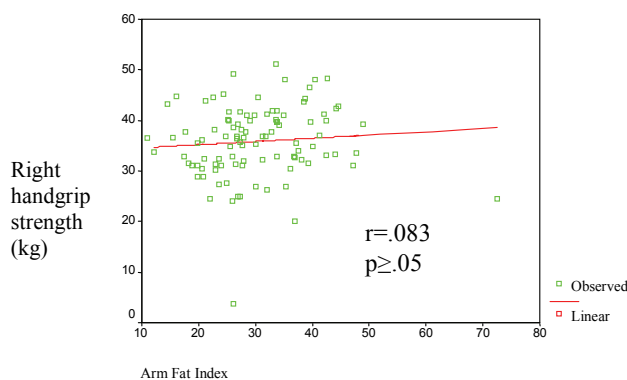


Fig. 12. Scatter plot of hand grip strength (right) of Indian Cricketers by arm fat index

Table 2. Correlation coefficients of right and left hand grip strength with other 12 variables in cricketers and controls

Variable	Cricketers		Controls	
	Right	Left	Right	Left
Height (cm)	0.383**	0.355**	0.566**	0.549**
Weight (kg)	0.498**	0.472**	0.505**	0.419**
BMI (kg/m ²)	0.401**	0.374**	0.342**	0.244*
Triceps skinfold (mm)	0.278**	0.210*	0.144	0.068
Subscapular skinfold (mm)	0.266**	0.208*	0.184	0.054
Percent body fat	0.401**	0.374**	0.139	0.054
Percent lean body mass	-0.400**	-0.372**	-0.347**	-0.247*
Arm muscle girth (cm)	0.513**	0.547**	0.525**	0.422**
Arm muscle area	0.506**	0.539**	0.266**	0.276**
Arm area	0.493**	0.481**	0.174	0.133
Arm fat area	0.326**	0.292**	0.040	0.018
Arm Fat Index	0.083	0.014	-0.042	-0.094
Right hand grip strength (kg)	1.000	0.699**	1.000	0.849**
Left hand grip strength (kg)	0.699**	1.000	0.849**	1.000

* Significant at 0.05 level, ** Significant at 0.01 level.

DISCUSSION

Cricket is a game of endurance as well as strength. For bowling, throwing the ball during fielding and batting, use of forearm strength is essential. For the holistic development of the game, the purpose of the study was fully justified. The findings of the study indicate that cricketers have higher mean values in height, triceps skinfold, percent of lean body mass, arm muscle area, and both right and left hand grip strength and lesser mean values in weight, BMI, percent of body fat, arm muscle girth, arm area, arm fat area and arm fat index than their control counterparts, showing statistically significant differences ($P \leq 0.05$) in height ($t = 2.75$), weight ($t = 2.81$), BMI ($t = 4.40$), triceps skinfold ($t = 8.42$), subscapular skinfold ($t = 6.000$), percent of body fat ($t = 4.10$), percent of lean body mass ($t = 4.49$), arm muscle girth ($t = 15.50$), arm area ($t = 3.72$), arm fat area ($t = 7.20$), right hand grip strength ($t = 3.28$) and left hand grip strength ($t = 4.12$) between cricketers and the control group. The differences may be due to the effect of regular physical activities and training program of cricketers. Greater height, lean body mass, arm muscle area and hand grip strength help the cricketers to generate more force in game. In this direction, Grants, Haler, Davies, Aitcheson, Wilson, & Whittaker (2001) recorded significantly higher values for right hand grip strength in elite rock climbers than recreational climbers, though Watts, Newbury & Sulentic (1996) reported earlier that hand grip strength and hand grip endurance decreased with continuous difficult rock climbing and remained depressed after 20 minutes of resting recovery. They also reported that hand grip strength recovered at a faster rate than hand endurance. De, Dasgupta, Panda, & Bhattacharya (1982) reported that the hand grip strength values of Indian inter-university male Kabaddi (an ancient Indian rural game) players were higher in comparison to those of Indian footballers and hockey players of the same sex.

In cricketers, right hand grip strength had significantly positive correlations with height ($r = 0.383$), weight ($r = 0.498$), BMI ($r = 0.401$), triceps skinfold ($r = 0.278$), subscapular skinfold ($r = 0.266$), percent of body fat ($r = 0.401$), arm muscle girth ($r = 0.513$), arm muscle area ($r = 0.506$), arm area ($r = 0.493$), arm fat area ($r = 0.326$), and negative correlations with percent of lean body mass ($r = -0.400$). Only three left hand dominant cricketers participated in the study, and correlation of handedness with hand grip strength was established (Incel, Ceceli, Durukan, Erdem, & Yorgancioglu, 2002), which is why the discussion would be confined to the right hand only. Though information is lacking regarding the hand grip strength and its association with physical and physiological traits, research findings are available in other sports. Tsuji, Tsunoda, Yata, Katsukawa, Onishi, & Yamazaki (1995) opined that grip strength was one of the determinant factors of radial bone mineral density in the dominant forearm of young college athletes. Whereas, Ducher, Jaffre, Arlettaz, Benhamou, & Courteix (2004) found that forearm bone mineral content adjusted to lean tissue mass or grip strength was higher on the dominant side, suggesting that tennis playing exerted a direct effect on bone. Pugh, Kovaleski, Heitman, & Pearsall (2001) observed that hand grip strength correlated with throwing speed in experienced pitchers. Nevertheless, they later showed no significant relationship among the strength variables and ball speed during the tennis serve (Pugh, Kovaleski, Heitman, & Gilley, 2003). The findings of the study of Hughes, Lyons & Mayo (2004) suggested that hand grip strength and bat velocity were not significantly correlated. In the same direction, Tan, Aziz, Teh, & Lee (2001) showed that the correlation coefficient between the bowling grip strength and bowling score was not significant.

PRACTICAL APPLICATIONS

The findings of the present study carry immense practical application in sports anthropometry. For the selection of talents in cricket as well as to utilize the bowlers (especially pacers) and batsmen, the present findings can be of great use. As per the physical strength and forearm strength of the pacers, the captain can use them in different spells (short or long) to extract their maximal performances. Pinch hitters in batting may be identified testing the hand grip strength of a batsman and subsequently may be placed in appropriate positions in batting order. Even fielders stationed in deeper positions are to through the ball with great strength. Studies of hand grip strength, a common indicator of upper extremity strength, will be of ample use in all the departments of the game.

REFERENCES

- Brozek, J. (1984). The assessment of motor function in adults. In *Malnutrition and Behaviour: Assessment of key issues*, Nestle Foundation Publication series vol 4, edited by J. Brozek and B. Schurch (Lausanne: Nestle Foundation), pp. 268-279.
- Chatterjee, S. & Chowdhuri, B.J. (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(1): 41-50.
- De, A.K., Dasgupta, P.K., Panda, B.K. & Bhattacharya, A.K. (1982). Physical efficiency tests on Indian male "Kabaddi" inter-university players. *British Journal of Sports Medicine*, 16 (1): 33-36.
- Dopsaj M., Koropanovski, N., Vuckovic, G., Blagojevic, M., Marinkovic, B. & Milijus, D. (2007). Maximal isometric hand grip force in well-trained university students in Serbia: descriptive, functional and sexual dimorphic model. *Serbian journal of sports sciences*, 1(4): 138-147.
- Ducher, G., Jaffre, C., Arlettaz, A., Benhamou, C.L. & Courteix, D. (2005). Effects of long-term tennis playing on the muscle-bone relationship in the dominant and nondominant forearms. *Canadian Journal of Applied Physiology*, 30 (1): 3-17.
- Grants, S., Haler, T, Davies, C., Aitcheson, T.C., Wilson, J. & Whittaker, A. (2001). A comparison of the anthropometric, strength, endurance and flexibility characteristics of female elite and recreational climbers and non-climbers. *Journal of Sports Sciences*, 19 (7): 499-505.
- Hughes, S.S., Lyons, B.C. & Mayo, J.J. (2004). Effect of grip strength and grip strengthening exercises on instantaneous bat velocity of collegiate baseball players. *Journal of Strength and Conditioning Research*, 18 (2): 298-301.
- Incel, N.A., Ceceli, E., Durukan, P.B., Erdem, H.R. & Yorgancioglu, Z.R. (2002). Grip strength: effect of hand dominance. *Singapore Medical Journal*, 43(5): 234- 237.
- Jeejeebhoy, K.N. (1998). Nutritional assessment. *Gastroentrol. The Clinics of North America*, 27: 347-369.
- Lucki, N. C., & Nicolay, C. W. (2007). Phenotypic plasticity and functional asymmetry in response to grip forces exerted by intercollegiate tennis players. *The American Journal of Human Biology*, 19: 566-577.
- Malina, R.M. Zavaleta, A.N. & Little, B.B. (1987). Body size, fatness, and leanness of Mexican American children in Brownsville, Texas: changes between 1972 and 1983. *American Journal of Public Health*, 77(5): 573-577.
- Mathews, D.K. (1973). *Measurement in Physical Education*. W.B. Saunders Company, Philadelphia.
- Melrose, D. R., Spaniol, F. J., Bohling, M. E., & Bonnette, R. A. (2007). Physiological and performance characteristics of adolescent club volleyball players. *Journal of Strength and Conditioning Research*, 21(2): 481-487.
- Pugh, S.F., Kovaleski, J.E., Heitman, R.J. & Pearsall, A.W. (2001). Upper and lower body strength in relation to underhand pitching speed by experienced and inexperienced pitchers. *Perceptual & Motor Skills*, 93(3): 813-818.
- Pugh, S.F., Kovaleski, J.E., Heitman, R.J. & Gilley, W.F. (2003). Upper and lower body strength in relation to ball speed during a serve by male collegiate tennis players. *Perceptual & Motor Skills*, 97 (3): 867-872.
- Ross, C.H. & Rösblad, B. (2002). Norms for grip strength in children aged 4–16 years. *Acta Paediatrica*, 91 (6): 617-625.
- Tan, B., Aziz, A. R., Teh, K. C., & Lee, H. C. (2001). Grip strength measurement in competitive ten-pin bowlers. *Journal of Sports Medicine and Physical Fitness*, 41: 68-72.

- Tsuji, S., Tsunoda, N., Yata, H., Katsukawa, F., Onishi, S. & Yamazaki, H. (1995). Relation between grip strength and radial bone mineral density in young athletes. *Archives of Physical Medicine and Rehabilitation*, 76 (3): 234-238.
- Vaz, M., Thangam, S., Prabhu, A. & Shetty, P.S. (1996). Maximal voluntary contraction as a functional indicator of adult chronic undernutrition. *British Journal of Nutrition*, 76: 9-15
- Watts, P., Newbury, V. & Sulentic, J. (1996). Acute changes in handgrip strength, endurance, and blood lactate with sustained sport rock climbing. *Journal of Sports Medicine and Physical Fitness*, 36 (4): 255-260.
- Weiner, J.S. & Lourie, J.A. (1969). *Human Biology: A guide to field methods*. 1BP No. 9, Blackwell, London.
- Wiles, C.M., Karni, Y. & Nicklin, J. (1990). Laboratory testing of muscle function in the management of neuromuscular disease. *Journal of Neurology, Neurosurgery & Psychiatry*, 53: 384-387.
- Womersley, J. & Durnin, J.V.G.A. (1977). A comparison of the skinfold method with extent of "overweight" and various weight-height relationships in the assessment of obesity. *British Journal of Nutrition*, 38 (2): 271-284.

VEZA IZMEĐU JAČINE STISKA RUKE I NEKIH ANTROPOMETRIJSKIH VARIJABLI KOD INDIJSKIH IGRAČA KRIKETA

Shyamal Koley, Mahendra Kumar Yadav

Ovo istraživanje imalo je dva cilja, prevashodno da poredi jačinu stiska ruke (i desne i leve) i dvanaest antropometrijskih varijabli igrača kriketa i njihovih parova iz kontrolne grupe, a kao drugo da ispita korelaciju između jačine stiska ruke sa tim antropometrijskim karakteristikama igrača kriketa. Da bismo ostvarili ove ciljeve, ukupno 103 okružna igrača kriketa iz Amritsara, Pundžab, Indija, starosti 17 – 21 godina (srednja vrednost 18.29 ± 2.21) je odabrano da bi činilo uzorak istraživanja, uz izbor adekvatne kontrolne grupe ($n=101$). Zaključci ovog istraživanja su da igrači kriketa imaju veće srednje vrednosti kod 6 varijabli, i manje srednje vrednosti u slučaju 7 varijabli, u odnosu na učesnike koji su činili kontrolnu grupu, uz statistički značajnu razliku ($P \leq 0.05$) u slučaju svih varijabli (izuzev varijable za mišiće ruke). Kod igrača kriketa, stisak desne i leve ruke su imali značajne pozitivne korelacije sa svim varijablama koje su ispitivane sem sa masom tela bez masnih naslaga. Iz ovih podataka može se zaključiti da jačina stiska ruke može biti prihvatljiv indikator odlične igre kao i koristan kriterijum u selekciji kandidata za ovaj sport.

Ključne reči: jačina stiska ruke, antropometrijske varijable, indijski igrači kriketa